Draft Environmental Impact Statement/ Environmental Impact Report

Volume I

Long Beach LNG Import Project

Federal Energy Regulatory Commission
FERC/EIS - 0168D
Docket No. CP04-58-000, et al.

Port of Long Beach
POLB Application No. HDP 03-079
SCH No. 2003091130

Cooperating Agencies:
U.S. Army Corps of Engineers
U.S. Coast Guard

October 2005

In Reply Refer To:
OEP/DG2E/Gas Branch 1
Long Beach LNG Import Project
FERC Docket No. CP04-58-000, et al.
POLB Application No. HDP 03-079
SCH No. 2003091130

TO THE PARTY ADDRESSED:

The environmental staffs of the Federal Energy Regulatory Commission (FERC or Commission) and the Port of Long Beach (POLB) (Agency Staffs) have prepared this draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) on the liquefied natural gas (LNG) import terminal and natural gas pipeline facilities proposed by Sound Energy Solutions (SES) in the above-referenced dockets. This draft EIS/EIR was prepared to satisfy the requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). A draft General Conformity Determination was also prepared by the FERC to assess the potential air quality impacts associated with construction and operation of the proposed project and is included as Appendix E of this draft EIS/EIR.

This draft EIS/EIR includes an Application Summary Report that was prepared by the POLB pursuant to the requirements of the CEQA, the certified Port Master Plan (PMP), and the California Coastal Act for the proposed project. Based on data contained in the draft EIS/EIR and Application Summary Report, the proposed project is in conformance with the stated policies of the PMP. An amendment to the PMP would be necessary, however, to accommodate the LNG facility because LNG is not an expressly identified "hazardous cargo" as permitted within Terminal Island Planning District 4. The POLB has submitted a draft PMP amendment (draft PMP Amendment No. 20) to the California Coastal Commission in conjunction with submittal of this draft EIS/EIR.

The U.S. Army Corps of Engineers (ACOE) is participating as a cooperating agency in the preparation of the EIS/EIR because the project would require permits pursuant to section 404 of the Clean Water Act [33 United States Code (USC) 1344] and section 10 of the Rivers and Harbors Act (33 USC 403). The ACOE must comply with the requirements of NEPA before issuing these permits. The ACOE would adopt the EIS/EIR per Title 40 Code of Federal Regulations (CFR) Part 1506.3 if, after an independent review of the document, it concludes that its comments and suggestions have been satisfied.

The U.S. Coast Guard (Coast Guard) within the U.S. Department of Homeland Security has elected to act as a cooperating agency in the preparation of the EIS/EIR because it exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC section 701). The Coast Guard also has authority for LNG facility security plan review, approval and compliance verification as provided in Title 33 CFR Part 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility. As required by its regulations, the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic. The Coast Guard plans to adopt the EIS/EIR if it adequately covers the impacts associated with issuance of the LOR.

SES' proposed facilities would provide up to 1 billion standard cubic feet per day of natural gas to southern California, supply up to 150,000 gallons per day of LNG vehicle fuel, and provide storage of up to 320,000 cubic meters of imported LNG to reduce fluctuations in the local natural gas supply. In order to provide LNG import, storage, and pipeline transportation services, SES requests authorization to construct, install, and operate an LNG import terminal and natural gas pipeline facilities.

The draft EIS/EIR addresses the potential environmental effects of the construction and operation of the following facilities:

- a 1,100-foot-long LNG ship berth and unloading facility with unloading arms, mooring and breasting dolphins, and a fendering system that would be capable of unloading one ship at a time;
- two LNG storage tanks, each with a gross volume of 160,000 cubic meters (1,006,000 barrels) surrounded by a security barrier wall;
- 20 electric-powered booster pumps;
- four shell and tube vaporizers using a primary, closed-loop water system;
- three boil-off gas compressors, a condensing system, a natural gas liquids recovery system, and an export ethane (C_2) heater;
- an LNG trailer truck loading facility with a small LNG storage tank;
- a natural gas meter station and odorization system;
- utilities, buildings, and service facilities;
- associated hazard detection, control, and prevention systems; site security facilities; cryogenic piping; and insulation, electrical, and instrumentation systems;
- a 2.3-mile-long, 36-inch-diameter pipeline and associated aboveground facilities to transport natural gas from the LNG terminal to the existing local distribution system; and
- a 4.6-mile-long, 10-inch-diameter pipeline and associated aboveground facilities to transport vaporized C_2 from the LNG terminal to an existing refinery.

Comment Procedures and Public Meetings

Any person wishing to comment on the draft EIS/EIR, draft General Conformity Determination, and/or draft PMP Amendment No. 20 may do so. **To expedite the Agency Staffs' receipt and consideration of your comments, electronic submission of comments is strongly encouraged**. See Title 18 CFR 385.2001(a)(1)(iii) and the instructions on the FERC's Internet website (www.ferc.gov) under the eFiling link and the link to the User's Guide. Before you can submit comments, you will need to create a free account by clicking on "Sign-up" under "New User." You will be asked to select the type of submission you are making. This type of submission is considered a "Comment on Filing." **Comments submitted electronically must be submitted by December 8, 2005.**

If you wish to mail comments on the draft EIS/EIR, draft General Conformity Determination, and/or draft PMP Amendment No. 20, please **mail your comments so that they will be received in Washington, DC on or before December 8, 2005** and carefully follow these instructions:

Send **an original and two copies** of your letter to:

- Magalie R. Salas, Secretary
  Federal Energy Regulatory Commission
  888 First Street, NE, Room 1A
  Washington, DC 20426;

- Reference **FERC Docket No. CP04-58-000**, **et al**. and **POLB Application No. HDP 03-079** on the original and both copies;

- Label one copy of your comments for the attention of the Gas Branch 1, DG2E;

- Send an additional copy of your letter to:

  Robert Kanter, Ph.D.
  Planning Division
  925 Harbor Plaza
  Port of Long Beach
  Long Beach, CA 90802.

In lieu of or in addition to sending written comments, we invite you to attend the joint public comment meeting the Agency Staffs will conduct in the project area to receive comments on the draft EIS/EIR, draft General Conformity Determination, and draft PMP Amendment No. 20. The joint meeting is scheduled as follows:

Monday, November 14, 2005, 6:00 PM (PST)
City of Long Beach
City Council Chambers
333 W. Ocean Boulevard
Long Beach, CA 90802
(562) 570-6555

The joint meeting will be posted on the FERC's calendar located at http://www.ferc.gov/EventCalendar/EventsList.aspx. Interested groups and individuals are encouraged to attend and present oral comments on the draft EIS/EIR, draft General Conformity Determination, and/or draft PMP Amendment No. 20. A transcript of the meeting will be prepared.

In accordance with the POLB's new protocols for preparing environmental documents, the POLB will hold three additional public comment meetings for interested groups and individuals to attend and present oral comments on the draft EIS/EIR and/or draft PMP Amendment No. 20. Transcripts of these meetings will be prepared. The additional meetings are scheduled as follows:

Date	Location
Tuesday, November 15, 2005, 6:00 PM (PST)	David Starr Jordan High School 6550 Atlantic Avenue Long Beach, CA 90805 (562) 423-1471
Wednesday, November 30, 2005, 6:00 PM (PST)	Robert A. Millikan High School 2800 Snowden Avenue Long Beach, CA 90815 (562) 425-7441
Thursday, December 1, 2005, 6:00 PM (PST)	Juan Rodriguez Cabrillo High School 2001 Santa Fe Avenue Long Beach, CA 90810 (562) 951-7700

After the comments from the meetings are reviewed, any significant new issues are investigated, and modifications are made to the draft EIS/EIR and draft General Conformity Determination, a final EIS/EIR, including a final General Conformity Determination, will be published and distributed by the Agency Staffs. The final EIS/EIR will contain the Agency Staffs' responses to timely comments received on the draft EIS/EIR and draft General Conformity Determination.

In addition, the POLB will consider comments on draft PMP Amendment No. 20 and prepare a final PMP amendment. The final PMP amendment will be presented to the Board of Harbor Commissioners for consideration of adoption when the final EIS/EIR is presented for certification. If the Board of Harbor Commissioners adopts the PMP amendment and certifies the final EIS/EIR, the PMP amendment will be submitted to the California Coastal Commission for review and certification. The POLB draft PMP Amendment No. 20 proposes to allow for the development of an LNG import terminal at Berth 126 on Pier T in the Terminal Island District (Planning District 4) of the POLB. The proposed project, if approved, is appealable to the California Coastal Commission. Copies of draft PMP Amendment No. 20 and the draft EIS/EIR are available to the public at the Harbor Department Administration Building or requests may be made to the Harbor Department, Planning Division at (562) 590-4158.

Comments on the draft EIS/EIR, draft General Conformity Determination, and draft PMP Amendment No. 20 will be considered by the FERC and the POLB but will not serve to make the commentor a party to the proceeding. Any person seeking to become a party to the proceeding must file a motion to intervene pursuant to Rule 214 of the FERC's Rules of Practice and Procedures (Title 18 CFR Part 385.214).

Anyone may intervene in this proceeding based on this draft EIS/EIR. You must file your request to intervene as specified above.[1] **You do not need intervenor status to have your comments considered and responded to.**

[1] Interventions may also be filed electronically via the Internet in lieu of paper. See the previous discussion on filing comments electronically.

The draft EIS/EIR, including the draft General Conformity Determination, has been placed in the public files of the FERC and the POLB and is available for public inspection at:

Federal Energy Regulatory Commission
Public Reference Room
888 First Street, NE, Room 2A
Washington, DC 20426
(202) 502-8371

and

Port of Long Beach
Planning Division
925 Harbor Plaza
Long Beach, CA 90802
(562) 590-4160

The draft EIS/EIR, including the draft General Conformity Determination, is also available for viewing on the FERC Internet website (www.ferc.gov) using the eLibrary link (see instructions for using eLibrary below).

A limited number of copies are available from the FERC's Public Reference Room and as .pdf files on compact disk (CD) from the POLB as identified above. Copies of draft PMP Amendment No. 20 are available from the POLB as identified above. In addition, copies of the draft EIS/EIR, including the draft General Conformity Determination, have been mailed to federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; POLB tenants; intervenors in the FERC's proceeding; local libraries and newspapers; and other interested parties.

To reduce printing and mailing costs for the final EIS/EIR, the Agency Staffs will be issuing that document in both CD and hard-copy formats. In a separate mailing, the parties on the current mailing list for the draft EIS/EIR will be sent a postcard providing an opportunity for them to select which format of the final EIS/EIR they wish to receive. The FERC and the POLB are strongly encouraging the use of the CD format in their publication of large documents. If you wish to receive a paper copy of the final EIS/EIR instead of a CD, you must return the postcard indicating that choice.

Additional information about the project is available from the FERC's Office of External Affairs, at **1-866-208-FERC** or on the FERC Internet website (www.ferc.gov) using the eLibrary link. Click on the eLibrary link, click on "General Search," and enter the docket number excluding the last three digits in the Docket Number field. Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FERCOnlineSupport@ferc.gov or toll free at 1-866-208-3676, or for TTY, contact (202) 502-8659. The eLibrary link on the FERC Internet website also provides access to the texts of formal documents issued by the FERC, such as orders, notices, and rulemakings.

In addition, the FERC now offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. To register for this service, go to the eSubscription link on the FERC Internet website.

Information about the project is also available from the POLB by calling the POLB Environmental Planning Division at (562) 590-4160.

Magalie R. Salas
Secretary
Federal Energy Regulatory Commission

Robert Kanter, Ph.D.
Director of Planning
Port of Long Beach

TABLE OF CONTENTS

Long Beach LNG Import Project
Draft Environmental Impact Statement/
Environmental Impact Report

VOLUME I — Page

TABLE OF CONTENTS i
LIST OF APPENDICES vii
LIST OF TABLES viii
LIST OF FIGURES xi
ACRONYMS AND ABBREVIATIONS xii

EXECUTIVE SUMMARY ES-1
PROPOSED ACTION ES-2
PUBLIC INVOLVEMENT AND AREAS OF CONCERN ES-3
ENVIRONMENTAL ISSUES ES-4
ALTERNATIVES CONSIDERED ES-15
ENVIRONMENTALLY PREFERABLE/SUPERIOR ALTERNATIVE ES-16

1.0 INTRODUCTION 1-1
1.1 PROJECT PURPOSE AND NEED 1-2
1.2 USES AND SCOPE OF THIS EIS/EIR 1-4
1.2.1 Federal Energy Regulatory Commission 1-5
1.2.2 City of Long Beach 1-6
1.2.3 U.S. Army Corps of Engineers 1-7
1.2.4 U.S. Coast Guard 1-7
1.2.5 Pipeline and Hazardous Materials Safety Administration 1-8
1.2.6 Responsible and Trustee Agencies 1-8
1.3 PUBLIC REVIEW AND COMMENT 1-9
1.4 CONSISTENCY WITH THE COASTAL ZONE MANAGEMENT ACT, THE CALIFORNIA COASTAL ACT, THE POLB PORT MASTER PLAN, AND OTHER REGIONAL AND LOCAL PLANS AND POLICIES 1-13
1.4.1 Coastal Zone Management Act 1-13
1.4.2 California Coastal Act of 1976 1-14
1.4.3 POLB Port Master Plan 1-14
1.4.4 Energy Policy Act of 2005 1-16
1.4.5 Other Regional and Local Plans and Policies 1-17
1.5 PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS 1-22

2.0 DESCRIPTION OF THE PROPOSED ACTION 2-1
2.1 PROPOSED FACILITIES 2-1
2.1.1 LNG Terminal Facilities 2-1
2.1.1.1 Ship Berth and Unloading Facility 2-5
2.1.1.2 LNG Storage Tanks 2-6
2.1.1.3 Vaporization System 2-7
2.1.1.4 Vapor Handling System 2-7
2.1.1.5 Natural Gas Liquids Recovery System 2-9
2.1.1.6 LNG Trailer Truck Loading Facility 2-9
2.1.1.7 Other Facility Components 2-9

TABLE OF CONTENTS (cont'd)

2.1.2 LNG Ships 2-10
2.1.3 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities 2-14
2.1.4 Electric Distribution Facilities 2-14
2.2 LAND REQUIREMENTS 2-14
2.2.1 LNG Terminal Facilities 2-15
2.2.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities 2-16
2.2.3 Electric Distribution Facilities 2-16
2.3 CONSTRUCTION PROCEDURES 2-19
2.3.1 LNG Terminal Facilities 2-20
2.3.1.1 LNG Storage and Processing Facilities 2-20
2.3.1.2 Reinforcement of the Shoreline Structures 2-22
2.3.1.3 Construction of the Ship Berth and Unloading Facility 2-23
2.3.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities 2-23
2.3.3 Electric Distribution Facilities 2-25
2.4 CONSTRUCTION SCHEDULE 2-25
2.5 ENVIRONMENTAL COMPLIANCE INSPECTION AND MITIGATION MONITORING 2-25
2.6 OPERATION AND MAINTENANCE PROCEDURES 2-26
2.7 SAFETY CONTROLS 2-27
2.7.1 LNG Terminal Facilities 2-27
2.7.1.1 Spill Containment 2-27
2.7.1.2 Hazard Detection System 2-28
2.7.1.3 Hazard Control System 2-28
2.7.1.4 Firewater System 2-29
2.7.1.5 Fail-Safe Shutdown 2-29
2.7.1.6 Security System 2-29
2.7.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities 2-30
2.7.2.1 Corrosion Protection and Detection Systems 2-30
2.7.2.2 Emergency Response Procedures 2-30
2.8 FUTURE PLANS AND ABANDONMENT 2-31

3.0 ALTERNATIVES 3-1
3.1 NO ACTION OR NO PROJECT ALTERNATIVE 3-1
3.2 ALTERNATIVE SYSTEM LOCATIONS 3-3
3.2.1 Pipeline System Alternatives 3-4
3.2.2 LNG System Alternatives 3-6
3.2.2.1 Existing LNG Facilities 3-6
3.2.2.2 Proposed LNG Facilities 3-7
3.2.3 System Alternatives Conclusions 3-17
3.3 LNG TERMINAL ALTERNATIVE LOCATIONS 3-18
3.3.1 Regional Review 3-19
3.3.2 Preferred Port Identification 3-19
3.3.2.1 Offshore Deepwater Ports 3-19
3.3.2.2 Coastline Ports and Harbors 3-19
3.3.3 Preferred Site Identification 3-21
3.3.3.1 Los Angeles Export Terminal Site 3-22
3.3.3.2 Pier A West Site 3-26
3.3.3.3 Navy Mole Site 3-26
3.3.4 Point Conception Site 3-27

TABLE OF CONTENTS (cont'd)

3.4 PIPELINE ALTERNATIVES 3-28
3.4.1 Oil Field Variation 3-29
3.4.2 Carrack Avenue Variation 3-29
3.4.3 Edison Variation 3-31
3.4.4 Dominguez Channel Variations 1 and 2 3-31
3.5 DREDGE AND FILL ALTERNATIVES 3-31
3.5.1 Reduced Dredge/Fill Alternatives and Alternative Ship Berth Configurations 3-32
3.5.2 Dredge Disposal Alternatives 3-34
3.5.3 Alternative Dredging Methods 3-34
3.6 VAPORIZER ALTERNATIVES 3-35

4.0 ENVIRONMENTAL ANALYSIS 4-1
4.1 GEOLOGY 4-2
4.1.1 Significance Criteria 4-2
4.1.2 Geologic Setting 4-2
4.1.2.1 Environmental Setting 4-2
4.1.2.2 Impact and Mitigation 4-3
4.1.3 Mineral Resources 4-4
4.1.3.1 Environmental Setting 4-4
4.1.3.2 Impact and Mitigation 4-4
4.1.4 Geologic Hazards 4-5
4.1.4.1 Seismic Hazards 4-5
4.1.4.2 Subsidence 4-12
4.1.4.3 Impact and Mitigation 4-12
4.1.5 Paleontological Resources 4-14
4.2 SOILS AND SEDIMENTS 4-15
4.2.1 Significance Criteria 4-15
4.2.2 Soil Resources 4-15
4.2.2.1 Environmental Setting 4-15
4.2.2.2 Impact and Mitigation 4-16
4.2.3 Sediments 4-18
4.2.3.1 Environmental Setting 4-18
4.2.3.2 Impact and Mitigation 4-19
4.3 WATER RESOURCES 4-20
4.3.1 Significance Criteria 4-20
4.3.2 Groundwater Resources 4-20
4.3.2.1 Environmental Setting 4-20
4.3.2.2 Impact and Mitigation 4-21
4.3.3 Surface Water Resources 4-24
4.3.3.1 Environmental Setting 4-24
4.3.3.2 Impact and Mitigation 4-26
4.3.4 Wetlands 4-32
4.4 BIOLOGICAL RESOURCES 4-33
4.4.1 Significance Criteria 4-33
4.4.2 Terrestrial Resources 4-33
4.4.3 Marine Resources 4-33
4.4.3.1 Marine Organisms 4-34
4.4.3.2 Water-Associated Birds 4-37
4.4.3.3 Essential Fish Habitat Assessment 4-38

TABLE OF CONTENTS (cont'd)

4.4.4 Threatened and Endangered Species 4-42
4.4.4.1 Federal Threatened and Endangered Species 4-42
4.4.4.2 State Threatened and Endangered Species 4-44
4.5 LAND USE, RECREATION, AND VISUAL RESOURCES 4-46
4.5.1 Significance Criteria 4-46
4.5.2 Land Use and Ownership....4-46
4.5.2.1 LNG Terminal Facilities....4-46
4.5.2.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities....4-48
4.5.2.3 Electric Distribution Facilities....4-50
4.5.3 Existing Residences and Planned Developments 4-51
4.5.4 Hazardous Waste Sites....4-51
4.5.5 Recreation and Special Interest Areas 4-54
4.5.6 Visual Resources....4-56
4.6 SOCIOECONOMICS....4-64
4.6.1 Significance Criteria 4-64
4.6.2 Population 4-64
4.6.3 Economy and Employment....4-65
4.6.4 Housing....4-68
4.6.5 Public Services....4-69
4.6.6 Utilities and Service Systems 4-70
4.6.7 Property Values....4-71
4.6.8 Tax Revenues....4-71
4.6.9 Environmental Justice....4-72
4.7 TRANSPORTATION....4-77
4.7.1 Significance Criteria 4-77
4.7.2 Ground Transportation....4-77
4.7.2.1 Environmental Setting....4-77
4.7.2.2 Project Impacts 4-81
4.7.2.3 Mitigation 4-86
4.7.3 Marine Transportation 4-88
4.7.3.1 Environmental Setting....4-88
4.7.3.2 Impact and Mitigation 4-91
4.7.4 Air Transportation....4-92
4.7.4.1 Environmental Setting....4-92
4.7.4.2 Impact and Mitigation 4-92
4.8 CULTURAL RESOURCES....4-93
4.8.1 Significance Criteria 4-93
4.8.2 Regulatory Requirements 4-93
4.8.2.1 Federal 4-93
4.8.2.2 CEQA 4-93
4.8.3 Cultural Resources Assessment....4-94
4.8.4 Unanticipated Discoveries 4-95
4.8.5 Native American Consultation....4-95
4.8.6 Impact and Mitigation....4-96
4.9 AIR QUALITY....4-97
4.9.1 Significance Criteria 4-97
4.9.2 Environmental Setting 4-98
4.9.2.1 Topography and Climate 4-98

TABLE OF CONTENTS (cont'd)

4.9.2.2 Ambient Air Quality 4-98
4.9.2.3 Attainment Status 4-101
4.9.2.4 Air Quality Management Plan 4-101
4.9.2.5 Toxic Air Contaminants 4-101
4.9.2.6 Baseline Site Emissions 4-102
4.9.2.7 Sensitive Receptor Locations 4-102
4.9.3 Applicable Air Quality Regulations 4-104
4.9.3.1 Federal Regulations 4-104
4.9.3.2 State Regulations 4-106
4.9.3.3 Local Regulations 4-107
4.9.4 Construction Impacts and Mitigation 4-108
4.9.5 Operational Impacts and Mitigation 4-112
4.9.6 General Conformity Determination 4-119
4.9.7 Health Risk Assessment 4-119
4.9.8 LNG Consumers 4-121
4.10 NOISE 4-124
4.10.1 Significance Criteria 4-124
4.10.2 Environmental Setting 4-124
4.10.3 Regulatory Requirements 4-125
4.10.4 Impact and Mitigation 4-125
4.11 RELIABILITY AND SAFETY 4-128
4.11.1 Significance Criteria 4-128
4.11.2 LNG Import Terminal Facilities 4-128
4.11.3 LNG Hazards 4-130
4.11.4 Storage and Retention Systems 4-131
4.11.5 Siting Requirements – Thermal and Vapor Dispersion Exclusion Zones 4-136
4.11.6 Cryogenic Design and Technical Review 4-143
4.11.7 Marine Safety 4-148
4.11.7.1 LNG Vessels and Ocean Voyage 4-148
4.11.7.2 LNG Vessel Transit in the Port of Long Beach 4-150
4.11.7.3 LNG Ship Safety 4-156
4.11.7.4 Requirements for LNG Ship Operations 4-162
4.11.8 Terrorism and Security Issues 4-165
4.11.9 Emergency Response and Evacuation Planning 4-167
4.11.10 POLB Hazards Analysis 4-169
4.11.10.1 Selection and Probability of Potential LNG Release Events 4-170
4.11.10.2 Consequence Analysis Results for Possible LNG Release Events 4-171
4.11.10.3 Mitigation 4-183
4.11.10.4 Summary 4-184
4.11.11 LNG Truck Safety 4-185
4.11.11.1 Proposed LNG Truck Operations 4-185
4.11.11.2 LNG Truck Operations in California 4-186
4.11.11.3 LNG Truck Operations in Northeastern United States 4-186
4.11.12 Pipeline Facilities 4-188
4.11.12.1 Safety Standards 4-188
4.11.12.2 Pipeline Accident Data 4-191
4.11.12.3 Impacts on Public Safety 4-193
4.11.13 Conclusions on Safety Issues 4-195
4.12 CUMULATIVE IMPACTS 4-197

TABLE OF CONTENTS (cont'd)

4.12.1 Geology....4-202
4.12.2 Soils and Sediments....4-202
4.12.3 Water Resources....4-202
4.12.4 Biological Resources....4-203
4.12.5 Land Use....4-204
4.12.6 Recreation....4-205
4.12.7 Visual Resources....4-205
4.12.8 Socioeconomics....4-205
4.12.9 Transportation....4-206
4.12.10 Cultural Resources....4-207
4.12.11 Air Quality....4-207
4.12.12 Noise 4-208
4.12.13 Reliability and Safety....4-208
4.13 GROWTH-INDUCING IMPACTS....4-210

5.0 APPLICATION SUMMARY REPORT....5-1
5.1 CONFORMANCE WITH THE PORT MASTER PLAN....5-1
5.2 CONFORMANCE WITH THE CALIFORNIA COASTAL ACT....5-1
5.3 CONFORMANCE WITH THE RISK MANAGEMENT PLAN....5-5

6.0 RECOMMENDATIONS....6-1
6.1 SUMMARY OF THE FERC AND POLB STAFFS' ENVIRONMENTAL ANALYSIS....6-1
6.2 ALTERNATIVES CONSIDERED....6-2
6.3 ENVIRONMENTALLY PREFERABLE/SUPERIOR ALTERNATIVE....6-4
6.4 UNAVOIDABLE SIGNIFICANT IMPACTS/STATEMENT OF OVERRIDING CONSIDERATIONS....6-4
6.5 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY....6-4
6.6 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES....6-4
6.7 FERC AND POLB STAFFS' RECOMMENDED MITIGATION....6-5

TABLE OF CONTENTS (cont'd)

VOLUME II – APPENDICES

APPENDIX A	DRAFT EIS/EIR DISTRIBUTION LIST FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX B	STORM WATER POLLUTION PREVENTION PLAN FOR THE LONG BEACH LNG IMPORT PROJECT (DRAFT)
APPENDIX C	HORIZONTAL DIRECTIONAL DRILL PLAN FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX D	TRAFFIC INTERSECTION WORKSHEETS FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX E	DRAFT GENERAL CONFORMITY DETERMINATION FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX F	HAZARDS ANALYSIS OF A PROPOSED LNG IMPORT TERMINAL IN THE PORT OF LONG BEACH, CALIFORNIA
APPENDIX G	REFERENCES AND CONTACTS
APPENDIX H	LIST OF PREPARERS

TABLES

Number	Title	Page
ES-1	Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures	ES-17
1.3-1	Issues Identified and Comments Received During the Public Scoping Process for the Long Beach LNG Import Project	1-11
1.4.5-1	Consistency of the Long Beach LNG Import Project with the Policies of the Southern California Association of Governments' Regional Comprehensive Plan and Guide and Regional Transportation Plan	1-18
1.5-1	Major Permits, Approvals, and Consultations for the Long Beach LNG Import Project	1-23
2.2-1	Summary of Land Requirements Associated with the Long Beach LNG Import Project	2-15
2.7.1-1	Federal Siting and Design Requirements for LNG Facilities	2-27
3.1-1	Comparison of Air Emissions from Burning Fossil Fuels	3-3
3.2.2-1	Proposed LNG Projects in Baja California, Mexico	3-8
3.2.2-2	Environmental Comparison of the Long Beach LNG Import Project and the Cabrillo Port LNG Deepwater Port	3-16
3.2.3-1	Existing and Proposed System Alternatives Compared to the Long Beach LNG Import Project	3-18
3.3.3-1	Select Regulations Related to the Siting of an LNG Terminal	3-22
3.3.3-2	Comparison of Alternative LNG Terminal Sites	3-24
3.6-1	Typical Air Emissions Associated with Vaporizer Combustion	3-36
4.1.4-1	Earthquakes of Moment Magnitude Greater Than 6.5 Within 100 Kilometers (63 miles) of the LNG Terminal Site	4-7
4.4.3-1	Managed Fisheries Potentially Affected by the Long Beach LNG Import Project	4-40
4.4.4-1	Threatened and Endangered Species Observed or Possibly Occurring in the Long Beach LNG Import Project Area	4-42
4.5.2-1	Area (Acres) Affected by Construction and Operation of the Proposed LNG Terminal	4-47
4.5.2-2	Area (Acres) Affected by Construction and Operation of the Proposed Pipeline Facilities	4-50
4.5.4-1	Listed Hazardous Waste Sites Within 0.25 Mile of the Long Beach LNG Import Project Facilities	4-52
4.5.5-1	Recreational Areas Within a 2-Mile Radius of the LNG Terminal Site	4-55
4.5.6-1	Visual Impact Summary for the LNG Terminal Facility Associated with the Long Beach LNG Import Project	4-58
4.6.2-1	Existing Population Conditions in the Long Beach LNG Import Project Area	4-64
4.6.3-1	Existing Socioeconomic Conditions in the Long Beach LNG Import Project Area	4-66
4.6.3-2	Construction Workforce Classifications for the Long Beach LNG Import Project	4-67
4.6.4-1	1990 and 2000 Housing Characteristics in the Long Beach LNG Import Project Area	4-68
4.6.9-1	Population Statistics for the Census Tracts Surrounding the Long Beach LNG Import Project	4-74
4.6.9-2	Population Statistics for the Cities and Counties Surrounding the Long Beach LNG Import Project	4-74
4.7.2-1	Study Intersections	4-79
4.7.2-2	Relationship Between the Volume-to-Capacity Ratio and Level of Service for Signalized Intersections	4-80
4.7.2-3	Relationship Between Delay and Level of Service for Stop-Controlled Intersections (Two-Way and Multi-Way Stops)	4-80
4.7.2-4	Relationship Between the Demand-to-Capacity Ratio and the Level of Service for Freeway Segments	4-80

TABLES (cont'd)

Number	Title	Page
4.7.2-5	Existing Intersection Level of Service Analysis	4-81
4.7.2-6	Trip Generation Summary for the Long Beach LNG Import Project LNG Terminal Construction Scenario	4-83
4.7.2-7	Future 2010 Long Beach LNG Import Project LNG Terminal Construction Scenario - Intersection Level of Service	4-84
4.7.2-8	Trip Generation Summary for the Long Beach LNG Import Project LNG Terminal Operation Scenario	4-85
4.7.2-9	Future 2010 Long Beach LNG Import Project LNG Terminal Operation Scenario – Intersection Level of Service	4-85
4.7.2-10	Future 2010 Long Beach LNG Import Project LNG Terminal Construction Mitigation Scenario – Intersection Level of Service (Mid-Day Peak Hour)	4-87
4.9.1-1	SCAQMD Emission Significance Thresholds for Criteria Air Pollutants	4-97
4.9.1-2	SCAQMD Significance Thresholds for Toxic Air Contaminants	4-97
4.9.2-1	Maximum Pollutant Concentrations Measured at the Long Beach Airport Monitoring Station	4-100
4.9.2-2	Key Air Toxic Contaminants Monitored in the MATES II Study and their Contribution to the Ambient Cancer Risk	4-102
4.9.4-1	Peak Daily Construction Emission Rates Associated with the Long Beach LNG Import Project	4-109
4.9.4-2	Peak Quarterly Construction Emission Rates Associated with the Long Beach LNG Import Project	4-110
4.9.5-1	Peak Daily Operational Emission Rates Associated with the Long Beach LNG Import Project	4-114
4.9.5-2	Peak Annual Operational Emission Rates Associated with the Long Beach LNG Import Project	4-115
4.9.5-3	Maximum Offsite Criteria Pollutant Concentrations Associated with the Long Beach LNG Import Terminal	4-117
4.9.5-4	Maximum Offsite Criteria Pollutant Concentrations Associated with the Long Beach LNG Import Terminal Project	4-118
4.9.7-1	Maximum Emission Rates of Toxic Air Contaminants	4-120
4.9.7-2	Maximum Potential Health Risks Associated with the Long Beach LNG Import Project	4-121
4.10.2-1	Summary of Existing Property Boundary Noise Levels Near the Proposed LNG Terminal Site	4-124
4.11.5-1	Impoundment Areas	4-139
4.11.5-2	Thermal Exclusion Zones	4-141
4.11.7-1	Typical LNG Ship Characteristics	4-150
4.11.7-2	Minimum Striking Speed to Penetrate LNG Cargo Tanks	4-158
4.11.7-3	LNG Spills on Water	4-161
4.11.10-1	Potential LNG Release Events Evaluated and the Probability of Their Occurrence	4-171
4.11.10-2	Consequence Analysis Results for the Possible[a] LNG Release Events - Impact on Humans	4-174
4.11.10-3	Consequence Analysis Results for the Possible[a] LNG Release Events - Impact on Structures/Equipment	4-180
4.11.11-1	LNG Trailer Truck Loadings at the Distrigas LNG Terminal	4-186
4.11.11-2	LNG Truck Accident Summary	4-187
4.11.12-1	Natural Gas Service Incidents by Cause	4-192

TABLE OF CONTENTS (cont'd)

4.11.12-2 Outside Forces Incidents by Cause (1970-1984) 4-193
4.11.12-3 External Corrosion by Level of Control (1970-1984) 4-193
4.11.12-4 Annual Average Fatalities - Natural Gas Transmission and Gathering Systems 4-194
4.11.12-5 Nationwide Accidental Deaths 4-194
4.12-1 Existing and/or Proposed Activities Cumulatively Affecting Resources of Concern for the Long Beach LNG Import Project 4-198

FIGURES

Number	Title	Page
1.4.3-1	Port of Long Beach Harbor Planning Districts	1-15
2.1-1	General Project Location	2-2
2.1.1-1	General Site Layout	2-3
2.1.1-2	Conceptual Process Flow Diagram	2-4
2.1.1-3	Conceptual Design of LNG Storage Tanks	2-8
2.2.2-1	Typical Construction Right-of-Way Configurations for the Natural Gas Pipeline	2-17
2.2.2-2	Typical Construction Right-of-Way Configurations for the C_2 Pipeline	2-18
3.2.1-1	Existing Pipeline Systems and Coastal Ports	3-5
3.2.2-1	Proposed Offshore LNG Terminal Projects	3-12
3.3.3-1	Alternative Sites in the Ports of Los Angeles and Long Beach	3-23
3.4-1	Pipeline Route Variations	3-30
3.5.1-1	Extended Ship Berth Alternative	3-33
4.1.4-1	Fault Location Map	4-6
4.5.6-1	Visual Impact Assessment Representative Viewing Points	4-59
4.5.6-2	Visual Simulation from Shoreline Park	4-60
4.5.6-3	Visual Simulation from Queensway Bridge	4-61
4.5.6-4	Visual Simulation from the Fire Station/Mole Entrance	4-62
4.5.6-5	Visual Simulation from Cabrillo Point	4-63
4.6.9-1	Census Tract Locations	4-73
4.7.2-1	Land Transportation Study Area	4-78
4.7.3-1	General Arrangement of the Port of Long Beach	4-90
4.9.2-1	South Coast Air Basin	4-99
4.9.2-2	Location of Nearest Sensitive Receptors	4-103
H.1	Examples of Single Containment Tanks	4-133
H.3	Examples of Double Containment Tanks	4-134
H.4	Examples of Full Containment Tanks	4-135
4.11.7-1	Inbound LNG Ship Transit Security Zone	4-153
4.11.10-1	Decision Tree for Analysis of Hazardous Material Releases	4-172
4.11.10-2	1,600 Btu/ft^2-hr Radiant Vulnerability Zone for a Release from LNG Ship Following Collision with Another Ship or with the Breakwater – 5 Tanks Fail	4-176
4.11.10-3	1,600 Btu/ft^2-hr Radiant Vulnerability Zone for a Release from Process Equipment at Location F	4-177
4.11.10-4	Facility Plot Plan and Adjacent Facilities	4-179
4.11.10-5	10,000 Btu/ft^2-hr Radiant Vulnerability Zone for a Release from LNG Ship Following Collision with Another Ship or with the Breakwater – 5 Tanks Fail	4-181
4.11.10-6	10,000 Btu/ft^2-hr Radiant Vulnerability Zone for a Release from Process Equipment at Location F	4-182

ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
ABSG	ABSG Consulting Inc.
ACHP	Advisory Council on Historic Preservation
ACOE	U.S. Army Corps of Engineers
A.D. Little	Arthur D. Little, Inc.
Agency Staffs	environmental staffs of the FERC and the POLB
ALT	Applied LNG Technologies USA
APE	area of potential effect
API	American Petroleum Institute
AQMP	Air Quality Management Plan
ASCE	American Society of Civil Engineers
ATIAA	Air Toxic "Hot Spots" Information and Assessment Act
BA	Biological Assessment
BACT	Best Available Control Technology
Basin Plan	Los Angeles River Basin (Region 4)
bgs	below ground surface
BHC	Board of Harbor Commissioners
BHP	BHP Billiton
BMPs	Best Management Practices
Bscfd	billion standard cubic feet per day
Btu	British thermal unit
Btu/ft^2-hr	British thermal units per square foot per hour
C_2	Ethane
C_{3+}	Propane and heavier hydrocarbons
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standards
CalARP	California Accidental Release Prevention Program
CalTrans	California Department of Transportation
CARB	California Air Resources Board
CCA	California Coastal Act of 1976
CCC	California Coastal Commission
CDFG	California Department of Fish and Game
CEC	California Energy Commission
CEII	Critical Energy Infrastructure Information
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
Chevron Texaco	ChevronTexaco Corporation
CLE	Contingency Level Earthquake
CMP	Congestion Management Program
CO	carbon monoxide
CO_2	carbon dioxide
Coast Guard	U.S. Coast Guard
Commission	Federal Energy Regulatory Commission
CPUC	California Public Utilities Commission
CRE	Comisión Reguladora de Energía
CRHR	California Register of Historical Resources
Crystal Energy	Crystal Energy LLC

CSLC	California State Lands Commission
CSWRCB	California State Water Resources Control Board
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
dBA	decibels of the A-weighted scale
DC	demand-to-capacity
DDT	dichlorodiphenyltrichloroethane
DEGADIS	Dense Gas Dispersion Model
Distrigas	Distrigas of Massachusetts Corporation
DMG	California Division of Mines and Geology
DO	dissolved oxygen
DOGGR	California Department of Conservation-Division of Oil, Gas, & Geothermal Resources
DOP	City of Long Beach, Department of Oil Properties
DOT	U.S. Department of Transportation
DSHA	deterministic seismic hazard analyses
DTSC	California Department of Toxic Substances Control
DWSAP	California Drinking Water Source Assessment and Protection
ECD	Environmental Compliance Department
EFH	Essential fish habitat
EI	Environmental Inspector
EIA	Energy Information Administration
EIR	environmental impact report
EIS	environmental impact statement
EIS/EIR	environmental impact statement/environmental impact report
El Paso	El Paso Natural Gas Company
EPA	U.S. Environmental Protection Agency
ERL	Effects Range Low
ERM	Effects Range Medium
ESA	Endangered Species Act of 1973
ESD	emergency shutdown
FERC	Federal Energy Regulatory Commission
FMP	Facilities Master Plan
FPC	Federal Power Commission
FR	Federal Register
FSO	Facility Security Officer
FSRU	floating storage and regasification unit
FWS	U.S. Fish and Wildlife Service
g	gravity
GB	Gasoducto Bajanorte
GBS	gravity-based structure
General Plan	City of Long Beach General Plan
gpd	gallons per day
gpm	gallons per minute
Hanjin	Hanjin Shipping Company
HCAs	high consequence areas
HDD	horizontal directional drill
HDD Plan	Horizontal Directional Drill Plan
HSC	Harbor Safety Committee

hp	horsepower
Inland Testing Manual	Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual
ICTF	International Container Transfer Facility
ILWU	International Longshore and Warehouse Union
IMO	International Maritime Organization
IP District	Port-Related Industrial District
IR	Installation Restoration
ISO	Insurance Service Organization
Jacobsen Pilots	Jacobsen Pilot Services, Inc.
kV	kilovolt
kW	kilowatt
LA Basin	Los Angeles Basin
LACFD	Los Angles County Fire Department
LADOT	Los Angeles Department of Transportation
LAER	Lowest Achievable Emission Rate
LAFD	City of Los Angeles Fire Department
LARC	Los Angeles Refinery Carson Plant
LAXT	Los Angeles Export Terminal
LBFD	Long Beach City Fire Department
LBPD	Long Beach Police Department
L_{dn}	day-night sound level
$L_{eq(24)}$	24-hour equivalent sound level
LFL	lower flammability limit
LNG	liquefied natural gas
LNG Working Group	LNG Permitting Interagency Working Group
LOI	Letter of Intent
LOR	Letter of Recommendation
LOS	level of service
LPG	liquefied petroleum gas
MAOP	maximum allowable operating pressure
MARAD	U.S. Maritime Administration
MARSEC	Maritime Security
MATES II Study	Multiple Air Toxics Exposure Study in the SCAB
MBC	MBC Applied Environmental Sciences
Mcf	thousand cubic feet
MEC	MEC Analytical Systems, Inc.
Memorandum	Memorandum of Understanding on Natural Gas Transportation Facilities
µg/kg	micrograms per kilogram
$\mu g/m^3$	micrograms per cubic meter
mg/kg	milligrams per kilogram
MLLW	mean lower low water
MMBtu	million British thermal units
MMscfd	million standard cubic feet per day
MOA	Memorandum of Agreement
MP	milepost
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
msl	mean sea level

MTA	Metropolitan Transportation Authority
MW	Megawatt
M_W	moment magnitude
NAAQS	National Ambient Air Quality Standards
NAHC	Native American Heritage Commission
NEPA	National Environmental Policy Act
NASFM	National Association of State Fire Marshals
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NGL	natural gas liquids
NHPA	National Historic Preservation Act
nm	nautical mile
NO_2	nitrogen dioxide
NOAA Fisheries	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NOI/NOP	*Notice of Intent to Prepare a Joint Environmental Impact Statement and Notice of Preparation of a Joint Environmental Impact Report, Application Summary Report for SES' Proposed Long Beach LNG Import Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting*
North Baja	North Baja Pipeline, LLC
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSA	noise-sensitive areas
NVIC	*Navigation and Vessel Inspection Circular – Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic*
OBE	Operating Basis Earthquake
OCIMF	Oil Companies International Marine Forum
OCORM	National Oceanic and Atmospheric Administration, Office of Coast and Ocean Resource Management
OEP	Office of Energy Projects
OLE	Operating Level Earthquake
OPS	Office of Pipeline Safety
PAH	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PD District	Planned Development District
PERC	powered emergency release coupling
PFMC	Pacific Fishery Management Council
PHMSA	Pipeline and Hazardous Materials Safety Administration
PGA	peak ground accelerations
PM_{10}	particulate matter having an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter having an aerodynamic diameter of 2.5 microns or less
PMP	Port Master Plan
POLA	Port of Los Angeles
POLB	Port of Long Beach
POLB Quest Study	*Hazards Analysis of a Proposed LNG Import Terminal in the Port of Long Beach, California*
Port	Port of Long Beach
ppmw	parts per million by weight

PSHA	probabilistic seismic hazard analyses
psig	pounds per square inch gauge
Quest	Quest Consultants, Inc.
RCPG	Regional Comprehensive Plan and Guide
RECLAIM	New Source Review for the Regional Clean Air Incentives Market
RMP	Risk Management Plan
ROC	reactive organic compounds
ROD	Record of Decision
RPT	rapid phase transition
RTP	Regional Transportation Plan
RWQCB	Regional Water Quality Control Board
SAC	spaced aerial cable
Sandia Report	*Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*
SCAB	South Coast Air Basin
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
Secretary	Secretary of the Commission
SEMARNAT	Secretaria de Medio Ambiente y Recursos Naturales
Sempra/Shell	Sempra Energy LNG/Shell International Gas Ltd.
SERRF	Southeast Resource Recovery Facility
SES	Sound Energy Solutions
SHPO	State Historic Preservation Office
SIGTTO	Society of International Gas Tanker and Terminal Operators
SIP	State Implementation Plan
SIS	Safety Instrumented System
SO_2	sulfur dioxide
SoCal Gas	Southern California Gas Company's
SO_x	sulfur oxides
SOLAS	International Convention for Safety of Life at Sea
Spill Procedure	Spill Prevention and Response Procedure
SRC	selective catalytic reduction
SSE	Safe Shutdown Earthquake
SSO	Ship Security Officer
Supplemental NOP	*Supplemental Notice of Preparation and Initial Study*
SWPPP	Storm Water Pollution Prevention Plan
Tcf	trillion cubic feet
TEU	twenty-foot equivalent units
TGN	Transportadora de Gas Natural de Baja California
THUMS-HB	THUMS-Huntington Beach
TNT	tri-nitro toluene
tpy	tons per year
TSS	total suspended solids
TTI/Hanjin	Total Terminals Inc./Hanjin Shipping Company
USC	United States Code
USGS	U.S. Geological Survey
UV/IR	ultraviolet/infrared

V/C	volume-to-capacity
VOC	volatile organic compounds
VTS	vessel traffic service
WDRs	Waste Discharge Requirements
West Coast Basin	West Coast sub-basin of the Los Angeles County Groundwater Basin
Western Terminal	Western LNG Terminal Company
WSA	Waterway Suitability Assessment

EXECUTIVE SUMMARY

On January 26, 2004, Sound Energy Solutions (SES) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under section 3 of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. SES seeks authorization from the FERC to site, construct, and operate a liquefied natural gas (LNG) receiving terminal and associated facilities in the Port of Long Beach (POLB or Port) in Long Beach, California as a place of entry for the importation of LNG. The FERC is the federal agency responsible for authorizing sites for onshore LNG import facilities. As such, the FERC is the lead federal agency for the preparation of the environmental impact statement (EIS). The FERC will use the document to consider the environmental impact that could result if it issues SES an Order Granting Authorization under section 3 of the NGA.

The Board of Harbor Commissioners (BHC) has authority over the City's Harbor District, commonly known as the POLB or Port. The City of Long Beach owns the land within the Harbor District in trust for the people of the State of California. SES would have to obtain a lease from the City of Long Beach to build and operate its proposed Long Beach LNG Import Project. SES submitted an application to the POLB for a Harbor Development Permit on July 25, 2003, seeking approval for a development project within the Port. The application was designated POLB Application No. HDP 03-079. The POLB is the lead agency in California for preparing the environmental impact report (EIR). The BHC will use the document to determine the project's consistency with the certified Port Master Plan (PMP) and the California Coastal Act of 1976 as well as to consider the environmental impact that could result if it issues Harbor Development Permits for the project.[1]

The environmental staffs of the FERC and the POLB (Agency Staffs) have jointly prepared this draft EIS/EIR to assess the environmental impacts associated with the construction and operation of the Long Beach LNG Import Project. The document was prepared in accordance with the requirements of the National Environmental Policy Act (NEPA), the Council on Environmental Quality regulations for implementing the procedural provisions of NEPA [Title 40 Code of Federal Regulations (CFR) Parts 1500-1508], the FERC's regulations implementing NEPA (Title 18 CFR Part 380), the California Environmental Quality Act (CEQA), and the guidelines for the implementation of the CEQA (California Code of Regulations Title 14, section 15000 et seq.). The purpose of this document is to inform the public and the permitting agencies about the potential adverse and beneficial environmental impacts of the proposed project and its alternatives, and to recommend all feasible mitigation measures.

The U.S. Army Corps of Engineers (ACOE) has jurisdictional authority pursuant to section 404 of the Clean Water Act [33 United States Code (USC) 1344], which governs the discharge of dredged or fill material into waters of the United States, and section 10 of the Rivers and Harbors Act (33 USC 403), which regulates any work or structures that potentially affect the navigable capacity of a waterbody. Because the ACOE must comply with the requirements of NEPA before issuing permits under sections 404 and 10, it has elected to act as a cooperating agency with the FERC and the POLB in preparing this EIS/EIR. The ACOE would adopt the EIS/EIR per Title 40 CFR Part 1506.3 if, after an independent review of the document, it concludes that its comments and suggestions have been satisfied.

The U.S. Coast Guard (Coast Guard) within the U.S. Department of Homeland Security exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC section 701). The Coast Guard is responsible for matters

[1] Some of the activities associated with the project would be conducted by the POLB and would require issuance of a Harbor Development Permit to the POLB as well as to SES.

related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval and compliance verification as provided in Title 33 CFR Part 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility. As required by its regulations, the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic. The Coast Guard has elected to act as a cooperating agency in the preparation of this EIS/EIR and plans to adopt the document if it adequately covers the impacts associated with issuance of the LOR.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) within the U.S. Department of Transportation has authority to promulgate and enforce safety regulations and standards for the transportation and storage of LNG in or affecting interstate or foreign commerce under the pipeline safety laws (49 USC Chapter 601). This authority extends to the siting, design, installation, construction, initial inspection, initial testing, and operation and maintenance of LNG facilities. The PHMSA's operation and maintenance responsibilities include fire prevention and security planning for LNG facilities under Title 49 CFR Part 193. The PHMSA is participating in the NEPA analysis under the terms of an interagency agreement between the PHMSA, the FERC, and the Coast Guard.

PROPOSED ACTION

LNG is natural gas that has been cooled to a temperature of about -260 degrees Fahrenheit so that it becomes a liquid. Because LNG is more compact than the gaseous equivalent, it can be transported long distances across oceans using specially designed ships. SES proposes to ship LNG from a variety of Asian and other foreign sources to provide a new, stable source of natural gas to serve the needs of southern California, particularly the Los Angeles Basin (LA Basin). The LNG would be unloaded from the ships, stored in tanks at the terminal, and then re-gasified (vaporized) and transported via a new 2.3-mile-long, 36-inch-diameter natural gas pipeline to Southern California Gas Company's (SoCal Gas) existing Line 765. A portion of the LNG would be distributed via trailer trucks to LNG vehicle fueling stations throughout southern California to fuel LNG-powered vehicles.

Natural gas is a mixture of hydrocarbon compounds, principally methane. It also contains small amounts of heavier hydrocarbons, such as propane, ethane (C_2), and butane, which have a higher heating value than methane. A portion of these components may need to be removed from the LNG that would be stored on the terminal site in order for the natural gas to meet the British thermal units (Btu) and gas quality specifications of SoCal Gas as well as the specifications for LNG vehicle fuel established by the California Air Resources Board (CARB). The components that are removed are called natural gas liquids (NGL). SES has stated that it would accept only lean LNG [i.e., LNG containing fewer heavy (non-methane) hydrocarbons than regular LNG] from its suppliers. However, up to 10,000 million Btu per day of C_2 recovered from the LNG would be vaporized and distributed to ConocoPhillips' existing Los Angeles Refinery Carson Plant (LARC) via a new 4.6-mile-long, 10-inch-diameter pipeline.

Specifically, SES' proposal would involve construction and operation of LNG terminal and pipeline facilities as described below.

The LNG terminal facilities would include:

- an LNG ship berth and unloading facility with unloading arms, mooring and breasting dolphins, and a fendering system;

- two LNG storage tanks, each with a gross volume of 160,000 cubic meters (1,006,000 barrels) surrounded by a security barrier wall;
- 20 electric-powered booster pumps;
- four shell and tube vaporizers using a primary, closed-loop water system;
- three boil-off gas compressors, a condensing system, an NGL recovery system, and an export C_2 heater;
- an LNG trailer truck loading facility with a small LNG storage tank;
- a natural gas meter station and odorization system;
- utilities, buildings, and service facilities; and
- associated hazard detection, control, and prevention systems; site security facilities; cryogenic piping; and insulation, electrical, and instrumentation systems.

The pipeline facilities would include:

- a 2.3-mile-long, 36-inch-diameter pipeline and associated aboveground facilities to transport natural gas from the LNG terminal to the existing SoCal Gas system; and
- a 4.6-mile-long, 10-inch-diameter pipeline and associated aboveground facilities to transport vaporized C_2 from the LNG terminal to the existing ConocoPhillips LARC.

PUBLIC INVOLVEMENT AND AREAS OF CONCERN

On June 30, 2003, SES filed a request with the FERC to implement the Commission's Pre-Filing Process for the Long Beach LNG Import Project. At that time, SES was in the preliminary design stage of the project and no formal application had been filed with the FERC. On July 11, 2003, the FERC granted SES' request and established a pre-filing docket number (PF03-6-000) to place information filed by SES and related documents issued by the FERC into the public record. The purpose of the Pre-Filing Process is to encourage the early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve issues before an application is filed with the FERC. After receipt of SES' Harbor Development Permit application on July 25, 2003, the POLB agreed to conduct its CEQA review of the project in conjunction with the Commission's Pre-Filing Process.

As part of the Pre-Filing Process, the FERC and the POLB worked with SES to develop a public outreach plan for issue identification and stakeholder participation. As part of the outreach plan, SES met with local associations, neighborhood groups, and other non-governmental organizations to inform them about the project and address issues and concerns. In coordination with the FERC and the POLB, SES also consulted with key federal and state agencies to identify their issues and concerns.

On September 4, 2003, SES sponsored two public workshops in the Long Beach area. The purpose of the workshops was to inform agencies and the general public about LNG and the proposed project and to provide them an opportunity to ask questions and express their concerns. The FERC and the POLB participated in these workshops and provided information on the joint environmental review process. Invitations to the public workshops were sent to federal, state, and local agencies; elected

officials; environmental groups; affected landowners; and tenants of the POLB. Notices of the public workshops were published in the local newspapers.

Between September 22, 2003 and November 3, 2004, the FERC and/or the POLB issued three separate notices that described the proposed project and invited written comments on the environmental issues to be addressed in the EIS/EIR. The September 22, 2003 notice also announced a joint NEPA/CEQA public scoping meeting that was held in Long Beach on October 9, 2003. All three notices were mailed to federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; POLB tenants; and local libraries and newspapers. Announcements of the public scoping meeting were published in the local newspapers. Each notice opened a formal scoping period for the project.

A transcript of the public scoping meeting and all written comments are part of the public record for the Long Beach LNG Import Project and are available for viewing on the FERC Internet website (http://www.ferc.gov).[2] The environmental scoping comments received during the public scoping periods raised issues related to the alternatives analysis, geologic hazards, contaminated soils and sediments, land use, socioeconomics, traffic, air quality, cumulative impacts, and reliability and safety.

This draft EIS/EIR was filed with the U.S. Environmental Protection Agency (EPA), submitted to the California State Clearinghouse, and mailed to federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; POLB tenants; intervenors[3] in the FERC's proceeding; local libraries and newspapers; and other interested parties (i.e., miscellaneous individuals who provided scoping comments or asked to be on the mailing list). A formal notice indicating that the draft EIS/EIR is available for review and comment was published in the Federal Register, posted in the Los Angeles County Clerk's office in California, and sent to the remaining individuals on the mailing list. The public has at least 45 days after the date of publication in the Federal Register to review and comment on the draft EIS/EIR both in the form of written comments and at public meetings to be held in Long Beach. All comments received on the draft EIS/EIR related to environmental issues will be addressed in the final EIS/EIR.

ENVIRONMENTAL ISSUES

The environmental issues associated with construction and operation of the Long Beach LNG Import Project are analyzed in this EIS/EIR using information provided by SES and further developed from data requests; field investigations; scoping; literature research; alternatives analysis; contacts with federal, state, and local agencies; and input from public groups and organizations. The Agency Staffs' analysis indicates that the project would result in certain adverse environmental impacts.

As part of the environmental analysis, specific mitigation measures were identified that are feasible and that, when implemented, would reduce potential adverse impacts of project construction and operation. Table ES-1 at the end of this Executive Summary summarizes the significant impacts of the project and the mitigation measures recommended by the Agency Staffs to reduce the impacts. These impacts are described in detail in section 4.0. A brief summary by resource is provided below.

---

[2] Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number excluding the last three digits in the "Docket Number" field (i.e., PF03-6 and CP04-58). Be sure to select an appropriate date range.

[3] Intervenors are official parties to the proceeding and have the right to receive copies of case-related Commission documents and filings by other intervenors. Likewise, each intervenor must provide 14 copies of its filings to the Secretary of the Commission and must send a copy of its filings to all other intervenors. Only intervenors have the right to seek rehearing of the Commission's decision.

Geology

The project area is underlain by fill materials, alluvial and marine sediments, sedimentary rocks, and metamorphic basement rocks. Construction of the LNG terminal, electric distribution facilities, and pipelines would occur primarily within near-surface non-native fill deposits and unconsolidated soils and sediments. Therefore, construction and operation of the Long Beach LNG Import Project would not materially alter the geologic conditions of the area or worsen existing unfavorable geologic conditions. All active and abandoned petroleum production wells would be identified in the field just prior to the commencement of construction.

The potential for tsunamis or surface rupture to affect the project facilities is very low and, therefore, no specific mitigation is proposed. Geologic hazards present in the project area are related to seismic activity and historical subsidence associated with petroleum production in the area. Seismic activity could potentially damage the LNG terminal site facilities, shoreline structures, and pipeline and electric distribution facilities through strong shaking or secondary ground deformation such as liquefaction, shaking-induced settlement, or lateral spreading.

SES conducted a detailed analysis that resulted in seismic design criteria that meet the POLB requirements and exceed the Office of Pipeline Safety and the FERC requirements as specified in National Fire Protection Association 59A (2001). This analysis indicates that an earthquake of Richter magnitude M9.0 on the Palos Verde fault or M7.5 on the THUMS-Huntington Beach fault would be necessary to generate ground motions strong enough to rupture the LNG storage tanks and release their contents. These events have estimated return intervals of approximately 15,000 years and, therefore, are extremely unlikely to occur during the 50-year life of the project.

The Agency Staffs reviewed the current engineering designs for the LNG storage tanks and other critical terminal structures. These designs are of sufficient detail to demonstrate that the project facilities would withstand the seismic hazards that could affect the site when they are constructed to the specifications of the plans. SES would ensure that final engineering designs also meet or exceed applicable seismic standards, and would provide the final plans to the FERC and the POLB for review and approval before construction. The POLB would construct the shoreline structures to meet the stringent seismic design criteria developed for the site, and stone columns would be installed between the shoreline structures and the LNG storage tanks, thereby providing the required lateral support to limit displacement and minimize stress and strain levels well within the design limits of the LNG storage tanks and other heavy load structures in the event of an earthquake.

Regional subsidence due to ongoing hydrocarbon production is effectively monitored and controlled and, therefore, would not affect construction or operation of the project.

Soils and Sediments

Because of the highly developed, industrial nature of the area and the presence of mostly fill materials under the majority of the project facilities, the project would not reduce soil productivity by compaction or soil mixing. However, construction of the project facilities would temporarily expose the fill materials on the affected portion of Terminal Island and the native soils at the end of the pipeline routes to the effects of wind, rain, and runoff, which could cause erosion and sedimentation in the area. Erosion control measures proposed for the Long Beach LNG Import Project are detailed in SES' Sediment Control Plan that is included in its Storm Water Pollution Prevention Plan (SWPPP).

Existing soils at the LNG terminal site are not capable of adequately supporting the LNG storage tanks or other heavy load structures. As a result, SES proposes to install deep-driven pile foundations

beneath the LNG storage tanks and other heavy load structures to meet the stringent static-settlement criteria for the structures at the LNG terminal. Other soil improvements at the site would include the installation of approximately 3,380 stone columns to depths of 60 to 80 feet below ground surface between the shoreline structures and the security barrier wall and an additional approximately 2,000 stone columns to a depth of 60 feet below ground surface between the security barrier wall and the LNG storage tanks. In addition to excavation for the soil improvements, construction of the project would involve excavation for the LNG spill impoundment systems and other utilities and foundations at the LNG terminal site, and trenching for the pipeline and electric distribution facilities. Contaminated soil and other hazardous materials could be encountered during any of these activities. If hazardous substances are encountered during construction, SES would notify the POLB. SES, in consultation with the POLB, would comply with all applicable environmental regulations. Before construction, SES and the pipeline contractor(s) would submit work plans that outline appropriate environmental site investigation and remediation activities to the appropriate agencies for approval. The work plans would include a site-specific Health and Safety Plan, Sampling and Analysis Plan, Project Contractor Quality Control Plan, and an Environmental Protection Plan that would also include a Waste Management Plan.

Spills or leaks of fuels, lubricants, or other hazardous substances during construction and/or operation of the project could also have an impact on soils. This potential impact is expected to be minor, however, because of the typically low frequency, volume, and extent of spills or leaks, and because of the hazard detection system and other safety controls designed to prevent or contain spills and leaks at the LNG terminal site. Implementation of SES' Spill Procedure included in its SWPPP would further reduce the likelihood of a significant spill or leak occurring during construction or operation of the project, and would reduce the impact of any spill or leak that may occur.

Disturbance of the West Basin sediments during in-water activities would temporarily resuspend sediments in the water column, which could cause turbidity. An increase in sediment and turbidity levels could adversely affect water quality and aquatic organisms. Resuspension of contaminated sediments could also impact marine organisms in the area. The POLB has recently negotiated a consent agreement with the California Department of Toxic Substances Control (DTSC) for its concurrence with the Installation Restoration Site 7 (West Basin) sediment remediation. Accordingly, the dredging associated with the project would be done only with the concurrence of the DTSC. Turbidity levels would return to baseline conditions after dredging operations were completed. Disposal suitability issues would be addressed in compliance with the EPA/ACOE *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual*. Disturbance of the West Basin sediments could also encounter ordnance. Any ordnance found during dredging for the proposed project would be handled in accordance with federal regulations and the POLB's procedures.

Water Resources

Activities associated with construction of the proposed project facilities, including hydrostatic test water appropriation, the installation of deep-driven pile foundations and stone columns at the LNG terminal site, the horizontal directional drills (HDDs) of the Cerritos Channel, site excavation and dewatering, and accidental spills or leaks of hazardous materials could adversely affect groundwater quality within the project area. SES would minimize the potential for these impacts by negotiating project water requirements with the City of Long Beach for appropriate fees and mitigation measures; driving, rather than excavating, the foundation piles at the LNG terminal site and installing a cement plug at the base of each stone column in order to prevent the creation of an opening where potential cross-contamination could occur; implementing its HDD Plan; identifying and protecting all underground piping in the construction area; evaluating all dewatered material for contamination prior to removal in accordance with the Health and Safety Plan and Sampling and Analysis Plan; and implementing its Spill

Procedure to address preventive and mitigative measures that would be used to minimize the potential impact of a hazardous spill during construction of the project facilities.

Potential operational impacts on groundwater include an accidental spill or leak of hazardous materials during operation of the project facilities and water requirements for the LNG terminal vaporization process, firewater system, and miscellaneous potable water needs. The measures in SES' Spill Procedure would reduce the potential impacts on groundwater associated with a hazardous spill or leak during project operation. All of the operational water required for the LNG terminal would be obtained from the POLB and the City of Long Beach municipal water system. SES would negotiate with the City of Long Beach or a local supplier to determine appropriate fees and to ensure that the project would have no impact on water availability in the area.

Activities associated with construction of the project facilities, including reinforcement of the shoreline structures, construction of the LNG ship berth and unloading facility and associated dredging, the HDDs of the Cerritos Channel, installation of the C_2 pipeline over the Dominguez Channel, hydrostatic test water discharge, storm water runoff, and accidental spills or leaks of hazardous materials could adversely affect surface water quality and/or water circulation within Long Beach Harbor. Adherence to the measures of all applicable permits, implementation of the POLB's Dredge and Disposal Plan and SES' HDD Plan and Spill Procedure, as well as disposal of all sediments at approved sites would minimize impacts on water quality. In addition, the Agency Staffs will recommend to their respective Commissions that SES revise its HDD Plan to describe the procedures that would be followed if an existing submerged pipeline is encountered during the HDD operations.

Operational impacts on water quality include the potential to contribute additional pollutants to the waterbody via accidental spills or leaks of hazardous materials, storm water runoff, or an LNG spill. There would be no intake or discharge of sea water during operation of the project facilities. Implementation of SES' Spill Procedure included in its SWPPP would reduce the likelihood of a significant spill or leak occurring during operation of the project, and would reduce the impact of any spill or leak that may occur. In accordance with its SWPPP, best management practices (BMPs) consisting of permanent features and operational practices designed or implemented to minimize the discharge of pollutants in storm water or non-storm water flows from the LNG terminal site would be implemented to reduce the potential operation-related impacts on surface water resources.

Biological Resources

Due to the highly developed nature of the POLB and the lack of vegetative habitats, the terrestrial environment in the project area supports few wildlife species. Individuals in the area are acclimated to the industrial nature of the POLB, routinely experience disturbance associated with Port activities, and would likely relocate into adjacent habitats. The project would not have a measurable impact on the local population of any species.

Activities associated with dredging could potentially affect marine organisms by destroying the benthic infauna of the dredged sediments and temporarily displacing mobile organisms, such as fish. In addition to the direct disturbances to the bottom substrates, dredging activities would temporarily increase turbidity and the presence of suspended sediments in the water column, which could indirectly affect marine organisms. However, monitoring of larger dredging projects within San Pedro Bay has shown that turbidity associated with dredging is short term and localized and that compliance with the requirements of the Regional Water Quality Control Board's Waste Discharge Requirements and the ACOE's section 404 permit results in minimal turbidity. The short-term loss of benthic organisms in a small portion of the harbor is generally recognized as an insignificant impact on aquatic resources and benthic communities would be expected to repopulate following the completion of construction activities.

Activities associated with the reinforcement of the shoreline structures and construction of the LNG ship berth and unloading facility could directly affect benthic and fish species during the removal or installation of any in-water structures (e.g., pilings, underwater rock buttress). Individuals of non-mobile species attached to hard substrates that are removed or covered would suffer mortality. However, these species are relatively widespread throughout the harbor and would recolonize new hard substrates within 2 to 3 years.

Noise could impact marine organisms that occur in the project area within Long Beach Harbor. Project vessels operating within Long Beach Harbor could create sounds that lead to responses in fish. Additionally, specific construction activities (e.g., driving steel piles) could also generate underwater sound pressure waves that potentially kill, injure, or cause a behavioral change in fish in the immediate vicinity of the construction activities. Given the abundance of fish in the harbor despite continuous maritime activity, marine organisms found in the project area have generally adapted to these conditions.

There is also the potential for spills, leaks, or accidental releases of potentially hazardous materials to occur during construction of the proposed project. SES' Spill Procedure specifies BMPs that would minimize the chances of a spill and, if a spill were to occur, minimize the chances of the spill reaching a waterbody and affecting marine organisms.

Dredging and construction activities associated with the Long Beach LNG Import Project would affect water-associated birds through disruptive noise and/or temporary loss or degradation of foraging habitats in the marine waters of the West Basin. Birds found in the area are acclimated to these types of activities and would use similar habitats in adjacent areas.

Consultation with the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) identified the proposed project area as designated essential fish habitat (EFH) for the Coastal Pelagics and Pacific Groundfish Management Plans. Fourteen of the 86 species managed under these two plans are known to occur in Long Beach Harbor and could be affected by the proposed project. Although disturbance of an estimated 11.9 acres of sea floor and the temporary resuspension of sediments into the water column during dredging activities could potentially adversely affect EFH (resulting in avoidance by adults and some loss of larval northern anchovy in the immediate vicinity of the dredging activity), implementation of the control measures and management practices proposed by SES or required by the regulatory agencies would serve to avoid or minimize impacts on EFH. Additionally, construction impacts would be temporary and turbidity levels would return to baseline conditions following construction.

Seven species listed as federally threatened or endangered potentially occur in the project area. The California brown pelican, California least tern, and leatherback sea turtle are federally listed endangered species and the western snowy plover, green sea turtle, olive Ridley sea turtle, and loggerhead sea turtle are federally listed threatened species. Both the U.S. Fish and Wildlife Service and NOAA Fisheries provided comments indicating that federally listed threatened or endangered species would not likely be adversely affected by the proposed project and the FERC staff concurs with these determinations. Three state-listed endangered species, the American peregrine falcon, the California brown pelican, and the California least tern, have been identified as potentially occurring in the proposed project area. The California brown pelican and the California least tern are also federally listed species and, as discussed above, would not likely be adversely affected by the project. Construction and operation of the Long Beach LNG Import Project could disturb the American peregrine falcon through temporary loss or degradation of foraging habitat and disruptive noise from construction and operation of the project facilities. However, peregrine falcons in the project area have become acclimated to POLB operations, including construction and dredging activities as evidenced by their continued use of the local bridges for nesting. In addition, the proposed project would not result in the permanent loss or

degradation of existing foraging habitat or significantly increase existing noise levels during construction and operation.

Land Use, Hazardous Waste, Recreation, and Visual Resources

A total of 88.0 acres of land would be affected during construction of the Long Beach LNG Import Project (56.9 acres for the LNG terminal facilities, 30.1 acres for the pipeline facilities, and 1.0 acre for the electric distribution facilities). Of the 88.0 acres of land affected by construction of the project, 37.0 acres would be permanently affected during operation of the project facilities (32.1 acres associated with the LNG terminal, 3.9 acres associated with the pipelines, and 1.0 acre associated with the electric distribution facilities). The LNG terminal would be an industrial use that generally conforms to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans and would be consistent with existing surrounding uses. However, an amendment to the PMP would be necessary to accommodate the LNG facility because LNG is not an expressly identified "hazardous cargo" as permitted within Terminal Island Planning District 4. The pipeline and electric distribution facilities would be an industrial/utility use that is consistent with existing surrounding uses and conforms to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans.

All of the land and marine uses immediately adjacent to and within 1 mile of the proposed project facilities are associated with the industrial activities of the ports of Long Beach and Los Angeles or the Cities of Long Beach, Los Angeles, and Carson. No permanent residences are located within the POLB or the Port of Los Angeles. The closest potential residences are in a recreational vehicle park about 1.3 miles east-northeast of the LNG terminal site and possibly live-aboard boats at two marinas in the East Basin of the Cerritos Channel between 1.2 and 1.6 miles northwest of the LNG terminal.

The Long Beach Naval Shipyard and Station are listed as hazardous waste sites. The Navy also documented soil contamination in the area during closure of its Long Beach Complex. Several other hazardous waste sites were identified within 0.25 mile of the pipeline routes and electric distribution facilities. Because none of these sites would be crossed by the proposed facilities, Phase I Environmental Assessments were not conducted.

Although the Long Beach area provides several opportunities for recreational activities, the immediate area surrounding the LNG terminal site, pipelines, and electric distribution facilities does not provide for recreational activities due to the industrial nature of the Port and the adjacent area to the north. Construction and operation of the Long Beach LNG Import Project would not threaten the viability of a recreational resource, prohibit access to recreational resources, or cause termination of a recreational use.

Construction and operation of the LNG terminal facilities would have a permanent but not significant impact on visual resources. Although there are a substantial number of potential mobile and stationary viewers and visibility is high in some locations, the LNG facilities would be seen in the context of the existing industrial facilities at the POLB and would not adversely affect the viewshed from sensitive locations or change the character of the landscape in terms of either physical characteristics or land uses. Construction and operation of the pipeline and electric distribution facilities would not result in significant impacts on visual resources.

Socioeconomics

Construction of the project would result in a temporary increase in population and the demands on temporary housing, public services, and utilities and service systems. Due to the temporary and limited nature of these impacts they are not considered significant. Of the 60 full-time workers SES would hire to operate the project facilities, about 54 workers are expected to be from the local area.

Therefore, operation of the project would not have a significant impact on population or the demand for housing. Because LNG would be a new product to the POLB, it would also be new to the local fire and emergency response services. SES is working with local emergency providers to develop procedures to handle potential fire emergencies and is working with the Long Beach City Fire Department (LBFD) to provide hazard control and firefighting training that is specific to LNG and LNG vessels. SES has also committed to funding all necessary security/emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs. These measures should adequately equip the LBFD to handle any type of emergency at the proposed LNG terminal. Construction and operation of the project would have a beneficial impact on local tax revenues.

Transportation

The duration of construction for the LNG terminal is estimated to be 48 months. During this time, traffic would be generated by trucks transporting materials and equipment to and from the laydown area and project site as well as trucks transporting materials directly to the project site. Driveway access to the laydown area is located along Pier S Avenue. Also, construction worker trips would occur during the construction period. These worker trips would total approximately 808 trips (404 in and 404 out) into the area. All construction workers would park adjacent to the laydown area. The construction workers would then be transported via buses to the project site. The transporting of these workers would generate a total of 46 daily bus trips (23 in and 23 out). The transporting of construction equipment and materials would generate approximately 676 daily truck trips (338 in and 338 out) during the most active construction period. These project construction worker and truck and material haul trips would result in a temporary, short-term significant impact at the intersections of Navy Way and Seaside Avenue (evening only) and Henry Ford Avenue and Anaheim Street (evening only). The Agency Staffs will recommend to their respective Commissions that SES require the construction workforce to work 6 a.m. to 2:30 p.m. instead of 7 a.m. to 3:30 p.m. Improvements at the Henry Ford Avenue/Anaheim Street intersection would be implemented if required by the Los Angeles Department of Transportation. Operation of the project would not result in a significant impact on traffic.

The Long Beach LNG Import Project would generate a maximum of 120 ship calls and 240 ship movements within the POLB each year. This would typically mean the addition of one ship movement per day on up to 240 days of the year or possibly two ship movements in the event of a rapid discharge call with arrival, discharge, and departure occurring during one calendar day. The increase in ship traffic associated with the LNG terminal could cause vessel traffic congestion within the harbor and/or conflicts with other commercial interests if an LNG ship arrival or departure delays the movement of another vessel, either due to scheduling or traffic management resulting in slow speed or waiting time. Delays experienced by other ships are expected to be temporary and of short duration. In addition, SES would participate with the Coast Guard in the development of procedures to reduce impacts on marine transportation, including implementation of an LNG Vessel Operation and Emergency Contingency Plan that would provide the basis for operation of LNG ships within the POLB.

Cultural Resources

The FERC and the POLB, in consultation with the State Historic Preservation Office, have determined that there would be no impact on any properties listed, or eligible for listing, on the National Register of Historic Places or the California Register of Historical Resources or on any unique archaeological resources for the proposed project; therefore, no mitigation would be required. SES prepared an Unanticipated Discovery Plan to be used during construction. The plan describes the procedures that would be employed in the event previously unidentified cultural resources or human remains are encountered during construction. SES' continued cooperation with Native American tribes

who were identified by the California Native American Heritage Commission as potentially having knowledge of cultural resources in the project area should address any tribal issues associated with the proposed project.

Air Quality

Construction emissions associated with the Long Beach LNG Import Project would be caused by tailpipe emissions from worker vehicles and supply trucks, as well as construction equipment and fugitive dust. The South Coast Air Quality Management District (SCAQMD) significance thresholds would be exceeded for all criteria pollutants except sulfur oxides (SO_x) on a peak daily and quarterly basis. The exceedances are considered a significant impact. To reduce project construction emissions from onsite diesel-fueled combustion equipment, SES' contract specifications would require that all off-road diesel-fueled equipment powered by compression ignition engines meet or exceed the various emission standards in accordance with table 1 of Title 40 CFR Part 89.112. For all other equipment, contract specifications would require that the newest equipment in the construction contractors' fleets be used to take advantage of the general reduction in emission factors that occurs with each model year. SES would also adhere to the POLB's air quality requirements and construction standards some of which include the use of electric-powered dredges for all hydraulic dredges and ultra-low sulfur or emulsified diesel in all other types of dredges, construction phasing to minimize concurrent use of construction equipment, turning equipment off when not in use, watering specifications, restrictions on soil excavation and hauling in windy conditions, suspension of construction activities during Stage II smog alerts, and speed limit restrictions. In addition to SES' proposed control measures, the Agency Staffs will recommend to their respective Commissions that SES require all contractors to use ultra-low sulfur or CARB-approved alternative diesel fuel in all diesel-powered equipment used onsite during construction.

The construction workforce would be relatively small (peak of about 404 workers) and would primarily consist of workers from within the Los Angeles and Orange County labor pool. The workers would commute to the temporary laydown and worker parking area on Ocean Boulevard and would then be transported to the site via buses. Materials and equipment would be shipped to the site by road, rail, or barge or to the temporary laydown area on Ocean Boulevard. The Agency Staffs will recommend to their respective Commissions that SES use alternative-fuel buses to transport workers to and from the temporary laydown and worker parking area.

Although implementation of SES' control measures and the mitigation measures recommended by the Agency Staffs would reduce emissions during the construction phase, the impacts of the project on air quality during construction are still expected to remain significant. Construction impacts would, however, be temporary and intermittent and cease at the end of the construction phase.

Operational emission sources associated with the project would include marine vessels, vaporization equipment, fugitive process emissions, on-road vehicles, and emergency generator and firewater pumps. The project's operational emissions would exceed the SCAQMD daily emission thresholds for nitrogen oxides (NO_x), reactive organic compounds (ROC), particulate matter having an aerodynamic diameter of 10 microns or less (PM_{10}), and SO_x. Therefore, the project would be significant for ozone, PM_{10}, and SO_x. The project would not be significant for carbon monoxide. SES proposes to minimize criteria pollutant emissions associated with operation of the Long Beach LNG Import Project through the following control measures: Lowest Achievable Emission Rate/Best Available Control Technology would be applied as needed to the stationary sources; LNG trailer trucks would be LNG-fueled and their engines would be turned off during onsite loading; LNG ships would generate power from combustion of boil-off LNG rather than fuel oil if they are equipped to do so; fugitive ROC emissions from various points in the terminal would be minimized by design elements and through the

implementation of a comprehensive leak detection and repair program; and operational personnel would be encouraged to rideshare and use mass transit.

SES would also ensure that all diesel-powered, non-road mobile terminal equipment would meet the emissions standards set forth in the EPA's Control of Emissions of Air Pollution From Non-Road Diesel Engines and Fuel and require ships calling at the terminal that do not use LNG boil-off gas in the main engines for power during unloading to use fuels such as the CARB's #2 diesel, gas-to-liquid diesel, biofuels, or a marine distillate fuel, in the ship's auxiliary power generator motors, or use exhaust treatment technology. Because the SCAQMD significance thresholds would be exceeded for NO_x, ROC, PM_{10}, and SO_x even after implementation of SES' control measures, the project's operational impact on air quality would be considered significant. Given the nature of the project operations, especially vessel operations, the Agency Staffs have determined that there are no additional feasible measures that would further reduce air emissions.

The proposed project would comply with all applicable regulations in the 2003 Air Quality Management Plan (AQMP). The AQMP includes control measures that are intended to be implemented by federal and state governments to reduce emissions from ships and on-road trucks in order to bring the South Coast Air Basin (SCAB) into conformity with federal ambient air quality standards.

The FERC is required to conduct a conformity analysis for the Long Beach LNG Import Project to determine if the emissions associated with the project would conform to the State Implementation Plan (SIP) and would not reduce air quality in the SCAB. This draft EIS/EIR includes a draft conformity analysis; however, documentation supporting conformity with the applicable SIP and AQMP in accordance with Title 40 CFR Part 93.158 has not been filed with the FERC. Until this information is provided by SES, the Long Beach LNG Import Project is deemed to not conform with the applicable SIP and AQMP. The FERC staff recommends that SES complete a full air quality analysis and identify any mitigation requirements necessary for a finding of conformity and file this information with the FERC before the end of the draft EIS/EIR comment period for review and analysis in the final EIS/EIR.

In accordance with SCAQMD Rule 1401, a Health Risk Assessment of toxic air contaminant emissions on humans was conducted for the water heaters associated with the vaporization equipment, the unloading of the LNG ships at berth (vessel activities during that period are referred to as hotelling), movement of the LNG ships within the SCAQMD's boundary, tugboats, pilot boats, Coast Guard escort boats, and idling emissions from the LNG trailer trucks that would load at the terminal. Although the proposed project would not exceed cancer risk level significance thresholds established by the SCAQMD for toxic air pollutant health impacts, the SCAB and Port areas in particular are assumed, on the basis of the SCAQMD's Multiple Air Toxics Exposure Study in the SCAB, to suffer significant impacts related to toxic air pollutants and associated cancer risk levels. Therefore, toxic air pollutants resulting from the project would likely contribute to an existing cumulatively significant air quality impact in the SCAB.

Noise

The noise associated with construction activities would be intermittent because equipment would be operated on an as-needed basis. Construction activities at the LNG terminal and along the routes of the pipelines and electric distribution facilities would generate short-term increases in sound levels during daylight hours when construction activities would occur. The strongest source of sound during construction would be noise associated with installing deep-driven pile foundations beneath the LNG storage tanks and other heavy load structures to meet the stringent static-settlement criteria for the LNG storage tanks and other heavy load structures at the LNG terminal. Although the noise levels at the property boundary during this activity would be higher than existing noise levels, the impacts would be

short term and would be contained within the industrial area immediately surrounding the LNG terminal site within the POLB.

The major noise-producing equipment associated with operation of the LNG terminal would be the boil-off gas compressors, primary and secondary booster pumps, water pumps and heaters, instrument air compressors, and fans for the heaters. Noise control measures included in the design of the LNG terminal facilities consist of buildings, barrier walls, and tanks to provide the appropriate level of noise screening. The predicted operational noise level is below the FERC limit of 55 decibels of the A-weighted scale (dBA) day-night sound level (L_{dn}) at the nearest noise-sensitive area (NSA). The predicted property boundary noise level is below the City of Long Beach noise limit of 70 dBA. To ensure that the actual noise resulting from the operation of the LNG terminal is below the FERC limit of 55 dBA L_{dn} at any nearby NSAs and the City of Long Beach property boundary noise limit of 70 dBA, the Agency Staffs will recommend to their respective Commissions that SES conduct a noise survey to verify that the noise from the LNG terminal when operating at full capacity does not exceed these limits.

Reliability and Safety

The safety of both the proposed LNG import terminal facility and the related LNG vessel transit was evaluated. With respect to the onshore facility, the FERC staff completed a cryogenic design and technical review of the proposed terminal design and safety systems. As a result of the technical review of the information provided by SES in its application materials, a number of concerns were identified by the FERC staff relating to the reliability, operability, and safety of the facility. In response to staff's questions, SES provided written answers prior to a site visit and cryogenic design and technical review conference for the proposed project that was held in Long Beach in July 2004. Specific recommendations have been identified for outstanding issues that require resolution. Follow up on those items requiring additional action would need to be documented in reports to be filed with the FERC.

The FERC staff calculated thermal radiation distances for incident flux levels ranging from 1,600 to 10,000 Btu per square foot per hour (Btu/ft^2-hr) for an LNG storage tank and trailer truck loading LNG storage tank fires. An incident flux level of 1,600 Btu/ft^2-hr is considered hazardous for persons located outdoors and unprotected, a level of 3,000 Btu/ft^2-hr is considered an acceptable level for wooden structures, and a level of 10,000 Btu/ft^2-hr would cause clothing and wood to ignite and is considered sufficient to damage process equipment. It was determined that the exclusion zone distance for the 10,000 Btu/ft^2-hr incident flux would not extend beyond the property line. The LNG storage tank thermal radiation exclusion zone distance for the 1,600 and 3,000 Btu/ft^2-hr incident flux would extend outside the terminal site to the east onto Pier T property. For the trailer truck loading storage tank, the thermal radiation exclusion zone distance for the 1,600 and 3,000 Btu/ft^2-hr incident flux also would extend outside the terminal site to the east onto Pier T property. Although no prohibited activities or buildings currently exist within these exclusion zones, according to Title 49 CFR Part 193, either a government agency or SES must be able to exercise legal control over activities in these areas for as long as the facility is in operation. The POLB owns the land surrounding the LNG terminal site but leases parcels to other tenants. In its application, SES stated that it is currently negotiating with the POLB and adjacent tenants for restrictive covenants to limit the use of the areas impacted. The FERC staff recommends that SES provide in its comments on the draft EIS/EIR, or in a separate document submitted at the same time, evidence of its ability to exercise legal control over the activities that occur within the portions of the thermal radiation exclusion zones that fall outside the terminal property line that can be built upon.

The FERC staff also conducted flammable vapor dispersion analyses and determined that design spills for the storage tanks, process area, and trailer truck loading area would not extend beyond the terminal property line.

Thermal radiation and flammable vapor hazard distances were also calculated for an accident or an attack on an LNG vessel. For 2.5-meter and 3-meter diameter holes in an LNG cargo tank, the FERC staff estimated distances to range from 4,372 to 4,867 feet for a thermal radiation level of 1,600 Btu/ft^2-hr.

In addition to the analysis conducted by the FERC staff, the POLB commissioned a study by Quest Consultants, Inc. (Quest) to identify the worst-case hazards that would result from a release of LNG or other hydrocarbons in or near SES' proposed LNG import terminal. Using a detailed methodology, Quest identified potential accidental and intentional release events involving the LNG terminal and LNG ships. Quest's final report is titled *Hazards Analysis of a Proposed LNG Import Terminal in the Port of Long Beach, California* (POLB Quest Study) and is included in its entirety in Appendix F.

The POLB staff reviewed each of the release events identified by Quest using probability definitions developed by the Los Angeles County Fire Department (LACFD). Using the LACFD criteria, an event is considered possible if it could occur once every 100 to 10,000 years. Based on the chances of their occurrence, the release events that are considered possible per the LACFD criteria are a release from process equipment within the LNG terminal and a release from an LNG ship following a collision with the breakwater or with another ship outside the breakwater.

There are no residential, visitor-serving, or recreation populations and essentially no exposed Port workers within the thermal radiation exclusion zone for the 1,600 Btu/ft^2-hr incident flux for a release from a rupture of process equipment at any location. Furthermore, the thermal radiation exclusion zone for the 10,000 Btu/ft^2-hr incident flux for a release from a process equipment rupture would not impact the adjacent industrial facilities.

The analyses in the draft EIS/EIR and the POLB Quest Study have shown that based on the extensive operational experience of LNG shipping, the structural design of an LNG vessel, and the operational controls imposed by the ship's master, the Coast Guard, and local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a vessel casualty – collision, grounding, or allision – is very small.

Unlike accidental causes, historical experience provides little guidance in estimating the probability of a terrorist attack on an LNG vessel or onshore storage facility. For a new LNG import terminal proposal that would store a large volume of flammable fluid near populated areas, the perceived threat of a terrorist attack is a primary concern of the local population. However, the POLB Quest Study reported that the historical probability of a successful terrorist event would be less than seven chances in a million per year. In addition, the multi-tiered security system that would be in place for an LNG import facility in the POLB would reduce the probability of a successful terrorist event.

Some commentors have expressed concern that the local community would have to bear some of the cost of ensuring the security of the LNG facility and the LNG vessels while in transit and unloading at the dock. The potential costs will not be known until the specific security needs have been identified, and the responsibilities of federal, state, and local agencies have been established in the Coast Guard's Waterway Suitability Assessment (WSA). SES has committed to funding all necessary security/ emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs. In addition, section 311 of the Energy Policy Act of 2005 stipulates that the FERC must require the LNG operator to develop an Emergency Response Plan that includes a Cost-Sharing Plan before any final approval to begin construction. The Cost-Sharing Plan shall include a description of any direct cost reimbursements to any state and local agencies with responsibility for security and safety at the LNG terminal and near vessels that serve the facility. To allow the FERC and the POLB the opportunity

to review the plan, the Agency Staffs will recommend to their respective Commissions that SES submit the plan concurrent with the submission of the Follow-on WSA.

Cumulative Impacts

When the impacts of the Long Beach LNG Import Project are considered additively with the impacts of other past, present, or reasonably foreseeable future actions, there is some potential for cumulative effect on water resources, socioeconomics, land transportation, air quality, and noise. For the Long Beach LNG Import Project, control measures have been developed and additional mitigation measures have been recommended by the Agency Staffs to minimize or avoid adverse impacts on these resources. However, the cumulative projects represent additions of potentially significant and unavoidable emissions to the SCAB. In addition, even though project-specific toxic air pollutant health impacts would not be significant, it is likely that the incremental increase in the cancer risk level for toxic air pollutants as a result of the proposed project would contribute to an existing cumulatively significant health impact in the SCAB.

Growth-inducing Impacts

The potential growth-inducing impacts of the Long Beach LNG Import Project would be an increase in development and population in the area associated with a new source of natural gas. Most of the natural gas that would be supplied by the LNG terminal would be transported into the SoCal Gas system and would be used to meet existing and future natural gas demand in the LA Basin. The demand for energy is a result of, rather than a precursor to, development in the region. Currently, imports from out of state represent approximately 87 percent of supply and are anticipated to rise to 88 percent by 2013, meaning that additional external supplies will be needed to keep up with demand. Given the short- and mid-term demand for natural gas and the need to reduce potential supply interruptions, the California Energy Commission has identified the need for California to develop new natural gas infrastructure to access a diversity of fuel supply sources and to remove constraints on the delivery of natural gas. The LNG that would be made available for vehicle fuel would be used to meet existing and projected future demand and provide a new source of fuel to facilitate conversion of diesel or gasoline-fueled vehicles to LNG, which could reduce air emissions in the area. Given the large local labor pool in Los Angeles and Orange Counties, no substantive influx of workers would occur during construction and operation of the Long Beach LNG Import Project.

ALTERNATIVES CONSIDERED

The No Action or No Project Alternative was considered. While the No Action or No Project Alternative would eliminate the environmental impacts identified in this EIS/EIR, none of the objectives of the proposed project would be met. Specifically, SES would not be able to provide a new and stable supply of natural gas and LNG vehicle fuel to southern California. It is purely speculative to predict the actions that could be taken by other suppliers or users of natural gas and LNG in the region as well as the resulting effects of those actions. Because the demand for energy in southern California is predicted to increase, customers would likely have fewer and potentially more expensive options for obtaining natural gas and LNG supplies in the near future. This might lead to alternative proposals to develop natural gas delivery or storage infrastructure, increased conservation or reduced use of natural gas, and/or the use of other sources of energy.

It is possible that the infrastructure currently supplying natural gas and LNG to the proposed market area could be developed in other ways unforeseen at this point. This might include constructing or expanding regional pipelines as well as LNG import and storage systems. Any construction or expansion work would result in specific environmental impacts that could be less than, similar to, or greater than those associated with the Long Beach LNG Import Project. Increased costs could potentially result in

customers conserving or reducing use of natural gas. Although it is possible that additional conservation may have some effect on the demand for natural gas, conservation efforts are not expected to significantly reduce the long-term requirements for natural gas or effectively exert downward pressures on gas prices.

Denying SES' applications could force potential natural gas customers to seek regulatory approval to use other forms of energy. California regulators are promoting renewable energy programs to help reduce the demand for fossil fuels. While renewable energy programs can contribute as an energy source for electricity, they cannot at this time reliably replace the need for natural gas or provide sufficient energy to keep pace with demand.

Alternatives involving the use of other existing or proposed LNG or natural gas facilities to meet the stated objectives of the proposed project were evaluated. None of the pipeline system alternatives could provide a stable source of LNG for vehicle fuel or the storage of up to 320,000 cubic meters of LNG to address fluctuating energy supply and demand (two of the three stated objectives of the Long Beach LNG Import Project). Several of the proposed LNG import systems (either offshore California or in Mexico) could provide a new source of natural gas to southern California markets; however, none of these system alternatives could meet the proposed project's stated objective of providing a stable source of LNG for vehicle fuel. Furthermore, each of the system alternatives could result in its own set of significant environmental impacts that could be greater than those associated with the proposed project.

Alternative sites for an LNG import terminal were evaluated. The examination of alternative sites for an LNG import terminal involved a comprehensive, step-wise process that considered environmental, engineering, economic, safety, and regulatory factors. The alternative sites evaluated for an LNG terminal were not found to avoid or substantially lessen any significant environmental effects of the proposed project and/or could not meet all or most of the project objectives.

An evaluation of alternative routes for the natural gas and C_2 pipelines was also conducted. The alternatives were not found to avoid or substantially lessen impacts associated with the corresponding segment of the proposed routes and/or were infeasible due to the number of existing utilities already in place along the alignments and the lack of adequate space to install the facilities.

Reduced dredge/fill alternatives and alternative ship berth configurations, dredge disposal alternatives, and alternative dredging methods were evaluated to avoid or minimize impacts on water quality or biological resources associated with the in-water work needed for construction of the LNG ship berth and unloading facility and strengthening the shoreline structures. None of these alternatives were found to be feasible or would avoid or substantially lessen any significant environmental effects of the proposed project.

Vaporizer alternatives were also evaluated. The shell and tube vaporizer, which is the proposed vaporizer for the Long Beach LNG Import Project, was found to be efficient, readily able to be integrated with the NGL extraction system, and to utilize proven vaporizer technology. Shell and tube vaporizers are also the most compact LNG vaporizers available, an important consideration given the size of the LNG terminal site. New vaporization processes that primarily utilize air exchangers as a heat source were also evaluated because they would have lower fuel gas requirements than conventional combustion vaporizers. Reduced fuel use would lead to a corresponding reduction in air emissions and operating costs. The space requirements of these new vaporization processes, however, appear to make this approach technically infeasible at the proposed site.

ENVIRONMENTALLY PREFERABLE/SUPERIOR ALTERNATIVE

The Agency Staffs will recommend to their respective Commissions that SES' proposed project is the environmentally preferable/superior alternative that can meet the project objectives.

TABLE ES-1

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
TRANSPORTATION				
Agency - Recommended Mitigation (ARM)1	There would be temporary adverse impacts on project area roadways during site preparation and construction. The duration of construction for the liquefied natural gas (LNG) terminal is estimated to be 48 months. During this time, traffic would be generated by trucks transporting materials and equipment to and from the laydown area and project site as well as trucks transporting materials directly to the project site. Construction worker trips would also occur during the construction period. Project construction worker and truck and material haul trips would result in a temporary, short-term significant impact at the intersections of Navy Way and Seaside Avenue (evening only) and Henry Ford Avenue and Anaheim Street (evening only) (see section 4.7.2.2).	Significant (CEQA Class II)	To mitigate the short-term impacts during the evening peak hour, Sound Energy Solutions (SES) shall require that the construction workforce work 6 a.m. to 2:30 p.m. instead of 7 a.m. to 3:30 p.m. With the shift change, the impact at the intersection of Navy Way/Seaside Avenue would be removed but the temporary impact at the Henry Ford Avenue/Anaheim Street intersection would remain between 2 and 3 p.m. Because the impact would be temporary, the Port of Long Beach (POLB) would reassess the Level of Service and the need for improvements with the City of Los Angeles Department of Transportation.	Less than significant (CEQA Class III)
AIR QUALITY				
ARM2	Total project construction emissions would exceed the South Coast Air Quality Management District (SCAQMD) significance thresholds for all criteria pollutants except sulfur oxides (SO_x) on a peak daily and quarterly basis even after the implementation of control measures (see section 4.9.4).	Significant (CEQA Class I)	SES shall: • require all contractors to use ultra-low sulfur or California Air Resources Board-approved alternative diesel fuel in all diesel-powered equipment used onsite during construction; and • use alternative-fuel buses to transport workers to and from the temporary laydown and worker parking area. Although implementation of the environmental staffs of the Federal Energy Regulatory Commission (Commission or FERC) and the POLB (Agency Staffs') recommended mitigation measure would reduce emissions during the construction phase of the project, impacts on air quality during construction are still expected to remain significant.	Significant (CEQA Class I)

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
ARM3	The project's operational emissions would exceed the daily SCAQMD significance thresholds for nitrogen oxides (NO_x), reactive organic compounds (ROC), particulate matter having an aerodynamic diameter of 10 microns or less (PM_{10}), and SO_x. Additionally, although dispersion modeling results for the facility vaporization equipment and the project as a whole indicate that the operation of the facility would have a minimal impact on the existing air quality in the vicinity of the proposed project area, the predicted impacts from operational emissions would potentially worsen an existing violation of the ambient air quality standards for PM_{10} and particulate matter having an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$) even after implementation of all of SES' proposed control measures. Consequently, the project's impact would be considered significant for ozone (NO_x and ROC), PM_{10}, $PM_{2.5}$, and SO_x. The project's impact would not be considered significant for carbon monoxide (see section 4.9.5).	Significant (CEQA Class I)	Given the nature of the project operations, especially vessel operations, the Agency Staffs have determined that there are no additional feasible measures that would further reduce air emissions.	Significant (CEQA Class I)
ARM4	A conformity analysis must be conducted by the lead federal agency if a federal action would result in the generation of emissions that would exceed the conformity threshold levels (*de minimis*) of the pollutant(s) for which an air basin is in non-attainment. A conformity analysis must show that the emissions would conform to the State Implementation Plan (SIP) and would not reduce air quality in the air basin, which can be demonstrated through offsets, SIP provisions, or modeling. Documentation supporting conformity has not been filed with the FERC. Until this information is provided by SES, the Long Beach LNG Import Project is deemed to not conform with the applicable SIP and Air Quality Management Plan (AQMP) (see section 4.9.6).	Significant (CEQA Class I)	SES shall complete a full air quality analysis and identify any mitigation requirements necessary for a finding of conformity with the applicable SIP and AQMP. SES shall file documentation supporting conformity with the Secretary of the Commission (Secretary) before the end of the draft environmental impact statement/environmental impact report (EIS/EIR) comment period for review and analysis in the final EIS/EIR.	Less than significant (CEQA Class III)
RELIABILITY AND SAFETY				
ARM5	Based on the analyses of the thermal radiation from the storage tanks and the trailer truck loading storage tank, several exclusion zone distances [as required by Title 49 Code of Federal Regulations (CFR) Part 193] extend beyond the property line of the facility that can be built upon. Although no prohibited activities or buildings currently exist within these exclusion zones, according to Title 49 CFR Part 193, either a government agency or SES must be able to exercise legal control over activities in these areas for as long as the facility is in operation.	Significant (CEQA Class II)	SES shall provide in its comments on the draft EIS/EIR, or in a separate document submitted at the same time, evidence of its ability to exercise legal control over the activities that occur within the portions of the thermal radiation exclusion zones that fall outside the site property line that can be built upon.	Less than significant (CEQA Class III)

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
	The POLB owns the land surrounding the LNG terminal site but leases parcels to other tenants. At this time, there is no assurance of limiting the type of activities that occur outside of the proposed terminal site within the exclusion zones (see section 4.11.5).			
ARM6	As a result of the FERC staff's cryogenic design and technical review of information provided by SES, a number of concerns were identified relating to the reliability, operability, and safety of the proposed LNG terminal (see section 4.11.6).	Significant (CEQA Class II)	The following measures shall apply to the LNG terminal design and construction details. Information pertaining to these specific recommendations shall be filed with the Secretary for the review and written approval of the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to commencement of service as specified in each recommendation below. This information shall be submitted a minimum of 30 days before approval to proceed is required. • A complete plan and list of the hazard detection equipment shall be filed prior to initial site preparation. The information shall include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings shall clearly show the location of all detection equipment. • Prior to initial site preparation, SES shall file a technical review of its facility design that: a. identifies all combustion/ventilation air intake equipment and the distance(s) to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and b. demonstrates that these areas would be adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion equipment whose continued operation could add to or sustain an emergency. • A complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment shall be filed prior to initial site preparation. The information shall include a list with the equipment tag number, type, size, equipment	Less than significant (CEQA Class III)

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings shall clearly show the planned location of all fixed and wheeled extinguishers. • The final design of the hazard detection equipment shall identify manufacturer and model. • The final design of the hazard detection equipment shall include redundancy and fault detection and fault alarm monitoring in all potentially hazardous areas and enclosures. • The final design of the hazard detection equipment shall provide flammable gas and ultraviolet/infrared hazard detectors with local instrument status indication as an additional safety feature. • The final design of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment shall identify manufacturer and model. • The final design shall include equipment and instrumentation for the measurement of translational and rotational movement of the inner vessel for use during and after cool down. • The final design shall include a minimum of three onsite seismic instruments that would have the capability of actuating an automatic plant-wide emergency shutdown in the event of seismic activity approaching the site Contingency Level Earthquake. SES shall specify the set point to be used. • In the final design all structures, besides the LNG storage tanks, shall be designed to withstand the effects of an Operating Basis Earthquake, as required by Title 49 CFR Part 193 and National Fire Protection Association (NFPA) 59A (2001), and, further, the condition of these structures shall not adversely affect the stability and integrity of the tanks in the Safe Shutdown Earthquake event. • The final design shall include details of the LNG tank tilt settlement and differential settlement limits between each LNG tank and piping and	

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			procedures to be implemented in the event that limits are exceeded. • The final design shall include drawings and specifications of the piping support structure of the LNG storage tanks. • The final design shall include provisions to ensure that hot water circulation is operable at all times when LNG is present in the secondary LNG booster pump discharge piping or when the temperature in the LNG inlet channel to any vaporizer is below 35 degrees Fahrenheit. • The final design shall include detection instrumentation and shutdown procedures for vaporizer tube leak, shell side overpressure, or bursting disc failure. • The final design shall include provisions to drain the fractionation systems to safe locations. • The final design shall ensure that air gaps are installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: would continuously monitor for the presence of a flammable fluid; would alarm the hazardous condition; and would shut down the appropriate systems. • The final design shall include a fire protection evaluation carried out in accordance with the requirements of NFPA 59A, Chapter 9.1.2. • The final design shall include details of the shutdown logic, including cause and effect lists for alarm and shut down. • The final design shall include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, cryogenic spills, and earthquake, when applicable. • The final design shall include procedures for offsite contractors' responsibilities, restrictions, limitations, and supervision of the contractors by SES staff. • Security personnel requirements prior to and	

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			during LNG vessel unloading shall be filed prior to commissioning. • An operation and maintenance manual and safety procedure manual shall be filed prior to commissioning. • Copies of the U.S. Coast Guard (Coast Guard)-approved Facility Security Plan and LNG Vessel Operation and Emergency Contingency Plan shall be filed prior to commissioning. • The contingency plan for failure of the outer LNG tank containment shall be filed prior to commissioning. • The final detailed drawings of the transfer line impoundment systems, including cross sections, shall be filed prior to commissioning. • A copy of the criteria for horizontal and rotational movement of the inner vessel for use during and after cool down shall be filed prior to commissioning. • The FERC staff and Coast Guard shall be notified of any proposed revisions to the security plan and physical security of the facility prior to commencement of service. • Progress on the construction of the LNG terminal shall be reported in monthly reports filed with the Secretary. Details shall include a summary of activities, problems encountered, and remedial actions taken. Problems of significant magnitude shall be reported to the FERC within 24 hours. The following measures shall apply throughout the life of the facility: • The facility shall be subject to regular FERC staff technical reviews and site inspections on at least a biennial basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, SES shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and	

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, shall be submitted. • Semi-annual operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.), and plant modifications including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boiloff rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant plant modifications proposed for the next 12 months (dates)" also shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility. • In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material,	

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			the Commission shall be notified within 24 hours and procedures for corrective action shall be specified. • Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (i.e., attempts to enter site, suspicious activities) shall be reported to the FERC staff and the Coast Guard within 24 hours. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include: a. fire; b. explosion; c. estimated property damage of $50,000 or more; d. death or personal injury resulting in patient hospitalization; e. free flow of LNG for 5 minutes or more that results in pooling; f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas or LNG; g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas or LNG; h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas or LNG to rise above its maximum allowable	

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices; i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency; j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank; k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shut down of operation of a pipeline or an LNG facility that contains or processes gas or LNG; l. safety-related incidents to LNG vessels occurring at or en route to and from the LNG facility; or m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan. In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.	
ARM7	The arrival, transit, cargo transfer, and departure of LNG ships in the POLB could have an impact on safety in the Port (see section 4.11.7.4).	Significant (CEQA Class II)	Prior to issuance of the final EIS, SES shall submit a Preliminary and Follow-on Waterway Suitability Assessment (WSA) to the Captain of the Port Coast Guard Sector Los Angeles-Long Beach for review	Less than significant (CEQA Class III)

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			and validation and provide a copy to the FERC staff.	
ARM8	Some commentors have expressed concern that the local community would have to bear some of the cost of ensuring the security of the LNG facility and the LNG vessels while in transit and unloading at the berth (see section 4.11.7.4)..	Significant (CEQA Class II)	Concurrent with the submission of the Follow-on WSA to the FERC staff, SES shall file its comprehensive plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning.	Less than significant (CEQA Class III)
ARM9	The WSA would be prepared well before import operations would commence, and the Port's overall operation/security situation may change over that time period. New Port activities may commence, infrastructure may be added, or population density may change. Improvements in technology to detect, deter, and defend against intentional acts may also be developed (see section 4.11.7.4).	Significant (CEQA Class II)	SES shall annually review its WSA for the project, update the assessment to reflect changing conditions, provide the updated assessment to the Captain of the Port Coast Guard Sector Los Angeles-Long Beach for review and validation, and provide a copy to the FERC staff.	Less than significant (CEQA Class III)
ARM10	SES has not indicated that it would hire a separate security staff (in addition to its permanent security staff) to conduct periodic patrols of the plant, screen visitors and contractors, and assist in maintaining security of the marine terminal during cargo unloading (see section 4.11.8).	Significant (CEQA Class II)	SES shall provide a separate 24-hours-per-day security staff and coordinate with the Coast Guard to define the responsibilities of SES' security staff in supplementing other security personnel and in protecting the LNG ships and terminal.	Less than significant (CEQA Class III)
ARM11 ARM12	Emergency response and evacuation planning procedures need to be in place to minimize impacts associated with a potential incident at the LNG terminal (see section 4.11.9).	Significant (CEQA Class II)	SES shall develop emergency evacuation routes for the areas along the route of the LNG vessel transit in conjunction with the local emergency officials and file the routes with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning prior to initial site preparation. SES shall also develop an Emergency Response Plan (including evacuation) and coordinate procedures with local emergency planning groups, the ports of Long Beach and Los Angeles, fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies. This plan shall include at a minimum: • designated contacts with state and local emergency response agencies; • scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and	Less than significant (CEQA Class III)

TABLE ES-1 (cont'd)

Summary of Significant Environmental Impacts and Agency-Recommended Mitigation Measures

Mitigation Number	Impact	Significance Before Mitigation [a]	Mitigation	Significance After Mitigation [a]
			severity of potential incidents; • procedures for notifying residents, employees, and recreational users within areas of potential hazard; • locations of permanent sirens and other warning devices; and • an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices. The Emergency Response Plan shall be filed with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning prior to initial site preparation. SES shall notify the FERC and POLB staffs of all planning meetings in advance and shall report progress on the development of its Emergency Response Plan at 3-month intervals.	

[a] California Environmental Quality Act Significance Classifications:
Class I - a significant impact that cannot be mitigated to non-significance.
Class II - a significant impact, but one that can be mitigated to non-significance with the application of appropriate mitigation measures.
Class III - a non-significant impact.
Class IV - a beneficial impact.

1.0 INTRODUCTION

On January 26, 2004, Sound Energy Solutions (SES) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under section 3 of the Natural Gas Act (NGA) and Part 153 of the Commission's regulations. The application was assigned FERC Docket No. CP04-58-000 and noticed in the Federal Register on February 2, 2004. SES seeks authorization from the FERC to site, construct, and operate a liquefied natural gas (LNG) receiving terminal and associated facilities in the Port of Long Beach (POLB or Port) in Long Beach, California as a place of entry for the importation of LNG. SES submitted an application to the POLB for a Harbor Development Permit on July 25, 2003, seeking approval for a development project within the Port. The application was designated POLB Application No. HDP 03-079.

LNG is natural gas that has been cooled to a temperature of about -260 degrees Fahrenheit (°F) so that it becomes a liquid. Because LNG is more compact than the gaseous equivalent, it can be transported long distances across oceans using specially designed ships. The LNG would be unloaded from the ships, stored in tanks at the terminal, and then re-gasified (vaporized) and transported through a natural gas sendout pipeline to Southern California Gas Company's (SoCal Gas) existing Line 765. Natural gas is a mixture of hydrocarbon compounds, principally methane. It also contains small amounts of heavier hydrocarbons, such as propane, ethane (C_2), and butane, which have a higher heating value than methane. A portion of these components may need to be removed from the LNG that would be stored on the terminal site in order for the natural gas to meet the British thermal units (Btu) and gas quality specifications of SoCal Gas as well as the specifications for LNG vehicle fuel established by the California Air Resources Board (CARB). The components that are removed are called natural gas liquids (NGL). SES' application included a proposal to store NGL on the LNG terminal site in two storage tanks before distribution offsite via pipeline and/or trailer truck.

On September 8, 2004, SES filed an amendment to its original application with the FERC in Docket No. CP04-58-003[1] seeking authorization to construct, own, and operate the natural gas sendout pipeline and associated facilities that would connect the LNG terminal to the SoCal Gas delivery point. On October 6, 2004, SES filed a modified proposal for the management of NGL that involved the transportation of the NGL via two pipelines from the LNG terminal site to an existing refinery and assorted modifications at the refinery to accommodate the NGL. This proposal eliminated on-site storage of the NGL, six NGL trailer truck loading bays, and approximately 140 trailer truck trips per day in the POLB to transport the NGL to market. Subsequently, on December 1, 2004, SES filed a supplement to its modified proposal to manage NGL that stated that SES would accept only lean LNG [i.e., LNG containing fewer heavy (non-methane) hydrocarbons than regular LNG] from its suppliers. Because lean LNG would produce fewer NGL, SES eliminated one of the pipelines and the additional facilities at the refinery that had been proposed in its October 2004 filing.

The environmental staffs of the FERC and the POLB (Agency Staffs) have jointly prepared this draft environmental impact statement/environmental impact report (EIS/EIR) to assess the environmental impacts associated with the construction and operation of the facilities proposed by SES in accordance with the requirements of the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

[1] Docket Nos. CP04-58-001 and CP04-58-002 were assigned to the FERC's May 12, 2004 Order Granting Rehearing for Further Consideration and August 5, 2004 Order Clarifying Prior Order, respectively.

SES' proposal, referred to as the Long Beach LNG Import Project, would involve the construction and operation of LNG terminal facilities consisting of a ship berth and unloading facility, two LNG storage tanks, vaporization and vapor handling systems, an NGL recovery system, an LNG trailer truck loading facility, 2.3 miles of 36-inch-diameter pipeline, one pig[2] launcher and receiver, a meter station, an odorization system, and various other facility components. Some of the activities associated with the project would be conducted by the POLB and would require the POLB to obtain a Harbor Development Permit.

Additional facilities associated with the project include 4.6 miles of 10-inch-diameter pipeline to transport vaporized C_2 from the LNG terminal to ConocoPhillips' existing Los Angeles Refinery Carson Plant (LARC), a meter station, one pig launcher and receiver, and approximately 0.8 mile of 66 kilovolt (kV) electric distribution lines and a new substation to connect the LNG terminal to two of Southern California Edison's (SCE) existing substation taps.

The C_2 pipeline, meter station, and pig launcher and receiver would be constructed, owned, and operated by ConocoPhillips. The electric distribution lines and substation would be constructed, owned, and operated by SCE. These intrastate facilities would be under the jurisdiction of the California Public Utilities Commission (CPUC), not the FERC and the POLB. Although these facilities do not come under the FERC's or the POLB's jurisdiction, they are evaluated in this EIS/EIR because they are integral parts of the proposed project. The CPUC is participating in the EIS/EIR process as a responsible agency (see section 1.2.6).

The proposed LNG terminal and associated facilities are described in detail in section 2.0.

1.1 PROJECT PURPOSE AND NEED

SES proposes to bring LNG from a variety of Asian and other foreign sources to provide a new, stable source of natural gas to serve the needs of southern California, particularly the Los Angeles Basin (LA Basin). Exporting countries of LNG include Algeria, Australia, Brunei, Indonesia, Malaysia, Nigeria, Oman, Qatar, Trinidad, and United Arab Emirates. In 2003, LNG imports to the United States came from Trinidad (72 percent), Nigeria (12 percent), Algeria (10 percent), Qatar (3 percent), Oman (2 percent), and Malaysia (1 percent). SES has indicated that the LNG for the proposed terminal would likely be imported from six plants in the Pacific (located in Brunei, Indonesia, Malaysia, and Australia) and four plants in the Middle East (located in Oman, United Arab Emirates, and Qatar). Several of these foreign sources would represent a new supply to the United States because natural gas has not been imported from these locations in the past.

The three stated objectives of SES' proposal are to:

- provide up to 1 billion cubic feet per day (Bscfd) of natural gas to southern California;
- supply up to 150,000 gallons per day (gpd) of LNG vehicle fuel; and
- provide storage of up to 320,000 cubic meters of imported LNG to reduce fluctuations in the local supply.

Each of these objectives is described in more detail below.

[2] A pig is an internal tool used to clean and dry a pipeline and/or to inspect it for damage or corrosion.

A primary objective of the Long Beach LNG Import Project is to provide the facilities needed to deliver up to 1 Bscfd of natural gas to local transmission and distribution systems. According to SES, the introduction of large volumes of natural gas directly into the LA Basin and southern California markets would reduce price volatility and ease gas supply concerns by enhancing the diversity and security of natural gas supplies for the state.

In September 2004, the CPUC acted to increase the availability of natural gas supplies in California. As part of its action, the CPUC voted to promote increases in California's LNG supply by designating three receipt points for access to imported LNG and ordering utilities to interconnect with LNG facilities when they are built. One of the designated receipt points is the Salt Works Station near the POLB. The Salt Works Station would be the end point of the proposed natural gas pipeline associated with the Long Beach LNG Import Terminal. The other two receipt points are Otay Mesa near San Diego and Center Road Station near Oxnard. Both of these locations are near other proposed LNG facilities in southern California and Mexico (see section 3.2.2.2).

The California Energy Commission (CEC) estimates that demand growth for all uses of natural gas will be approximately 1 percent per year from 2003 to 2013 (Gopal, 2003; Marks, 2004). According to the CEC, although increases in efficiency and use of renewable energy sources are expected to moderate future demand, they are offset by population and business growth.

The ability of California consumers to pay for natural gas is also of state-wide concern. Even though prices have moderated since the peaks of the recent energy crisis in the state (which resulted in part from short- and mid-term imbalances in natural gas supply and demand), the price Californians currently pay for natural gas is nearly double the price consumers paid in the 1990s (Bakker et al., 2003). For example, a California residential gas customer in 1999 paid an average of $6.62 per thousand cubic feet, but in July 2004 that customer paid $10.14 per thousand cubic feet [Energy Information Administration (EIA), 2004]. Any action that can reduce prices will have a significant impact on the total amount spent by consumers because the California gas market is the second largest in the U.S. If prices are reduced by $0.50 per million British thermal unit (MMBtu), then California consumers will save over $1 billion per year.

Additional interstate pipeline capacity has recently been increased, including the Kern River 2003 Expansion Project, which has increased access to the Rocky Mountain supply basin [FERC and the California State Lands Commission (CSLC), 2002]. The North Baja Pipeline Project also has increased the natural gas supply to California significantly (FERC and CSLC, 2000). However, California, the second largest natural gas consumer in the nation, is expected to use 2.4 trillion cubic feet of natural gas by 2013, which is an increase of about 9 percent from the 2.2 trillion cubic feet used in 2003.

Currently, imports from out of state represent approximately 87 percent of supply and are anticipated to rise to 88 percent by 2013, meaning that additional external supplies will be needed to keep up with demand. This need is compounded by California's position at the western end of an American and Canadian pipeline network, exposing it to supply/demand imbalances that occur in other regions of the United States. California must compete for declining domestic gas supplies and interstate pipeline capacity with neighboring states, including Nevada and Arizona, whose gas demand is growing faster due to many gas-fired generators (Marks, 2004).

Although the CEC estimates that domestic and Canadian sources could fulfill projected California natural gas demand through 2013, it has strongly recommended that the state pursue other measures to secure supplies, noting public and private sector concern about declines in domestic and Canadian gas field production (Marks, 2004). Additionally, the ability of these sources to supply California would

depend on pipeline capacity improvements in the Rocky Mountain Basin as well as on industry success in finding and extracting new sources (Bakker et al., 2003).

Given the short- and mid-term demand for natural gas and the need to reduce potential supply interruptions, the CEC has identified the need for California to develop new natural gas infrastructure to access a diversity of fuel supply sources and to remove constraints on the delivery of natural gas. In addition to efficiency programs and use of renewable power sources, the CEC has identified LNG receiving terminals on the Pacific Coast as a potential future source, enabling California gas markets to access supplies from producing basins throughout the Pacific and Indian Oceans (e.g., Indonesia, Australia, Russia, South America, and Alaska).

An LNG receiving terminal sized to provide 1 Bscfd of natural gas could supply nearly 16 percent of the average daily need for natural gas in the state (Marks, 2004).

Another objective of the Long Beach LNG Import Project is to provide an abundant, stable source of LNG for distribution to LNG fueling stations throughout southern California to fuel LNG-powered vehicles. SES estimates that up to 150,000 gpd of LNG would be made available to this market by the proposed project. Use of LNG for medium- and heavy-duty vehicles is growing rapidly in California for several reasons. First, LNG is traditionally less expensive than diesel fuel. Second, there is a potential for air quality benefits because natural gas-powered vehicles have lower nitrogen oxides (NO_x) and carbon dioxide (CO_2) emissions than diesel-powered vehicles. LNG can be stored on board heavy duty vehicles with natural gas-fueled engines. The proposed project would make an alternative cleaner burning fuel, LNG, more available to the fleets of vehicles and equipment operated by public agencies, transit districts, municipalities, and industries. Furthermore, the use of LNG as a replacement for diesel fuel helps to reduce California's petroleum dependence, which is a state requirement under AB2076 (Chapter 936, Statutes of 2000).

Nearly all of the LNG currently used for vehicle fuel in California is trucked in from Arizona (86,000 gpd) and delivered to LNG fueling stations where it is dispensed into individual vehicles as fuel. Another LNG plant exists northwest of Sacramento, California but it does not typically supply substantial quantities of LNG vehicle fuel. Four out-of-state plants in Wyoming, Kansas, and Colorado have occasionally supplied LNG to California. The substantial trucking distance to California from out-of-state sources does not make this a cost effective or energy efficient option.

A third objective of the Long Beach LNG Import Project is to address fluctuating energy supply and demand. Because the project allows for up to 320,000 cubic meters of imported LNG to be stored and then vaporized for delivery as needed into the southern California market or to be used as LNG vehicle fuel, it can reduce the effects of fluctuating energy supply and demand. The storage component of the project would enhance the reliability of supply and be consistent with the goal of the State of California Energy Action Plan II, which is to ensure that adequate, reliable, and reasonably priced electrical power and natural gas supplies, including reserves, are achieved and provided (CEC, 2005c).

1.2 USES AND SCOPE OF THIS EIS/EIR

The principal reasons for preparing an EIS/EIR are to:

- identify and assess the potential direct, indirect, and cumulative impacts on the natural and human environment that would result from the implementation of the proposed project;

- describe and evaluate reasonable alternatives to the proposed project, or to the location of the project, that would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any significant adverse effects of the project on the environment;

- identify and recommend specific mitigation measures, as necessary, to avoid or minimize significant environmental effects; and

- encourage and facilitate involvement by the public and interested agencies in the environmental review process.

The topics addressed in this EIS/EIR include geology (including hazards and mineral and paleontological resources); soils and sediments; water resources; biological resources; land use, recreation, and visual resources; socioeconomics (including population, housing, public services, and utilities and service systems); transportation; cultural resources; air quality; noise; reliability and safety; cumulative impacts; growth-inducing impacts; and alternatives. The EIS/EIR describes the affected environment as it currently exists, discusses the environmental consequences of the proposed project, and compares the project's potential impact to that of alternatives. The EIS/EIR also presents recommended mitigation measures.

The FERC and the POLB are the lead agencies for the preparation of this EIS/EIR. The U.S. Army Corps of Engineers (ACOE) and the U.S. Coast Guard (Coast Guard) within the U.S. Department of Homeland Security are federal cooperating agencies. A cooperating agency has jurisdiction by law or special expertise with respect to environmental impacts involved with the proposal and is involved in the NEPA analysis. The Pipeline and Hazardous Materials Safety Administration (PHMSA) within the U.S. Department of Transportation (DOT) is participating in the NEPA analysis under the terms of an interagency agreement between the PHMSA, the FERC, and the Coast Guard. The purpose of the interagency agreement is to ensure that these three agencies work in a coordinated manner to address land and marine safety and security issues at waterfront LNG facilities, including the terminal facilities and vessel operations. The specific roles of these agencies are described below. Several state and local agencies are also participating in the project review as responsible and trustee agencies as discussed in section 1.2.6. The federal, state, and local permits, approvals, and consultations required for the project are listed in section 1.5.

1.2.1 Federal Energy Regulatory Commission

The FERC is the federal agency responsible for authorizing the site for onshore LNG import facilities. As such, the FERC is the lead federal agency for the preparation of this EIS/EIR in compliance with the requirements of NEPA, the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA [Title 40 Code of Federal Regulations (CFR) Parts 1500-1508], and the FERC's regulations implementing NEPA (Title 18 CFR Part 380).

As the lead federal agency for the Long Beach LNG Import Project, the FERC is required to comply with section 7 of the Endangered Species Act of 1973 (ESA), the Magnuson-Stevens Fishery Conservation and Management Act (MSA), section 106 of the National Historic Preservation Act (NHPA), and section 307 of the Coastal Zone Management Act of 1972 (CZMA). Each of these statutes has been taken into account in the preparation of this EIS/EIR. The FERC will use the document to consider the environmental impact that could result if it issues SES an Order Granting Authorization under section 3 of the NGA.

In conjunction with the NEPA review, the FERC conducts a cryogenic design review of the proposed facilities. The cryogenic design review involves analyzing the engineering design and safety concepts as well as the projected operational reliability of the proposed facilities. A summary of that review, including the FERC's recommendations, is included in this EIS/EIR. The FERC will also consider other non-environmental issues in its review of SES' application. Final federal authorization will be granted only if the FERC finds that the proposed project is in the public interest. The safety, security, and environmental impact assessments and mitigation development discussed herein are important factors in this final determination.

1.2.2 City of Long Beach

The Board of Harbor Commissioners (BHC) has authority over the City's Harbor District, commonly known as the POLB or Port. The City of Long Beach owns the land within the Harbor District in trust for the people of the State of California. SES would have to obtain a lease from the City of Long Beach to build and operate the project. The POLB is the lead agency in California for preparing the EIS/EIR, complying with the CEQA (Public Resources Code section 21000 et seq.), and following the guidelines for the implementation of the CEQA (California Code of Regulations Title 14, section 15000 et seq.). As part of its responsibilities, the POLB would provide the EIS/EIR to the California State Clearinghouse for it to coordinate the review of the document by state and local responsible and trustee agencies (see section 1.2.6).

The BHC will use the EIS/EIR to determine the project's consistency with the certified Port Master Plan (PMP) and the California Coastal Act of 1976 (CCA) (see section 1.4) as well as to consider the environmental impact that could result if it issues Harbor Development Permits for the project.

When the EIS/EIR is completed, the BHC must determine whether it can certify that:

- the final EIS/EIR has been completed in compliance with the CEQA;
- the final EIS/EIR was presented to the BHC in a public meeting and that the BHC reviewed and considered the information contained in the final EIS/EIR; and
- the final EIS/EIR reflects the BHC's independent judgment and analysis [CEQA Guidelines section 15090(a)].

If the BHC approves the project, it must adopt a resolution containing findings of fact for each significant environmental impact identified in the EIS/EIR. These findings must either state that:

- the project has been changed (including adoption of mitigation measures) to avoid or substantially reduce the magnitude of the impact;
- changes to the project are within another agency's jurisdiction and have been or should be adopted; or
- specific considerations make mitigation measures or alternatives infeasible.

If any of the impacts identified in the EIS/EIR cannot be reduced to a level that is less than significant, the BHC must issue a Statement of Overriding Considerations for approval of the project if specific social, economic, or other factors justify a project's unavoidable adverse environmental effects. If the BHC decides to approve a project for which an EIS/EIR has been prepared and the project has been determined to be consistent with the certified PMP and the CCA, the BHC would issue a Notice of

Determination and could issue Harbor Development Permits for construction and operation of the project. Under Public Resources Code section 21151(c), the Long Beach City Council has appellate jurisdiction over any CEQA determination made by the BHC. Additional discussion of the determination of consistency with the PMP and the CCA and the California Coastal Commission's (CCC) role in the process is presented in section 1.4.

1.2.3 U.S. Army Corps of Engineers

The ACOE has jurisdictional authority pursuant to section 404 of the Clean Water Act (CWA) [33 United States Code (USC) 1344], which governs the discharge of dredged or fill material into waters of the United States, and section 10 of the Rivers and Harbors Act (33 USC 403), which regulates any work or structures that potentially affect the navigable capacity of a waterbody. Some specific elements of the project within the ACOE's jurisdiction include dredging, reinforcement of the shoreline structures, and construction of the ship berth and unloading facility within the waters of the United States. The ACOE also has jurisdiction over the placement of the natural gas and C_2 pipelines beneath the Cerritos Channel and the placement of the C_2 pipeline over the Dominguez Channel. Because the ACOE must comply with the requirements of NEPA before issuing permits under sections 404 and 10, it has elected to act as a cooperating agency with the FERC and the POLB in preparing this EIS/EIR. The ACOE would adopt the EIS/EIR per Title 40 CFR Part 1506.3 if, after an independent review of the document, it concludes that its comments and suggestions have been satisfied.

As an element of its review, the ACOE must consider whether a proposed project represents the least environmentally damaging practicable alternative pursuant to the CWA section 404(b)(1) guidelines. The term practicable means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Although this document addresses impacts on aquatic resources and navigation associated with the proposed action as they relate to sections 404 and 10, it does not serve as a public notice for any ACOE permits. The POLB will request such permits, and public notice will be issued by the ACOE when an application is received. A draft of the section 404(b)(1) alternatives analysis may be included as an appendix of the final EIS/EIR for public review. The ACOE's Record of Decision (ROD) resulting from consideration of the EIS/EIR would formally document its decision on the proposed action, including any required environmental mitigation commitments.

1.2.4 U.S. Coast Guard

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC section 1221, et seq.); and the Maritime Transportation Security Act of 2002 (46 USC section 701). The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval and compliance verification as provided in Title 33 CFR Part 105, and siting as it pertains to the management of vessel traffic in and around the LNG facility.

As required by its regulations, the Coast Guard is responsible for issuing a Letter of Recommendation (LOR) as to the suitability of the waterway for LNG marine traffic. The process of preparing the LOR begins when an applicant submits a Letter of Intent (LOI) to the local Captain of the Port.

On June 14, 2005, the Coast Guard issued a *Navigation and Vessel Inspection Circular – Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC). The purpose of this NVIC is to provide Coast Guard Captains of the Port/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic that takes into account conventional navigation safety/waterway management issues contemplated by the existing LOI/LOR process, but in addition, will also take completely into account maritime security implications.

The Coast Guard has elected to act as a cooperating agency in the preparation of this EIS/EIR and assisted the FERC and the POLB with preparation of the marine safety and security sections (see sections 4.11.7 and 4.11.8, respectively). The Coast Guard plans to adopt the EIS/EIR if it adequately covers the impacts associated with issuance of the LOR.

1.2.5 Pipeline and Hazardous Materials Safety Administration

The PHMSA has authority to promulgate and enforce safety regulations and standards for the transportation and storage of LNG in or affecting interstate or foreign commerce under the pipeline safety laws (49 USC Chapter 601). This authority extends to the siting, design, installation, construction, initial inspection, initial testing, and operation and maintenance of LNG facilities. The PHMSA's operation and maintenance responsibilities include fire prevention and security planning for LNG facilities under Title 49 CFR Part 193. The PHMSA carries out these responsibilities through its Office of Pipeline Safety (OPS), which inspects and enforces compliance with the regulations through a broad range of administrative and judicial actions.

1.2.6 Responsible and Trustee Agencies

Under CEQA, the POLB is responsible for providing the EIS/EIR to the California State Clearinghouse for it to coordinate the review of the document with state and local responsible and trustee agencies. A responsible agency is an agency other than the lead agency that has a legal responsibility for also carrying out or approving a project. A responsible agency must actively participate in the lead agency's CEQA review process, review the EIS/EIR, and use the document when making a decision on the project. A trustee agency has jurisdiction over certain resources held in trust for the people of California but does not have a legal authority over approving or carrying out the project. Responsible and trustee agencies for the Long Beach LNG Import Project include the CCC, the California Department of Conservation-Division of Oil, Gas, & Geothermal Resources (DOGGR), the California Department of Fish and Game (CDFG), the California Department of Transportation (CalTrans), the CPUC, the CSLC, and the South Coast Air Quality Management District (SCAQMD).

The CCC is responsible for implementing the CCA and determining consistency with the CZMA. The CCC also approves and certifies amendments to PMPs. The DOGGR supervises the drilling, maintenance, and abandonment of oil, gas, and geothermal wells and conducts Construction Site Reviews to ensure that activities do not affect oil production in the project area. The CDFG is consulted to identify any known state-listed threatened, endangered, or sensitive species potentially affected by the project. Authorization to encroach along and within state highways and rights-of-way is issued by CalTrans as well as approval of Traffic Management Plans. The CPUC's responsibilities include issuing a Certificate for construction and operation of intrastate pipeline and powerline facilities. The CSLC has jurisdiction over state-owned tide and submerged lands granted in trust to the City of Long Beach that would be affected by the project. The SCAQMD has the responsibility of issuing authorization to build, install, alter, replace, or operate equipment that emits or controls the emission of air contaminants.

Many of these responsible and trustee agencies are members of the LNG Permitting Interagency Working Group (LNG Working Group), which was organized by the CEC. The LNG Working Group consists of California agencies potentially involved in permitting or approving proposed LNG facilities in the state. The LNG Working Group meets periodically to develop and disseminate information and technical expertise on LNG issues, identify key issues of concern to the state, understand each group member's roles and concerns regarding the construction and operation of LNG facilities in California, and coordinate review of California LNG facility proposals. One of the goals of the LNG Working Group is to foster early and extensive cooperation among federal and state agencies to ensure a thorough review of all proposed LNG facilities.

The POLB is a member of the LNG Working Group and is actively participating and coordinating analysis of the proposed project with the other members of the group. The other members of the group include the Coast Guard, the CARB, the CCC, the CEC, the CPUC, the CDFG, the CCC, the California Department of Conservation, the California Department of General Services, the San Francisco Bay Conservation and Development Commission, the CSLC, the Governor's Office of Planning and Research, and the Port of Humboldt Bay.

1.3 PUBLIC REVIEW AND COMMENT

On June 30, 2003, SES filed a request with the FERC to implement the Commission's Pre-Filing Process for the Long Beach LNG Import Project. At that time, SES was in the preliminary design stage of the project and no formal application had been filed with the FERC. On July 11, 2003, the FERC granted SES' request and established a pre-filing docket number (PF03-6-000) to place information filed by SES and related documents issued by the FERC into the public record. The purpose of the Pre-Filing Process is to encourage the early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve issues before an application is filed with the FERC. After receipt of SES' Harbor Development Permit application on July 25, 2003, the POLB agreed to conduct its CEQA review of the project in conjunction with the Commission's Pre-Filing Process.

As part of the Pre-Filing Process, the FERC and the POLB worked with SES to develop a public outreach plan for issue identification and stakeholder participation. As part of the outreach plan, SES met with local associations, neighborhood groups, and other non-governmental organizations to inform them about the project and address issues and concerns. In coordination with the FERC and the POLB, SES also consulted with key federal and state agencies to identify their issues and concerns.

On September 4, 2003, SES sponsored two public workshops in the Long Beach area. The purpose of the workshops was to inform agencies and the general public about LNG and the proposed project and to provide them an opportunity to ask questions and express their concerns. The FERC and the POLB participated in these workshops and provided information on the joint environmental review process. Invitations to the public workshops were sent to federal, state, and local agencies; elected officials; environmental groups; affected landowners; and tenants of the POLB. Notices of the public workshops were published in the local newspapers. Approximately 70 individuals attended the workshops. The questions and concerns raised by the public at the workshop are addressed in this EIS/EIR.

On September 22, 2003, the FERC and the POLB issued a *Notice of Intent to Prepare a Joint Environmental Impact Statement and Notice of Preparation of a Joint Environmental Impact Report, Application Summary Report for SES' Proposed Long Beach LNG Import Project, Request for Comments on Environmental Issues, and Notice of Public Scoping Meeting* (NOI/NOP). The NOI/NOP was noticed in the Federal Register on September 22, 2003 as well and briefly described the project and the joint environmental review process. The NOI/NOP also invited written comments on the environmental issues

to be addressed in the EIS/EIR and announced a joint NEPA/CEQA public scoping meeting to be held in Long Beach on October 9, 2003. The NOI/NOP was mailed to 412 interested parties, including federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; POLB tenants; and local libraries and newspapers. Announcements of the public scoping meeting were published in the local newspapers. The comment period on the NOI/NOP closed on October 30, 2003.

On November 10, 2003, the POLB issued a Supplemental Notice of Preparation and Initial Study (Supplemental NOP) for the project, which provided more specific details regarding the proposed project facilities. The Supplemental NOP provided project information that was not available when the initial NOI/NOP was issued, listed the project's potential environmental effects, and invited additional written comments on the environmental issues to be addressed in the EIS/EIR. The Supplemental NOP was sent via certified mail to 439 interested parties, including the same parties who were mailed the initial NOI/NOP and additional parties who submitted comments in response to the NOI/NOP. The comment period on the Supplemental NOP closed on December 12, 2003.

On November 3, 2004, the POLB issued a second Supplemental NOP for the project. The second Supplemental NOP provided information on SES' October 2004 modified proposal to manage NGL at the LNG terminal site and invited written comments on the scope of the analysis of the modified NGL facilities that should be included in the EIS/EIR. The second Supplemental NOP was sent via certified mail to 925 interested parties, including the same parties who were mailed the previous notices, additional parties who submitted comments in response to the notices, and landowners affected by the modified proposal. The comment period on the second Supplemental NOP closed on December 6, 2004. Prior to the close of the comment period, SES submitted a revision to the modified proposal to manage NGL at the site that eliminated several of the facilities announced in the second Supplemental NOP. Because the revised proposal eliminated facilities that were presented in the second Supplemental NOP and did not add new facilities, another notice was not issued.

A transcript of the public scoping meeting and all written comments are part of the public record for the Long Beach LNG Import Project and are available for viewing on the FERC Internet website (http://www.ferc.gov).[3] Table 1.3-1 summarizes the environmental issues that were identified during the scoping process described above and indicates the section of the EIS/EIR in which each issue is addressed.

Some issues that were raised during the scoping process are not environmental issues or are outside the FERC's and the BHC's jurisdiction. These issues include the worldwide corporate record of the applicant, imposition of a tax on the project to provide funds in the event of an emergency, legal liability for losses due to LNG spills, assessment of environmental impacts on the sources of the natural gas withdrawals in foreign countries, and economic issues (e.g., general natural gas/LNG demand and supply issues, pricing, contracts, insurance liabilities and limits, etc.). These issues are not within the scope of this EIS/EIR (CEQA Guidelines section 15131).

[3] Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number excluding the last three digits in the "Docket Number" field (i.e., PF03-06 and CP04-58). Be sure to select an appropriate date range.

TABLE 1.3-1

Issues Identified and Comments Received During the Public Scoping Process for the Long Beach LNG Import Project

Issue/Specific Comment	EIS/EIR Section Addressing Comment
GENERAL	
Beneficial impact of the project because of the competition it would provide in the supply of natural gas	1.1
Need for an LNG terminal	1.1
Identification of agencies responsible for making energy regulatory and planning decisions and the Liquefied Natural Gas (LNG) Permitting Interagency Working Group	1.2
Accessibility of project information and discussion of environmental impact statement/environmental impact report process and timeline	1.3
Consistency with regional and local plans	1.4
Discussion of proposed connections to California's intrastate gas transmission system and electric grid	2.1.2
Description of significant environmental impacts when making LNG siting decisions	4.0
PROJECT DESCRIPTION	
Description of LNG terminal facilities, including the ship berth and unloading facility, LNG storage tanks, vaporization and vapor handling systems, and natural gas liquids recovery system	2.1.1
Temporary extra workspace requirements (e.g., barges)	2.2
Potential for future changes to the design and operation of the facilities	2.8
GEOLOGY	
Evaluation of plugged and abandoned wells within or in close proximity to the project boundaries; procedures to follow if damage to plugged and abandoned wells or discovery of unrecorded wells occurs	4.1.3
Description of design standards of the LNG storage tanks that would ensure their integrity during geological events (e.g., ground rupture, seismic shaking, mass wasting and slope instability, liquefaction, subsidence, expansion or collapse of soil structures, and tsunamis)	4.1.4
SOILS AND SEDIMENTS	
Measures to avoid, reduce, or eliminate any potential site erosion and potential impacts from hazardous materials spills and cleanup measures; erosion/sediment control plan; identification of any known or potentially contaminated sites and evaluation of whether the conditions pose a threat to human health or the environment; implementation of appropriate health and safety procedures	4.2.2, 4.5.4
Potential for dredged materials to contain contaminated sediments; disposal of contaminated sediments	4.2.3
WATER RESOURCES	
Description of proposed water sources for construction and operation activities, intake/discharge requirements, and potential impacts on water resources	4.3.2, 4.3.3
Potential impacts on water resources from construction debris, spills of hazardous materials, and storm water runoff	4.3.2, 4.3.3
Description of dredging activities; identification of fill/borrow sources and disposal sites; potential for turbidity or siltation from shoreline erosion; impacts on marine resources and/or water quality	4.3.3, 4.4.3
BIOLOGICAL RESOURCES	
Potential impacts on terrestrial and marine resources; impacts associated with the import of exotic species in ballast water of LNG ships	4.4.2, 4.4.3
Impacts on fishing activities and on sport and commercial species	4.4.3, 4.5.5
Impacts on rare, threatened, or endangered species, including the California least tern (*Sterna antillarum browni*) and the California brown pelican (*Pelecanus occidentalis californicus*)	4.4.4
LAND USE, RECREATION, AND VISUAL RESOURCES	
Impacts on existing and planned uses and sensitive receptors (e.g., schools, residences) within 1 mile of the project site	4.5.2, 4.5.3
Impacts on recreation areas and recreational activities in San Pedro Bay	4.5.5
Impacts on visual resources	4.5.6
SOCIOECONOMICS	
Number of construction and permanent workers expected; project schedule and peak labor force; number of workers and skill levels to be drawn from the Long Beach/Los Angeles area	4.6.3
Impacts on emergency response services in communities affected by the project and fire training programs specific to LNG	4.6.5, 4.11.9
Impacts on existing utilities during construction	4.6.6

TABLE 1.3-1 (cont'd)

Issues Identified and Comments Received During the Public Scoping Process for the Long Beach LNG Import Project

Issue/Specific Comment	EIS/EIR Section Addressing Comment
Economic impact of a closure of the POLB due to disruption of the LNG terminal	4.6.3
Expected capital cost and tax revenue distribution	4.6.8
Identification of environmental justice population; use of the vapor cloud exclusion zone boundaries to identify environmental justice communities	4.6.9
TRANSPORTATION	
Impacts on land transportation and traffic; completion of a traffic study	4.7.2
Description of the project's impacts on existing and planned tanker and other marine traffic in the Port of Long Beach (POLB); impacts associated with the exclusion zone enforced by the U.S. Coast Guard (Coast Guard)	4.7.3, 4.11.7
Issues regarding proximity to the Long Beach airport	4.7.4
CULTURAL RESOURCES	
Impacts on historic POLB facilities, cultural resources during pipeline construction, and indigenous peoples' lands	4.8.3, 4.8.5
AIR QUALITY	
Location of and impacts on sensitive receptors	4.9.2, 4.9.4, 4.9.5, 4.9.7
Description of applicable air quality regulations	4.9.3
Potential impacts on air quality associated with construction emissions and odors; impacts associated with criteria pollutant emissions during operation of the project, including from marine vessels, vaporization equipment, and on-road vehicles; mitigation of air quality impacts during construction and operation of the project	4.9.4, 4.9.5
Analysis of toxic air contaminant emissions associated with the project on human health	4.9.7
Beneficial impact of the project on the air pollution problem in California; description of the fleets that would use the LNG; comparison of vehicle emission levels from diesel fuel versus LNG; discussion of recent emission studies regarding benefits of LNG fuel use in vehicles	4.9.8
NOISE	
Description of major noise sources of the project and an estimate of the project's noise levels during construction and operation; noise impacts on sensitive receptors, including vessel residents in the Cerritos Channel	4.10.4
RELIABILITY AND SAFETY	
Identification of the international, federal, state, and local agencies that govern the design and operation of the proposed LNG terminal and the LNG tankers that would offload at the terminal and each agency's regulations to prevent and protect against hazardous spills or releases; identification of agencies responsible for safety inspections; discussion of required operation procedures and plans	2.1.2, 4.11.2, 4.11.5, 4.11.7, 4.11.9
History and description of LNG safety record	4.11
Advisability of building an LNG terminal near a downtown area	4.11.5, 4.11.10
Discussion of proposed LNG terminal design measures to reduce the potential for safety hazards; emergency response procedures; coordination with the Coast Guard to address marine safety issues and the enforcement of a security zone around the LNG ships and facilities	4.11.5, 4.11.6, 4.11.7
Discussion of terrorism and security issues	4.11.8
Pipeline reliability and safety	4.11.12
CUMULATIVE IMPACTS	
Cumulative impacts on traffic levels, ocean resources, fossil fuels, and downstream natural gas pipeline infrastructure	4.12
ALTERNATIVES	
Alternatives analysis to identify the least environmentally damaging, practicable alternative that meets the overall project objective (level of analysis commensurate with level of impact)	3.0
Consideration of a no action alternative and the use of alternative energy sources	3.1
Consideration of system alternatives	3.2
Potential onshore and offshore alternative locations and designs for the LNG terminal	3.2.2, 3.3
Alternative to the proposed ship berth location	3.3.3
Evaluation of reduced dredge/fill alternatives, dredge disposal alternatives, and alternative dredging methods	3.5
Consideration of alternative vaporizer designs	3.6

This draft EIS/EIR was filed with the U.S. Environmental Protection Agency (EPA), submitted to the California State Clearinghouse, and mailed to federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; POLB tenants; intervenors[4] in the FERC's proceeding; local libraries and newspapers; and other interested parties (i.e., miscellaneous individuals who provided scoping comments or asked to be on the mailing list). A formal notice indicating that the draft EIS/EIR is available for review and comment was published in the Federal Register, posted in the Los Angeles County Clerk's office in California, and sent to the remaining individuals on the mailing list. The distribution list for the draft EIS/EIR and formal notice is in Appendix A. The public has at least 45 days after the date of publication in the Federal Register to review and comment on the draft EIS/EIR both in the form of written comments and at public meetings to be held in Long Beach. All comments received on the draft EIS/EIR related to environmental issues will be addressed in the final EIS/EIR.

1.4 CONSISTENCY WITH THE COASTAL ZONE MANAGEMENT ACT, THE CALIFORNIA COASTAL ACT, THE POLB PORT MASTER PLAN, AND OTHER REGIONAL AND LOCAL PLANS AND POLICIES

1.4.1 Coastal Zone Management Act

In 1972, Congress passed the CZMA to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone" [16 USC 1452, section 303 (1) and (2)].

Section 307 (c)(3)(A) of the CZMA states that "any applicant for a required federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or natural resource of the coastal zone of that state shall provide a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." In order to participate in the coastal zone management program, a state is required to prepare a program management plan for approval by the National Oceanic and Atmospheric Administration, Office of Coast and Ocean Resource Management (OCORM). Once the OCORM has approved a plan and its enforceable program policies, a state program gains "federal consistency" jurisdiction. This means that any federal action (e.g., a project requiring federally issued licenses or permits) that takes place within a state's coastal zone must be found to be consistent with state coastal policies before the federal action can take place.

The Long Beach LNG Import Project is subject to a federal Coastal Zone Consistency Review because it would involve activities within the coastal zone of California, which extends from 3 miles at sea to an inland boundary that varies from a few blocks in urban areas to several miles in less developed areas. The facilities associated with the Long Beach LNG Import Project are located within the South Coast Area, which includes coastal areas in Los Angeles and Orange Counties. California has a federally approved Coastal Management Program, which includes the CCA. The program was approved by the OCORM in 1977 and gave the CCC the authority to conduct federal consistency reviews for projects in California's coastal zone with the exception of projects in San Francisco Bay. The CCA excludes the San

[4] Intervenors are official parties to the proceeding and have the right to receive copies of case-related Commission documents and filings by other intervenors. Likewise, each intervenor must provide 14 copies of its filings to the Secretary of the Commission and must send a copy of its filings to all other intervenors. Only intervenors have the right to seek rehearing of the Commission's decision.

Francisco Bay, which has its own coastal management program administered by the San Francisco Bay Conservation and Development Commission.

1.4.2 California Coastal Act of 1976

The CCA includes specific polices that address various issues, such as terrestrial and marine habitat protection, landform alteration, industrial uses, water quality, and ports. The policies of the CCA represent the statutory standards applied to planning and regulatory decisions made by the CCC and local governments (CCC, 2003a). Implementation of the CCA is accomplished primarily through the preparation of local coastal programs, which are required to be completed by each of the 15 counties and 59 cities located in whole or in part in the coastal zone (CCC, 2003a). Chapter 8 of the CCA recognizes the California ports, including the POLB, as primary economic and coastal resources and as essential elements of the national maritime industry. However, each port was required to prepare a PMP for approval by the CCC that outlines how the port will comply with the general policies of the CCA. The POLB has a CCC-certified PMP that addresses environmental, recreational, economic, and cargo-related concerns of the Port and surrounding regions (see section 1.4.3). Amendments to certified PMPs only become effective after approval by the CCC. To certify a PMP amendment, the CCC must find the amendment consistent with the policies of Chapters 3 and 8 of the CCA.

Chapter 3 of the CCA lists the six coastal resources planning and management polices that are used to evaluate a proposed project's consistency with the CCA:

- maximizing access to California's coast;
- protecting water-oriented recreational activities;
- maintaining, enhancing, and restoring California's marine environment;
- protecting sensitive habitats and agricultural uses;
- minimizing environmental and aesthetic impacts of new development; and
- locating coastal-dependent industrial facilities within existing sites whenever possible.

1.4.3 POLB Port Master Plan

The purpose of the PMP is to provide long-range planning goals and objectives for developing policies involving current and future POLB activities within the Port in compliance with the goals of the CCA. The CCC certified the POLB's PMP in October 1978, subject to submission of a Risk Management Plan (RMP) for assessing hazardous risks. Since that time, there have been 18 amendments to the PMP that have been submitted to and approved by the CCC. Projects that are approved pursuant to Chapter 8 of the CCA are deemed to be consistent with the CCA under Public Resources Code section 30719.

The POLB has been divided into 10 harbor planning districts, which are geographical areas established to serve functional purposes by consolidating similar land and water uses, maximizing efficient use of POLB facilities, and separating hazardous cargo from other areas of the POLB (see figure 1.4.3-1). The goals for each district serve as guidelines for long-term development within each district. To be consistent with the PMP, a project must conform to the goals of the district within which it is located. The project facilities would be located within two districts of the POLB, the Northwest Harbor Planning District 3 and Terminal Island Planning District 4.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 1-15
Figure 1.4.3-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

The LNG terminal facilities, the first 0.9 mile of the natural gas and C_2 pipelines, and the electric distribution facilities would be located within the Terminal Island Planning District 4. Current uses include the privately owned Long Beach Generating Station; the Southeast Resource Recovery Facility (SERRF); a container terminal on Pier T and another proposed on Pier S; and lumber, scrap, and oil terminals. Permitted uses within this district include primary port facilities, hazardous cargo facilities, port-related uses, navigation, ancillary port facilities, federal uses, oil production, and utilities. Primary port facilities are those facilities that are primarily dependent on access to water frontage, such as shipping/unloading facilities. Hazardous cargo facilities are defined as "operations and terminals engaged in the loading/unloading, storage and transfer of crude oil and refined petroleum products and chemicals with a National Fire Protection Association (NFPA) rating of 2 or greater" (POLB, 1999).

The next approximately 0.7 mile of the natural gas and C_2 pipelines would be located within the Northwest Harbor Planning District 3. The current use in this district is the container terminal on Pier A. Permitted uses are oil production, primary POLB facilities, utilities, and ancillary POLB activities.

The remaining 0.7 mile of the natural gas pipeline and the next 2.1 miles of the C_2 pipeline, including the 0.7 mile located along the remaining route associated with the natural gas pipeline, would be located within the boundaries of the City of Los Angeles. The remaining 0.9 mile of the C_2 pipeline would be located within the boundaries of the City of Carson (see section 1.4.5).

The pipelines and electric distribution facilities are considered utilities, which are permitted uses within both the Terminal Island Planning District 4 and the Northwest Harbor Planning District 3. The LNG terminal generally conforms to the overall goals of the current PMP; however, an LNG facility is not an expressly identified "hazardous cargo facility" as permitted within Terminal Island Planning District 4. As a result, an amendment to the PMP would be necessary to accommodate the LNG facility. The POLB has submitted a draft PMP amendment to the CCC in conjunction with submittal of this draft EIS/EIR. An announcement that the draft PMP amendment is available for public review was sent to the environmental mailing list along with the draft EIS/EIR and included in a formal notice published in the Federal Register and posted in the Los Angeles County's office. The public meetings to receive comments on the draft EIS/EIR (see section 1.3) will also be hearings on the draft PMP amendment.

The final PMP amendment will be presented to the BHC for consideration of adoption when the final EIS/EIR is presented for certification (see section 1.2.2). If the BHC adopts the PMP amendment and certifies the final EIS/EIR, the PMP amendment will be submitted to the CCC for review and certification. The CCC must act within 90 days of receipt of the PMP amendment.

If the CCC approves and certifies the PMP amendment, the project would be considered consistent with the CCA and, therefore, the CZMA. A more detailed discussion of how the project conforms to the PMP and CCA policies is presented in section 5.0.

1.4.4 Energy Policy Act of 2005

The Energy Policy Act of 2005, enacted on August 8, 2005, is designed to encourage energy efficiency and conservation, promote alternative and renewable energy sources, reduce dependence on foreign sources of energy, increase domestic production, modernize the electricity grid, and encourage the expansion of nuclear energy. Among the infrastructure-related provisions of the act, section 311(d) addresses state and local safety concerns regarding proposed LNG export or import terminals. The section provides that the Governor of a state in which an LNG terminal is proposed to be located may designate a state agency to consult with the FERC regarding the proposal. Accordingly, the Governor of the State of California designated the CEC for such purposes.

Section 311(d) provides that the designated state agency may furnish the FERC with an advisory report on its safety considerations with respect to a proposed LNG terminal. In addition, section 311(d) stipulates that the FERC shall review and respond specifically to the issues raised by the state in its advisory report before issuing an Order authorizing an LNG terminal.

On September 7, 2005, the CEC submitted to the FERC a Safety Advisory Report on the proposed Long Beach LNG Import Project. At the time of the printing of this draft EIS/EIR, the report is under review. After completing its review, the FERC will respond specifically to the issues raised by the CEC.

1.4.5 Other Regional and Local Plans and Policies

Southern California Association of Governments Regional Plans

The Southern California Association of Governments (SCAG) is a metropolitan planning organization for the six-county southern California region (i.e., Ventura, Los Angeles, Orange, San Bernardino, Riverside, and Imperial Counties). The SCAG was established under California Government Code 6502 et seq. and is designated a Council of Governments, a Regional Transportation Planning Agency, and a Metropolitan Planning Organization.

The SCAG's responsibilities include development of solutions to the region's common problems including transportation management, growth, land use, housing, air quality, waste management, and other regional issues. The SCAG also acts as an information clearinghouse and provides counties and cities with data on demographics, forecasting, mapping, and other regional statistics. The SCAG has developed a Regional Comprehensive Plan and Guide (RCPG) and a Regional Transportation Plan (RTP). These plans include individual plans that address specific issues such as growth management, regional housing needs, regional mobility, water quality, and air quality.

In a letter dated October 20, 2003, the SCAG outlined several policies of its RCPG and RTP that apply to the Long Beach LNG Import Project. A summary of these policies and the project's consistency with these policies is presented in table 1.4.5-1.

Air Quality Management Plan

The EPA, under the provisions of the Clean Air Act (CAA), requires each state that has not attained National Ambient Air Quality Standards (NAAQS) to prepare a separate local plan detailing how such standards will be met in each local area. These plans are prepared by local agencies designated by the governor of each state and incorporated into a State Implementation Plan (SIP). The Lewis Air Quality Act of 1976 established the four-county SCAQMD and charged it with the preparation of an Air Quality Management Plan (AQMP). The AQMP is reviewed every 3 years and revised as necessary. The latest revision was adopted by the SCAQMD in August 2003, but has yet to be approved by the EPA; the last version with EPA approval is the 1997/1999 AQMP. The proposed project would comply with all applicable air regulations. Additional information on air quality in the area and impacts associated with the Long Beach LNG Import Project is presented in section 4.9.

TABLE 1.4.5-1

Consistency of the Long Beach LNG Import Project with the Policies of the Southern California Association of Governments' Regional Comprehensive Plan and Guide and Regional Transportation Plan

Policy Group/ Policy No.	Policy Description	Project Consistent (Yes/No)	Comments
Consistency with Regional Comprehensive Plan and Guide (RCPG) Policies			
3.03	The timing, financing, and location of public facilities, utility systems, and transportation systems shall be used by the Southern California Association of Governments (SCAG) to implement the region's growth policies.	Yes	The project facilities could be in service by early 2010 and would be privately financed. The project would not significantly affect regional growth because of the relatively small operational workforce. Of the 60 full-time employees required for operation of the facilities, only 6 would be obtained from outside the project area (see section 4.6.2).
Growth Management Chapter (GMC) Policies Related to the RCPG Goal to Improve the Regional Standard of Living			
3.05	Encourage patterns of urban development and land use, which reduce costs on infrastructure construction and make better use of existing facilities.	Yes	The project would be located in a previously developed, industrial area within and adjacent to the Port of Long Beach (POLB) and would require the construction of minimal new infrastructure (see sections 2.1 and 4.5.2.1).
3.09	Support local jurisdictions' efforts to minimize the cost of infrastructure and public service delivery, and efforts to seek new sources of funding for development and the provision of services.	Yes	The project would require the construction of minimal new infrastructure (see section 2.1) and would not interfere with local jurisdictions' efforts to provide public services (see section 4.6.5). In addition, the project would provide a new source of tax revenues in the area (see section 4.6.8).
3.10	Support the local jurisdiction's actions to minimize red tape and expedite the permitting process to maintain economic vitality and competitiveness.	Yes	Sound Energy Solutions (SES) is in the process of working with the applicable local agencies to obtain the permits, approvals, and consultations necessary for the construction and operation of the Long Beach LNG Import Project (see section 1.5).
GMC Policies Related to the RCPG Goal to Improve the Regional Quality of Life			
3.18	Encourage planned development in locations least likely to cause environmental impact.	Yes	The project would be located in a previously developed, industrial area within and adjacent to the POLB. Several alternative locations were also analyzed (see section 3.0).
3.20	Support the protection of vital resources such as wetlands, groundwater recharge areas, woodlands, production lands, and land containing unique and endangered plants and animals.	Yes	The project would be located in a previously developed, industrial area within and adjacent to the POLB and would not affect wetlands, groundwater recharge areas, woodlands, production lands, or land containing unique and endangered plants and animals (see sections 4.3.2, 4.3.4, 4.4.2, and 4.4.4).
3.21	Encourage the implementation of measures aimed at the preservation and protection of recorded and unrecorded cultural resources and archaeological sites.	Yes	The project would not affect any known recorded cultural resources or archaeological sites. SES has developed an Unanticipated Discovery Plan that would be followed in the event that sites are found during construction (see section 4.8.4).
3.22	Discourage development, or encourage the use of special design requirements, in areas with steep slopes, high fire, flood, and seismic hazards.	Yes	The project would not be located in an area with steep slopes or high fire or flood hazards. SES has designed the project facilities to withstand seismic hazards, including tsunamis (see section 4.1.4).

TABLE 1.4.5-1 (cont'd)

Consistency of the Long Beach LNG Import Project with the Policies of the Southern California Association of Governments' Regional Comprehensive Plan and Guide and Regional Transportation Plan

Policy Group/ Policy No.	Policy Description	Project Consistent (Yes/No)	Comments
3.23	Encourage mitigation measures that reduce noise in certain locations, measures aimed at preservation of biological and ecological resources, measures that would reduce exposure to seismic hazards, minimize earthquake damage, and to develop emergency response and recovery plans.	Yes	Impacts on noise levels associated with construction and operation of the proposed facilities would be less than significant (see section 4.10). The project would have minimal impact on biological and ecological resources (see section 4.4). SES has designed the LNG storage tanks to withstand a Richter magnitude M7.9 earthquake on the Palos Verde and Newport-Inglewood faults and a magnitude M6.6 earthquake on the THUMS-HB fault (see section 4.1.4). SES is working with local emergency groups to develop an Emergency Response Plan (see sections 4.6.5 and 4.11).
GMC Policies Related to the RCPG Goal to Provide Social, Political, and Cultural Equity			
3.27	Support local jurisdictions and other service providers in their efforts to develop sustainable communities and provide, equally to all members of society, accessible and effective services such as: public education, housing, health care, social services, recreational facilities, law enforcement, and fire protection.	Yes	The project would not interfere with efforts to develop sustainable communities or to provide public services because it would be located in a previously developed, industrial area within and adjacent to the POLB. The project would, however, provide a new source of tax revenues to the area (see section 4.6.8).
Air Quality Chapter Core Actions			
5.07	Determine specific programs and associated actions needed (e.g., indirect source rules, enhanced use of telecommunications, provision of community-based shuttle services, provision of demand management based programs, or vehicle-miles-traveled/emission fees) so that options to command and control regulations can be assessed.	Yes	Table 1.5-1 lists the major federal, state, and local permits, approvals, and consultations identified for the construction and operation of the Long Beach LNG Import Project. The requirements of all of these permits would be complied with. Measures to reduce impacts on the air quality of the region are discussed in section 4.9.
5.11	Through the environmental document review process, ensure that plans at all levels of government (regional air basin, county, subregional and local) consider air quality, land use, transportation, and economic relationships to ensure consistency and minimize conflicts.	Yes	This environmental impact statement/environmental impact report for the Long Beach LNG Import Project will be used by several agencies at various levels of government to determine their respective actions on the project (see section 1.2). Section 1.4 presents an overview of applicable plans and policies and the project's consistency with those plans and policies.
Water Quality Chapter Recommendations and Policy Options			
11.07	Encourage water reclamation throughout the region where it is cost-effective, feasible, and appropriate to reduce reliance on imported water and wastewater discharges. Current administrative impediments to increased use of wastewater should be addressed.	Yes	To the extent practicable, SES would minimize reliance on imported water and wastewater discharges (see sections 4.3.3 and 4.6.6).

Water Quality Control Plan – Los Angeles River Basin

The Water Quality Control Plan for the Los Angeles River Basin (Region 4) (Basin Plan) was adopted by the Regional Water Quality Control Board (RWQCB), Los Angeles Region, in 1978 and updated in 1994 (RWQCB, 1994). The Basin Plan designates beneficial uses of the basin's water resources and describes water quality objectives, implementation plans, and surveillance programs to protect or restore designated beneficial uses. The beneficial uses of water resources in the POLB would not be adversely affected by construction and operation of the Long Beach LNG Import Project (see section 4.3.3).

Los Angeles County Congestion Management Program

The Congestion Management Program (CMP) for Los Angeles County was adopted by the Metropolitan Transportation Authority (MTA) in 1992 and is updated biannually. The CMP was developed in conformance with Proposition 111, the Gas Tax Initiative, approved by California voters in 1990. The 1993 program update includes an element called the Countywide Deficiency Plan that establishes a partnership between the 88 cities in Los Angeles County and the MTA. Each jurisdiction is responsible for annually monitoring building permit activity and then deciding how to offset the potential effects of that development by choosing from a series of transportation mitigation strategies. The CMP also includes a series of monitoring programs that measure the level of service (LOS) on critical transportation systems, including major intersections, freeways, and major transit routes. Since 1994, jurisdictions have been required to track new development activity and report it to the MTA. All development activity in the POLB must be included in the City of Long Beach development activity report.

The CMP includes a backbone highway system called the CMP system, which includes all state highways and other major arterial routes as decided by the cities in conjunction with the MTA. A total of 160 intersections are included in the highway system for periodic monitoring of service levels. Projects are evaluated with respect to the closest arterial and freeway monitoring stations to determine their potential effects on regional highways. Additional information on traffic in the area and impacts associated with the Long Beach LNG Import Project is presented in section 4.7.2.

City of Long Beach General Plan

The LNG terminal site, the electric distribution facilities, and the first 1.6 miles of the natural gas and C_2 pipelines would be located within the boundaries of the City of Long Beach. This area is included in the City of Long Beach General Plan (General Plan). In the General Plan, the Long Beach Harbor area falls within Land Use District No. 12. This district is composed of existing freeways, the Long Beach Harbor, and the Long Beach Airport. The General Plan assumes that the water and land use designations within the harbor area are formulated separately and adopted by due process as the Specific Plan of the Long Beach Harbor (also known as the PMP as amended). The General Plan provides for delegation of responsibilities for planning within the legal boundaries of the POLB to the BHC. A discussion of the project's consistency with the PMP is provided in section 1.4.3.

City of Long Beach Municipal Code

The Long Beach Municipal Code establishes the zoning within the POLB as IP – Port-Related Industrial District (IP District) and PD – Planned Development District (PD District). The IP District is characterized by Port-related or water-dependent uses. All new uses in the IP District must be consistent with the PMP. The PD District (or Queensway Bay Planning District) includes portions of the eastern side of the POLB and was created in 1987 to provide a flexible planning mechanism for the phased

recreation-commercial development of the Queen Mary Hotel and adjacent shorelands. The facilities associated with the Long Beach LNG Import Project would be located solely within the IP District and would be consistent with the industrial, water-dependent uses of the district; however, an amendment to the PMP would be necessary to accommodate the LNG facility (see section 1.4.3).

The Long Beach Municipal Code also sets limits for exterior noise levels based on receiving land use districts. The project facilities would be located in an industrial land use district (District 4) associated with the POLB. The Long Beach LNG Import Project would be in compliance with the City of Long Beach noise ordinance (see section 4.10).

The General Plan of the City of Los Angeles

The northernmost 0.7 mile of the natural gas pipeline and 2.1 miles of the C_2 pipeline associated with the Long Beach LNG Import Project would be located within the boundaries of the City of Los Angeles. The General Plan of the City of Los Angeles (2002) is a "comprehensive long-range declaration of purposes, policies, and programs for the development of the City of Los Angeles" and comprises 11 elements that apply citywide. The Land Use Element is divided into 35 local area plans known as Community Plans, the Port of Los Angeles (POLA) Port Master Plan, and the Los Angeles World Airport Plan. The pipelines would be located within the Wilmington-Harbor City Community Plan of the City of Los Angeles, and would be on land that is currently used for industrial purposes. Because the majority of the pipeline route would be located adjacent to or within existing utility rights-of-way, no conflicts with planned uses are anticipated. However, the POLA has indicated that it is currently investigating the feasibility of developing an Intermodal Container Transfer Facility (ICTF) on a portion of the property that would be crossed by the proposed C_2 pipeline. The POLA also stated that any pipeline constructed within an ICTF would need to be designed to handle railroad loads. SES would need to acquire the necessary right-of-way permits from the POLA in order to cross this property and those permits would specify construction standards. Overall, the pipelines would be consistent with the General Plan of the City of Los Angeles and the surrounding industrial uses.

City of Los Angeles Municipal Code

The applicable zoning ordinances for the area around the northernmost 0.7 mile of the natural gas pipeline and 2.1 miles of the C_2 pipeline are detailed in the City of Los Angeles Municipal Code (1989). Chapter 1, Articles 2 and 3 provide specific planning and zoning information for the city. The proposed pipelines would cross land that is zoned M3 or Heavy Industrial and, therefore, would be consistent with the City of Los Angeles Municipal Code and the surrounding industrial uses.

The General Plan of the City of Carson

The northernmost 0.9 mile of the C_2 pipeline would be located within the boundaries of the City of Carson. The current General Plan for the City of Carson was adopted in 1971 and updated in the early 1980s. The city is currently in the process of updating the General Plan. The current General Plan consists of four units, each containing multiple elements and two elements not included within a unit. The Land Use Element is included in Unit 1 and identifies land use designations and the uses permitted for each land use category. The C_2 pipeline would be located within an area where the land use designation is classified as heavy industrial. Industrial areas are intended to accommodate the manufacturing, processing, warehousing, and distribution functions of the community. As a result, the pipeline would be consistent with the General Plan of the City of Carson and the surrounding industrial uses.

City of Carson Zoning Ordinance

According to the City of Carson, the Zoning Ordinance is the most important implementing tool for the General Plan. The ordinance text and zoning map provide permitted land uses and development standards for each category of land use, consistent with the land use designations contained in the General Plan. The proposed C_2 pipeline would cross land that is zoned MH or Manufacturing, Heavy and, therefore, would be consistent with the City of Carson Zoning Ordinance and the surrounding industrial uses.

POLB Facilities Master Plan

The POLB's Facilities Master Plan (FMP) describes growth strategies for the POLB through 2020. The FMP focuses on potential development projects and general patterns of land use within the POLB. It incorporates long-term cargo forecasts and capacity estimates. The FMP explores a wide range of development and landfill options and addresses both cargo and non-cargo land uses.

The FMP presents forecasts of the types and amounts of cargo expected to move through the POLB in 2020. These forecasts are based on economic forecasts of United States trade with the rest of the world. The FMP identifies existing cargo handling capacities and determines the additional capacity needed to handle the anticipated future cargo volumes.

The FMP identifies the construction of a new, deep-water, liquid bulk terminal facility on Pier T to service larger vessels as a near-term project that would help meet the needs anticipated in the FMP. Liquid bulk is defined as liquid cargo shipped without a package or container, such as crude petroleum, refined petroleum, and chemicals. Although LNG is not specifically identified, it would generally fit into the category of a liquid bulk chemical; however, an amendment to the PMP would be necessary to accommodate the LNG facility (see section 1.4.3).

1.5 PERMITS, APPROVALS, AND REGULATORY REQUIREMENTS

Table 1.5-1 lists the major federal, state, and local permits, approvals, and consultations identified for the construction and operation of the Long Beach LNG Import Project. The responsibilities of the FERC, the POLB, the ACOE, the Coast Guard, and the PHMSA in relation to these permits, approvals, and consultations are described in the applicable sections of this EIS/EIR. All permits and approvals required for the Long Beach LNG Import Project would need to be obtained, regardless of whether they appear in this table.

TABLE 1.5-1

Major Permits, Approvals, and Consultations for the Long Beach LNG Import Project

Agency	Permit/Approval/Consultation	Agency Action
FEDERAL		
Advisory Council on Historic Preservation	Section 106 Consultation, National Historic Preservation Act (NHPA)	Has the opportunity to comment on the undertaking.
Federal Energy Regulatory Commission	Authorization under section 3 of the Natural Gas Act (NGA)	Consider issuance of Approval of Place of Import and Authorization of Siting, Construction, and Operation of LNG Terminal Facilities.
U.S. Department of the Army Corps of Engineers (ACOE)		
Los Angeles District	Section 10, Rivers and Harbors Act	Consider issuance of permit for placement of structures or work in, or affecting, navigable waters of the United States.
	Section 404, Clean Water Act (CWA)	Consider issuance of permit for the placement of dredge or fill material into all waters of the United States, including wetlands.
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries)	Section 7, Endangered Species Act	Opportunity to consult regarding impact on federally listed or proposed threatened and endangered species and their habitat.
	Magnuson-Stevens Fishery Conservation and Management Act	Conduct review and oversight of essential fish habitat.
U.S. Department of Energy	Authorization under section 3 of the NGA	Consider issuance of authorization to import natural gas.
U.S. Department of the Interior		
Fish and Wildlife Service	Section 7, Endangered Species Act	Opportunity to consult regarding impact on federally listed or proposed threatened and endangered species and their habitat.
	Migratory Bird Treaty Act	Review the proposed project for consistency with Executive Order 13186 (January 2001).
	Fish and Wildlife Coordination Act	Provide comments to prevent loss of and damage to wildlife resources.
U.S. Department of Homeland Security		
Coast Guard	Facility Security Plan	Review and consider approval of the Facility Security Plan.
	Letter of Intent	After the operator submits its Letter of Intent, the Captain of the Port determines the suitability of the waterway for issuance of a Letter of Recommendation to the operator.
	LNG Vessel Operation and Emergency Contingency Plan	Review and consider approval of the LNG Vessel Operation and Emergency Contingency Plan.
	Operations Manual and Emergency Manual	Review and consider approval of a plan to deal with the transfer operations and emergency response.

TABLE 1.5-1 (cont'd)

Major Permits, Approvals, and Consultations for the Long Beach LNG Import Project

Agency	Permit/Approval/Consultation	Agency Action
	Permission to Establish Aids to Navigation	Captain of the Port issues permission to establish any navigational aids (buoys or day beacons) associated with the LNG unloading facility.
	Spill Prevention and Spill Response Plan	Review and consider approval of a plan for responding to spills from LNG ships.
	Waterway Suitability Assessment	Validate and consider approval of a report assessing the suitability of the waterway for LNG marine traffic.
U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration	LNG Facilities Petition for Approval	Consider issuance of approval that the new LNG facility meets standards governing siting, design, installation, personnel qualifications, and training.
Federal Aviation Administration	Notification of Proposed Construction Possibly Affecting Navigable Air Space	Review notification of construction activities and/or permanent structures within 3 miles that may have an impact on navigable air space.
STATE		
California Coastal Commission	Federal Coastal Zone Management Act (CZMA) and California Coastal Act of 1976 (CCA) Consistency Determination	Consider issuance of determination of consistency with the CZMA and the CCA.
	Approval of amendment to the certified Port Master Plan (PMP)	Consider approval of the PMP amendment.
California Department of Fish and Game	State-Listed Threatened and Endangered Species Consultation (California Endangered Species Act)	Identify any known state-listed threatened and endangered species.
California Department of Transportation	Encroachment and Crossing Permits	Consider issuance of authorization to encroach along and within state highways and rights-of-way.
	Traffic Management Plan (TMP)	Consider issuance of approval of TMPs for state highways and freeway encroachments.
California Environmental Protection Agency		
Regional Water Quality Control Board, Los Angeles Region	Section 401, CWA, Water Quality Certification or California Water Code Waste Discharge Requirements Permit	Consider issuance of certification or permit for activities related to dredge and fill materials.
	General National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties	Consider issuance of authorization to discharge hydrostatic test water.
State Water Resources Control Board	NPDES General Permit for Storm Water Discharges Associated with Construction Activity	Consider issuance of authorization to discharge storm water associated with construction activities.
California Public Utilities Commission	Certificate of Public Convenience and Necessity (Certificate)	Consider issuance of Certificate for construction and operation of the intrastate pipeline and powerline facilities.

TABLE 1.5-1 (cont'd)

Major Permits, Approvals, and Consultations for the Long Beach LNG Import Project

Agency	Permit/Approval/Consultation	Agency Action
California Department of Conservation-Division of Oil, Gas, & Geothermal Resources	Construction Site Review	Review the project site and provide a list of control measures that must be incorporated into the construction plans to protect active production wells, as well as management techniques for dealing with abandoned wells.
California State Historic Preservation Office	Consultation under section 106 of the NHPA	Review and comment on activities potentially affecting cultural resources.
Native American Heritage Commission	Consultation to obtain comments on the project and its effect on Sacred Lands.	Review of Sacred Lands file/consultation.
LOCAL		
City of Long Beach		
Engineering/Public Works Department	Encroachment Permit	Consider issuance of authorization for encroachment/crossing on city streets.
Harbor Department	Project Approval	Consider certification of the environmental impact report prepared in accordance with the California Environmental Quality Act.
	Harbor Development Permit	Consider issuance of approval for development within Long Beach Harbor District.
Planning and Building Department	Building Permit	Consider issuance of authorization to construct structures and buildings within Long Beach Harbor District.
City of Los Angeles		
Engineering/Public Works Department	Encroachment Permit	Consider issuance of authorization for encroachment/crossing on city streets.
County of Los Angeles		
Health Hazardous Materials Division	Hazardous Materials Business Plan	Review plan for storage and management of hazardous wastes.
Port of Los Angeles		
Engineering/Public Works Department	Encroachment Permit	Issue authorization for encroachment/crossing on Port of Los Angeles streets.
South Coast Air Quality Management District (SCAQMD)	Permit to Construct/Permit to Operate (Title V, Clean Air Act, Rule 201, 203, SCAQMD Rules)	Consider issuance of written authorization to build, install, alter, replace, or operate equipment that emits or controls the emission of air contaminants.

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 PROPOSED FACILITIES

SES proposes to construct and operate an LNG import, storage, and vaporization terminal on a 25-acre site on a portion of Pier T, designated Berth T-126, on Terminal Island within the POLB, Los Angeles County, California (see figure 2.1-1). The import terminal would deliver an average of 700 million standard cubic feet per day (MMscfd) of natural gas with a peak capacity of 1 Bscfd to the existing SoCal Gas pipeline system via a new 2.3-mile-long, 36-inch-diameter natural gas pipeline that would be constructed and operated by SES. In addition, a portion of the LNG would be distributed via trailer trucks to LNG vehicle fueling stations throughout southern California to fuel LNG-powered vehicles. Up to 10,000 MMBtu per day of C_2 recovered from the LNG would be vaporized and distributed to the existing LARC via a new 4.6-mile-long, 10-inch-diameter pipeline that would be constructed and operated by ConocoPhillips. Power to the LNG terminal would be supplied via 0.8 mile of electric distribution lines and a new substation that would be constructed and operated by SCE. The proposed LNG terminal and associated facilities are described below.

2.1.1 LNG Terminal Facilities

The LNG terminal facilities would include:

- a 1,100-foot-long LNG ship berth and unloading facility with unloading arms, mooring and breasting dolphins, and a fendering system that would be capable of unloading one ship at a time;
- two LNG storage tanks, each with a gross volume of 160,000 cubic meters (1,006,000 barrels) surrounded by a security barrier wall;
- 20 electric-powered booster pumps;
- four shell and tube vaporizers using a primary, closed-loop water system;
- three boil-off gas compressors, a condensing system, an NGL recovery system, and an export C_2 heater;
- an LNG trailer truck loading facility with a small LNG storage tank;
- a natural gas meter station and odorization system;
- utilities, buildings, and service facilities; and
- associated hazard detection, control, and prevention systems; site security facilities; cryogenic piping; and insulation, electrical, and instrumentation systems.

The general layout of the proposed LNG terminal facilities is provided on figure 2.1.1-1. A conceptual process flow diagram showing the general operation of these facilities is shown on figure 2.1.1-2.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 2-2
Figure 2.1-1

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 2-3
Figure 2.1.1-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

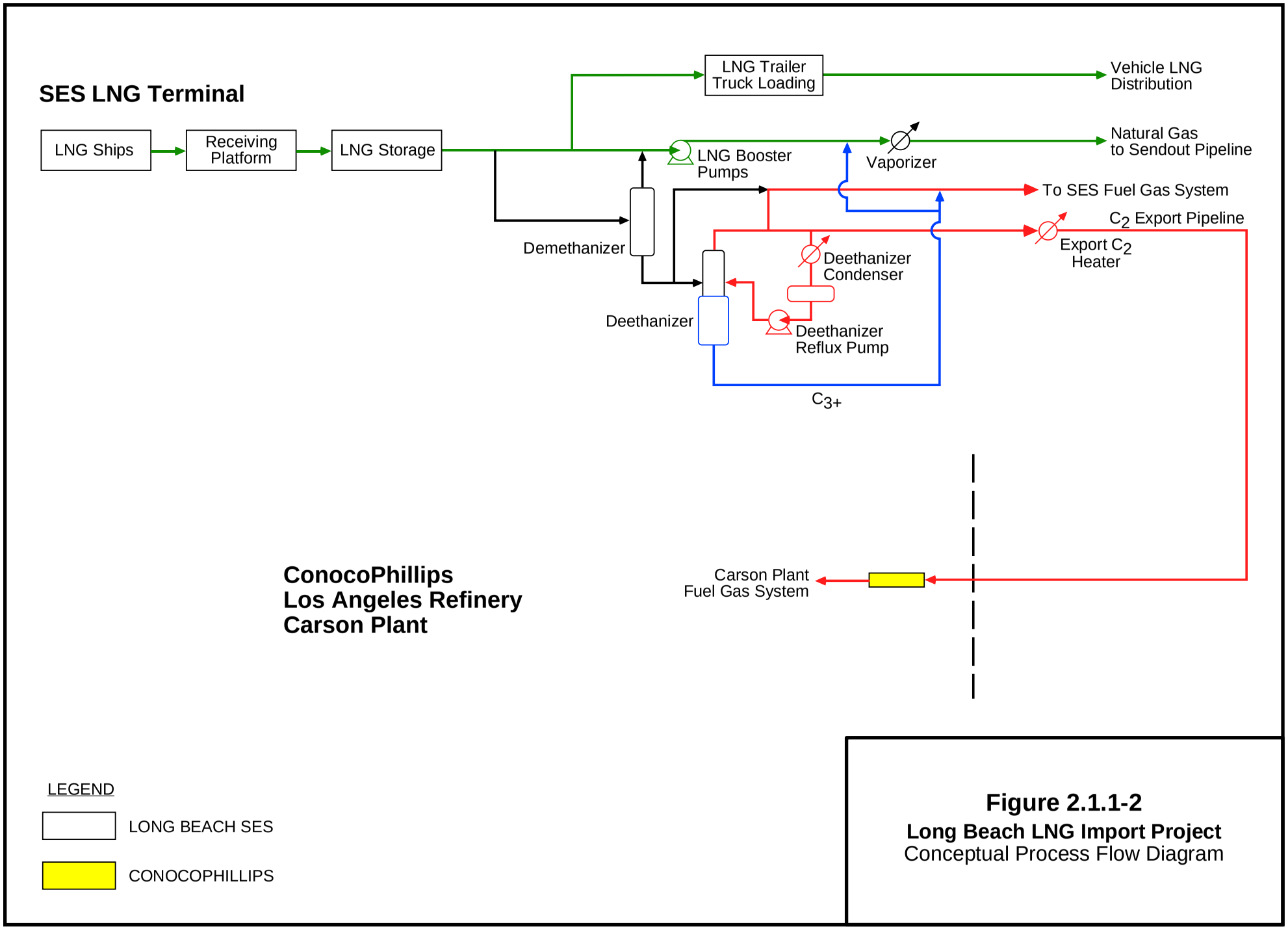


Figure 2.1.1-2
Long Beach LNG Import Project
Conceptual Process Flow Diagram

The proposed site for the terminal facilities, which was formerly part of a naval shipyard, is currently paved with concrete and asphalt and contains two abandoned buildings. The POLB would demolish the buildings on the site and remove the pavement prior to SES' initiation of activities associated with the proposed project. The environmental impact analysis for the demolition activities was conducted as part of the EIS/EIR prepared for the disposal and reuse of the naval complex (Department of the Navy/City of Long Beach, 1998); therefore, those activities are not addressed in this EIS/EIR. The other activities associated with the project that would be conducted by the POLB (see discussion below) are addressed in this EIS/EIR.

The existing shoreline structures consist of a cellular steel sheet pile bulkhead along the south side of the site and a rock dike with a pile-supported concrete wharf along the west side of the site. The POLB would reinforce or replace these structures as needed to support the upland loads generated by the LNG storage tanks and other heavy load structures.

2.1.1.1 Ship Berth and Unloading Facility

The proposed ship berth and unloading facility would be designed to handle ships with a capacity ranging from 75,000 cubic meters and an overall length of 844 feet to a capacity of 208,000 cubic meters and an overall length of 1,115 feet. The typical ship size would be between 125,000 and 165,000 cubic meters. LNG vessels of this size would typically have a total length of 950 to 1,000 feet, a beam (width) of about 150 feet, and a loaded draft of about 40 feet. The facility would be capable of mooring and unloading one LNG ship at a time. SES anticipates that up to 120 ships per year would unload LNG at the proposed facility.

The ships would enter the area through Queens Gate, a 1,200-foot-wide opening into San Pedro Bay between the Long Beach and Middle breakwaters. To access Pier T, the vessels would travel northwest within the Long Beach Main Channel into the Middle Harbor. Pier T is located within the West Basin of the Middle Harbor.

The current water depth at Pier T-126 ranges from 46 feet to 53 feet below mean lower low water (MLLW). Preparation of the berth would require the dredging of approximately 175,000 cubic yards of sediments to a depth of about -55 feet MLLW to accommodate safe under keel clearance and tidal fluctuation. This depth would accommodate the largest LNG ships expected to use the terminal. Sediment sampling in the West Basin has indicated that there are chemically impacted sediments present and the West Basin of Long Beach Harbor is designated as Installation Restoration (IR) Site 7. The POLB has recently negotiated a consent agreement with the California Department of Toxic Substances Control (DTSC) for its concurrence with the IR Site 7 sediment remediation. A portion of IR Site 7 is adjacent to Berth T-124, at the southern end of the project site, and at Berth T-126, which is the berth proposed for the Long Beach LNG Import Project (see figure 2.1.1-1). Accordingly, the dredging associated with the proposed project would be done only with the concurrence of the DTSC and in accordance with permits issued by the ACOE and the RWQCB (see section 4.2.3). The dredged area for the ship berth would be about 200 feet wide by 1,150 feet long. The POLB would conduct the dredging and dispose of the dredged material at an approved site within the Port.

The ship berth and unloading facility would consist of a pile-supported concrete unloading platform, multiple mooring and breasting dolphins, and a fendering system. The unloading platform would be capable of accommodating up to five unloading arms with their associated hydraulic control system, associated piping, utilities, fire protection equipment, and a gangway tower. A trestle would provide access to the unloading platform from shore. The trestle would consist of a roadway of sufficient width for one lane of traffic as well as all piping, utilities, and fire projection equipment. The POLB would be responsible for the engineering design and construction of the structural and in-water portions of

the ship berth and unloading facility; SES would be responsible for the engineering design and construction of the LNG transfer and associated facilities.

The mooring and breasting dolphins would be constructed on either side of the unloading platform to provide the means to secure the vessel. The dolphins would be constructed of reinforced concrete slabs supported on piles and would include fenders against which the vessel would be berthed. The dolphin elevation would be approximately +15.5 feet MLLW and each structure would include mooring line release hooks and a high capacity fender system. A computer system would be installed to monitor the unloading process and all safety alarms.

SES' proposal includes on-board ship pumps running on LNG boil-off gas or residual fuel oil to deliver the LNG to the LNG storage tanks. A total of four marine unloading arms would be installed on the unloading platform, three for liquid delivery to the storage tanks and one for use in vapor return to the ship. Space would also be provided for potential future installation of a fifth arm, which would increase unloading capacity and flexibility. The unloading arms would be designed with swivel joints to provide the required range of movement between the ship and the shore connections and would be able to withstand wind speeds up to 150 miles per hour (mph). Each arm would be fitted with powered emergency release coupling (PERC) valves to protect the arm and avoid spillage of its liquid contents. The unloading platform would be curbed to confine LNG spillage and its surface would be sloped to direct drainage from the platform to the LNG storage tank area containment system via a trough (see section 2.7.1.1). It would take approximately 12 hours to unload one LNG ship of typical size.

The marine facilities would be designed to provide a safe berth for the receipt and support of LNG ships and to ensure the safe transfer of LNG from the ships to onshore storage facilities. Design would be in accordance with applicable codes and standards, including but not limited to the Oil Companies International Marine Forum (OCIMF), Society of International Gas Tanker and Terminal Operators (SIGTTO), American Petroleum Institute (API), and American Society of Civil Engineers (ASCE). In this regard, SES has consulted extensively with the Coast Guard, Jacobsen Pilot Services, Inc. (Jacobsen Pilots), the Marine Exchange, the Los Angeles/Long Beach Harbor Safety Committee (HSC), and local law enforcement.

The marine facilities would also be designed to current POLB design criteria for shoreline structures and in accordance with the California Code of Regulations Marine Oil Terminal Engineering and Maintenance Standards. These standards provide structural loading criteria for marine structures including dead and live loads, earthquake loads, mooring and berthing loads, influence from passing vessels, wind and current loads, load combinations, and safety factors.

A discussion of design and safety features of LNG ships is presented in section 2.1.2.

2.1.1.2 LNG Storage Tanks

LNG unloaded from the ships would be stored in two 160,000 cubic meter (1,006,000 barrel) full containment storage tanks at a normal pressure of 1 to 3 pounds per square inch gauge (psig). Each tank would have a primary 9 percent nickel-steel inner container and a secondary pre-stressed concrete outer container wall, a reinforced concrete outer container bottom, a reinforced concrete domed roof, and an aluminum insulated support deck suspended from the outer container roof over the inner container (see figure 2.1.1-3). The double-walled tanks are designed, and would be constructed, so that both the primary container and the secondary container could independently contain the stored LNG. The primary container would contain the cryogenic liquid under normal operating conditions. The secondary container is capable of containing the cryogenic liquid and of controlling vapor resulting from product release from the inner

container. The diameter of the outer containers would be approximately 255 feet and the height to the top of the storage tank domes would be approximately 176 feet.

The space between the inner container and the outer container would be insulated to allow the LNG to be stored at a temperature of -260 °F while maintaining the outer container at near ambient temperature. The insulation under the inner container's bottom would consist of a cellular glass block. The outer concrete container above the approximately 15-foot-high thermal corner protection system would be lined on the inside with carbon steel plates. This carbon steel liner would serve as a barrier to moisture migration from the atmosphere reaching the insulation inside the outer container. This liner also would form a barrier that prevents vapor from escaping from inside the tank during normal operations. All piping into and out of the tank would enter from the top of the tank (i.e., there would be no penetration through the side or bottom of the tank).

The foundations for the storage tanks would be supported on driven steel piles. A reinforced concrete base slab foundation would be constructed on the piles on which the LNG storage tanks would be built with seismic isolators or a flexible foundation to reduce horizontal seismic load (see figure 2.1.1-3).

The area around the storage tanks would be graded so that any spill of LNG would flow to a containment sump system. The containment sump system and both LNG storage tanks would be inside an approximately 20-foot-high concrete security barrier wall that would prevent LNG escape and restrict LNG vapors during potential LNG spills. Additional discussion of the containment system is presented in section 2.7.1.1.

2.1.1.3 Vaporization System

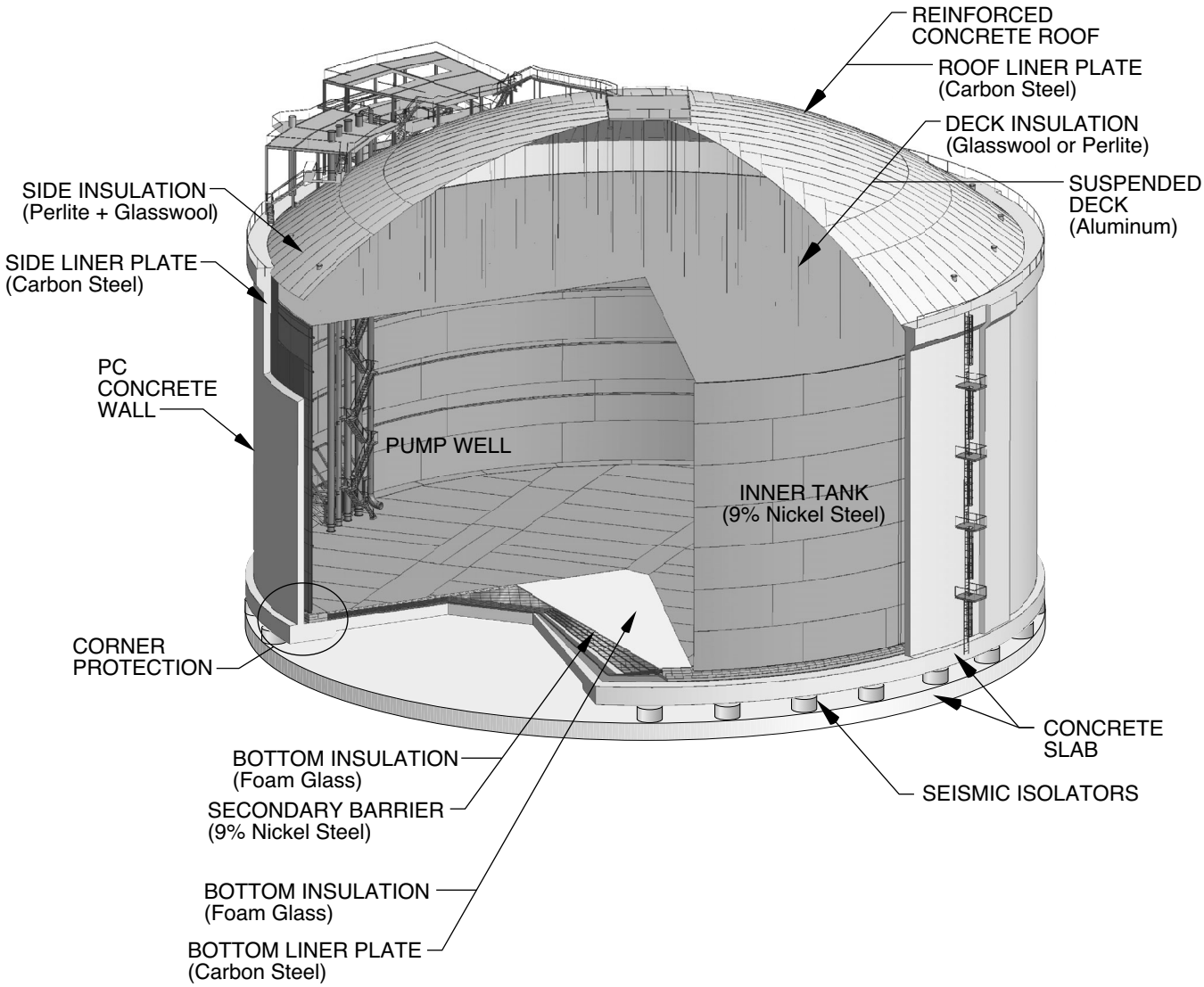
LNG would be pumped from the storage tanks to the vaporizers for sendout to the pipeline. Three closed-loop vertical shell and tube heat vaporizers, plus a spare, would be used to vaporize the LNG. Each vaporizer would be capable of vaporizing approximately 350 MMscfd of LNG. This process would involve warming the LNG and converting it back to a gaseous state. Heat for the process would be provided by three direct-fired heaters using 100,000 gallons of deaerated fresh water purchased from a local supplier. Another 10,000 gallons of deaerated fresh water would be stored in a tank to be used as makeup water for the closed-loop system. No by-products would be generated or discharged by the system.

The pumps and vaporizers would be installed within curbed spill collection areas. Drainage from these collection areas would be conveyed through LNG spill collecting troughs to a containment sump system (see section 2.7.1.1).

2.1.1.4 Vapor Handling System

During normal operation, ambient heat input into the LNG storage tanks would cause a small portion of the stored LNG to be vaporized, commonly referred to as boil-off gas. SES' vapor handling system would condense the vapor and combine it back with the LNG.

In order to maintain the ship tanks' pressure and system equilibrium, a portion of this vapor would be returned to the ship during ship unloading to compensate for the volume of liquid pumped out of the ship into the onshore LNG storage tanks. The boil-off gas compressors would be designed to handle the vapor, which would be either returned to the ship or sent to the recondenser.



NOTE: APPROVED DESIGN WOULD INCLUDE EITHER SEISMIC ISOLATORS OR A FLEXIBLE FOUNDATION TO REDUCE HORIZONTAL SEISMIC LOAD.

Figure 2.1.1-3

Long Beach LNG Import Project

Conceptual Design of LNG Storage Tanks

2.1.1.5 Natural Gas Liquids Recovery System

Natural gas is a mixture of hydrocarbon compounds, principally methane. It also contains small amounts of heavier hydrocarbons, such as propane, C_2, and butane, which have a higher heating value than methane. A portion of these components may need to be removed from the LNG that would be stored on the terminal site in order for the natural gas to meet the Btu and gas quality specifications of SoCal Gas as well as the specifications for LNG vehicle fuel established by the CARB. The components that are removed are called NGL. Accordingly, LNG that does not meet the required specifications would be routed through the NGL recovery unit. The NGL recovery facilities would consist of a demethanizer extraction column to extract the heavier hydrocarbons from the methane and a deethanizer extraction column to separate the C_2 and propane and heavier hydrocarbons (C_{3+}). The same heated water used in the vaporizers would also be used as the heat transfer fluid to supply heat necessary for the extraction column reboilers in the NGL recovery unit. The general operation of the NGL recovery system is shown on the conceptual process flow diagram depicted on figure 2.1.1-2.

As shown on figure 2.1.1-2, the C_2 extracted from the LNG in the NGL recovery unit would be used as fuel gas within the terminal and/or vaporized and transported via the proposed C_2 pipeline to the existing LARC and subsequently used as fuel gas or feedstock. The amount of C_2 available for sendout would depend on the Btu content of the LNG cargoes but would not exceed 10,000 MMBtu per day, which is the amount that can be handled at the LARC without requiring any new processing or storage facilities. The C_{3+} extracted from the LNG in the NGL recovery unit would be used as fuel gas within the LNG terminal, primarily to fire the water heaters.

A portion of the LNG from the NGL recovery system would be sent to the LNG trailer truck loading facility where it would be further processed and recondensed to produce vehicle fuel grade LNG (see section 2.1.1.6).

2.1.1.6 LNG Trailer Truck Loading Facility

After the LNG has been processed to meet LNG vehicle fuel quality specifications, it would be stored in a trailer truck loading facility at the LNG terminal. The trailer truck facility would consist of a 3,800 cubic meter (23,901 barrels) full containment storage tank and two trailer truck loading bays. SES anticipates that an average of 16 trailer trucks would be loaded per day to transport LNG to LNG vehicle fueling stations throughout southern California. Refer to section 4.7.2.2 for a discussion of LNG trailer truck traffic**.**

The area around the trailer loading facility would be curbed and graded so that a spill would flow to a containment sump system (see section 2.7.1.1).

2.1.1.7 Other Facility Components

Electrical System

The project power supply would be purchased from SCE, which is the local public electric power supplier (see section 2.1.4). Emergency power would be provided by a backup internal combustion engine generator. An uninterruptible power supply system would be provided and the plant electrical system would be furnished with automatic start and transfer devices to ensure that a loss of power would immediately start the emergency power generator.

Water System

Hot water would be used as an intermediate heat transfer fluid to supply heat for LNG vaporization and to the NGL recovery unit extraction columns. A closed circulating system would be used where the water would be pumped through heating coils in a fuel-gas-fired furnace prior to delivery to the LNG vaporizers as well as the NGL recovery unit. A 10,000-gallon storage tank would be provided to store the deaerated water that would be used, as necessary, as makeup water for the closed loop system. Potable water would also be used for various utilities such as firewater, hose stations, and use in the buildings' lavatories.

2.1.2 LNG Ships

LNG could be shipped from a variety of sources around the world, including Algeria, Australia, Brunei, Indonesia, Malaysia, Nigeria, Oman, Qatar, Trinidad, and United Arab Emirates. The LNG for the proposed terminal would likely be imported from six plants in the Pacific (located in Brunei, Indonesia, Malaysia, and Australia) and four plants in the Middle East (located in Oman, United Arab Emirates, and Qatar). Although LNG vessels and their operation are directly related to the use of the proposed import terminal, they are not subject to section 3 authorization. LNG vessels are, however, regulated through other methods. A detailed discussion of LNG ship standards and design features is presented below. Additional information on LNG ship regulations and safety measures is presented in section 4.11.7.

Ship Standards and Requirements

The LNG ships arriving at the SES terminal must comply with all federal and international standards regarding LNG shipping. This compliance is demonstrated by the operator of the LNG ship having proper certificates authorizing the transport of LNG as follows:

- United States Flag LNG Ship - The Coast Guard Certificate of Inspection must be valid and endorsed for the ship to transport LNG (Title 46 CFR Part 154, 1979).

- Foreign Flag LNG Ship - The ship must have a valid Certificate of Compliance issued by the Coast Guard. The certificate is issued after the ship has proved that it complies with the Coast Guard regulations and after it has been satisfactorily inspected by a Coast Guard Marine Safety Office (Title 46 CFR Part 154, 1979).

Both United States and foreign flag ships must be annually inspected by the Coast Guard and the flag state. A Coast Guard Certificate of Inspection is required every 2 years. Coast Guard officers may board the LNG ships arriving at the mouth of Queens Gate to ensure safety standards. The specific identity of LNG ships that would unload at the terminal would depend on the commercial terms of the LNG purchase agreements.

Ship Design and Construction

As discussed in section 2.1.1.1, the typical ship size associated with the proposed LNG terminal would be between 125,000 and 165,000 cubic meters. LNG vessels of this size would typically have a total length of between 950 to 1,000 feet, a beam (width) of about 150 feet, and a loaded draft of about 40 feet.

The ships that transport LNG are specially designed and constructed to carry LNG for long distances. As described below, LNG ship construction is highly regulated and consists of a combination of conventional ship design and equipment, with specialized materials and systems designed to safely contain liquids stored at temperatures of -260 °F.

Profile – LNG ships have a distinctive appearance compared to other transport ships. An LNG ship has a high freeboard (i.e., that portion of the ship above water) in comparison with vessels such as an oil tanker because of the comparatively low density of the cargo. Because of the high freeboard, wind velocity can adversely affect the maneuverability of the ship, particularly at slow speed, such as during docking.

Hull System – The International Maritime Organization's (IMO) Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (Gas Tanker Code) and Coast Guard regulations require that LNG ships meet a Type IIG standard of subdivision, damage stability, and cargo tank location. The Type IIG design ensures the LNG ship could withstand flooding of any two adjacent compartments without an adverse effect upon the stability of the ship. The Type IIG design also requires that the cargo tanks must be a minimum of 30 inches from the outer hull and minimum distance above the bottom of the ship equal to the beam of the ship divided by 15, or 6.5 feet, whichever is less. This distance is intended to prevent damage to the cargo tanks in case of low-energy-type accidents that might occur in harbors and during docking. Most large LNG ships have a distance of 10 to 15 feet between the outer hull and cargo tank.

Containment Systems – The LNG containment system on an LNG ship consists principally of the cargo tank (sometimes called a primary barrier), the secondary barrier, and insulation. The containment system also includes cargo monitoring and control and safety systems.

Three basic tank designs have been developed for LNG cargo containment: prismatic free-standing, spherical, and membrane. The earliest form of LNG containment is the prismatic free-standing tank. It consists of an aluminum alloy or 9 percent nickel-steel, self-supporting tank that is supported and restrained by the hull structure. Insulation consists of reinforced polyurethane foam on the bottom and the sides, with fiberglass on the top. The spherical tank design uses an unstiffened, spherical, aluminum alloy tank that is supported at its equator by a vertical cylindrical skirt, with the bottom of the skirt integrally welded to the ship's structure. This free-standing tank is insulated with multi-layer close-cell polyurethane panels.

In the membrane containment system, the ship's hull constitutes the outer tank wall, with an inner tank membrane separated by insulation. Two forms of membrane are commonly used: the Technigaz membrane using stainless steel and the Gas-Transport membrane using Invar.

LNG tankers are of the double-hull design regardless of the containment system used. A double bottom and double sides are provided for the full length of the cargo area and arranged as ballast tanks, independent of the cargo tanks. The double-hulled design provides greatly increased reliability of cargo containment in the event of grounding and collisions. Further, the segregated ballast tanks prevent ballast water from mixing with any residue in the cargo tanks.

Pressure/Temperature Control – A basic goal of all LNG containment systems is to maintain the LNG cargo at or near atmospheric pressure at the boiling temperature of the LNG (about -260 °F). This is accomplished using "auto-refrigeration," a phenomenon that results from the constant heat flow into the tank and the removal of the associated vapor.

The vapor generated during auto-refrigeration is known as boil-off gas. Typical boil-off gas rates of LNG ships range from 0.15 to 0.25 percent (by volume) per day. Currently, all LNG ships burn the boil-off gas as fuel. Because the Coast Guard does not permit routine venting of boil-off gas to the atmosphere in the United States, all LNG ships that trade in the United States are fitted with an internalized combustion energy system that allows the ship's boilers to consume all of the boil-off gas to

fuel the ship's steam propulsion system. As a result, LNG ships have reduced emissions compared to conventional oil-fired ships.

Propulsion Systems – Almost all of the currently operational large LNG ships are steam turbine driven. Steam ships use a boiler that is fired from the ship's natural gas cargo (the boil-off gas referred to above). The boiler can also be fired with heavy fuel oil or in any ratio with natural gas. At sea, the ship normally uses natural gas plus a small quantity of fuel oil (approximately 2 tons per day) for a pilot flame.

As a ship approaches port, the use of fuel oil may increase to about 10 tons per day. The increase occurs because the natural gas fuel supply system is complicated with greater risk of shutdown. Therefore, the additional fuel oil is used for safety to ensure adequate steam supply for propulsion.

Both underway and in port, the power on a steam ship is provided by separate steam turbine-driven generators. There may also be a diesel generator that would be used for emergencies.

At the berth, the main boilers are generally kept running to provide power to the cargo pumps. During cargo unloading, the cargo pumps and ship auxiliary equipment require 5 to 10 megawatts (MW) of power. Part of the fuel used to provide power is LNG; the rest is fuel oil. LNG ships are not currently equipped to receive shoreside power for use during cargo unloading. Generally some LNG is left onboard for the return voyage fuel and for keeping the cargo tanks cold.

Several large diesel electric-powered LNG ships are currently under construction. These ships have four or more diesel-driven electric generators that provide both propulsion and electric power. Ship propulsion is with two electric motors directly connected to the propeller shaft.

The switch to diesel is being driven by several factors. The first is fuel consumption. The overall thermal efficiency of a steam propulsion system is about 28 percent while diesel power is over 40 percent efficient. This increased efficiency would result in large fuel savings, particularly for the new longer distance trade routes. Because of the rarity of steam systems outside of LNG ships, it has become difficult for the ship operators to obtain adequately trained personnel. In addition, locations with steam maintenance capabilities are becoming fewer.

Two approaches are being used for diesel electric-powered LNG ships. One is to use engines that will consume boil-off natural gas with partial heavy fuel oil pilot injection. Under full load, the engine uses 10 to 15 percent oil with the balance being natural gas. At lower power levels, these engines consume a higher portion of fuel oil. At idle they may require 100 percent fuel oil and no natural gas.

The second diesel electric-powered approach uses all heavy fuel oil and no natural gas. On these ships, a system will be installed to reliquefy the boil-off gas and return it to the ship's cargo tanks. Some of these ships may be equipped with secondary low sulfur fuel tanks for port operation.

Ballast Tanks – Sufficient ballast water capacity must be provided to permit the ship to return to the loading port safely under various sea conditions. LNG cargo tanks are not used as ballast tanks because these tanks must contain a minimal amount of LNG in them at all times, even when "empty" in order to keep the tanks cold during normal operation. Consequently, LNG ships must be designed to provide adequate ballast capacity in other locations.

Ballast water tanks of the LNG ships are arranged within the LNG ship's double hull. It is essential that ballast water not leak into the LNG containment system. To reduce the potential for leakage, the ballast tanks, cofferdams, and the walls of the void spaces are typically coated to reduce corrosion. LNG ships are also periodically inspected to examine the coating and to renew it as necessary.

A ballast control system, which permits the simultaneous ballasting during cargo transfer operations, is also incorporated into each LNG ship. This allows the LNG ship to maintain a constant draft during all phases of its operation to enhance performance.

Ship Safety Systems

Ships that transport LNG to the proposed terminal would be fitted with an array of cargo monitoring and control systems. These systems would automatically monitor key cargo parameters while the ship is at sea and during the remote-control phase of cargo operations at the unloading terminal.

The system includes provisions for pressure monitoring and control, temperature monitoring of the cargo tanks and surrounding ballast tanks, emergency shutdown of cargo pumps and closing of critical valves, monitoring of tank cargo levels, and gas and fire detection.

LNG ships are fitted with many navigation and communication systems, including:

- two separate marine radar systems, including automatic radar plotting and radio direction finders;
- LORAN-C receivers;
- echo depth finders; and
- a satellite navigation system.

All LNG ships also have redundant, independent steering control systems that are operable from the bridge or steering gear room to maintain rudder movement in case of a steering system failure. In addition, all LNG ships must have an Automatic Identification System that displays the vessel's identity, location, course, and speed to the Coast Guard and other vessels for collision avoidance and maritime security.

Fire Protection

All LNG ships arriving at the proposed terminal would be constructed according to structural fire protection standards contained in the International Convention for Safety of Life at Sea (SOLAS). This would be done under the review and approval procedures of the Coast Guard.

LNG ships using the terminal would also be fitted with active fire protection systems that meet or exceed design parameters in Coast Guard regulations and international standards, such as the Gas Tanker Code and SOLAS, including:

- a water spray (deluge) system that covers the accommodation house and control room and all main cargo control valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the ship;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a CO_2 system for protecting the machinery, the ballast pump room, emergency generators, compressors, etc.

Crew Qualifications and Training

All officers and crews of the LNG ships are required to comply with the International Convention Standards of Training, Certification, and Watch Keeping for Seafarers. Key members of the crew must have specific training in the handling of LNG and the use of safety equipment. Officers must receive simulator training in the handling of the ship and the cargo systems specific to the conditions at the project site.

2.1.3 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities

A 2.3-mile-long, 36-inch-diameter pipeline would be constructed to transport natural gas from the LNG terminal to the existing local distribution system. Associated aboveground facilities include a meter station, odorization system, and pig launcher and receiver. These facilities would be constructed, owned, and operated by SES. The meter station would provide custody transfer of the sendout gas. The odorization system is designed for proportional-to-flow odorant (e.g., methyl mercaptan) injection, odorization measurement, system monitoring, and alarm notification. The locations of these facilities are shown on figure 2.1-1.

A 4.6-mile-long, 10-inch-diameter pipeline would be constructed to transport vaporized C_2 from the LNG terminal to the existing LARC. Associated facilities include a meter station and a pig launcher and receiver. The meter station would provide custody transfer of the C_2. These facilities would be constructed, owned, and operated by ConocoPhillips. The locations of these facilities are shown on figure 2.1-1.

As shown on figure 2.1-1, the first 2.3 miles of the C_2 pipeline would be installed adjacent to the proposed natural gas pipeline. Both pipelines would run north from the terminal along Carrack Avenue and beneath the Cerritos Channel to the intersection with Pier A Way. The pipelines would then turn west along Pier A Way to the Los Angeles/Long Beach city boundary and then north along Carrack Avenue to the SoCal Gas pipeline system (Salt Works Station) north of Anaheim Street.

The C_2 pipeline would continue west to Foote Street where it would turn north for about 0.6 mile before turning west to join the east side of the Dominguez Channel. It would continue north along the east side of the Dominguez Channel and then turn west and be installed across the Dominguez Channel on an existing pipe bridge. It would then continue west to Alameda Street where it would turn north for about 0.2 mile before crossing Alameda Street and entering the LARC.

2.1.4 Electric Distribution Facilities

SCE would install 0.8 mile of electric distribution lines to provide 66 kV service to a new substation (the Sound Substation) that would be located within the terminal boundaries at the northern end of the site. The new substation would provide a dedicated and redundant service for the Long Beach LNG Import Project. The locations of the proposed electric distribution lines are shown on figure 2.1-1. The location of the new substation is shown on figures 2.1-1 and 2.1.1-1.

2.2 LAND REQUIREMENTS

Table 2.2-1 summarizes the land requirements for the facilities associated with the Long Beach LNG Import Project. A detailed discussion of land requirements is presented in section 4.5.2.

TABLE 2.2-1

Summary of Land Requirements Associated with the Long Beach LNG Import Project

Facility	Land Affected During Construction (acres)	Land Affected During Operation (acres)
LNG Terminal Facilities		
LNG Terminal Site	25.0	25.0
Ship Berth and Unloading Facility [a]	5.3	0.5
Reinforcement of the Shoreline Structures [b]	6.6	6.6
Temporary Laydown and Worker Parking Area	16.0	0.0
Temporary Barges	4.0	0.0
LNG Terminal Facilities Subtotal	56.9	32.1
Natural Gas and C_2 Pipelines and Associated Aboveground Facilities		
Natural Gas Pipeline Facilities		
Pipeline Right-of-Way [c]	9.5	1.1
Temporary Extra Workspace	1.1	0.0
Aboveground Facilities	0.3	0.3
Natural Gas Pipeline Facilities Subtotal	10.9	1.4
C_2 Pipeline Facilities [d]		
Pipeline Right-of-Way [c]	17.8	2.2
Temporary Extra Workspace	1.1	0.0
Aboveground Facilities	0.3	0.3
C_2 Pipeline Facilities Subtotal	19.2	2.5
Natural Gas and C_2 Pipelines and Associated Aboveground Facilities Subtotal	30.1	3.9
Electric Distribution Facilities	1.0	1.0
Project Total	88.0	37.0

[a] Includes impacts on the sea floor of the West Basin associated with dredging and operation of the ship berth and unloading facility.

[b] Includes impacts on the sea floor of the West Basin associated with dredging to reinforce the shoreline structures.

[c] Based on a 30- to 50-foot-wide construction right-of-way. Operation acreage is based on a 4-foot-wide permanent right-of-way in all areas.

[d] The first 2.3 miles of the C_2 pipeline would follow the same route as the proposed natural gas pipeline; however, the two pipelines would be constructed at different times. Therefore, the acreage presented includes the entire 4.6 miles of the C_2 pipeline.

2.2.1 LNG Terminal Facilities

The entire 25-acre previously developed site would be used for construction and operation of the LNG terminal facilities. In addition to the 25-acre site on land, a 200-foot-wide by 1,150-foot-long area would be dredged for the ship berth and unloading facility adjacent to Pier T. These dredging activities would result in about 5.3 acres of disturbance to the sea floor within the West Basin. Of these 5.3 acres, the ship berth and unloading facility would permanently occupy about 0.5 acre. Two additional areas along the western and southern edges of Pier T would be dredged to reinforce the shoreline structures. These areas would be 150 feet wide by 250 feet long and 180 feet wide by 1,400 feet long for a total disturbance to the sea floor of 6.6 acres during both construction and operation. However, no new land would be created.

A 16-acre gravel-covered site located on Pier T about 1 mile northwest of the LNG terminal would be used for temporary construction laydown, staging, storage, and worker parking (see figure 2.1-1). In addition to the temporary laydown area on land, construction materials would be shipped by barge to the LNG terminal site. An estimated four to six barges would be moored around the LNG terminal site at

various times during construction of the LNG storage tanks. These barges would provide about 4.0 acres of additional temporary extra workspace.

2.2.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities

Construction of the pipeline facilities would disturb a total of about 30.1 acres of land, including the pipeline construction rights-of-way, temporary extra workspace, and aboveground facilities. Of the 30.1 acres of land affected by construction of the pipeline facilities, about 1.4 acres would be retained for operation of the natural gas pipeline facilities and 2.5 acres would be retained for operation of the C_2 pipeline facilities.

A 30- to 50-foot-wide construction right-of-way would be used for each of the pipelines. Following construction, a 4-foot-wide permanent right-of-way would be retained for operation and maintenance of the pipelines. The right-of-way configurations for the natural gas and C_2 pipelines are shown on figures 2.2.2-1 and 2.2.2-2, respectively. In general, the pipelines would be located adjacent to or within existing utility or road rights-of-way.

For the portion of the pipelines on private land, SES and/or ConocoPhillips would need to acquire an easement or property to construct and operate the proposed facilities. The easement would convey both temporary (for construction) and permanent rights-of-way and give the right to construct, operate, and maintain the pipeline facilities. An easement agreement between a company and a landowner typically specifies compensation for losses resulting from construction, including losses of non-renewable and other resources, damages to property during construction, and restrictions on existing uses that would not be permitted on the permanent right-of-way after construction.

The meter station, odorization system, and pig launcher associated with the natural gas pipeline would be located on a 150-foot by 150-foot site located within the LNG terminal facility site. The pig receiver would be constructed on a 75-foot by 150-foot site in an industrial area at the end of the pipeline where it interconnects with the SoCal Gas system.

The meter station and pig launcher for the C_2 pipeline would be located adjacent to the meter station and pig launcher associated with the natural gas pipeline within the 150-foot by 150-foot site at the LNG terminal facility. The pig receiver would be constructed on a 100-foot by 150-foot fenced site within the LARC.

2.2.3 Electric Distribution Facilities

Construction and operation of the electric distribution facilities would affect about 1.0 acre of industrial land**.**

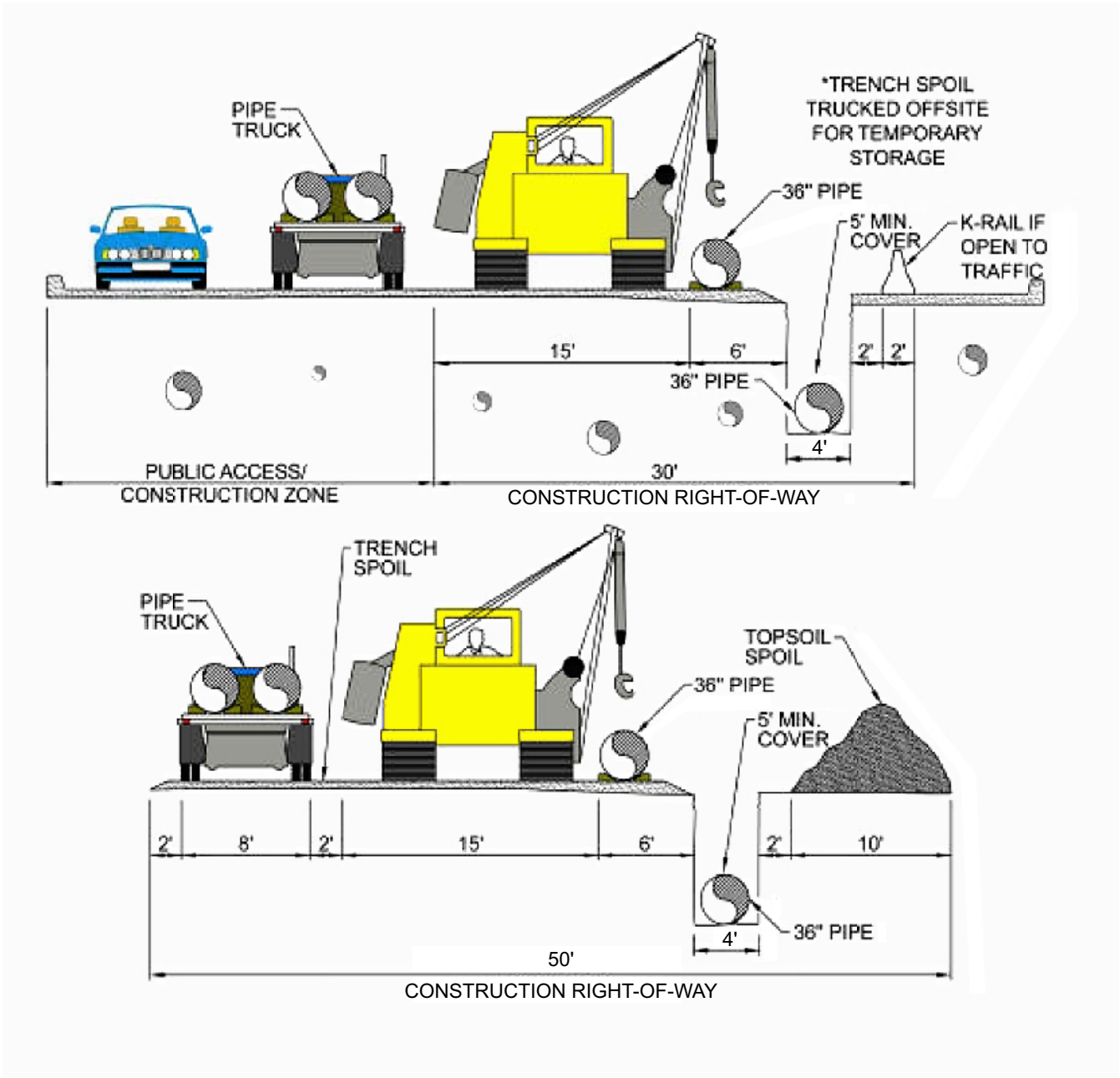


Figure 2.2.2-1

Long Beach LNG Import Project

Typical Construction Right-of-Way Configurations for the Natural Gas Pipeline

29018301NRGINC2-16 REV.01/04/05

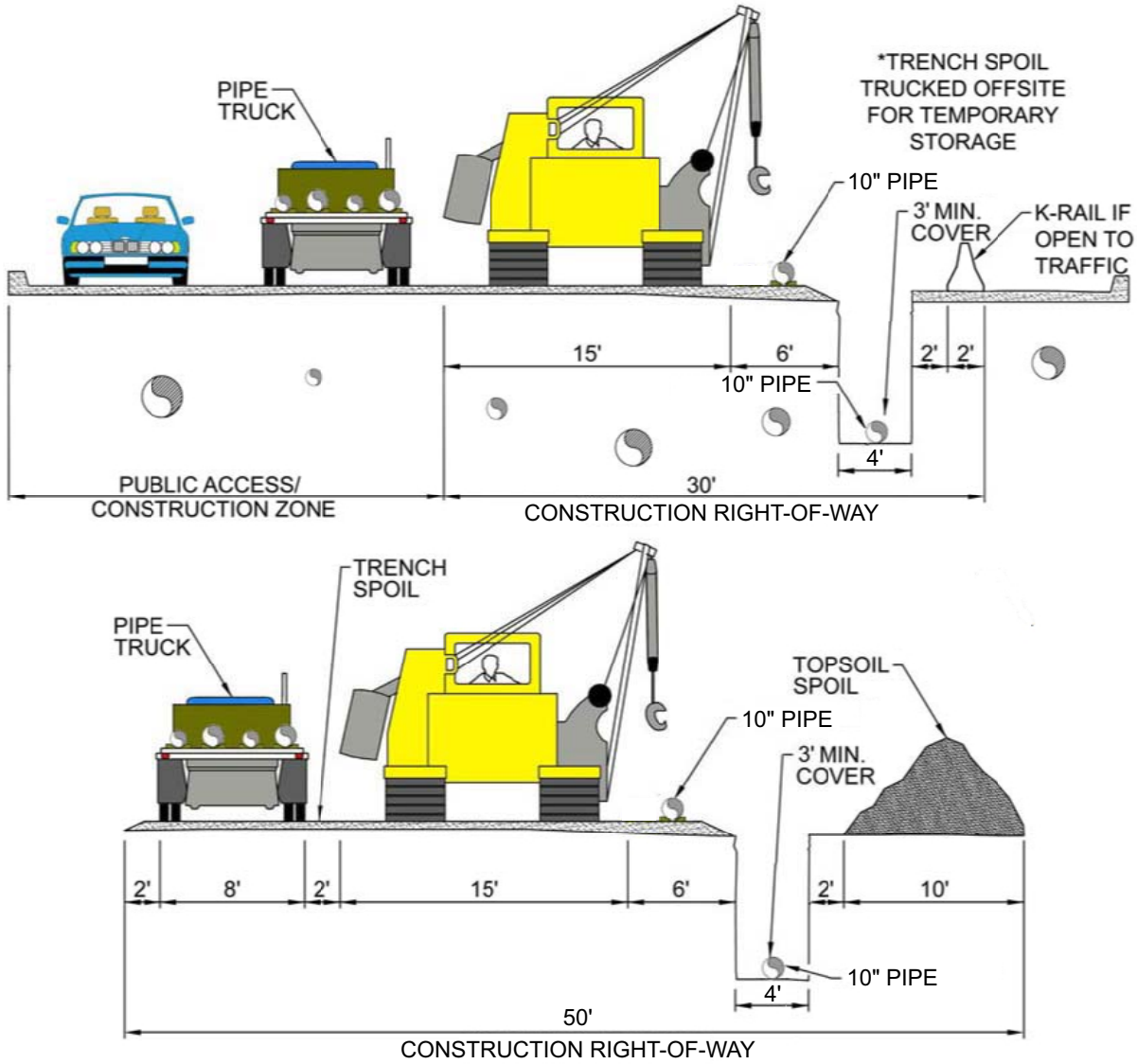


Figure 2.2.2-2

Long Beach LNG Import Project

Typical Construction Right-of-Way Configurations for the C_2 Pipeline

2.3 CONSTRUCTION PROCEDURES

This section describes the general procedures that would be used for construction of the LNG terminal, the natural gas and C_2 pipelines and associated aboveground facilities, and the electric distribution facilities. Refer to section 4.0 for more detailed discussions of proposed construction and restoration procedures as well as additional measures recommended by the Agency Staffs to mitigate environmental impacts.

The proposed LNG terminal facilities would be designed, constructed, operated, and maintained in accordance with federal safety standards that are intended to ensure adequate protection for the public and to prevent LNG accidents or failures. Specifically, these are the DOT *Federal Safety Standards for Liquefied Natural Gas Facilities*, Title 49 CFR Part 193 and the *National Fire Protection Association Standards for the Production, Storage, and Handling of LNG* (NFPA 59A). These standards specify siting, design, construction, equipment, and fire protection requirements for new LNG facilities. The ship unloading facility and any appurtenances located between the LNG ships and the last valve immediately before each LNG storage tank would comply with applicable sections of the Coast Guard regulations for *Waterfront Facilities Handling LNG* (Title 33 CFR Part 127 and Executive Order 10173).

The proposed natural gas and C_2 pipeline facilities would be designed, constructed, operated, and maintained in accordance with DOT regulations in Title 49 CFR Part 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards*. Among other design standards, Title 49 CFR Part 192 specifies pipeline material selection; minimum design requirements; protection from internal, external, and atmospheric corrosion; and qualification procedures for welders and operations personnel.

Construction activities would comply with all permit conditions and the requirements and Best Management Practices (BMPs) included in SES' Storm Water Pollution Prevention Plan (SWPPP) prepared in accordance with the California State Water Resources Control Board's (CSWRCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity. SES' SWPPP includes a Sediment Control Plan that incorporates the measures of the FERC staff's Upland Erosion Control, Revegetation, and Maintenance Plan and Wetland and Waterbody Construction and Mitigation Procedures (January 17, 2003 versions) that are relevant to the environmental conditions at the project site. The SWPPP also incorporates a Spill Prevention and Response Procedure (Spill Procedure) that addresses potential spills of fuels, lubricants, and other hazardous materials and describes spill prevention practices, spill handling and emergency notification procedures, and training requirements. SES' SWPPP, Spill Procedure, and Sediment Control Plan are discussed in more detail in sections 4.3.3.2, 4.3.2.2, and 4.2.2.2, respectively. A draft of the SWPPP is provided in Appendix B**.**

In addition, SES has prepared a Horizontal Directional Drill Plan (HDD Plan) for the crossings of the Cerritos Channel that identifies specific procedures and steps involved with pipeline installation as well as corrective actions and cleanup procedures in the event of an inadvertent release of drilling fluid. The HDD Plan is discussed in more detail in section 4.3.3.2 and provided in Appendix C.

Activities conducted by the POLB would comply with the requirements and BMPs in the POLB's SWPPP and all permit conditions, including the Dredge and Disposal Plan the POLB would prepare in accordance with its ACOE section 404 permit (see section 4.3.3.2). As discussed in section 2.1.1.1, the dredging activities would be done only with the concurrence of the DTSC.

2.3.1 LNG Terminal Facilities

2.3.1.1 LNG Storage and Processing Facilities

Site Preparation and Materials and Equipment Delivery

The site plot plan (figure 2.1.1-1) shows the location of the terminal facilities, which include site offices, office parking, construction gates, crew change and toilet facilities, tool trailers, and ready-to-use material laydown areas. An approximate 16-acre laydown area on Ocean Boulevard would also be used for temporary storage of construction materials and equipment (see figure 2.1-1). The construction workforce would park in this 16-acre area and be transported to the site via buses.

Materials and equipment would be shipped from the place of origin to the POLB by road, rail, or barge either to the terminal site or to the temporary laydown area on Ocean Boulevard. Unloading would be conducted either by crane or roll-on/roll-off. Local fabrication shops would be used to fabricate pipe spool pieces and other prefabricated units of equipment and skid-mounted process equipment modules with delivery to the site in accordance with the construction schedule. Where possible, skid-mounted equipment would be utilized to minimize the pieces that must be erected at the site.

The first step in the construction of the LNG storage tanks and processing facilities would be site preparation, including demolition and removal of existing buildings and pavement. The buildings and structures associated with the former Long Beach Naval Shipyard would be demolished, removed, and disposed of at an approved landfill by the POLB. In addition, the existing concrete/asphalt surface would be removed.

Excavation, Ground Stabilization, and Foundation Installation

Following POLB demolition and removal of the existing structures, approximately 1 foot or 40,000 cubic yards of soil would be stripped from the site by SES. Where necessary, soft areas would be over-excavated and filled with structural fill. Temporary drainage ditches, sediment fences, and silt traps would be installed as necessary to prevent erosion.

The next step would be construction of foundations for the storage tanks, process equipment, and pipe racks. Because the site soils are generally unsuitable for direct support of the proposed LNG storage tanks, the foundations would be supported by steel piles that would be driven to depths of approximately 90 to 120 feet. A reinforced concrete base slab foundation would be constructed on the piles on which the LNG storage tanks would be built with seismic isolators or a flexible foundation to reduce horizontal seismic load (see figure 2.1.1-3). Additional details of the foundation soil improvements are presented in section 4.1.4.3. The installation of the seismic isolators, settlement monitoring system, foundation heating conduit, and sensing conduit along with upper and lower layers of reinforcing steel would be included with construction of the concrete slab for the storage tanks. The top of the concrete foundations for all critical equipment and structures would be installed at an elevation of 20 feet above mean sea level (msl). Following completion of the foundations, the site would be filled, compacted, and brought up to final grade.

In addition to the soil improvements described above to support the tank foundations, other ground stabilization measures would be necessary to support the upland loads generated by the LNG storage tanks and other heavy structures. These stabilization measures would consist of stone columns installed in the area between the back of the existing concrete Berth T-126 wharf and north of the Berth T-124 structure to the face of the LNG storage tanks. Columns would likely be on 8-foot centers along the entire length of Berth T-126 and along approximately 560 feet of Berth T-124. Approximately 2,400 stone columns would

be drilled behind Berth T-126 to a depth of 60 feet, an estimated 980 columns would be drilled behind Berth T-124 to a depth of approximately 80 feet, and an estimated 2,000 stone columns would be drilled within the security barrier wall to a depth of 60 feet. The stone columns would be formed by using a vibratory or rotary probe to penetrate to the design depth and then filling the resulting cavity with stone. The stone would be forced through the probe starting at the bottom and compacted as the probe is raised toward the surface. Responsibility for the installation of the stone columns has not been established. The work could be done by SES or the POLB in conjunction with other work such as the tank foundation soil improvements described above, construction of the concrete security barrier wall described in section 2.1.1.2, or the reinforcement of the shoreline structures described in section 2.3.1.2.

The storm water drainage system would be installed so that surface water and spills would drain to designated areas for safe containment and disposal. Storm water runoff collected in the spill containment systems would be pumped to nearby culverts, swales, and ditches that discharge through the existing storm water outfall located at the northwest corner of the terminal site.

Storage Tank Construction

One of the more labor-intensive and time-consuming activities would be the construction of the full containment storage tanks. Storage tank construction would take approximately 37 months of the 48-month construction period and would begin approximately 11 months after the initiation of construction. Details of the construction workforce are discussed in section 4.6.3. After the foundations of the tanks are installed as discussed above, the tank construction would consist of the following activities:

- construction of the 9 percent nickel-steel inner containers;
- construction of the outer concrete container walls;
- installation of the steel dome roofs and suspended decks;
- installation of internal tank accessories, roof platforms, walkways, and piping;
- construction of the concrete roof;
- hydrostatic testing of the inner tanks and pneumatic testing of the outer tanks (see discussion below); and
- installation of fiberglass blankets and perlite insulation between the inner and outer tanks.

The inner containers of the storage tanks would be hydrostatically tested in accordance with API 620 to ensure that the tanks are capable of operating at the design pressure. Approximately 24 million gallons of water obtained from the City of Long Beach municipal system would be used to test the tanks. Water would be pumped into each tank at rates not exceeding the limitation set by API 620 and piped into the inner container through the manhole in the outer container concrete roof. The water would remain in each tank for approximately 7 weeks from start of filling to completion of discharge. The water would be transferred between each tank and ultimately discharged using the POLB storm water drainage system upon completion of the test(s). The discharge would be regulated over a period of approximately 40 hours to not exceed the capacity of the system.

The pneumatic test of the LNG storage tank outer container would be performed in accordance with API 620. The outer container would be held at 1.25 times the design pressure for 1 hour.

Other Facility Construction

During the construction of the storage tanks, other facility structures and buildings would be constructed and major mechanical and electrical equipment, process and utility piping, and instrumentation would be installed. All of these facilities would be completed and precommissioned in readiness for completion of the storage tanks.

Final Grading and Site Restoration

Areas disturbed by construction of the LNG terminal facilities would be stabilized with temporary erosion controls until construction is complete unless covered by equipment, gravel, or other covering. Following construction, the site would be final graded; cleaned up; and surfaced with gravel, asphalt, and concrete.

2.3.1.2 Reinforcement of the Shoreline Structures

The existing shoreline structures consist of a rock dike with a pile-supported concrete wharf along the west side of the site (Berth T-126) and a bulkhead composed of a cellular steel sheet pile cofferdam system with a continuous concrete beam on steel and timber pile forming the pierhead along the south side of the site (Berth T-124). These structures would need to be reinforced to support the upland loads generated by the LNG storage tanks and other heavy load structures. The geotechnical and structural analysis of the shoreline structures and the necessary reinforcement work would be the responsibility of the POLB.

The POLB is evaluating three different options for reinforcement of the wharf along Berth T-126. These include:

- repairing, maintaining, and seismically upgrading the existing wharf structure. The seismic upgrade would include strengthening the lateral load-resisting system (which would include driving additional piling), retrofitting the pile capitals, and stabilizing the existing rock slope with an underwater rock buttress;

- demolishing the existing wharf deck (leaving the embedded concrete pile in place) and constructing an underwater and above water rock buttress large enough to accommodate access to the LNG unloading platform and the perimeter road; or

- demolishing the westerly portion of the existing wharf (i.e., cutting the structure's width by approximately half) to reduce the seismic mass. This would be done in conjunction with the repair, maintenance, and seismic upgrade of the remaining structure. The existing rock slope would also be stabilized with an underwater rock buttress.

The underwater rock buttress at Berth T-126 would be approximately 180 feet wide at the base and extend the full length of the 1,400-foot-long berth. Depending on the final wharf improvement option selected, construction of the Berth T-126 rock buttress would require between 900,000 to 1.2 million tons of rock. An underwater rock buttress would also be necessary along the westerly portion of Berth T-124. This rock buttress would be approximately 150 feet wide and 250 feet long and would require between 100,000 and 500,000 tons of rock. No additional structural improvements would be necessary at Berth T-124. Installation of the rock buttresses at Berth T-126 and Berth T-124 would require the dredging of between 100,000 and 300,000 cubic yards of sediments depending on the west wharf improvement and rock buttress configuration option chosen.

Demolition activities would require a combination of water- and land-based equipment including barges, tugboats, workboats, bulldozers, other track crawler-mounted equipment, and trucks for hauling concrete debris and miscellaneous small equipment. Processing of concrete and steel debris would take place upland and the crushed concrete used as base material either on site or elsewhere at the Port. Steel reinforcing bar would be recycled.

Wharf rehabilitation including driving replacement piles would be accomplished from both water- and land-based equipment including a pile driver (crane), workboats, trucks, and miscellaneous small equipment.

The reinforcement of the shoreline structures and associated dredging would be under the jurisdiction of the ACOE and would require separate permits.

2.3.1.3 Construction of the Ship Berth and Unloading Facility

As stated in section 2.1.1.1, the current water depth at Pier T-126 ranges from -46 feet to -53 feet MLLW. Preparation of the berth would require the dredging of approximately 175,000 cubic yards of sediments to a depth of about -55 feet MLLW to accommodate safe under keel clearance and tidal fluctuation. This depth would accommodate the largest LNG ships expected to use the terminal. As part of the POLB's consent agreement with the DTSC regarding the sediment remediation in the West Basin, the dredging associated with the proposed project would be done only with the concurrence of the DTSC and in accordance with separate permits issued by the ACOE and the RWQCB (see section 4.2.3). The dredged area would be about 200 feet wide by 1,150 feet long. The POLB would conduct the dredging and dispose of the dredged material at an approved site within the Port.

The ship unloading facility would likely be constructed using floating equipment. Several options are available for the construction of the unloading platform and mooring and breasting dolphins. The unloading platform could be constructed of a cast-in-place concrete deck supported by a combination of steel and concrete plumb and batter piles. The piles would be driven in the proper location to the appropriate depth, concrete pile caps cast, and the cast-in-place platform slab placed. An alternative method for the construction of the unloading platform would be to use an offshore technique. A jacket would be prefabricated at an offsite location and transported to the site on a barge. The jacket would be placed at the proper location with the use of ballast tanks and cranes mounted on a work barge. Piles would then be driven through the legs of the jacket to secure the platform.

The construction of the dolphins could be completed in several ways including driving large diameter steel pipe plumb, or a combination of steel and concrete plumb and batter piles, then casting a concrete cap. An alternative method would be to use jacketed structures for the dolphins. The jackets would be fabricated offsite and transported for installation at the site. Piles would be driven through the legs. The dolphins would be fitted with quick release hooks and a fendering system. Due to the weight of the pipe piles and the weight of the hammer to drive the piles, large floating equipment would be necessary.

2.3.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities

The entire route of the natural gas and C_2 pipelines is within heavily disturbed, industrialized areas. No wetlands or residential areas would be crossed. One waterbody (the Cerritos Channel) and several railroad lines, driveways, and roads would be crossed by both pipelines. The C_2 pipeline would also cross the Dominguez Channel.

Standard pipeline construction proceeds in the manner of an outdoor assembly line composed of specific activities that make up the linear construction sequence. In an industrial area, these operations collectively include survey and marking of the right-of-way, potholing to locate existing substructures or utilities; sawing an outline of the trench in paved areas so that pavement can be broken and removed; trenching, pipe stringing, and bending; welding, x-ray inspection of welds, weld coating, and testing; lowering-in and backfilling; hydrostatic testing; and cleanup and replacement of paving. The natural gas and C_2 pipelines would be installed as separate activities because they would be constructed using different pipeline construction spreads. The natural gas pipeline would require much larger equipment and workspace than the C_2 pipeline and there are few areas with open utility slots that would allow both lines to be installed simultaneously in the same trench. Where the pipelines are adjacent to each other (i.e., the first 2.3 miles), the C_2 pipeline would be installed either before or after installation of the natural gas pipeline where the work areas do not interfere with each other or create unmanageable traffic patterns. During pipeline construction along Carrack Avenue, it may be necessary to temporarily close the road. SES would develop traffic control plans and drawings in conjunction with the construction permitting with the POLB, POLA, City of Long Beach, and City of Los Angeles. The northernmost 2.3 miles of the C_2 pipeline would be installed on a separate schedule. The specific construction methods that would be used to install the pipelines consist of the open-cut, stovepipe, slick bore, and HDD methods as described below.

Along much of the route, the pipelines would be installed using the open-cut method. This method consists of excavating a trench of sufficient depth to provide a minimum depth of cover of 30 inches. However, in many places the pipelines would pass under existing utilities, which would provide a greater depth of cover. The pipe sections would be welded together using approved welding procedures and the welds would be inspected to ensure their structural integrity. The pipeline would then be lowered into the trench and the trench would be backfilled with a granular fill or slurry composed of earth removed from the trench or with other fill material hauled to the site.

In some areas of the route where workspace is particularly limited, the stovepipe construction method would be used. This technique would involve excavating limited segments of open trench to the appropriate depth and installing the pipeline a pipe section at a time. The welding and weld inspection would be conducted in the trench. The trench would be backfilled at the end of each day after the welding and coating processes are completed. If any open trench remains at the end of the work day, it would be covered with steel plates.

The slick bore construction method would be used at the railroad and certain driveway and road crossings along the route. This method involves excavating bore pits on each side of the road or crossing at the depth of the pipeline and boring a hole equal to the diameter of the pipeline. The pipe section would then be pushed through the bore hole.

The HDD construction method would be used to install the pipelines beneath the Cerritos Channel. This technique involves drilling a hole from one side of the channel to the other side. Throughout the drilling process, a slurry made of naturally occurring non-toxic materials, such as bentonite clay and water, would be circulated through the drilling tools to lubricate the drill bit, remove drill cuttings, and hold the hole open. This slurry is referred to as drilling mud or drilling fluid. Drilling mud and any groundwater and soil produced during construction would be handled and disposed of in accordance with federal and state regulations so as to minimize the chance of soil and water pollution. Pipe sections long enough to span the entire crossing would be staged and welded along the construction right-of-way on the opposite side of the channel and then pulled through the drilled hole. The natural gas and C_2 pipelines would be installed as two separate HDDs. Because the natural gas and C_2 pipelines would not be constructed concurrently, no additional HDD staging areas would be needed. Additional discussion of the HDD crossing of the Cerritos Channel is presented in section 4.3.3.2.

The C_2 pipeline would be installed across the Dominguez Channel on an existing pipe bridge that has sufficient capacity to accommodate the pipeline.

The HDD crossings of the Cerritos Channel and the crossing of the Dominguez Channel would be under the jurisdiction of the ACOE and would require separate permits.

Hydrostatic Testing

After burial, each pipeline would be tested to ensure the system is capable of withstanding the operating pressure for which it was designed. This procedure is called hydrostatic testing and is completed using pressurized water in the pipeline. If leaks are found, the leaks would be repaired and the section of pipe retested until specifications are met. Following testing, the water would be discharged into the POLB storm water drainage system. The test water would be sampled before use and before discharge. Additional discussion of hydrostatic testing is presented in sections 4.3.2.2 and 4.3.3.2.

Cleanup and Restoration

Once pipeline construction activities are complete in a given section, the grade and drainage patterns would be reestablished. Permanent erosion controls would be installed to minimize post-construction erosion in dirt areas, and pavement would be reinstalled in paved areas.

2.3.3 Electric Distribution Facilities

The entire route of the electric distribution lines is within heavily disturbed, industrialized areas of the POLB. A total of 10 new steel poles would be required to support the new conductors. A backhoe would be used to excavate a hole large enough for placement of a casing to form the concrete foundations. A mobile crane would be used to set the new steel pole structures in place. After the new structures are erected, the new conductors would be strung using standard stringing equipment such as roller and puller assemblies.

2.4 CONSTRUCTION SCHEDULE

No work would begin until all required permits and approvals are in place. Assuming the project is approved, once SES begins construction of the LNG terminal facilities, it would take approximately 48 months to complete. The POLB would begin the reinforcement of the shoreline structures and conduct the dredging concurrently with SES' initiation of activities. The wharf improvements would take about 6 to 8 months; dredging and placement of the rock buttresses would take 8 to 10 months. Construction of the ship unloading facility would require about 10 to 12 months. Storage tank construction would take approximately 37 months and would begin approximately 11 months after the initiation of construction. Construction of the pipelines and electric distribution facilities would take approximately 10 months to complete and would occur toward the middle of the 48-month construction period.

2.5 ENVIRONMENTAL COMPLIANCE INSPECTION AND MITIGATION MONITORING

As the lead federal agency for the project, the FERC may impose conditions on any authorization granted for the project. These conditions could include additional requirements and mitigation measures identified in the EIS/EIR to minimize the environmental impact that would result from the construction of the project (see sections 4.0 and 6.0). The FERC staff will recommend to its Commission that these additional requirements and mitigation measures (offset with bold type in the text) be included as specific conditions to any approval issued for the project. If it approves the project, the FERC will require SES to

implement the construction procedures and control measures that it has proposed as part of the project unless specifically modified by other conditions of the authorization.

The ACOE, as lead agency for compliance with section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act, may similarly impose conditions to mitigate or prevent impacts on aquatic resources due to construction of the project.

As the California state lead agency, the POLB would adopt a mitigation monitoring program for the project pursuant to the CEQA. While there would be some jurisdictional differences between the FERC's and the POLB's requirements, the mitigation monitoring program for the Long Beach LNG Import Project would include requirements placed on the project by the FERC, the POLB, and other agencies. The FERC and the POLB would monitor compliance with project control and mitigation measures and requirements through FERC and POLB staffs or by use of a third-party compliance monitor. The POLB would also be responsible for mitigation resulting from potential ACOE permit decisions, dependent on the potential impacts of the final design on waters of the United States. Other federal and state agencies would conduct oversight of inspection and monitoring to the extent determined necessary by the individual agency.

SES would assign an Environmental Inspector (EI) to the project who would be responsible for all environmental compliance activities at the construction site. The responsibilities of the EI are outlined in section IV.C. and Appendix H of SES' draft SWPPP (see Appendix B) and would include ensuring that the environmental conditions attached to the FERC's section 3 authorization, the POLB's Harbor Development Permit, the ACOE's section 404 and section 10 permits, and other permits and authorizations are met. The EI would have peer status with all other activity inspectors and would have the authority to stop activities that violate the conditions of the project's permits and authorizations.

2.6 OPERATION AND MAINTENANCE PROCEDURES

SES would operate and maintain the LNG terminal facilities in compliance with NFPA 59A, Title 49 CFR Part 193, Title 33 CFR Part 127, and other applicable federal and state regulations. In accordance with Title 49 CFR Parts 193.2503 and 193.2605 and sections 11.3.1 and 11.5.2 of NFPA 59A, SES would prepare and submit to the DOT for approval before construction, operation and maintenance manuals that address specific procedures for the safe operation and maintenance of the LNG storage and processing facilities. These manuals would address startup, shutdown, cooldown, purging, and other routine operation, maintenance, and monitoring procedures. In accordance with Title 33 CFR Part 127.305, SES would also prepare an operation manual that addresses specific procedures for the safe operation of the ship unloading facility. These manuals would include training requirements and programs for operations and maintenance personnel.

The natural gas and C_2 pipeline facilities would be operated and maintained in accordance with Title 49 CFR Part 192, *Minimum Federal Safety Standards for the Transportation of Natural and Other Gas by Pipeline*, as required by the DOT. Section 4.11.12 presents a discussion of the DOT's safety regulations and requirements for natural gas pipelines and describes how these requirements would be met by the pipeline operator.

The electric distribution facilities would be operated and maintained in accordance with federal and state regulations and the operations plan of SCE.

2.7 SAFETY CONTROLS

2.7.1 LNG Terminal Facilities

The LNG terminal facilities would be sited, designed, constructed, operated, and maintained in compliance with federal safety standards. Federal siting and design requirements for LNG facilities are summarized in table 2.7.1-1.

TABLE 2.7.1-1

Federal Siting and Design Requirements for LNG Facilities

Requirement	Description
Thermal Radiation Protection (Title 49 CFR Part 193.2057 and section 2.2.3.2 of NFPA 59A)	This requirement is designed to ensure that certain public land uses and structures outside the LNG facility boundaries are protected in the event of an LNG fire.
Flammable Vapor-Gas Dispersion Protection (Title 49 CFR Part 193.2059 and sections 2.2.3.3 and 2.2.3.4 of NFPA 59A)	This requirement is designed to prevent a flammable vapor cloud associated with an LNG spill from reaching a property line that can be built upon.
Wind Forces (Title 49 CFR Part 193.2067)	This requirement specifies that all facilities be designed to withstand wind forces of not less than 150 mph without the loss of structural integrity.
Impounded Liquid (section 2.2.3.8 of NFPA 59A)	This requirement specifies that liquids in spill impoundment basins cannot be closer than 50 feet from a property line that can be built upon or a navigable waterway.
Container Spacing (section 2.2.4.1 of NFPA 59A)	This requirement specifies that LNG containers with capacities greater than 70,000 gallons must be located a minimum distance of 0.7 times the container diameter from the property line or buildings.
Vaporizer Spacing (section 2.2.5.2 of NFPA 59A)	This requirement specifies that integral heated vaporizers must be located at least 100 feet from a property line that can be built upon and at least 50 feet from other select structures and equipment.
Process Equipment Spacing (section 2.2.6.1 of NFPA 59A)	This requirement specifies that process equipment containing LNG or flammable gases must be located at least 50 feet from sources of ignition, a property line that can be built upon, control rooms, offices, shops, and other occupied structures.
Marine Transfer Spacing (Title 33 CFR Part 127.105)	This requirement specifies that each LNG unloading flange must be located at least 985 feet from any bridge crossing a navigable waterway.

2.7.1.1 Spill Containment

The LNG impoundment systems for the terminal facilities would be designed and constructed to comply with DOT regulations in Title 49 CFR Part 193 sections 193.2149 through 193.2185. These regulations require that each LNG container and each LNG transfer system be provided with a means of secondary containment that has been sized to hold the quantity of LNG that could be released as a result of the design spill that is appropriate for the area and LNG equipment. The design spills are defined in NFPA 59A.

SES would use spill containment troughs and sump systems in the process area, the trailer truck loading area, and inside the security barrier wall adjacent to the LNG storage tanks to provide containment for a 10-minute spill in accordance with NFPA requirements. The troughs would be concrete lined and graded and curbed so that a spill would flow to the collection sumps. The containment system in the process area would be 35 feet long by 25 feet wide with a depth of 18 feet. The trailer truck loading area containment system would be 10 feet long by 10 feet wide with a depth of 18.8 feet. The containment system for the LNG storage tanks would be 210 feet long by 25 feet wide with a depth of 17.6 feet. Any spills from the unloading lines on the ship unloading facility would be directed towards the LNG storage

tank area sump system via a trough from the ship to the sump. The trough from the unloading facility to the sump would be approximately 3 feet wide by 2.8 feet deep, while the trenches in the process area that drain to the process area sump would be approximately 3 feet wide by 1.2 feet deep.

The LNG storage tanks would follow a full containment design capable of containing all of the inner tank contents by the outer tank. The 20-foot-high concrete LNG security barrier wall surrounding the LNG storage tanks would also prevent LNG from leaving the LNG terminal site in the event that both the inner tank and the outer concrete container of the storage tanks fail and spill the entire contents onto the site.

Any storm water collected in the spill containment systems would be routinely pumped to the existing drainage system. The systems would be equipped with automatic level control activators and low-temperature sensors and switches to prevent operation of the pumps in the event of an accidental release of LNG to the sump system.

2.7.1.2 Hazard Detection System

Hazard detectors would be installed throughout the facility to provide operating personnel early detection of releases of flammable gases and fires, to show the general location of a release or fire, to initiate shutdowns of equipment in the affected area, and to initiate discharge of selected fire control systems. The hazard detection system would consist of separate combustible gas, ultraviolet/infrared (UV/IR), smoke, ammonia, and high and low temperature sensor units. These detectors would be integrated into an independent Safety Instrumented System (SIS) that would allow for the safe, sequential shutdown and isolation of rotating equipment, fired equipment, and LNG storage facilities. The detectors would also be hard wired to the main control system for alarm and emergency shutdown.

SES would also install a security video monitoring system. Cameras would monitor the fence line and terminal entry gates, the main gate, administration building, control room building, LNG and NGL process areas, LNG storage tanks, LNG relief valves, trailer truck loading area, and the ship berth and unloading facility. This monitoring system would be used to detect visual evidence of intruders, LNG releases, fires, or other emergencies.

2.7.1.3 Hazard Control System

The project would contain “passive” and “active” hazard prevention and mitigation systems and controls. Passive systems would generally include those that do not require human intervention such as spill drainage and collection systems, ignition source control, and fireproofing. Active systems normally are either automatic or require some action by an operator. Active spill and fire control systems and equipment would consist of:

- a looped, underground firewater distribution piping system serving hydrants, firewater monitors, hose reels, water spray, or deluge and sprinkler systems (see section 2.7.1.4);
- three fixed high expansion foam systems (one for each LNG spill containment system);
- fixed dry chemical systems;
- portable and wheeled fire extinguishers employing dry chemical and CO_2, the latter intended primarily for energized electrical equipment;
- sprinkler systems, as needed; and

- emergency shutdown system activation.

The type of agent that would be used in a specific situation would depend on the characteristics of a particular event and the relative effectiveness of the various agents on that type of fire.

2.7.1.4 Firewater System

A firewater supply and distribution system would be provided for extinguishing fires, cooling structures and equipment exposed to thermal radiation, and dispersing flammable vapors. Hydrants, manual monitors, automatic sweep monitors, and hose reels would be located throughout the LNG terminal. The main components of the system would include:

- a 1.3-million-gallon fresh water storage tank;
- two diesel-driven and two electric-driven fresh water fire pumps;
- numerous firewater monitors, compression-type fire hydrants, and hose reels;
- remote-operated deluge systems for all LNG storage tanks;
- an automatic sprinkler system in the administration and warehouse buildings; and
- an underground/aboveground piping distribution system.

The firewater system is intended to be run on fresh water. The firewater storage tank would be filled and replenished with water supplied from the municipal water system and would have capacity for at least 2 hours of continuous pumping. The firewater pumps would be designed and installed in accordance with NFPA 20.

2.7.1.5 Fail-Safe Shutdown

The LNG terminal facilities would have the following three levels of emergency shutdown:

- Level 1 - A manual emergency shutdown (ESD) system that would be used for a major incident and would result in a total plant shutdown. This system would be manually activated via hard-wired ESD buttons located in the main control room, main security gate entrance, process area, and the control rooms on the unloading platforms.

- Level 2 - An automatic and manual ESD system that would shut down the unloading facility. This system would be activated manually, automatically by programmable instrumentation, by a Level 1 shutdown, or from ship-to-shore operations.

- Level 3 - Individual pieces of equipment would be shut down automatically via the SIS as the result of signals from various detectors and sensors located throughout the facilities.

2.7.1.6 Security System

Security at the facility would be provided by both active and passive systems. The entire site would be surrounded by a protective fence and the LNG storage tanks and process area would be surrounded by a 20-foot-high concrete barrier wall. The site would be illuminated between sunset and sunrise. As stated in section 2.7.1.2, SES would install a security video monitoring system to monitor the fence line and other components of the facility. As stated in section 4.11.8, SES would be required to hire a separate 24-hours-per-day security staff and coordinate with the Coast Guard to define the responsibilities of this staff in supplementing other security personnel and in protecting the LNG ships and terminal.

SES' proposed systems would be outlined in the Facility's Security Plan in accordance with Title 33 CFR Part 105 and must be approved by the Coast Guard before operations. In completing the Facility Security Plan, SES would conduct a Facility Security Assessment that examines and evaluates the infrastructure and operations of the facility taking into account possible threats; vulnerabilities; consequences; and existing protective measures, procedures, and operations. From this analysis, SES would develop a plan to ensure the application of security measures designed to protect the facility and its servicing vessels or those vessels interfacing with the facility, their cargoes, and persons on board at the respective Maritime Security (MARSEC) levels. The Coast Guard's MARSEC level increases with the threat level and also relates to the Department of Homeland Security's Homeland Security Advisory System levels. In particular, the plan must identify the Facility Security Officer (FSO) by name and position, provide 24-hour contact information, address each vulnerability identified in the Facility Security Assessment, and describe security measures for each MARSEC level.

The Facility Security Plan would be prepared in close coordination with the FERC, the DOT's OPS, and state and local law enforcement offices for Coast Guard approval. The plan would establish a written program for physical security for the entire LNG terminal facility. The plan would provide for MARSEC levels of security carried out by trained personnel during all operations and, if necessary, to respond to serious threats. Additional discussion of the Facility Security Plan is presented in section 4.11.8.

In addition to the Facility Security Plan, SES would be required to develop a Waterway Suitability Assessment (WSA) that will determine the appropriate safety and security measures to mitigate the risks while the LNG ship is operating in the vessel traffic service (VTS) area. SES is currently working with the Coast Guard and state and local officials to develop the WSA. Once the WSA is developed, it will be validated and approved by the Coast Guard. Additional discussion of the WSA is presented in section 4.11.7.4.

2.7.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities

The pipelines and aboveground facilities associated with the Long Beach LNG Import Project would be designed, constructed, operated, and maintained in accordance with DOT Minimum Federal Safety Standards in Title 49 CFR Part 192. These safety standards are discussed in section 4.11.12.1.

2.7.2.1 Corrosion Protection and Detection Systems

A cathodic protection system would be installed to prevent or minimize corrosion and to mitigate alternating current interference from the overhead electric distribution lines. The interior of the pipe would be periodically monitored for corrosion using internal corrosion probes and/or in-line pigging tools.

2.7.2.2 Emergency Response Procedures

Pipeline system emergencies can include gas leaks, fire or explosion, and/or damage to the pipeline and aboveground facilities. In accordance with DOT regulations, the operating company would develop a new emergency plan or revise its existing plan to address procedures to be followed in the event of an emergency along the pipeline. This plan would include training of employees on emergency procedures; establishing liaisons with appropriate fire, police, and other community officials; and informing the public on how to identify and report an emergency condition on the pipeline route. Additional discussion of the emergency plan for pipeline facilities is presented in section 4.11.12.1.

2.8 FUTURE PLANS AND ABANDONMENT

SES has no future plans for expansion or abandonment of the proposed facilities. Any future expansion would require additional FERC and POLB authorizations and appropriate environmental analyses. Any future abandonment would be subject to appropriate federal, state, and local regulations in effect at that time.

3.0 ALTERNATIVES

Several alternatives to SES' Long Beach LNG Import Project (the proposed action) were evaluated to determine whether they would meet all or most of the project objectives, be feasible, and reduce one or more of the impacts identified for the proposed action. These alternatives include the:

- no action or no project alternative;
- alternative system locations;
- LNG terminal alternative locations;
- pipeline alternatives;
- dredge and fill alternatives; and
- vaporizer alternatives.

Based on NEPA and CEQA regulatory guidance (see Title 40 CFR Part 1502.14 and California Code of Regulations Title 14, section 15126.6, respectively) the evaluation criteria for selecting alternatives to consider in this EIS/EIR include whether they:

- are technically and economically feasible and practical;

- avoid or substantially lessen one or more of the significant environmental effects of the proposed project; and

- accomplish all or most of the project objectives of providing the LA Basin and southern California markets with: 1) a new source of up to 1 Bscfd of natural gas; 2) up to 150,000 gpd of LNG for vehicle fuel; and 3) storage capacity of up to 320,000 cubic meters of LNG (see section 1.1).

Using the evaluation criteria discussed above and subsequent environmental comparisons, each alternative was considered to the point where it was clear that the alternative was either not reasonable, would result in substantially greater environmental impacts that could not be readily mitigated, or would not avoid or substantially lessen one or more of the significant environmental effects of the proposed project. Those alternatives that appeared to offer environmental advantages or that would result in less than or similar levels of environmental impact were reviewed in greater detail.

The analysis was based on information provided by SES, aerial photography, U.S. Geological Survey (USGS) topographic maps, other publicly available environmental data, and agency consultations.

3.1 NO ACTION OR NO PROJECT ALTERNATIVE

The actions triggering this environmental review were SES' applications to the FERC for a section 3 authorization and to the POLB for a Harbor Development Permit. This environmental review will also satisfy the NEPA responsibilities of the ACOE in considering issuance of section 404 and section 10 permits for activities associated with the project and of the Coast Guard for issuance of an LOR. In addition, this document may be used to meet the CPUC's CEQA responsibilities in considering authorization of the intrastate facilities associated with the project (i.e., the C_2 pipeline and electric distribution facilities).

In analyzing a proposed project in a joint CEQA/NEPA format, the ACOE must distinguish the scientific and analytical basis for its decisions from the CEQA lead agency's decision. The ACOE baseline condition for determining significance of impacts is primarily dependent on the baseline

condition that is defined by examining the full range of construction and operational activities the applicant could implement and is likely to implement without permits from the ACOE. This baseline includes all of the construction and operational impacts likely to occur without ACOE permits (i.e., air emissions and traffic likely to occur without issuance of permits to dredge or modify shoreline structures). The determination is based on direct statements and empirical data from the applicant, as well as the judgment and experience of the ACOE. For the proposed Long Beach LNG Import Project, the ACOE has determined, in consultation with the FERC and the POLB, that the proposed project cannot be constructed without permits from the ACOE. Therefore, the no action or no project analysis presented herein is reasonably the ACOE's baseline for future permit decisions.

The FERC, POLB, ACOE, Coast Guard, and CPUC have two alternative courses of action in considering proposed projects. They may: 1) deny the respective applications; or 2) approve the project with or without conditions. If the FERC, POLB, ACOE, Coast Guard, or CPUC deny SES' applications, the short- and long-term environmental impacts identified in this EIS/EIR (both positive and negative) would be avoided. However, should the no action or no project alternative be selected, the objectives of the proposed project would not be met. Specifically, SES would not be able to provide a new supply of natural gas and LNG to southern California. It is purely speculative to predict the actions that could be taken by other suppliers or users of natural gas and LNG in the region as well as the resulting effects of those actions. Because the demand for energy in southern California is predicted to increase (see section 1.1), customers would likely have fewer and potentially more expensive options for obtaining natural gas and LNG supplies in the near future. This might lead to alternative proposals to develop natural gas delivery or storage infrastructure, increased conservation or reduced use of natural gas, and/or the use of other sources of energy.

It is possible that the infrastructure currently supplying natural gas and LNG to the proposed market area could be developed in other ways unforeseen at this point. This might include constructing or expanding regional pipelines as well as LNG import and storage systems. Any construction or expansion work would result in specific environmental impacts that could be less than, similar to, or greater than those associated with the Long Beach LNG Import Project. An analysis of the most reasonably foreseeable natural gas and LNG system alternatives has been included in section 3.2.

Increased costs could potentially result in customers conserving or reducing use of natural gas. During the energy crisis of the 1970s, numerous aggressive energy conservation programs were developed in California. Regulators in the state have demanded that gas and electric companies implement aggressive, cutting edge conservation programs and have promoted public programs encouraging energy conservation. Although it is possible that additional conservation may have some effect on the demand for natural gas, conservation efforts are not expected to significantly reduce the long-term requirements for natural gas or effectively exert downward pressures on gas prices (EIA, 2003). It seems more likely that higher natural gas prices would adversely influence the regional economy by reducing realized household incomes and business profits (Greenspan, 2003).

Denying SES' applications could force potential natural gas customers to seek regulatory approval to use other forms of energy. California regulators are promoting renewable energy programs to help reduce the demand for fossil fuels. One of these programs provides funding for emerging technologies such as: photovoltaic (direct conversion of sunlight to electricity), solar thermal electric (the conversion of sunlight to heat and its concentration and use to power a generator to produce electricity), fuel cell (the conversion of hydrogen or hydrogen rich gases into electricity by a direct chemical process), and small wind turbines (small electricity-producing, wind-driven generating systems with a rated output of 50 kilowatts or less). Another program, the Geothermal Program, promotes the research, development, demonstration, and commercialization of California's enormous earth heat energy sources. While renewable energy programs can contribute as an energy source for electricity, they cannot at this time

reliably replace the need for natural gas or provide sufficient energy to keep pace with demand. Further, the aggressive acceleration to use more renewable energy generation is predicted to take 6 to 15 years and, even then, only account for 20 percent of the state's energy needs (CEC, 2003).

Compared to other fossil fuels such as coal or oil, natural gas is a relatively clean and efficient fuel that can reduce the emission of regulated pollutants [e.g., NO_x, sulfur dioxide (SO_2), and particulate matter having an aerodynamic diameter of 10 microns or less (PM_{10})] or unregulated greenhouse gases (e.g., CO_2). Given that there are emissions associated with producing, processing, transmitting, and distributing natural gas and other fossil fuels, it is difficult to exactly quantify the impact of an LNG import project on local and regional air quality. However, credible estimates of air emissions can be developed based upon reasonable assumptions regarding burning natural gas delivered by the project compared to burning fossil fuels that would likely be utilized if the gas from the project was not available. Table 3.1-1 lists the emissions that would result from the combustion of approximately 1 Bscfd of natural gas in southern California markets and the corresponding emissions that would result if an equivalent amount of energy were generated using fuel oil or coal in lieu of natural gas (inside or outside of California). It is clear from the table that the use of either fuel oil or coal would increase emissions significantly. To comply with current air emission regulations, emission control technologies could be required that could limit the economic viability and/or affect the location of any new oil- or coal-fired facility. For example, it is conceivable that California's demand for electricity would increasingly be met by oil- or coal-fired facilities outside of California (e.g., Mexico) if new sources of natural gas are not developed.

TABLE 3.1-1

Comparison of Air Emissions from Burning Fossil Fuels [a]

	Emission Rate (tons per year)					
Fossil Fuel	SO_2	NO_x	PM_{10}	CO	CO_2	C
Natural Gas	110	16,555	1,325	16,445	18,333,333	5,000,000
Fuel Oil	86,643	33,113	1,878	17,440	26,583,333	7,250,000
Coal	231,785	115,893	5,133	3,618	34,833,333	9,500,000

[a] The emissions generated by coal, fuel oil, and natural gas were estimated using the most recent Best Available Control Technology (BACT) Analyses found on the U.S. Environmental Protection Agency Reasonably Available Control Technology/BACT/Lowest Achievable Emission Rate Clearinghouse for boilers with heat input ratings between 100 and 250 million British thermal units (MMBtu) per hour. The emissions from each fuel source are estimated based on a total annual fuel use of 146,000,000 MMBtu per year (1 billion standard cubic feet per day, 365 days per year, 1,000 Btu per cubic foot).

SO_2 = sulfur dioxide
NO_X = nitrogen oxides
PM_{10} = particulate matter having an aerodynamic diameter of 10 microns or less
CO = carbon monoxide
CO_2 = carbon dioxide
C = carbon

Denying SES' applications could also limit the availability of LNG as an alternative vehicle fuel in the LA Basin and southern California. Although it is difficult to quantify the specific differences in air emissions between LNG and diesel fuel, any potential environmental benefits associated with greater availability of LNG for vehicle fuel (see section 4.9.8) would not be realized with the selection of the no action or no project alternative.

3.2 ALTERNATIVE SYSTEM LOCATIONS

Alternative system locations (system alternatives) would make use of other existing or proposed LNG or natural gas facilities to meet all or most of the stated objectives of the proposed project. A system alternative would make it unnecessary to construct all or part of the proposed project although

some modifications or additions to the existing or proposed facilities may be necessary. These modifications or additions would result in environmental impacts that could be less than, similar to, or greater than those associated with construction of the Long Beach LNG Import Project. Ultimately, the point of identifying and evaluating system alternatives is to determine whether potential environmental impacts associated with the construction and operation of the Long Beach LNG Import Project could be avoided or reduced by using another system.

As noted above and described in section 1.1, the objectives of the Long Beach LNG Import Project are to provide markets in southern California, particularly the LA Basin, with a new source of up to 1 Bscfd of natural gas, a reliable source of LNG for vehicle fuel, and a large natural gas storage facility that can reduce fluctuations in the local supply. Natural gas is currently supplied to southern California markets by four interstate pipeline systems; some LNG is supplied via trucking from existing facilities located in several western states. Although the only existing LNG import terminals in the United States are along the east and gulf coasts, there are currently several proposals to build onshore or offshore LNG import terminals along the west coast (both in the United States and in Mexico). The analysis below examines the existing and proposed LNG and natural gas systems that currently or could eventually serve southern California markets, and considers whether those systems avoid or substantially lessen one or more of the significant environmental effects of the Long Beach LNG Import Project and could meet all or most of the project objectives.

3.2.1 Pipeline System Alternatives

Currently, interstate pipeline systems deliver about 5.7 Bscfd of natural gas to markets in southern California (EIA, 2003). A majority of this natural gas comes from production areas in the Rocky Mountains or central United States via pipeline systems owned by Mojave Pipeline Company, Kern River Gas Transmission Company, Transwestern Pipeline Company, and El Paso Natural Gas Company (El Paso) (see figure 3.2.1-1). These existing interstate natural gas pipelines are operating at or near capacity and are not currently capable of delivering an additional 1 Bscfd of natural gas to southern California.

Questar Southern Trails Pipeline Company has proposed and received approval from the FERC for another interstate pipeline that would eventually extend from northwestern New Mexico to Long Beach. This new natural gas pipeline system would involve converting an existing crude oil pipeline and constructing some new pipeline segments and compressor stations. A portion of this pipeline has been converted and is already providing natural gas; the in-service date for the entire system is unknown. As originally proposed, the western half of the pipeline would have a capacity of about 120 MMscfd, well below the volume that would be supplied by the Long Beach LNG Import Project.

North Baja Pipeline, LLC (North Baja) is currently considering an expansion of its pipeline system in southeastern California to allow up to 2 Bscfd of natural gas to be delivered to an interconnect with the SoCal Gas system in Blythe, California. Additional discussion of this pipeline system alternative, which is directly related to an LNG system alternative, is included in section 3.2.2.2.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 3-5
Figure 3.2.1-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

The primary distribution system that delivers gas from the interstate pipelines serving southern California is operated by SoCal Gas. Other secondary distribution pipelines, all of which receive the majority of their natural gas from SoCal Gas, are operated by San Diego Gas and Electric (SDG&E), the City of Long Beach Energy Department, and the Los Angeles Department of Water and Power. SoCal Gas is capable of receiving up to 1 Bscfd of natural gas at its Salt Works Station in Long Beach (the proposed delivery location for the Long Beach LNG Import Project), but may not be capable of receiving these volumes at other locations on its system without construction of new facilities. However, it is impossible to identify the specific nature of these new facilities without more information from SoCal Gas. To provide this information, SoCal Gas would have to complete a system capacity study for the defined gas supply scenario(s), identifying receipt and delivery points, and source and volumes of natural gas delivered to the receipt point. That said, assuming there are available natural gas supplies other than those derived from LNG, it is theoretically possible that an existing or proposed pipeline system could be expanded or modified to deliver an additional 1 Bscfd of natural gas to the LA Basin and southern California markets.

Any expansion or modification of an existing pipeline system of sufficient magnitude to provide a new source of up to 1 Bscfd of natural gas would, at a minimum, require several hundred miles of new large-diameter pipeline loop[1] and the construction of new compression facilities to increase the existing capacity of those systems. Expansion of existing pipeline systems would likely entail impacts on water resources, upland vegetation, wetlands, wildlife habitats, land use, and air quality in California and other states.

Regardless of the type of pipeline facilities that might be needed to deliver the volumes proposed by the Long Beach LNG Import Project, no pipeline system alternative is capable of meeting two of the project's objectives, which are to provide a stable source of LNG for vehicle fuel and the storage of up to 320,000 cubic meters of LNG to address fluctuating energy supply and demand.

3.2.2 LNG System Alternatives

There are currently no existing LNG import facilities serving southern California or the west coast of the United States. As described previously, markets in southern California historically have received LNG via truck from existing natural gas liquefaction facilities in the western United States; none of the natural gas currently used in California is derived from imported LNG. In the future, LNG and natural gas could be supplied to the region via proposed LNG import terminals in California and Mexico. A discussion of existing and proposed LNG facilities is presented below.

3.2.2.1 Existing LNG Facilities

To improve air quality in California, truck and bus fleets are being encouraged to replace diesel-fueled vehicles with LNG-fueled vehicles or other clean burning fuel systems. This has resulted in demand for LNG that is projected to rise from an estimated current average use of between 15,000 and 50,000 gpd to as high as 195,000 gpd by mid 2006 (Powars and Pope, 2002). Nearly all of the LNG currently used in California is trucked in from a liquefaction plant in Topock, Arizona. This plant includes a natural gas liquefier owned by El Paso Field Services and an LNG storage and truck loading facility owned by Applied LNG Technologies USA (ALT). Although the ALT-El Paso Field Services facility is able to produce up to 86,000 gpd of LNG, currently only about one-third of this is available for California fleet vehicles.

[1] A loop is a segment of pipeline that is installed adjacent to an existing pipeline and connected to it at both ends. The loop allows more gas to be moved through the system.

Aside from the ALT-El Paso Field Services liquefaction plant, there are a number of other LNG facilities that have occasionally provided LNG to California. There is one LNG liquefaction facility operating in California. The Quadren Cryogenics facility in Robbins (northwest of Sacramento) produces ultra-high-purity methane for the specialty gas market and does not typically supply substantial quantities of LNG for vehicle fuel. Currently this facility is able to produce about 4,000 gpd of LNG. Although Quadren Cryogenics is exploring the expansion of its facility to provide additional volumes of LNG for the transportation-fuel market, details of the specific schedules and volumes provided by an expansion are confidential. There are also four other out-of-state natural gas liquefaction facilities that have historically provided limited volumes of LNG to California. These include the ExxonMobil Corporation nitrogen rejection unit near Shute Creek, Wyoming; the BP p.l.c. nitrogen rejection unit near Painter, Wyoming; the Pioneer Natural Resources USA nitrogen rejection unit near Santana, Kansas; and a Williams Field Services NGL plant near Durango, Colorado.

Even assuming that all of their production capacities were dedicated to providing LNG for transportation fuel, the existing ALT-El Paso Field Services and Quadren Cryogenics facilities could not satisfy the projected future demand for LNG in California. Extensive use of out-of-state facilities could provide some additional LNG to California. However, the significant trucking distances to California (600 to 900 miles) would limit the economic feasibility of using out-of-state facilities as well as likely increase the risks of LNG truck accidents, highway congestion, and air pollution from tanker truck emissions. These out-of-state facilities may also have existing contractual arrangements that would preclude them from being able to make the required deliveries. Regardless, the use of these existing LNG facilities could not satisfy the project objectives of providing markets in southern California, particularly the LA Basin, a new source of up to 1 Bscfd of natural gas and the storage of up to 320,000 cubic meters of LNG to address fluctuating energy supply and demand.

3.2.2.2 Proposed LNG Facilities

There are currently over 50 LNG import terminals that have been proposed and/or are being considered at various coastal locations throughout North America. At least 12 of these LNG import projects are along the west coast including sites in Mexico, southern California, Oregon, and Canada. Additionally, several relatively small-scale projects in California have been proposed that would involve liquefying natural gas that is available from local sources. This analysis is limited to those projects that could provide LNG to the California market. Although LNG facilities under the jurisdiction of another country would inherently not provide the same security of supply that a facility in the United States would, the nearby projects in Mexico were also evaluated for possible environmental advantages.

Mexico

Two LNG import terminal projects are proposed for the Tijuana-Rosarito area of northern Baja California, Mexico (see figure 3.2.1-1). These terminals would be between 135 and 150 miles south of Los Angeles and could indirectly serve the greater southern California market. The projects include proposals by ChevronTexaco Corporation (ChevronTexaco) and Sempra Energy LNG/Shell International Gas Ltd. (Sempra/Shell). Such projects need to obtain several key approvals to site an LNG facility in Mexico. These include a permit from the Comisión Reguladora de Energía (CRE), an environmental permit obtained from the Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT), and a local land use authorization. The CRE, or Energy Regulatory Commission, has regulatory authority over public and private activities in the electricity and natural gas industries. Approval of a CRE application is required for any new LNG terminal to be built. The SEMARNAT, or Secretariat of the Environment, Natural Resources and Fishing, has sole jurisdiction over those acts that affect two or more states in Mexico. The agency is responsible for examining environmental impacts of new projects. The ChevronTexaco and Sempra/Shell projects have obtained a majority of the necessary regulatory

approvals. Table 3.2.2-1 includes a description of these two proposed Mexican LNG import projects and their current permitting status.

TABLE 3.2.2-1

Proposed LNG Projects in Baja California, Mexico

Project Name (Location)	Sponsor	Project Description	Project Schedule and Permitting Status
Terminal GNL Mar Adentro (offshore Rosarito)	ChevronTexaco	Offshore LNG import terminal facility located 8 miles off the coast of Mexico near the Coronado Islands. The project would have an LNG storage capacity of 250,000 cubic meters and an average natural gas sendout capacity of 750 MMscfd (peak 1.4 Bscfd). The project would also include onshore components. The project would primarily import Australian LNG.	Proposed completion date of 2007-2008. Mexico's Comisión Reguladora de Energía (CRE) application filed on October 7, 2002; accepted in July 2003; approved in January 2005. Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT) project approval obtained in September 2004. Communication and Transport Secretariat project authorization obtained in January 2005.
Energy Costa Azul LNG (14 miles north of Ensenada)	Sempra Energy LNG and Shell International Gas Ltd.[a]	Onshore LNG import terminal facility and 45-mile-long pipeline. The project would have an LNG storage capacity of 320,000 cubic meters in two tanks and an average natural gas sendout capacity of 1 Bscfd (peak 1.3 Bscfd). The project would primarily import LNG from Indonesia and Russia. Project sponsors indicated that 500 MMscfd would be sent to the Mexican market and 500 MMscfd would be sent to the southern California and southwestern United States markets through the North Baja/GB/TGN pipeline system.	Anticipated completion date of 2007. CRE application filed on September 6, 2002; accepted on November 12, 2002; approved on August 18, 2003. Local Land Use Permit approved on August 18, 2003. SEMARNAT project approval obtained on April 16, 2003.[b] Construction of the LNG terminal began on March 30, 2005. Sempra/Shell expect the facility will be operational and receive its first LNG cargo in 2008. Although it did not halt construction, a September 2005 ruling by a Mexican federal court required the SEMARNAT to complete additional analyses of several environmental issues related to the project.

[a] Originally, Shell International Gas Ltd. had proposed its own LNG import terminal near Ensenada, Baja California. In December 2003, Shell International Gas Ltd. announced that it would be jointly pursuing the Energy Costa Azul LNG Project with Sempra Energy LNG.

[b] A temporary federal court injunction was placed on the project's environmental permit in November 2003 due to project opposition. In March 2004, the injunction was lifted and the environmental permit is still in effect.

Sources: Natural Gas Intelligence. North American LNG Import Terminals. December 15, 2004.
http://www.chevrontexaco.com/gnlbaja/default_eng.asp (Accessed April 14, 2005).
http://www.sempra.com/lng_energiaCostaAzul.htm (Accessed April 14, 2005).

Of the two proposed Mexican LNG import projects, the Sempra/Shell project (Terminal GNL Mar Adentro Project) is the furthest along in the permitting process. By March 2005, Sempra/Shell had obtained the necessary permits and begun construction of roads and the terminal facilities. This onshore project would likely deliver a portion (up to half) of its natural gas to markets in the southwestern United States. Although growing, the current demand for natural gas in northern Baja California (Mexico) is about 500 MMscfd.[2] The Sempra/Shell onshore LNG terminal is designed to provide 1 Bscfd of natural gas to the Mexican and United States markets. The project sponsors have indicated that 500 MMscfd

[2] Current natural gas demand in northern Baja California includes the CFE 1090 megawatt (MW) Presidente Juarez Power Plant in Rosarito, Mexico; the Sempra 600 MW Thermoelectrica de Mexicali and Intergen 1050 MW Energia Azteca power plants in Mexicali, Mexico; and ECOGAS' natural gas distribution system in Mexicali, Mexico.

would be sent to the Mexican market and 500 MMscfd would be available for export to the United States. Sempra/Shell anticipates completing the project and receiving its first LNG cargo in 2008. ChevronTexaco proposes an offshore LNG project (Energy Costa Azul LNG Project) that is scheduled to be in operation by 2007 or 2008. This offshore project could provide an average of 750 MMscfd of natural gas to regional markets. If both the Sempra/Shell and ChevronTexaco projects are built, they would provide about 1.75 Bscfd of natural gas to markets in Mexico and the United States. However, the specific amount of natural gas that would be available for export over the long term would depend on factors that include actual LNG import volumes and sendout capacities, Mexican power plant electric generation requirements, customer contracts, and the pipeline infrastructure in Mexico and the United States. Based on current demand for natural gas in northern Baja California, it is conceivable that up to 70 percent of the sendout capacity of the natural gas from the Sempra/Shell and ChevronTexaco projects could be available for delivery to markets in other parts of Mexico or the United States.

There are two existing pipeline systems that could be used to deliver natural gas from LNG import terminals in Mexico to markets in southern California. These are the North Baja/Gasoducto Bajanorte (GB)/Transportadora de Gas Natural de Baja California (TGN) system and the SDG&E system (see figure 3.2.1-1).

Sempra/Shell indicated that the Energy Costa Azul LNG Project would deliver about 500 MMscfd of natural gas to the southern California and southwestern United States markets via the North Baja/GB/TGN pipeline system. Currently, the North Baja/GB/TGN system consists of three interconnected pipelines that were recently constructed to deliver natural gas from the United States to Rosarito, Mexico. The United States portion of the system (North Baja pipeline) starts at an interconnection with an El Paso mainline at Ehrenberg, Arizona at the California/Arizona border and runs southward to the Mexican border. In Mexico, the natural gas is transported westward by the GB pipeline to the TGN pipeline near Tijuana/Rosarito. The North Baja/GB/TGN system is currently capable of delivering 500 MMscfd of natural gas to Rosarito. To use this system to transport natural gas to southern California markets, the direction of flow on the system would have to be reversed so that natural gas would flow from an interconnect with the LNG import terminal(s) through the TGN pipeline to the GB pipeline to the North Baja pipeline. Near the northern end of the North Baja pipeline, natural gas could be delivered to the SoCal Gas system through a short lateral[3] or El Paso's existing system.

In early 2005, the FERC received information that plans were underway to expand the North Baja/GB/TGN system. On August 31, 2005, the FERC and the CSLC issued an NOI/NOP to prepare an EIS/EIR for the North Baja Pipeline Expansion Project. This project would involve reversing the flow of the system and constructing up to 80 miles of new large-diameter pipeline loop along the North Baja system. The expansion would allow up to 2 Bscfd of natural gas to be delivered from Mexico to an interconnect with the SoCal Gas system in Blythe, California. With this expansion, natural gas from an LNG terminal located in northern Baja California, approximately 135 to 150 miles south of Los Angeles, would have to be transported a minimum of 400 miles west to east and then east to west to reach the proposed market area. Additionally, some of the volumes of natural gas provided by the Mexican LNG facilities could be provided indirectly to southern California through displacement of existing volumes that are currently provided to the North Baja/GB/TGN system from the El Paso system. That is, 500 MMscfd of natural gas from El Paso that is currently going to northern Mexico could also be diverted directly into the SoCal Gas system. Regardless of whether the natural gas would be transported from an LNG terminal in Mexico or delivered via displacement from the El Paso system, the existing SoCal Gas system could only accommodate about 500 MMscfd of natural gas (half of the proposed project volumes) without upgrades.

[3] A lateral is typically a smaller diameter pipeline that takes gas from the main system to deliver it to a customer, local distribution system, or another interstate transmission system.

The SDG&E pipeline system distributes natural gas in the San Diego area. For this pipeline to be used to transport gas from LNG import terminals in Mexico, a project proponent could utilize a currently inactive pipeline that runs from the TGN system near Tijuana, north into the United States and connects with the SDG&E pipeline. This system alternative would involve construction of a receipt lateral from the LNG terminal(s) to the TGN pipeline, modification of the inactive pipeline and the interconnect with the SDG&E pipeline, upgrading of the SDG&E system in order to reverse the flow (SDG&E currently receives gas from SoCal Gas), and modification and upgrading of the interconnection between the SDG&E and SoCal Gas systems. Depending on the volume imported to the United States, it may also be necessary to loop all or part of the 23-mile-long TGN pipeline. According to a preliminary analysis conducted by SoCal Gas and SDG&E in May 2003, facility improvements would be required on the SDG&E system to accommodate any new natural gas volumes between 300 and 700 MMscfd (Sempra Energy Utilities, 2003). Larger volumes would require looping the existing pipeline from Santee to Escondido, as well as from Escondido to Rainbow, with associated environmental impacts.

The North Baja/GB/TGN and the SDG&E pipeline systems are not currently capable of reliably delivering the natural gas volumes proposed by the Long Beach LNG Import Project to the broader southern California market. Providing significant volumes of natural gas to southern California from Mexico would require a variety of pipeline facility upgrades/expansions and/or an inefficient delivery pathway, both of which would entail associated economic and environmental costs. Serving the LA Basin would require the construction of a new pipeline through densely populated and commercial areas, which would increase environmental and landowner impacts as well as the transportation cost for gas delivery when compared to the much shorter, more direct delivery to the LA Basin through the existing SoCal Gas system from the Long Beach LNG Import Project. While the possible use of the SDG&E system is a much more direct route than the North Baja/GB/TGN system, it is not a reliable, practicable alternative at this time. Furthermore, it is unclear whether contractual arrangements could be made to allow additional deliveries on either of these systems. However, the CPUC has issued a decision that would streamline the contract approval process for receiving LNG imports at several interconnect points in southern California, including one at the border between California and Mexico associated with the SDG&E pipeline system at Otay Mesa (see figure 3.2.1-1). Upgrades/expansion of the existing pipeline systems in the California-Mexico border region would be constrained by existing land uses and could potentially result in a variety of impacts on biological and cultural resources (CEC, 2005a).

Another issue associated with the Mexican-based LNG projects is that to meet the objective of providing a stable source of LNG for vehicle fuel to the southern California market, LNG from a terminal in the Baja California area would have to be trucked between 135 to 150 miles (depending on the location of the LNG terminal) on Mexican and United States highways.[4] Transporting LNG from Baja California to the LA Basin would have the same potential problems as transporting LNG from LNG-producing plants in the United States, including potential increased risks of LNG truck accidents, highway congestion, and air pollution from tanker truck emissions.

The proposed LNG import projects in Mexico would involve a variety of environmental impacts that would differ from the Long Beach LNG Import Project. The Sempra/Shell LNG project is located on a new site with no prior infrastructure development. Construction and operation would include ground disturbance and accompanying environmental impacts that are typical of new development (e.g., land use conversion, vegetation/habitat removal, noise, aesthetic impact). Additionally, the project would require construction of LNG ship docking/berthing facilities that would likely result in impacts on the nearshore marine environment. Finally, there would be environmental impacts associated with construction of the 40-mile-long sendout pipeline needed to connect the new LNG facility with the existing pipeline system infrastructure. Similarly, the ChevronTexaco LNG project would be developed in a previously

[4] It is not economically or technically practical to transport LNG via pipeline for distances greater than about 3 miles.

undeveloped location off the coast of Baja California. In addition to the direct impacts on benthic habitats at the LNG terminal and along the offshore pipeline route, this project would use significant volumes of seawater to vaporize the LNG. Resource agencies and nongovernmental organizations in the United States have expressed serious concerns regarding the impacts a seawater vaporization system could have on fish populations due to the entrainment of large numbers of fish eggs and larvae for proposed projects of similar design in the Gulf of Mexico (LNG Express, 2004). Additionally, concerns have been raised about this project's impacts on seabirds and the potential to introduce invasive species to the nearby Coronado Islands.

Southern California

There are a number of proposals to build LNG facilities in California. These include relatively small facilities capable of liquefying natural gas from pipelines, natural gas from regional reserves, and/or natural gas produced from local sources of decomposing organic materials (e.g., landfills, sewage treatment facilities) for use as vehicle fuel as well as larger facilities that would import and vaporize LNG to supply natural gas to California. Three of the larger proposed facilities that would import and vaporize LNG are offshore facilities. The Long Beach LNG Import Project and the smaller proposed liquefaction facilities are onshore facilities.

Onshore

Currently, at least seven onshore natural gas liquefaction facilities are being planned or proposed in California. Because each of these facilities would be limited by the availability of a consistent and relatively inexpensive source of natural gas that could be converted to LNG as well as by other economic factors, it is difficult to determine which facilities will ultimately be built. However, it seems reasonable to assume that at least some of the natural gas liquefaction facilities will be built. In comparison with the proposed project, these liquefaction facilities are relatively small and limited in the volumes of LNG they could produce and store. Given the proprietary nature of these proposals, information on the specific status and the volumes of LNG that would be provided by these projects is not available. However, Powars and Pope (2002) estimate that all of these projects combined would likely result in providing about 70,000 gpd of LNG to the California market for use as vehicle fuel (as compared to the Long Beach LNG Import Project's 150,000 gpd of LNG).

Offshore

There are three offshore LNG import projects currently under consideration in southern California. These include projects by BHP Billiton (BHP), Crystal Energy LLC (Crystal Energy), and ChevronTexaco (see figure 3.2.2-1).

Offshore LNG import terminals located in federal waters are under the jurisdiction of the DOT and the Coast Guard pursuant to the Deepwater Port Act of 1974 (as amended by the Maritime Transportation Security Act of 2002). Among other things, this legislation requires that the DOT [U.S. Maritime Administration (MARAD)] and the Coast Guard regulate the licensing, siting, construction, and operation of deepwater ports for natural gas. Offshore LNG import terminals located in state waters fall under the jurisdiction of the FERC, pursuant to the NGA.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 3-12
Figure 3.2.2-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

The operational history of LNG import facilities located entirely offshore is currently limited. Nevertheless, the technology for offshore LNG storage and regasification facilities is being developed and guidance documents have been produced (American Bureau of Shipping, 2002). The DOT and Coast Guard authorized construction of one offshore LNG import terminal that began operating in the Gulf of Mexico in early 2005 (i.e., the Gulf Gateway Project). Additionally, the DOT and Coast Guard are currently reviewing nine other applications to construct and operate offshore LNG import terminals in the United States. Offshore LNG terminals have also been proposed in Australia, West Africa, Taiwan, Mexico, and Italy (LNG Express, 2002). Recently, companies have introduced various strategies for operating LNG import terminals in offshore waters (LNG Express, 2003). All of these approaches would allow offshore docking and unloading of LNG ships as well as offshore regasification of LNG for delivery as natural gas to onshore markets via undersea pipelines. Some of these approaches would allow storage capability. The offshore design strategies that are currently being considered for use in southern California are discussed below.

BHP Billiton – Floating Storage and Regasification Unit

BHP proposes to construct the Cabrillo Port LNG Deepwater Port, which would be a floating storage and regasification unit (FSRU) located about 21 miles offshore of Port Hueneme and Oxnard. As proposed, the project would include a floating vessel that would house three spherical LNG storage tanks mounted within the hull, accommodations for personnel, a ship berthing and mooring system, and eight vaporizers for LNG regasification. The facility would have an LNG storage capacity of about 273,000 cubic meters. The FSRU would be anchored in deep water offshore of the proposed market area where conventional LNG ships could dock next to and unload LNG to the FSRU. After the LNG is unloaded into storage tanks, it would be vaporized and the natural gas transported to onshore markets through an undersea pipeline. The eight vaporizers on the vessel would allow for the vaporization and sendout of about 800 MMscfd of natural gas (peak sendout of up to 1.5 Bscfd). LNG would be used to fuel the vaporization process that would be entirely self contained and would use its own fresh water, thus eliminating the need to intake or discharge sea water. BHP would construct two new 21.5-mile-long, 24-inch-diameter undersea pipelines from the FSRU to a new onshore interconnect that would be owned and operated by SoCal Gas at the Reliant Energy Ormond Beach Generating Station. The project would also include construction of a new 14.3-mile-long, 36-inch-diameter onshore pipeline between the Reliant Energy Ormond Beach Generating Station and an existing SoCal Gas valve station (i.e., the Center Road Station) as well as a new 7.7-mile-long, 30-inch-diameter onshore pipeline loop on the existing SoCal Gas pipeline system.

BHP initially filed its application with the Coast Guard on January 27, 2004 anticipating that the project facilities would be in service some time in 2008. The application was processed and an NOI/NOP was issued on February 24, 2004. The Coast Guard's regulatory review process was suspended on April 16, 2004 due to data gaps but restarted on September 3, 2004. In October 2004, a draft EIS/EIR for the project was released by the Coast Guard, the MARAD, and the CSLC. On January 5, 2005, the CSLC and the Coast Guard again suspended the regulatory review process pending BHP's submittal of additional information needed to address public and agency comments on the draft EIS/EIR.

Crystal Energy – Fixed Platform

Crystal Energy proposes to convert an existing oil platform off of the coast of Ventura County (Platform Grace) into an LNG receiving and regasification terminal. The platform is located in the Santa Barbara Channel about 13 miles offshore and west of Oxnard. Crystal Energy would modify the platform to operate as an LNG receiving and processing facility by installing an LNG transfer system, a cool-down tank, six LNG pumps, and six LNG vaporizers. Reinstallation and upgrade of the platform's power production capability would also be necessary. Once the facility is operational, LNG would be

transferred to the platform from a carrier ship where it would be vaporized and sent to the onshore markets as natural gas through a new 32-inch-diameter undersea pipeline. A new docking structure would be installed adjacent to the platform to safely moor LNG vessels during transfer. From depths of about 318 feet at the platform, the pipeline would generally be constructed adjacent to existing undersea pipeline rights-of-way 13 miles to an onshore landing near the Mandalay Power Generating Station. From the landing, a new 12-mile-long, 36-inch-diameter onshore pipeline would be constructed to an interconnect with the existing 30-inch-diameter SoCal Gas pipeline system near Camarillo. The Crystal Energy facility would not store LNG; natural gas sendout capacity would average 800 MMscfd with a peak capacity of 1.2 Bscfd.

Crystal Energy initially filed its application with the Coast Guard on January 28, 2004 and the CSLC on February 10, 2004 anticipating that the project facilities would be in service by early 2007. Crystal Energy's applications were subsequently re-filed with the Coast Guard on July 27, 2004 and the CSLC on July 29, 2004. The applications were found deficient in the scope and depth of the information needed. As of August 2005, the project remained in suspension pending Crystal Energy providing additional project information before the regulatory review will continue (CEC, 2005b).

ChevronTexaco – Gravity-Based Structure

ChevronTexaco publicly discussed plans to construct the Port Penguin LNG Terminal off of the coast of southern California. Reportedly, this terminal would be designed similar to ChevronTexaco's proposed Terminal GNL Mar Adentro Project in Mexico and would include a gravity-based structure (GBS) with an anticipated natural gas sendout of 750 MMscfd. This design involves placing LNG storage tanks and associated facility platforms on new foundations anchored directly on the sea floor. LNG would be offloaded from conventional LNG ships, placed in storage tanks, and then vaporized for delivery to the onshore market via an undersea pipeline. GBS terminals are only feasible in areas of relatively shallow water, where the depths range from between 45 and 100 feet. Based on information provided by the CEC, ChevronTexaco discontinued pursuing this project in June 2005 (CEC, 2005b).

Offshore LNG Import Terminal Technical Issues

To facilitate receiving imported natural gas from the proposed LNG facilities in southern California, the CPUC issued a decision that would streamline the contract approval process for several interconnect points in southern California, including one at SoCal Gas' Center Road Station near Oxnard that would serve the Crystal Energy and BHP projects (see section 1.1). If approved and constructed, both the BHP and Crystal Energy projects would provide a new source of large volumes of natural gas to markets in southern California. Because the Crystal Energy project would not include LNG storage, it would not be able to provide stability to a market with fluctuating energy supply and demand. Although the BHP project would provide offshore storage of LNG, it is only designed to store about 85 percent of the LNG that would be stored by the Long Beach LNG Import Project. Furthermore, neither the Crystal Energy nor BHP projects could provide supplies of LNG for vehicle fuel. As such, neither of these projects would satisfy all of the objectives of the Long Beach LNG Import Project.

A disadvantage of offshore LNG facilities that do not have LNG storage capacity (such as the one proposed by Crystal Energy) is the potential for delays in ship arrivals and the associated delays in the delivery of natural gas to meet the daily demand of customers. Because of the uncertain maritime sailing conditions (e.g., adverse weather), LNG ships can take up to 24 days to get from the export or loading port to the import or unloading location. A facility with fixed LNG storage tanks (either onshore such as proposed by SES or offshore such as proposed by BHP) with standing vaporization capacity compensates for variations in ship arrivals as well as fluctuations in onshore natural gas demand and allows for controlled deliveries of natural gas to onshore customers between LNG deliveries.

Weather not only significantly influences ship travel time between ports, but adverse weather has a higher probability of delaying LNG deliveries to unprotected offshore terminals such as those proposed by Crystal Energy and BHP. Adverse weather (e.g., high seas) could delay the unloading of LNG vessels for several days to a week, depending on the conditions, while the same weather would have little impact on deliveries to onshore facilities located in a protected port. The potential for severe weather delays would equate to a need for increased storage volume at offshore terminals to maintain a predictable, constant flow of natural gas to shore.

As noted above, the offshore terminal designs could not provide LNG for use as a vehicle fuel, which is an objective of the Long Beach LNG Import Project. Once LNG is vaporized, it does not appear practical to reliquefy the product onshore in southern California. This is because the reliquefaction process is energy intensive and is generally only done on a large scale when there is a relatively inexpensive source of natural gas. In addition to the cost and energy expenditure associated with liquefying natural gas, the impact of constructing a liquefaction facility and the air emissions associated with operating such a facility would have to be considered.

Offshore LNG Import Terminal Environmental Issues

Both the BHP and Crystal Energy proposals are undergoing an environmental review by the Coast Guard, the MARAD, and the CSLC. Specific details on environmental impacts will or have been presented in EIS/EIRs for the respective projects. In October 2004, a draft EIS/EIR was issued for BHP's Cabrillo Port LNG Deepwater Port. As of September 2005, a draft EIS/EIR for the Crystal Energy project has not been issued. Because an application to construct ChevronTexaco's Port Penguin LNG Terminal has not been filed, a formal environmental review by the appropriate regulatory agencies has not been initiated for that project.

Table 3.2.2-2 includes a summary of the comparative environmental issues associated with the Long Beach LNG Import Project and the Cabrillo Port LNG Deepwater Port. Much of the information for the comparative analysis presented in table 3.2.2-2 and the discussion presented below was taken from the Cabrillo Port LNG Deepwater Port draft EIS/EIR (CSLC et al., 2004).

It has been suggested that an onshore terminal would present more visual effects, land use conflicts, risks to public safety, biological impacts, and air quality issues when compared to an offshore terminal. However, these generalizations cannot be accurately applied to all LNG projects. The Long Beach LNG Import Project would be located in a previously developed industrial area associated with the POLB where it would not change the existing industrial land use of the site or significantly alter the visual character of the area. In comparison, the Cabrillo Port LNG Deepwater Port would involve permanent facilities that would change the visual character of the offshore view, both during the day and at night. While the evaluation of aesthetics is necessarily subjective, the presence of this deepwater port terminal could have a significant negative impact on the experience of recreational boaters, tourists, and coastal residents who view the offshore environment from land.

TABLE 3.2.2-2

Environmental Comparison of the Long Beach LNG Import Project and the Cabrillo Port LNG Deepwater Port

Resource Issue/Impact	Long Beach LNG Import Project	Cabrillo Port LNG Deepwater Port
Aesthetics/Visual Effects/Recreation	The LNG terminal would have a negligible impact on the visual character of the surrounding Port complex. Construction and operation of the Long Beach LNG Import Project would not threaten the viability of a recreational resource, prohibit access to recreational resources, or cause termination of a recreational use.	The FSRU would significantly change the visual character of the ocean view for recreational boaters that travel near the facility. Safety zones around the FSRU would restrict sportfishing activities in the project area.
Land Use	The LNG terminal and pipelines would be constructed in an area dominated by industrial land use.	The FSRU and offshore pipelines would be constructed in areas of soft bottom marine sediments. The onshore pipelines would be constructed in an area that includes a mix of agricultural, industrial, commercial, open space, and residential land uses.
Construction Disturbance		
Terminal	57 acres	147 acres
Offshore pipeline	Not Applicable	511 acres
Onshore pipeline [a]	30 acres	225 acres
Operational Disturbance		
Terminal	32 acres	147 acres
Offshore pipeline	Not Applicable	511 acres
Onshore pipeline [a]	4 acres	144 acres
Public Safety	The risks of a safety incident are considered manageable.	The risks of a safety incident are considered manageable. The consequences of an incident at the proposed facility are potentially less than at an onshore terminal due to the site's more remote location.
Water Quality and Biological Resources	Dredging and the temporary resuspension of sediments during construction would disrupt benthic communities in the dredged area and subject organisms in adjacent areas to increased sedimentation. Recovery of the benthic community would take up to 3 years.	Installation of the FSRU and the offshore pipeline would result in the temporary resuspension of sediments, destroying benthic communities at the anchor points and along the pipeline route in previously undisturbed natural habitats. The benthic community would recover, but an exposed pipeline would introduce a permanent new habitat type to the area. Construction and operation of the onshore pipeline would result in temporary, short-term, and long-term impacts on terrestrial species and habitats.
Transportation	Construction of the project would result in impacts on vehicle traffic at one intersection near the proposed LNG terminal. Operation of the project would increase ship traffic into the POLB, potentially affecting other industrial marine traffic.	Construction of the onshore pipeline could temporarily impact vehicle traffic at some locations in the Cities of Oxnard and Santa Clarita. Construction and operation of the FSRU could impact some commercial, recreational, and industrial marine traffic in the area.
Air Quality	Given the project location within the Port, air pollutants resulting from the project would likely contribute to cumulative air quality impacts in the area. Because the project would provide LNG vehicle fuel that could be used as an alternative to diesel-fueled trucks, some overall reductions in regional air emissions might be achieved.	Given the location of the FSRU 21 miles offshore of Port Hueneme and Oxnard, air pollutants resulting from operation of the project would disperse and would not likely contribute to cumulative air quality impacts at onshore areas.
Operational Emissions		
NO_X	63 tons/year	187 tons/year
SO_X/SO_2	111 tons/year	<1 ton/year
CO	37 tons/year	162 tons/year
PM_{10}	15 tons/year	15 tons/year
ROC	22 tons/year	50 tons/year

[a] The acreage of construction and operation disturbance for the onshore pipelines includes associated aboveground facilities.

Offshore LNG import terminals have been represented as being safer and more easily secured compared to LNG facilities located onshore. Any assessment of risk to human health and safety must consider both the potential for an incident and the consequences of an incident. For either an onshore or offshore facility, the risks of an accidental release of LNG are small and can be managed with current safety policies and practices (Sandia National Laboratories, 2004). Additionally, the risk from intentional incidents (such as a terrorist act) at either an offshore or onshore facility could be significantly reduced with appropriate security, planning, prevention, and mitigation. A recent congressional report suggested that offshore LNG facilities may be more vulnerable to terrorist attack because of their remote locations compared to an onshore facility (Parfomak, 2003). Also, workers' health and safety may be more at risk at an offshore facility because of the distance to emergency response and health care services compared to an onshore facility. The risks and safety issues associated with operation of SES' proposed onshore facility are discussed in detail in section 4.11.

The construction of an offshore LNG terminal and pipeline has the potential to disturb a number of marine resources that would not be affected by the Long Beach LNG Import Project. For example, offshore pipeline construction typically involves excavating a shallow trench or laying the pipeline directly on the sea floor in areas of benthic marine habitats, frequently in areas that have not previously been extensively disturbed. Excavating a shallow trench to bury the pipeline would affect bottom substrates and habitats due to excavation and redeposition of sediments and the associated organisms. Laying the pipeline directly on the sea floor could disturb and/or replace existing substrates and destroy individual benthic organisms. Although these impacts have not been specifically identified for the Cabrillo Port LNG Deepwater Port, laying a pipeline directly on the seafloor has been shown to create a potential barrier to invertebrate movements (Glaholt et al., 2000). Additionally, operation of an offshore terminal might disrupt the behavior of marine birds and mammals.

Both the Long Beach LNG Import Project and the Cabrillo Port LNG Deepwater Port would be located in air quality management districts that do not meet federal air quality standards for certain air contaminants. Construction and operation of both projects would result in the emission of regulated pollutants above applicable regulatory thresholds. As such, both projects would be required to apply for and obtain permits to construct and operate the facilities, conditions of which would require the installation of appropriate emission controls and/or the acquisition of emission offsets. It is likely, given the location of SES' project within the Port, that toxic air pollutants resulting from the Long Beach LNG Import Project would have a direct impact on the existing air quality in the area. Because BHP's FSRU would be located about 21 miles offshore, air emissions from its operation would disperse and be less likely to noticeably impact air quality in onshore areas. However, an onshore LNG import terminal could indirectly improve air quality by providing another source of alternative fuel for heavy-duty vehicles, most of which currently run on diesel fuel. While emissions resulting from the combustion of diesel fuel are improving due to more stringent emission and fuel formulation standards, a switch to LNG-fueled vehicles could serve to further reduce the emissions of regulated criteria and toxic air pollutants (e.g., NO_x).

3.2.3 System Alternatives Conclusions

As shown in table 3.2.3-1, none of the existing or proposed systems could (individually or in combination) meet all of the stated objectives of the Long Beach LNG Import Project. Several of the proposed LNG import systems (either offshore California or in Mexico) could meet the project objective of providing a new source of natural gas to southern California markets. Trucking LNG from existing liquefaction facilities and/or construction of the proposed liquefaction facilities could not meet the project objective of providing a source of up to 150,000 gpd of LNG for vehicle fuel to southern California. Only the Mexican LNG projects could potentially accommodate fluctuating energy supply and demand in southern California by storing up to 320,000 cubic meters of LNG in the region. However, the reliability

of a foreign source of LNG satisfying this project objective is questionable. The offshore BHP project could partially satisfy the project objective of reducing fluctuations in the local supply by storing up to 273,000 cubic meters of LNG (about 85 percent of the storage volume proposed by SES).

TABLE 3.2.3-1

Existing and Proposed System Alternatives Compared to the Long Beach LNG Import Project

SES Project Objectives	Pipeline System Alternatives	Existing or Proposed Liquefaction Facilities	Mexican LNG Import Terminals	California Offshore LNG Import Terminals
Providing markets in southern California, particularly the LA Basin with:				
• a new source of natural gas (up to 1 Bscfd)	No	No	Yes [a] ChevronTexaco - 1.4 Bscfd Sempra/Shell - 1.3 Bscfd	Yes Crystal Energy - 1.2 Bscfd BHP - 1.5 Bscfd
• a stable source of LNG for vehicle fuel (up to 150,000 gpd)	No	No [b]	No	No
• a facility that can reduce fluctuations in the local supply by storing LNG (up to 320,000 cubic meters)	No	No	Yes ChevronTexaco - 250, 000 cubic meters Sempra/Shell - 320,000 cubic meters	Partially BHP - 273,000 cubic meters

[a] Assuming expansion of existing pipeline infrastructure and significant volumes are available to the markets in southern California.

[b] Even assuming access to LNG from existing and proposed LNG liquefaction facilities considered in combination [e.g., 70,000 gpd from new liquefaction facilities in California as well as 30,000 gpd from the existing facility in Topock, Arizona (one-third of this facility's capacity)].

In conclusion, construction of one or more of the California or Mexican LNG import terminals would partially satisfy the objectives of the Long Beach LNG Import Project. If these system alternatives were constructed in place of the Long Beach LNG Import Project, some of the significant environmental effects of the proposed project might be avoided or substantially lessened. For example, construction of an offshore LNG import terminal would not result in local air emissions and the release of toxic air pollutants in Long Beach as would the Long Beach LNG Import Project. However, each of the system alternatives could result in its own set of significant environmental impacts that could be far greater than those associated with the proposed project (e.g., alteration of natural habitats and/or offshore viewshed and recreational experience).

3.3 LNG TERMINAL ALTERNATIVE LOCATIONS

Alternative sites were also evaluated for the proposed project. The examination of alternative sites for an LNG import terminal involved a comprehensive, step-wise process that considered environmental, engineering, economic, safety, and regulatory factors. In the first step, the most suitable geographic area for an LNG terminal was determined based on the stated purposes of the project to provide a new source of natural gas and LNG vehicle fuel as well as to ensure stability of natural gas supply to southern California markets, particularly the LA Basin. The second step included identification of specific ports within the area that are capable of accommodating ships that are able to transport up to 145,000 cubic meters of LNG. The third step in the identification and evaluation of sites included comparatively evaluating specific sites within suitable ports that are capable of providing or supporting the necessary docking, storage, and vaporization facilities, as well as access to pipeline infrastructure.

3.3.1 Regional Review

As discussed previously, there is a current and growing demand for natural gas and LNG in southern California, particularly the LA Basin. Due to the limitations in the existing natural gas pipeline infrastructure serving the region as well as the disadvantages associated with trucking large quantities of LNG long distances (see section 3.2.2.1), an LNG import facility located north of Ventura County or south of San Diego County would have difficulty serving southern California markets (see figure 3.2.1-1).

3.3.2 Preferred Port Identification

Ships that are presently used to transport LNG typically have capacities ranging between 125,000 and 165,000 cubic meters. Ships of this size are 950 to 1,000 feet long with typical fully loaded drafts of about 40 feet. To ensure that the LNG ships do not easily or frequently run aground, an additional 2 feet of water is required under the keel. It is predicted that most LNG ships built in the future will have larger capacities and deeper drafts than those currently in operation. Ports with water depths 50 feet or greater could accommodate these newer ships with deeper drafts. Although dredging in shallow water areas could provide access for LNG ships, the costs and environmental impacts of significant dredging requirements in undeveloped ports could be prohibitive. Consequently, the analysis of alternative LNG terminal sites was primarily limited to offshore (deepwater) or shoreline ports that could readily accommodate LNG ships.

3.3.2.1 Offshore Deepwater Ports

An offshore LNG import terminal would not be capable of delivering LNG vehicle fuel to markets in southern California. Consequently, offshore site alternatives were not considered in this aspect of the analysis. However, there are several proposals to build offshore LNG import terminals in southern California. The potential for one or more of these proposed offshore terminals to satisfy some of the other objectives of the Long Beach LNG Import Project and the environmental issues associated with offshore LNG terminals are discussed in section 3.2.2.2.

3.3.2.2 Coastline Ports and Harbors

Based on the review to identify the most suitable regional setting for an LNG terminal, 12 existing ports or harbors in Ventura, Los Angeles, Orange, and San Diego Counties that are close to the natural gas markets in southern California were identified. These ports/harbors included Ventura Harbor, Channel Island Harbor, Port Hueneme, Marina Del Rey, Redondo Beach-King Harbor, San Pedro Bay (including the ports of Los Angeles and Long Beach), Newport Beach Harbor, Dana Point Harbor, Oceanside Harbor, Mission Bay, and San Diego Harbor. These ports are shown on figure 3.2.1-1.

Of the 12 existing harbors along the southern California coast, 8 have water depths that average about 20 feet and primarily support recreation and sport/commercial fishing. These harbors include Ventura Harbor, Channel Island Harbor, Marina del Rey, Redondo Beach-King Harbor, Newport Beach Harbor, Dana Point Harbor, Oceanside Harbor, and Mission Bay. Given the current depths of these harbors, substantial dredging would be necessary to accommodate LNG ships. Also the recreational nature of these harbors would likely make it difficult to locate an appropriate site for the LNG terminal and could potentially lead to conflicts with current users of these harbors. Consequently, these harbors were considered inappropriate for development of an LNG import terminal and were eliminated from further consideration.

Port Hueneme is a relatively small deepwater port located about 60 miles northwest of Los Angeles in the cities of Port Hueneme and Oxnard in Ventura County. It is roughly divided into two

jurisdictions: the Port Hueneme U.S. Naval Construction Battalion and the Oxnard Harbor District. Commercial and industrial use of Port Hueneme primarily involves the import and export of cars, fresh fruit and produce, and forest products. Port Hueneme is the top seaport in the United States for citrus export and ranks among the top 10 ports in the country for automobile and banana imports; however, there are few heavy industrial uses in the port. To accommodate the proposed project, the current harbor would need to be dredged to 50 feet (from its current depth of about 35 feet) and an area to dispose of the dredged materials would have to be located. About 10 miles of pipeline would need to be constructed to interconnect with the existing SoCal Gas system. Given the land use in the area, this pipeline would likely traverse industrial, residential, commercial, and agricultural lands before interconnecting with the SoCal Gas system. Also, SoCal Gas estimates that it could only accept up to 400 MMscfd in this area without extensive system upgrades. Given the additional environmental disturbance compared to the proposed project, limitations in natural gas sendout capacity of the nearby SoCal Gas system, and the inability of an LNG terminal within this port to avoid or substantially lessen any significant environmental effects of the proposed project, Port Hueneme was eliminated from further consideration in this EIS/ER.

San Diego Harbor is a major naval, commercial, and recreational harbor that is approximately 110 miles south of Los Angeles and several miles north of the Mexican border. This crescent-shaped 18-mile-long harbor and bay is separated from the ocean by a low peninsula that has been extensively developed for residential and recreational purposes. To enter the harbor, ships must travel north 4 miles to enter the channel at the north end of the Silver Strand, and then several miles east between the Naval Air Station and Harbor Island (located immediately south of the San Diego International Airport), then south by the municipal yacht basin and commercial fish harbor to the harbor entrance and central and southern harbor areas. The entrance channel depth is 53 feet and the main channel depths are 42 feet from the entrance to the turning basin. The harbor is home to a major U.S. Naval fleet, the Naval Communications Station, a Naval Air Station, and a Naval supply center. It is a major shipping point for agricultural goods from southern California, as well as a major recreational harbor that has over 4,000 boat slips for recreational craft, a sport-fishing fleet, and cruise ships. It is also the center of the west coast commercial tuna fishing industry. The marine terminals within San Diego Harbor accommodate container, dry bulk, liquid bulk, refrigerated, vehicle, and break bulk cargoes.

Although an LNG terminal in San Diego Harbor could be linked to the SDG&E pipeline system, this distribution system includes relatively small (6- to 12-inch) diameter pipelines in the vicinity of the harbor. Significant additional upgrades to the SDG&E system would be required to accommodate natural gas deliveries of 1 Bscfd as proposed by the Long Beach LNG Import Project (e.g., construction or expansion of large-diameter pipeline(s) to accommodate the proposed natural gas sendout volumes). The specifics are unavailable without a detailed engineering analysis, but it is assumed that upgrades of the SDG&E pipeline system would result in substantial environmental impacts given the residential and commercial developments in the area surrounding San Diego Harbor. Because of the distances ships would have to travel in confined waters to access the harbor; the potential for incompatibility of an LNG terminal with current naval, recreational, and port uses; the potential environmental impacts associated with upgrades of the SDG&E system; and the inability of an LNG terminal within this port to avoid or substantially lessen any significant environmental effects of the proposed project, San Diego Harbor was eliminated from further consideration in this EIS/EIR.

The ports of Los Angeles and Long Beach, although politically divided into two jurisdictions, are adjacent to each other and together form the fifth busiest port complex in the world after Hong Kong, Singapore, Shanghai, and Kaohsiung. The combined port complex comprises over 7,500 acres of land and is dominated by container cargo terminals, bulk terminals for the import/export of other products including automobiles, and oil and gas production facilities. Because of the size and industrial nature of these ports, there are established areas for the import of hazardous cargo. Although there are some

recreational boating and fishing fleets within the complex, the ports are primarily used for industrial purposes. Access to the ocean is through "gates" in the stone breakwaters that extend along the 50-foot bottom contour and that mark the seaward limit of the harbors. Channels are dredged to at least 50 feet and major entrances are dredged to over 65 feet. Access to the existing SoCal Gas system is within 2 to 4 miles of the port complex. At this location, the SoCal Gas system could accommodate the proposed natural gas volumes from the LNG terminal without the need for upgrades.

The ports of Los Angeles and Long Beach offer the most compatible harbors for developing an LNG import terminal to serve the markets of southern California, particularly the LA Basin. First, the ports maintain sufficient channel depth to accommodate even the largest LNG ships. Second, these are highly industrialized ports with limited recreational boating facilities or nearby residential areas. Third, both ports already import and store hazardous materials, including petroleum products, and LNG would represent a similar class of import. Fourth, both the ports and the nearby cities could benefit from an ample and readily available supply of LNG vehicle-quality fuel. Fifth, the existing SoCal Gas system, which is within 2 to 4 miles of the ports, can accommodate the volumes without the need for upgrades. For these reasons and because sites in other ports in the region would not avoid or substantially lessen any significant environmental effects of the proposed project, the ports of Los Angeles and Long Beach were determined to be preferable for the proposed project and other ports were eliminated from further consideration in this EIS/EIR.

3.3.3 Preferred Site Identification

After identifying the ports of Los Angeles and Long Beach as areas that would provide reasonable access to southern California markets, specific alternative sites suitable for developing an LNG terminal were evaluated. Regulations specific to siting an LNG terminal that are relevant to the alternatives analysis are listed in table 3.3.3-1.

Within the ports of Los Angeles and Long Beach, three sites were identified and evaluated as alternatives to the proposed site because they are potentially available and meet the regulatory siting criteria listed in table 3.3.3-1. These sites are the Los Angeles Export Terminal (LAXT) Site, the Pier A West Site, and the Navy Mole Site. Figure 3.3.3-1 shows the location of these alternative terminal sites and associated sendout pipelines. Similar to the proposed site, all of the alternatives are located within an industrialized port complex that currently imports and provides storage for petroleum products. Consequently, construction of an LNG terminal at any of these sites would be consistent with surrounding land uses. Given the lack of habitats for protected species and absence of historic properties, impacts related to these resources would be insignificant and similar to those discussed for the proposed terminal site (see sections 4.4.4 and 4.8). An environmental comparison of the alternative LNG terminal sites in the ports of Los Angeles and Long Beach with the proposed LNG terminal site is provided in table 3.3.3-2. A discussion of each of these sites is included below.

TABLE 3.3.3-1 **Select Regulations Related to the Siting of an LNG Terminal**	
Regulations	Description
U.S. Department of Transportation - LNG Federal Safety Standards	
Thermal Exclusion/Vapor Dispersion (Title 49 CFR Parts 193.2057 and 193.2059)	Safety requirements pertaining to thermal exclusion and vapor dispersion zones must be identified in accordance with National Fire Protection Association (NFPA) 59A *Standards for the Production, Storage, and Handling of Liquefied Natural Gas* (2001 edition). These federal guidelines are established to minimize the potential damaging effects of an LNG release reaching beyond the property line that can be built upon and/or that, at the time of terminal siting, is used for outdoor assembly by groups of 50 or more persons (see section 4.11.5).
Airports [Title 49 CFR Part 193.2155(b)]	LNG storage tanks must not be located within a horizontal distance of 1 mile from the ends, or 0.25 mile from the nearest point of a runway, whichever is longer. The height of LNG structures in the vicinity of an airport must also comply with Federal Aviation Administration requirements.
U.S. Coast Guard - LNG Waterfront Handling Requirements (Title 33 CFR Part 127.105)	Waterfront facilities where LNG is handled must comply with U.S. Coast Guard regulations pertaining to layout and spacing of the marine transfer area. These regulations require that each LNG loading flange be located at least 985 feet from general public or railway bridges crossing navigable waterways or entrances to any tunnel under navigable waterways.

3.3.3.1 Los Angeles Export Terminal Site

Mitsubishi Corporation, the parent company of SES, is currently part owner of properties within the POLA that are referred to as the LAXT Site. These properties consist of a remote terminal facility that is currently configured for the receipt, storage, blending, and reclaiming of bulk coal and petroleum coke; a ship loading facility on Pier 301; and a 5,200-foot-long conveyor corridor that connects the remote terminal and ship loading facilities. Because global market conditions have made export of coal and coke from the United States uneconomical, the owners of the LAXT Site (including Mitsubishi Corporation) were considering the conversion of this facility to accommodate imported LNG.

Conversion of this site to an LNG import terminal would require modification of the existing ship berth; the demolition of the existing remote terminal facilities and replacement with the LNG storage tanks, vaporizers, and associated structures; and removal of the conveyor corridor and replacement with a 5,200-foot-long cryogenic pipeline to carry the LNG from the ship berth to storage tanks at the remote terminal facility. The cryogenic pipeline would cross the site in a northeast-southwest line, then follow the current conveyor corridor from the remote terminal facility to the ship loading area. The berth at Pier 301 is already over 50 feet deep and could accommodate current and future LNG ships. The location of the LAXT Site at the western tip of Terminal Island in the POLA and the new Terminal 300 container dock would also accommodate LNG tankers with a minimum of navigational challenges. The pipeline that would deliver natural gas from a facility at the LAXT Site to the SoCal Gas system would be 3.9 miles in length, which is about 1.6 miles longer than the sendout pipeline from the proposed site. Trucking distances between the LAXT Site and the Terminal Island Freeway are essentially the same as those between the proposed site and the Terminal Island Freeway. There are 180 housing units within 1.0 mile of the LAXT Site compared to 0 housing units within 1.0 mile of the proposed site.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 3-23
Figure 3.3.3-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

TABLE 3.3.3-2

Comparison of Alternative LNG Terminal Sites

Feature	Proposed Site (Pier T East)	LAXT Site	Pier A West Site	Navy Mole Site
General Site Characteristics				
Adequate land available	Yes	Yes	Yes	Only if fill is added
Present land use	Vacant	Abandoned coal export	Oil extraction	Vacant
Adjacent land use	Other vacant areas, container terminal, scrap metal facility, lumber storage facility	Rail yard, container terminal, parking for fish pier adjacent to conveyor corridor	Recreational boat docking on three sides, other oil field work, POLB main access highway (Terminal Island Freeway)	Naval fuel pier, U.S. Maritime Administration pier, and Sea Launch facility
Recreational boat traffic	None	Offload site and conveyor corridor adjacent to fish harbor entry (within 500 feet)	Significant recreational boat traffic adjacent to any offload site	Within 1,000 feet of entry to POLB Middle Harbor
Potential for interruptions to ship/boat traffic	Low-Medium	Low-Medium	High	Low-Medium
LNG ship access	Clear	Clear	No access to wharf	Clear
Zoning	Port Industrial (PI)	PI	PI	PI
LNG trailer truck access to the Terminal Island Freeway	1.2 miles	1.1 miles	0.3 mile	2.4 miles
Nearby housing units (based on LandView Census 2000 Population Estimator)	0 within 0.25 mile 0 within 0.5 mile 0 within 1.0 mile	2 within 0.25 mile 12 within 0.5 mile 180 within 1.0 mile	0 within 0.25 mile 42 within 0.5 mile 465 within 1.0 mile	0 within 0.25 mile 0 within 0.5 mile 0 within 1.0 mile
Environmental Site Characteristics				
Impact on essential fish habitat	Minor, short-term impacts on water quality from dredging	Minimal, temporary, no long-term net loss	None known	Minor, short-term impacts on water quality from dredging; potential loss/alteration of about 16 acres of soft bottom habitat due to filling necessary to develop the site
Construction Considerations				
Construction access	Good	Good for terminal, poor (multiple conflict) for cryogenic pipeline	Poor, high traffic crossing with railroad crossing	Good
Preconstruction remediation/demolition required	The POLB would demolish two remaining buildings	Significant demolition of existing coal export terminal required	Significant remediation of oil field, removal of existing oil wells and pipelines	None
Feet of cryogenic pipeline needed	None	5,200	Unknown - No access to wharf	None

TABLE 3.3.3-2 (cont'd)

Comparison of Alternative LNG Terminal Sites

Feature	Proposed Site (Pier T East)	LAXT Site	Pier A West Site	Navy Mole Site
Amount of dredging needed for ship berth and/or to reinforce shoreline structures	275,000 to 475,000 cubic yards	None	Unknown - No access to wharf	Unknown - minor dredging may be required for new wharf and pier construction
Amount of fill needed to create site and/or to reinforce shoreline structures	6.6 acres (below 0 feet MLLW)	None	Unknown	16 acres (above 0 feet MLLW)
Wharf and pier construction needs	Berth modifications, the POLB would modify wharf, add pilings, dolphins	Wharf and pier modifications needed to accommodate LNG ships	Unknown - No access to wharf	New wharf and pier construction needed
Length of sendout pipeline	2.3 miles	3.9 miles	1.7 miles	4.8 miles

The existence of a ship berth at Pier 301 that could accommodate LNG ships without the need for additional dredging is a slight advantage over the proposed site. Development of the proposed site at Pier T would involve dredging of approximately 175,000 cubic yards of sediments for the ship berth. An additional 100,000 to 300,000 cubic yards of sediments would also have to be dredged to accommodate an underwater rock buttress necessary to reinforce the shoreline structures. Because this dredging and fill would be limited to a localized area that has been dredged in the past and an appropriate spoil disposal location is available, the environmental benefit of the reduced dredging at the LAXT site compared to the proposed site is minimal. Refer to sections 4.3.3.2 and 4.4.3 for a detailed discussion of impacts associated with dredging and filling at the proposed site and effects on biological communities. On the other hand, the extensive building demolition, the cryogenic pipeline, and the longer sendout pipeline are disadvantages of the LAXT Site. Based on the 1.6 miles of additional pipeline, the extensive building demolition, and the negligible environmental benefits of reduced dredging and filling compared to the proposed project, the LAXT Site was eliminated from further consideration in this EIS/EIR.

3.3.3.2 Pier A West Site

There is currently property on the western portion of Pier A within the POLB that is large enough to accommodate an LNG terminal and is available for lease. Because there is an active oil field on a portion of the Pier A West Site, development of the remaining property for an LNG terminal would potentially require significant remediation of contaminated soils. Pier A is also relatively close to residential areas. Based on a review of U.S. Census Bureau data, there are 0 housing units within 0.25 mile of the alternative site; however, there are 42 housing units between 0.25 mile and 0.5 mile of the site and 465 housing units between 0.5 and 1.0 mile of the site. In total, there are about 1,476 people living within 1.0 mile of the Pier A West Site (U.S. Census Bureau, 2001). This compares to 0 housing units within 1.0 mile of the proposed site.

Another drawback of the Pier A West Site is that there is no area to construct a wharf, thus the site would have no access to water. Therefore, space would have to be found at another berth and a cryogenic pipeline would need to be run from that berth to the regasification facility and storage tanks on Pier A West. Depending on where berth space were found, the cryogenic pipeline could be anywhere from 0.5 mile to 3.0 miles in length, with the most likely distance being approximately 2.5 miles. Once the LNG is on Pier A West, the sendout pipeline to deliver natural gas to the SoCal Gas system would be 1.7 miles in length, which is 0.6 mile shorter than the sendout pipeline from the proposed site.

Because of the necessary site remediation, proximity to neighborhoods, and LNG ship berth constraints, the Pier A West Site was determined not to be a reasonable alternative to the proposed site. Furthermore, because the Pier A West Site would not avoid or substantially lessen any significant environmental effects of the proposed project, it was eliminated from further consideration in this EIS/EIR.

3.3.3.3 Navy Mole Site

The Navy Mole Site is part of the former naval complex, part of which is now owned by the POLB and part of which is leased to the POLB by the Navy. It was installed as a breakwater for the naval shipyard harbor and currently houses facilities operated by Sea Launch (a commercial operator that provides services related to marine-based satellite launches). In addition to Sea Launch, there is an existing pier for a Navy fuel depot (Pier 12) and berth space for two DOT (MARAD) ships. Given the availability of property at this site, it is possible that the LNG terminal could be placed on fill at the northern side of the Navy Mole.

Development of the Navy Mole Site for an LNG terminal would require filling about 16 acres on the north side of the existing mole. This would result in a permanent loss of soft bottom marine habitats that would require mitigation. Despite the existence of contaminated sediments that will require remediation, this area of soft bottom is considered essential fish habitat (EFH) for a number of managed species and the fill would be a permanent impact on waters of the United States. Development of the Navy Mole Site for an LNG terminal would also require construction of a new wharf and pier structures, with associated dredging. The U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) generally recommends avoidance of impacts on EFH as its first preference (NOAA Fisheries, 1991).

Another drawback of the Navy Mole Site is the length of sendout pipeline that would be needed to connect the terminal to the SoCal Gas system. This pipeline would be 4.8 miles long, which is 2.5 miles longer than the sendout pipeline from the proposed site. LNG trucks accessing the site would also have to travel about twice the distance from the Terminal Island Freeway compared to the proposed site (2.4 miles for the Navy Mole Site compared to 1.2 miles for the proposed site). There are no housing units within 1.0 mile of either the Navy Mole Site or the proposed site.

Development of the proposed site at Pier T would involve dredging approximately 175,000 cubic yards of sediments for the ship berth. An additional 100,000 to 300,000 cubic yards of sediments would also have to be dredged to accommodate an underwater rock buttress necessary to reinforce the shoreline structures. Nevertheless, the resulting impacts on aquatic resources at the proposed site would be outweighed by the impacts on aquatic resources resulting from the permanent fill of 16 acres of open waters and the dredging required for construction of a new wharf and pier at the Navy Mole Site. Considering the greater impacts on aquatic resources, the greater length of the sendout pipeline, and the increased trucking distance, the Navy Mole Site would potentially result in more environmental impacts than the proposed site. Because use of the Navy Mole Site would not avoid or substantially lessen any significant environmental effects of the proposed project, it was eliminated from further consideration in this EIS/EIR.

3.3.4 Point Conception Site

Some commentors have asked why SES does not locate its facilities at a site near Point Conception, California, where the CPUC authorized another LNG import terminal project in 1978 (see figure 3.2.1-1). This earlier project, proposed by the Western LNG Terminal Company (Western Terminal), was designed to store and vaporize LNG shipped from Alaska and Indonesia.

Western Terminals' proposed Point Conception LNG terminal facility was the culmination of several years of effort to bring LNG to the California coast. As part of that effort, environmental impact studies were prepared for applications to construct LNG terminals at Los Angeles, Oxnard, and Point Conception. These proposals were designed so that each site would receive LNG produced at a different location. After these proposals failed to develop, Western Terminal proposed the project that was authorized by the CPUC for Point Conception.

The Point Conception Site is about 120 miles northwest of Los Angeles and is situated on a coastal cliff about 80 feet above the water level near the northern end of the Santa Barbara Channel. The project included a 6,000-foot-long LNG transfer line to connect the ships to the storage tanks and a 112-mile-long pipeline to deliver the natural gas to the Pacific Gas and Electric system. The FERC analyzed the project in a final EIS that was issued in October 1978.

The final EIS identified severe concerns with the Point Conception Site and recommended that LNG facilities not be constructed there. The basis for the recommendation to reject the Point Conception location was primarily the presence of an active fault on the site, the extraordinary amount of land work

required to develop the site (such as filling in ravines), and a significant cultural resources impact on the Chumash Nation.

Although the final EIS determined that other locations were environmentally superior to the Point Conception Site, those locations were eliminated from consideration due to the California LNG Terminal Act of 1977, which set limits of population density within 4 miles of an LNG terminal. Consequently, the CPUC issued its decision (in 1978) authorizing a conditional permit for the Point of Conception LNG facilities and the FERC approved the site in 1979. However, project opponents appealed the FERC's approval to the United States Court of Appeals for the District of Columbia, and the Court remanded the case back to the FERC for reconsideration.

During the ensuing years of hearings and legal proceedings, increasing domestic natural gas supplies rendered the project uneconomical. The project was never constructed and the agencies' approvals are no longer valid. Subsequently, the LNG Terminal Act of 1977 was repealed in 1987.

The current owner of the Point Conception property objects to the site being used for an LNG import terminal and is considering putting a conservation easement on the property to protect it from future industrial development (Allen & Kimbell, 2004). Given this and based on the adverse environmental impacts of constructing an LNG facility at Point Conception that were identified in the previous EIS, the additional impacts of constructing more than 100 miles of interconnecting pipeline, and the fact that the site is located outside of the geographic area that could efficiently serve the southern California LNG and natural gas markets, the Point Conception Site is not considered a practicable or environmentally preferable alternative to the proposed site.

3.4 PIPELINE ALTERNATIVES

To meet the project objectives, an alternative to the natural gas pipeline must be able to transport up to 1 Bscfd of natural gas from the LNG terminal to the SoCal Gas system; an alternative to the C_2 pipeline must be able to transport up to 10,000 MMBtu per day of vaporized C_2 from the LNG terminal to the ConocoPhillips LARC. Currently, the existing pipeline systems do not have the available capacity to transport these volumes of natural gas or vaporized C_2 to the delivery points.

The heavily industrialized nature of the project area limits the range of potential alternatives to the proposed route alignments. Nevertheless, the evaluation of variations to the proposed routes includes those that might avoid or minimize environmental impacts. Typically route variations would be identified and evaluated that have the potential to reduce overall environmental impacts associated with the proposed pipeline alignment by avoiding environmentally or otherwise sensitive resources such as residences, cultural resources sites, special-use areas, steep terrain, major waterbodies, and extensive wetlands. Due to the lack of environmentally sensitive areas crossed by the proposed pipeline routes, route variations were examined that might:

- maximize collocation with existing utility corridors;
- reduce the overall length of pipeline (in order to minimize construction impacts);
- minimize the need for construction workspace;
- avoid potential problems associated with crossing the Cerritos and Dominguez Channels; and
- minimize disturbance to other POLB activities including crane, truck, and rail traffic.

Additionally, the analysis of route variations is limited to those that are technically and economically reasonable. Based on the above criteria, two variations to the proposed pipeline routes were evaluated between the LNG terminal and the SoCal Gas system interconnect (i.e., Oil Field Variation and Carrack Avenue Variation). Because the proposed natural gas and C_2 pipeline routes follow the same alignment between the LNG terminal and the SoCal Gas system interconnect, the route variations considered for this segment apply to both the natural gas and C_2 pipelines. The analysis also includes three variations to the C_2 pipeline route between the end of the natural gas pipeline and the LARC (i.e., Edison Variation and Dominguez Channel Variations 1 and 2). All of these route variations are shown on figure 3.4-1.

3.4.1 Oil Field Variation

The Oil Field Variation would replace the corresponding segment of the proposed pipeline routes between mileposts (MPs) 0.40 and 1.61. Instead of crossing Ocean Boulevard at MP 0.40, the Oil Field Variation turns west and generally follows the south side of Ocean Boulevard for about 4,400 feet through the "W Strip" oil wells to the Terminal Island Freeway. On the north side of Ocean Boulevard, the route variation continues north for about 2,900 feet across Henry Ford Avenue and Dock Street to a location where the Cerritos Channel could be crossed using the HDD technique. After the channel crossing, the route variation continues north and the pipelines would be installed aboveground on precast pipe supports through an oil field. At the north end of the oil field, the route variation turns east and the pipelines would be bored under several railroad lines, the Terminal Island Freeway, and Hanjin Way. After crossing Hanjin Way, the pipelines would again be laid on precast concrete supports, adjacent to other existing steam and oil pipelines along Pier A Way. The route variation follows Pier A Way to Pier B Street where it rejoins the proposed route at MP 1.61.

The variation would be about 1.7 miles longer than the corresponding segment of the proposed routes and would require about 1 mile of the natural gas and C_2 pipelines to be located aboveground. Generally, pipelines that are placed aboveground are not as preferable as underground pipelines because they are more exposed to accidental or intentional damage. Because the Oil Field Variation does not avoid or substantially lessen impacts associated with the corresponding segment of the proposed pipeline routes, this variation was eliminated from further consideration in this EIS/EIR.

3.4.2 Carrack Avenue Variation

The Carrack Avenue Variation would replace the corresponding segment of the proposed pipeline routes between MPs 1.31 and 2.08. Instead of turning west at the intersection of Carrack Avenue and Pier A Way at MP 1.31, the Carrack Avenue Variation continues along and adjacent to Carrack Street until its end where it rejoins the proposed routes at MP 2.08. This variation is 0.3 mile shorter than the corresponding segment of the proposed routes and would require two less horizontal or slick bore crossings[5] compared to the proposed routes (seven rather than eight crossings for each of the pipelines). However, construction along the Carrack Avenue Variation would involve crossing 17 pipelines that connect to the pipelines that currently run parallel to Carrack Avenue. Crossing this many pipelines would complicate and slow construction. Additional workspace would also likely be necessary to accommodate construction activities in these areas. Although somewhat shorter, the Carrack Avenue Variation does not avoid or substantially lessen impacts associated with the corresponding segment of the proposed routes; therefore, this variation was eliminated from further consideration in this EIS/EIR.

[5] In order to avoid interrupting vehicle or rail traffic, pipelines are frequently installed at road or railroad crossings by boring beneath the feature and pulling a section of pipe through the bore hole (see section 2.3.2). This technique generally requires additional extra workspace on each side of the road or railroad and is more expensive than conventional open-cut crossings.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 3-30
Figure 3.4-1

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov

3.4.3 Edison Variation

The Edison Variation would replace the corresponding segment of the proposed C_2 pipeline route between MPs 2.25 and 3.65. This variation begins near the point where the natural gas pipeline ends at the interconnection with the SoCal Gas system at about MP 2.25. From there, the Edison Variation continues north on the west side of the Edison powerline right-of-way for 1.14 miles. The variation then turns west for approximately 0.2 mile to rejoin the proposed route at about MP 3.65, just before the Dominguez Channel crossing. The Edison Variation would not be appreciably longer than the proposed route, would cross similar industrial land uses, and would offer no apparent environmental advantages. Furthermore, it is unlikely that a right-of-way for the C_2 pipeline could be obtained because of the existing utilities already in place. Because the Edison Variation does not avoid or substantially lessen impacts associated with the corresponding segment of the proposed C_2 pipeline route, this variation was eliminated from further consideration in this EIS/EIR.

3.4.4 Dominguez Channel Variations 1 and 2

The Dominguez Channel Variations 1 and 2 were identified as potential options for routing the C_2 pipeline along the Dominguez Channel. The Dominguez Channel Variation 1 turns west from the proposed route near MP 2.45 and continues west for about 0.28 mile to the Dominguez Channel. At that point, this variation turns north and continues for 0.47 mile along the east side of the Dominguez Channel to rejoin the proposed route at MP 3.08. The Dominguez Channel Variation 2 turns west from the proposed route near MP 2.72, continues west for about 0.17 mile to the Dominguez Channel, and then turns north to rejoin the proposed route at MP 3.08. Both of the Dominguez Channel route variations were eliminated from further consideration in this EIS/EIR because the number of existing utilities already in place along these alignments and the lack of adequate space to install the C_2 pipeline make these variations infeasible.

3.5 DREDGE AND FILL ALTERNATIVES

As described in sections 2.1.1.1 and 2.3.1.3, the Long Beach LNG Import Project would require the modification of Berth T-126 to accommodate LNG ships. The proposed project would involve dredging of approximately 175,000 cubic yards of sediments at Berth T-126 to achieve a uniform water depth of -55 feet MLLW. The area affected by the dredging of the ship berth would be about 200 feet by 1,150 feet (5.3 acres) and currently ranges in depths from -46 to -53 feet MLLW. The LNG ship berth and unloading facility would require the construction of an unloading platform and multiple mooring and breasting dolphins that would be supported by concrete and/or steel piles or jacketed structures.

As described in section 2.3.1.2, it would be necessary to reinforce the existing shoreline structures to support the upland loads generated by the LNG storage tanks and other heavy load structures. Three strengthening options being considered for the wharf at Berth T-126 include rehabilitation of the existing structure, demolition of the entire deck structure, or demolition of half of the deck structure and retrofitting of the remaining portion. All three options would require installation of an underwater rock buttress. Depending on the final wharf improvement option selected, construction of the Berth T-126 rock buttress would require between 900,000 to 1.2 million tons of rock. An underwater rock buttress would also be necessary along the westerly portion of Berth T-124. This rock buttress would require between 100,000 and 500,000 tons of rock. Installation of the rock buttresses at Berth T-126 and Berth T-124 would require the dredging of between 100,000 and 300,000 cubic yards of sediments depending on the west wharf improvement and rock buttress configuration option chosen. This dredging would disturb an area up to 6.6 acres along the edge of the existing pier.

Dredging and placement of structures within waters of the United States fall under the jurisdiction of the ACOE and require a CWA section 404 permit from the ACOE (see section 1.2.3). As an element

of its review, the ACOE is required to consider whether a proposed project represents the least environmentally damaging practicable alternative pursuant to the CWA section 404(b)(1) guidelines (see Title 40 CFR Part 230). The term practicable means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. As a cooperating agency, the ACOE has recommended that the alternatives analysis in this EIS/EIR consider project design, configuration, and construction alternatives that avoid or minimize effects on the aquatic environment. In this way, this EIS/EIR could be used to identify the ACOE's least environmentally damaging practicable alternative.

Ultimately, activities associated with dredging, construction of the LNG ship berth and unloading facility, and strengthening the shoreline structures would be conducted in accordance with ACOE permit stipulations as well as the requirements of state and local permits (see sections 1.5, 4.3.3.1, and 4.3.3.2). To avoid or minimize impacts on water quality or biological resources associated with these activities (see sections 4.3.3 and 4.4.3), reduced dredge/fill alternatives, alternative ship birth configurations, dredge disposal alternatives, and alternative dredging methods were considered.

3.5.1 Reduced Dredge/Fill Alternatives and Alternative Ship Berth Configurations

The extent of dredging that would be necessary for the proposed project for the ship berth was established based on the minimum volumes needed to safely accommodate the largest LNG ships expected to be operating in the future during all periods of the tidal cycle. The proposed berth on the west side of Pier T would be dredged to a depth of approximately -55 feet MLLW at the breasting dolphins. This would provide at least 7 feet of depth under the deepest draft ships. Alternatives requiring less dredging may not be able to fully accommodate all LNG ships. Similarly, any in-water pilings, structures, or rocks would result in the least fill necessary while still providing for a sound LNG ship berth and shoreline structures that would adequately support the heavy upland loads generated by the LNG terminal facilities. As such, it was not considered practicable or feasible to reduce dredging or the use of in-water piles/structures/rocks and still satisfy the stated objectives of the project.

As an alternative to dredging, an evaluation was conducted to determine whether it would be possible to locate the ship berth in deeper water by increasing the distance between the face of the pier and the dolphins/platform. The water depths extending for at least 800 feet from the west side of Pier T are similar to the depth adjacent to the pier; therefore, increasing the distance between the face of the pier and the dolphins/platform to the west would not reduce the amount of dredging. Similar water depths occur for at least 500 feet to the south side of Pier T; consequently, this increase in distance would not reduce dredging. However, beginning 500 feet to the south side of Pier T, the water depths increase to approximately -55 feet MLLW. Therefore, to eliminate dredging in waters of the United States would require using additional and/or larger pilings to support a larger platform or a trestle between a platform located more than 500 feet to the south of the pier. A platform in this location would be within the shipping channel of the Middle Harbor and would impact other vessel movements and use of the West Basin (see figure 3.5.1-1). Additionally, it would increase the distance required to transport the LNG from the ship to shore, requiring a greater length of cryogenic transfer pipeline, which could result in lowered transfer efficiencies and increased safety considerations. Given the temporary, minor direct impacts of construction-related dredging on aquatic resources (see sections 4.3.3.2 and 4.4.3), the fact that the area in question has been dredged in the past and is part of an active commercial port, and the fact that the benthic community would be expected to recover rapidly after dredging, the alternative of extending the ship berth further from the pier was not considered a practical alternative when compared to the reduction in safety that could result from the required design modifications associated with this alternative. Because an alternative design of the ship berth would not avoid or substantially lessen any significant environmental effects of the proposed project, this alternative was eliminated from further consideration in this EIS/EIR.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 3-33
Figure 3.5.1-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

An alternative location for the LNG terminal that would reduce the amount of dredge and fill associated with the project was previously discussed in section 3.3.3.1.

3.5.2 Dredge Disposal Alternatives

Disposal of dredged materials within waters of the United States requires a permit from the ACOE. As discussed in section 2.1.1.1, a portion of IR Site 7 is adjacent to Berth T-124, at the southern end of the project site, and at Berth T-126, which is the berth proposed for the Long Beach LNG Import Project. Past sampling has indicated that there are chemically impacted sediments present. The POLB has recently negotiated a consent agreement with the DTSC for its concurrence with the IR Site 7 sediment remediation. Accordingly, the dredging associated with the proposed project would be done only with the concurrence of the DTSC and in accordance with permits issued by the ACOE and the RWQCB (see section 4.2.3). The POLB currently plans to dispose of the sediments at a confined disposal site previously approved for contaminated materials within Long Beach Harbor (e.g., ITS Slip fill, East Basin Slip 1 fill, or upland site). The POLB could propose to dispose of uncontaminated dredged materials at an unconfined aquatic location (i.e., Western Anchorage Temporary Sediment Storage Site) if the sediments were determined by the ACOE to be suitable for unconfined aquatic disposal. In order to determine disposal site suitability, the POLB would prepare and implement a Sampling and Analysis Plan in accordance with the three-tiered testing protocols in the EPA/ACOE Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (Inland Testing Manual). Based on the results of the tiered testing protocols, the ACOE would review and approve or deny the use of an unconfined aquatic location, or alternately a request to take the materials to a confined or upland site. Because there are approved disposal sites for contaminated and uncontaminated sediments available in the area, no other alternatives were evaluated for disposal of the dredged materials.

3.5.3 Alternative Dredging Methods

The POLB typically uses mechanical dredging equipment for maintenance and improvement dredging of the harbors and channels. Mechanical dredging involves equipment such as clamshell dredges, dipper dredges, draglines, grab buckets, and barge-mounted excavators for the removal of bottom sediments and other materials. The dredged material removed by mechanical methods is typically high in solids content and lower in mixed waters than are sediments removed by hydraulic dredge methods. Mechanical dredging equipment involves the use of a bucket to place dredged materials in scows or on barges for transport to a disposal area. Various bucket designs are available that are able to reduce the amount of solids suspended in the water column.

Alternatively, hydraulic dredging equipment could be used for this project. Hydraulic dredges operate using a centrifugal pump capable of handling solids to transport a slurry of dredged sediments and water through a pipeline. The slurry containing the dredged materials is hydraulically transported through the pipeline from the dredged area to a disposal site. For long distance transport, the slurry can also be placed in barges for removal to the disposal site. Although hydraulic dredging typically generates somewhat lower levels of turbidity throughout the water column at the dredge site compared to mechanical dredging methods, the environmental advantages of hydraulic dredging equipment are not compelling given the setting and the disadvantages associated with disposing of the higher volume of dredge slurry. However, there are several disadvantages associated with the use of this equipment. First, the hydraulic dredge would typically require a long, temporary pipeline system, which could potentially become an obstruction to navigation and/or vessel movement with the harbor. Hydraulic dredging also entrains significant amounts of water during the dredging process, requiring a much larger disposal area and longer drying times. If barges are used to transport dredged materials, it requires more barge movements between the dredge site and the disposal area than would be necessary if mechanical dredging

were used. There are sometimes water quality issues associated with overflow off of the barge. Given the limited extent of the dredging necessary for this project and the relatively minor associated environmental impacts, hydraulic dredging methods are not believed to be a practical alternative to mechanical dredging equipment for this project. Because hydraulic dredging would not avoid or substantially lessen any significant environmental effects of the proposed project, this alternative dredging method was eliminated from further consideration in this EIS/EIR.

3.6 VAPORIZER ALTERNATIVES

There are various designs of equipment that are used to warm LNG to the point it returns to a gaseous state. SES considered operational advantages and stability, space requirements, environmental controls, and costs in selecting the vaporization equipment for the Long Beach LNG Import Project. Because SES selected a vaporizer design that utilizes the combustion of natural gas for heating, and air emissions would be generated, other designs were evaluated to determine if an alternative design could result in reduced impacts. For purposes of an environmental comparison, vaporizers can be broadly categorized into two groups depending on whether or not they require onsite combustion of a fuel to warm the LNG.

Vaporizers Not Requiring Combustion

LNG vaporizers generally utilize a warm water bath to provide the heat exchange required to increase the temperature of the LNG and cause it to vaporize. Generally, the LNG is pumped through a closed system of stainless steel pipes that are immersed in the warm water bath. As the LNG is vaporized, the warm water in the bath is cooled and needs to be continually rewarmed. Generally the heat used to rewarm the water bath is provided by the combustion of natural gas. However, at some locations with warm climates, it is possible to use ambient warm air to rewarm the water bath or ambient warm water as a source of the heat needed to vaporize the LNG. The advantage of vaporizers that utilize ambient air or water vaporization systems is that air emissions tend to be lower than for a system that involves combustion of a hydrocarbon fuel (Coast Guard and MARAD, 2003). Although air or water vaporizers can result in very small quantities of air emissions associated with electrical generation required to power fans or pumps, the power is generally produced offsite and the amount needed for the vaporizers is relatively minor.

Ambient air-heated vaporizers utilize air warming structures as heat exchangers to recirculate the cooled water from the water bath and warm it through exposure to the air. Because the surface area of the water–air interface needs to be large for efficient heat transfer, the structures are generally large and require significant space for construction and operation. Ambient air-heated vaporizers were not considered practical for the Long Beach LNG Import Project because of the comparatively large footprint necessary to operate this system and the limitations associated with periods of cool weather in the Long Beach area along the coast.

Circulating warm sea water through the warm bath and over heat exchangers (i.e., once-through heating) is sometimes used as a method for vaporizing LNG. For the Long Beach LNG Import Project, a sea water vaporization system would require withdrawing (and discharging) water from Long Beach Harbor at the rate of about 78,000 gallons per minute (gpm) (40 billion gallons per year). Representatives of NOAA Fisheries and the CDFG indicated that significant numbers of fish and/or fish larvae could be entrained during the withdrawal of sea water. Additionally, the Los Angeles RWQCB noted concern about the thermal plume associated with discharging cold water back into the harbor. Based on these environmental concerns, SES eliminated the use of sea water as a method of vaporizing the LNG from further consideration.

Vaporizers Requiring Combustion

Two vaporizers that require the combustion of fuel were considered for the Long Beach LNG Import Project, the submerged combustion vaporizer and the shell and tube vaporizer.

Submerged combustion vaporizers are generally based around a concrete structure containing a water bath with submerged stainless steel pipe coils. LNG enters the coils and, as it is warmed by the water bath, the vaporized LNG (natural gas) exits the coils. The water bath is warmed by burning natural gas. Blowers provide combustion air at a pressure sufficient to force the combustion emissions up through the water bath where they heat the water. This type of submerged combustion vaporizer system is very efficient and is able to accommodate wide fluctuations in the amount of LNG vaporized. It tends to have higher air emissions than other combustion units because the use of selective catalytic methods to control emissions has not proven reliable.

The shell and tube vaporizer is based on a simple heat transfer between the LNG on the tube side and the source of heat on the shell side of the exchanger. The source of heat may vary depending on the particular design. A vertical shell and tube design with a closed-loop hot water system that provides heat to the vaporizers was considered. The water is heated using direct-fired heaters run on natural gas. About 100,000 gallons of fresh water would be necessary to operate this closed-loop system. An advantage of the shell and tube vaporizer is that selective catalytic reduction (SRC) systems and oxidation catalysts can be used on the heaters to reduce NO_x and CO emissions.

Typical air emissions associated with submerged combustion vaporizers and shell and tube vaporizers are presented in table 3.6-1. The proposed vaporizer for the Long Beach LNG Import Project is the shell and tube vaporizer. In addition to having lower air emissions, this type of vaporizer is efficient, can be readily integrated with the NGL extraction system, and utilizes proven vaporizer technology. Shell and tube vaporizers are also the most compact LNG vaporizers available, an important consideration given the size of the LNG terminal site.

TABLE 3.6-1

Typical Air Emissions Associated with Vaporizer Combustion

	Air Emissions (tons per year)		
Vaporizer Design	NO_x	CO	PM_{10}
Submerged Combustion Vaporizer [a]	110	94	19
Shell and Tube Vaporizer [b]	14	25	27

[a] Emissions are based on a vendor quote for a system utilizing water injection as a control method for NO_x.

[b] The shell and tube vaporizer used in this estimate is of the vertical shell and tube design. This design uses water as an intermediate heat transfer fluid in a closed-loop system, whereby the water is warmed using direct-fired heaters. Emissions are based on utilizing selective catalytic reduction and oxidation catalysts on the fired heaters to control both NO_x and CO emissions.

NO_X = nitrogen oxides
CO = carbon monoxide
PM_{10} = particulate matter having an aerodynamic diameter of 10 microns or less

Recently, new vaporization processes have been developed that primarily utilize air exchangers as a heat source. Standard fin-fan type air exchangers are used to warm an intermediate fluid loop (consisting of propane, water/glycol, potassium formate/water, or other liquid solutions) that circulate through the LNG vaporizers. These systems, particularly in areas where ambient conditions drop below 50 ºF, require a secondary backup whereby heat can be added to the circulating intermediate fluid from natural gas-fired heaters or where the LNG can be vaporized by a parallel system (e.g., submerged

combustion vaporizers). These new vaporization processes would have lower fuel gas requirements than conventional combustion vaporizers. For example, it is estimated that a vaporization process utilizing air exchangers could reduce fuel use by about 90 percent compared to conventional combustion vaporizers in an area like Long Beach where the average air temperature is about 64 ºF. Reduced fuel use would lead to a corresponding reduction in air emissions and operating costs. While air exchange systems have been successfully demonstrated and operated at other facilities (e.g., Dahej LNG terminal in India), the space requirements of air exchangers and back-up heaters/vaporizers appear to make this approach technically infeasible at the site proposed for the Long Beach LNG Import Project. Therefore, this alternative was eliminated from further consideration in this EIS/EIR.

4.0 ENVIRONMENTAL ANALYSIS

This section describes the affected environment as it currently exists and discusses the environmental consequences of the proposed project. The discussion is organized by the following major resource topics: geology; soils and sediments; water resources; biological resources; land use, recreation, and visual resources; socioeconomics; transportation; cultural resources; air quality; noise; reliability and safety; cumulative impacts; and growth-inducing impacts.

The environmental consequences of constructing and operating the Long Beach LNG Import Project would vary in duration and significance. Four levels of impact duration were considered: temporary, short term, long term, and permanent. Temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. Short-term impact could continue for up to 3 years following construction. Impact was considered long term if the resource would require more than 3 years to recover. A permanent impact could occur as a result of any activity that modifies a resource to the extent that it would not return to preconstruction conditions during the life of the project.

The specific criteria used to determine the significance of an impact are presented at the beginning of each major resource section. Unless otherwise noted, all identified impacts are considered to be potentially significant adverse impacts before applying SES' proposed mitigation (i.e., control measures). If any impacts remain significant (i.e., continue to exceed the significance criteria) after SES implements its proposed control measures, the FERC and POLB staffs developed additional mitigation in an effort to reduce any significant impact to a less than significant level. These recommended mitigation measures appear offset with bold type in the text. The staffs of the FERC and the POLB will recommend to their respective Commissions that these additional mitigation measures be included as specific conditions to any approvals issued by the FERC and the POLB for the Long Beach LNG Import Project.

The conclusions in this EIS/EIR are based on the analysis of the environmental impact and the following assumptions:

- all applicable laws and regulations would be complied with;
- the proposed facilities would be constructed as described in section 2.0 of this EIS/EIR; and
- the control measures included in SES' applications and supplemental submittals to the FERC and the POLB would be implemented.

4.1 GEOLOGY

4.1.1 Significance Criteria

Impacts on the geologic environment would be considered significant if:

- construction activities or the siting of project facilities would worsen existing unfavorable geologic conditions;
- construction or operation of the project would preclude or disrupt the development of mineral resources; or
- project construction would result in damage or loss of vertebrate or invertebrate fossils that are considered important by paleontologists.

Impacts of geologic hazards on the proposed project would be considered significant if:

- earthquake-induced ground motion or liquefaction would cause damage to the LNG terminal, pipelines, electric distribution facilities, or shoreline structures that would expose the public to substantial risk of injury.

4.1.2 Geologic Setting

4.1.2.1 Environmental Setting

The facilities and work areas associated with the Long Beach LNG Import Project would be located within the Pacific Border physiographic province, which consists of rugged coastal and inland mountain ranges separated by broad, flat basins. More specifically, the project would be located on the southwest edge of the LA Basin, an alluvial plain created by tectonic subsidence and subsequent filling by sediments eroded from surrounding mountains. The LA Basin is bounded to the north by the Santa Monica Mountains, to the east by the Santa Ana Mountains and the San Joaquin Hills, and to the south and west by the Pacific Ocean. The basin is a coastal plain of low relief that slopes gradually seaward. Topography in the project area ranges from approximately 20 feet above mean sea level (msl) at the proposed LNG terminal site to between 5 and 15 feet above msl along the pipeline routes.

The LA Basin is situated within the active boundary zone between the North American and Pacific tectonic plates. In the project area, the width of the boundary zone extends more than 220 miles from the offshore San Clemente fault zone to the eastern California shear zone in the Mojave Desert. Deformation along the boundary zone is predominantly right-lateral strike-slip, but is complicated in the Los Angeles area by compressional deformation along the "Big Bend" in the San Andreas fault zone, about 50 miles northeast of the POLB, and by changes in regional tectonics over the last 4 to 5 million years. Deformation in the area is now accommodated by northwest-trending right-lateral strike-slip faulting of the San Andreas system and other parallel faults, east to northeast-trending left-lateral strike-slip and reverse oblique-slip faulting, and west to northwest-trending thrust and reverse faulting (Walls et al., 1998).

The LA Basin is underlain by a major structural depression that has been the site of subsidence and deposition since the Miocene epoch (5 to 23 million years ago). The POLB is located over the southwest flank of the Wilmington Anticline, a northwest-southeast trending, basement-cored fold situated on the upper plate of the THUMS-Huntington Beach (THUMS-HB) fault. Recent studies by the USGS indicate that sediments as young as early Holocene (approximately 11,000 years old) are deformed

over the Wilmington Anticline, but there is no apparent faulting of these sediments or older strata in the project area (Edwards et al., 2001, 2002, 2003). Faults and seismic activity in the project area are discussed in section 4.1.4.1.

The project area is underlain by fill materials, alluvial and marine sediments, sedimentary rocks, and metamorphic basement rocks. Terminal Island is a largely manmade island that has been constructed and expanded since the early 1900s through various reclamation projects. Most of the infilling was by hydraulic methods; however, land-based materials were placed by mechanical methods after the occurrence of subsidence in the area (see section 4.1.4.2). Fill ranging in thickness from approximately 45 to 60 feet below ground surface (bgs) was encountered in all of the geotechnical soil borings conducted at the LNG terminal site (URS, 2003a). The upper 20 to 25 feet of fill beneath most of the southern portion of the terminal site is fine grained, whereas the upper 20 to 25 feet of fill beneath the northern portion of the terminal site is more coarse grained. Below a depth of about 25 feet, the fill materials across the entire LNG terminal site consist of predominantly loose to medium dense sands and silty sands, with layers of medium stiff to stiff fine-grained materials.

Beneath the fill materials at the LNG terminal site are 20 to 35 feet of silt and clay estuarine deposits. The estuarine deposits are underlain by predominantly marine sands to the maximum depth explored of about 160 feet bgs. Quaternary (1.8 million years ago to present) sand, silt, and clay deposits are estimated to be approximately 5,000 feet thick in the project area, and as much as 15,000 feet thick near the depositional center of the LA Basin located several miles to the north (Davis and Namson, 1998).

Quaternary deposits in the project area are underlain by approximately 10,000 feet of Tertiary (65 to 1.8 million years ago) sedimentary rocks that are underlain by Mesozoic (245 to 65 million years ago) metamorphic basement rocks (Davis and Namson, 1998). The Tertiary sedimentary rocks also expand towards the north, attaining a thickness of at least 25,000 feet near the center of the LA Basin. Tertiary and Quaternary units also thicken to the southwest, off the southwest flank of the Wilmington Anticline.

Similar fill and sedimentary deposits would be crossed by the electric distribution facilities and the southern 1.4 miles of the pipeline routes. Surficial deposits from MPs 1.4 to 3.8 of the pipeline routes have been mapped as soft clay, silt, silty sand, and sand of distal fan deposits associated with the active Los Angeles River system. Older alluvial deposits, generally described as dense to very dense sand and silty sand, are present at the surface from MPs 3.8 to 4.6 of the C_2 pipeline route.

4.1.2.2 Impact and Mitigation

Construction of the LNG terminal, electric distribution facilities, and pipelines would occur primarily within near-surface non-native fill deposits and unconsolidated soils and sediments. The construction laydown and worker parking area is gravel-covered and would not require any surface disturbance. Therefore, construction and operation of the Long Beach LNG Import Project would not materially alter the geologic conditions of the area or worsen existing unfavorable geologic conditions. No blasting would be required for construction of the project facilities. Effects from construction would be limited to disturbances to the existing topography due to grading, tank foundation excavation, pipeline trenching activities, and improvement of subsurface materials at the LNG terminal site by pile driving and the installation of stone columns. Foundations and soil improvements are discussed in section 4.1.4.3. As discussed in section 2.3.1.1, approximately 1 foot or 40,000 cubic yards of soil would be stripped by SES from the LNG terminal site following demolition and removal of the existing structures at the site by the POLB. Where necessary, soft areas would be over-excavated and filled with structural fill and the site would be brought up to final grade**.** Pipeline trenching would result in temporary, localized, and minor disturbance to near-surface fill and geologic materials. Once pipeline construction activities are complete in a given section, the grade and drainage patterns would be reestablished. As a result, impacts associated

with the Long Beach LNG Import Project on the overall geologic setting of the area would be less than significant. A discussion of the potential effects of geologic hazards on the LNG terminal site facilities is presented in section 4.1.4.3.

4.1.3 Mineral Resources

4.1.3.1 Environmental Setting

Due to the local geologic conditions, historic infilling, and urban setting of the project area, the only mineral resource in the area is petroleum.

Petroleum production began shortly after the 1932 discovery of oil on the Wilmington Anticline, which partly underlies the project area. Oil production has primarily occurred from sedimentary rocks at depths of around 4,000 feet.

There are no active petroleum production wells located within the LNG terminal site boundaries. The nearest active oil well is located approximately 75 feet east of the proposed LNG terminal site and is presently shut-in. There are 8 abandoned production wells adjacent to the terminal site, and the pipeline routes are adjacent to over 40 other abandoned production wells. Additionally, the LNG terminal site is crossed by a number of pipelines associated with oil production, water injection, former naval operations, and more recent POLB activities (URS, 2003a).

4.1.3.2 Impact and Mitigation

Underground pipelines that serve oil wells in the area could be encountered during project construction. All active and inactive pipelines encountered during LNG terminal site preparation would be relocated, removed, or abandoned in place using a sand-cement slurry after review of their location and approval by the project geotechnical engineer and pipeline owner. Before construction, SES would submit an application to the DOGGR to conduct a Construction Site Review to identify and manage all active and abandoned petroleum production wells. Through the Construction Site Review process, the DOGGR assists in identifying and managing oil and gas wells located near or beneath proposed structures by specifying procedures for:

- locating wells, including records review and the use of test pits and magnetometer surveys, if necessary;
- surveying and identifying wells on site plans;
- testing of accessible, abandoned wells on the construction site for gas and oil leaks; and
- plugging and abandonment, or re-abandonment of wells, if necessary.

Upon completion of any required well work and the Construction Site Review process, the DOGGR would affix either a Division certification or review stamp to the construction plans and forward a copy of the approved plans to the local permitting agency to assist in the issuance of local construction permits.

SES would ensure that the construction contractor applies for the Construction Site Review and abides by the DOGGR's requirements. Implementation of these measures would reduce any potential impacts on oil production in the area associated with construction and operation of the proposed project to less than significant levels. Conversely, ongoing petroleum production would have no significant impact

on the operation of the LNG facility because ground subsidence due to petroleum production in the area has been, and will continue to be, controlled through water injection (see section 4.1.4.2).

4.1.4 Geologic Hazards

Geologic hazards present in the project area are related to seismic activity and historical subsidence associated with petroleum production in the area. Conditions or activities necessary for the development of other geologic hazards including karst terrain, avalanches, landslides, and volcanism are not present in the immediate project area.

4.1.4.1 Seismic Hazards

SES conducted site-specific geotechnical and geoseismic studies to evaluate the risk of seismic-induced damage to the proposed LNG terminal site (URS, 2003a, 2003b, 2004). These studies were conducted to meet the seismic design requirements of the OPS (Title 49 CFR Part 193), the FERC, and the POLB. The geotechnical and geoseismic studies were prepared in general conformance with *Data Requirements for the Seismic Review of LNG Facilities, NBSIR 84-2833* and California Geological Survey Note 48, *Checklist for the Review of Geologic/Seismic Reports for California Public Schools, Hospitals, and Essential Services Buildings.* The studies contain the baseline data, assumptions, analysis, and rationale behind SES' proposed seismic control measures described in section 4.1.4.3. The geotechnical and geoseismic studies are available for viewing on the FERC Internet website and at the POLB offices in Long Beach.[1] The results of these studies are summarized in the following sections.

The Agency Staffs have reviewed SES' analysis of seismic hazards in the project area and its proposed design measures to mitigate seismic-induced damage to the LNG terminal. In conducting their review, the Agency Staffs were assisted by Dr. Felix Yokel, formerly of the National Institute of Standards and Technology.

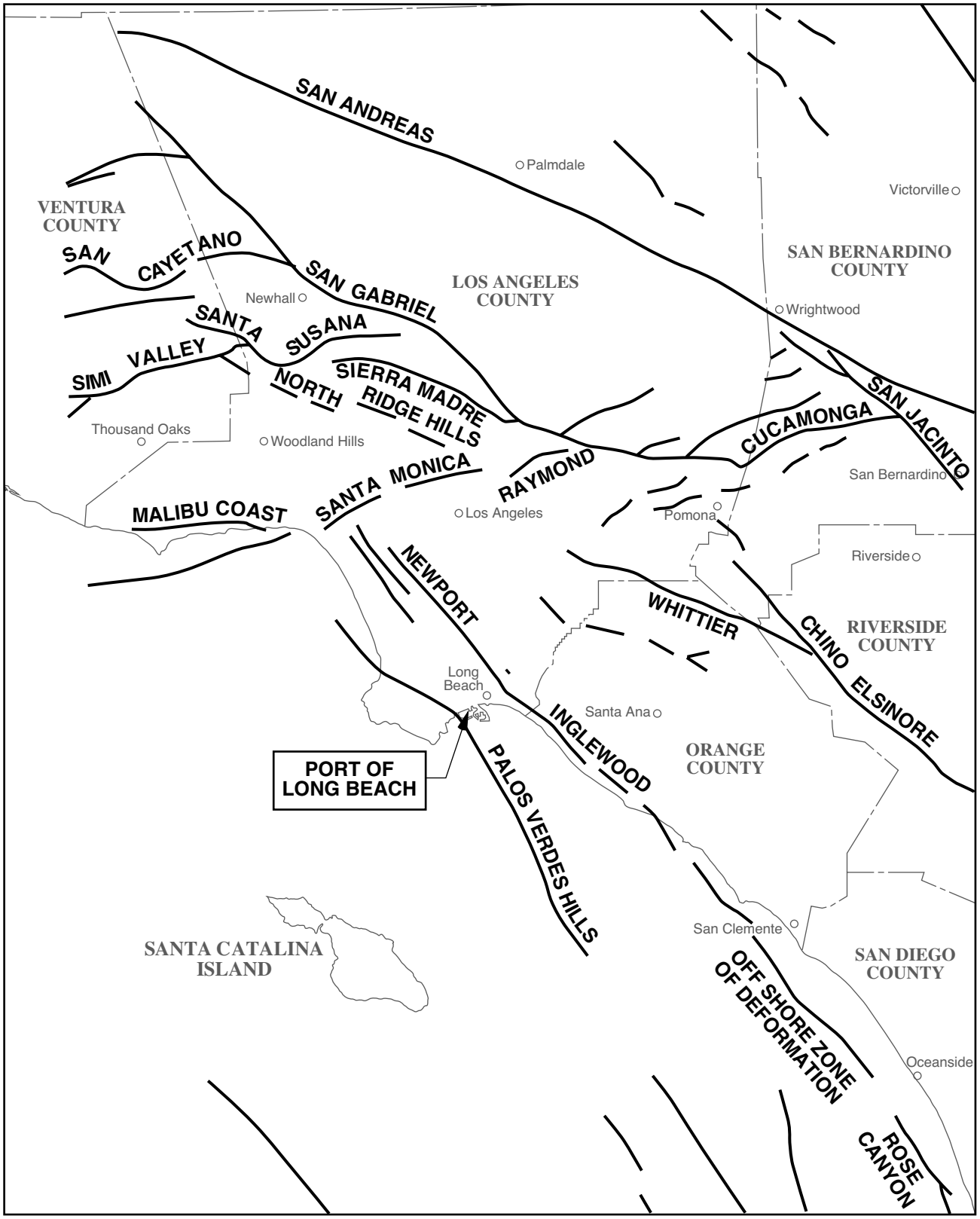
In summary, the project is located in a region of high seismic activity due to its tectonic setting in the boundary between the North American and Pacific tectonic plates. Seismic-related hazards that could affect the project facilities include earthquakes; surface rupture; soil liquefaction, settlement, and lateral spreading; and tsunamis. These hazards are discussed in the following sections.

Earthquakes

In the project region, the high rate of relative motion between the North American and Pacific tectonic plates is largely accommodated along eight major fault zones. From west to east, these fault zones are the San Clemente, Santa Cruz-Santa Catalina Ridge, Palos Verdes (2.5 miles west of the LNG terminal site), Newport-Inglewood (4.3 miles east of the LNG terminal site), Elsinore, San Jacinto, San Andreas, and the eastern California shear zone (see figure 4.1.4-1). The Elsinore, San Jacinto, and San Andreas faults to the east of the project area are among the most active faults in California, and each has had moderate to large magnitude earthquakes with recurrence intervals on the order of several hundred years.

[1] URS, 2003a and 2003b are included as Appendices 6-1 and 6-2 of Resource Report 6 on the FERC Internet website (http://www.ferc.gov). URS, 2004 is on the website as a separate submittal. Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number excluding the last three digits in the "Docket Number" field (i.e., CP04-58). Be sure to select an appropriate date range. Copies are also available for viewing at the POLB's offices at 925 Harbor Plaza, Long Beach, California.

29018301NRGINC3-08 REV.05/17/05



0 15 30 MILES

SCALE

SOURCE: Ninyo & Moore, 1995.

Figure 4.1.4-1

Long Beach LNG Import Project

Fault Location Map

Some of the larger historical earthquakes that have occurred within approximately 20 kilometers (13 miles) of the LNG terminal site include:

- The 1933 Long Beach earthquake, a moment magnitude (M_W) 6.4 event generated by the Newport-Inglewood fault. Although the epicenter of this earthquake was approximately 18 miles southeast of the LNG terminal site, the fault rupture proceeded northwest along the fault and into Long Beach, causing significant damage to buildings in downtown Long Beach and minor damage to facilities in the Port (which were then relatively undeveloped).

- Two local magnitude 4.8 earthquakes in 1941, also within the Newport-Inglewood fault zone, centered approximately 2.5 and 4.4 miles from the LNG terminal site.

Four additional earthquakes greater than the 1933 Long Beach earthquake have occurred within about 100 kilometers (63 miles) of the LNG terminal site as shown in table 4.1.4-1.

TABLE 4.1.4-1

Earthquakes of Moment Magnitude Greater Than 6.5 Within 100 Kilometers (63 miles) of the LNG Terminal Site

Date	Earthquake	Causative Fault	M_W	Epicentral Distance (miles)
December 8, 1812	Wrightwood	San Andreas	7.5 (estimated)	49 [a]
January 9, 1857	Fort Tejon	San Andreas	7.9 (estimated)	49 [b]
February 9, 1971	San Fernando	San Fernando	6.6	40
January 17, 1994	Northridge	Northridge blind thrust	6.7	37

[a] The exact location of the 1812 earthquake on the San Andreas fault is uncertain, but there is evidence of surface rupture on both the Wrightwood and Mojave segments. The referenced distance is the closest distance of the Mojave segment to the LNG terminal site.

[b] The referenced distance is the closest distance of surface rupture to the LNG terminal site; the epicentral distance was approximately 187 miles northwest of the site.

Ground motions associated with earthquakes are complex, but are often expressed in terms of how quickly the speed of the ground is changing or accelerating. Seismic hazard analysis also expresses earthquake-related motions in terms of the response spectra, or the approximate motions that would be experienced by a building. The greatest ground motion that has occurred at the proposed LNG terminal site during the past 150 years is estimated to have been associated with the 1933 Long Beach earthquake during which maximum or peak ground accelerations (PGA) of 20 percent gravity (0.20 g) horizontal component and 0.29 g vertical component were recorded at the nearby Long Beach Public Utilities Building. Before the 1933 earthquake, the greatest recorded ground motion at the proposed LNG terminal site was judged to be caused by the 1857 Fort Tejon M_W 7.9 earthquake, with an estimated median PGA of 0.09 g and an 84th percentile PGA of 0.14 g (URS, 2003b).

NFPA 59A Seismic Design Criteria – The OPS and the FERC require that seismic risk at proposed LNG terminals be assessed in accordance with NFPA 59A (2001). These requirements are discussed below. To satisfy these requirements, probabilistic seismic hazard analyses (PSHA) and deterministic seismic hazard analyses (DSHA) were conducted to quantify the magnitude and likelihood of certain ground motions that could occur at the LNG terminal site (URS, 2003b). In completing the seismic hazard assessment, Dr. Tom Rockwell of San Diego State University; Dr. John Shaw of Harvard University; and Michael Fisher, Daniel Ponti, and Brian Edwards of the USGS were consulted to obtain unpublished information and data on the potentially active faults in the project area, and to confirm that the most current data were used in the assessment.

The seismic hazard analysis included input data for 38 potential seismic sources in the region, including fault type, maximum anticipated magnitude, distance from the LNG terminal site, recurrence intervals, and consideration of local geology in modeling ground motion attenuation. The Palos Verdes fault/fault zone and the Newport-Inglewood fault/fault zone were found to be the main contributors to the potential ground motion hazard at the LNG terminal site because of their proximity and relatively high recurrence rates.

As required by NFPA 59A, the results of the seismic analysis were used to obtain PGA and response spectra for two design level earthquakes: the Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE). For the proposed LNG terminal site, the results of the PSHA governed the determination of the OBE and SSE motions. In general, the OBE represents the level of ground shaking through which a well-constructed facility should be able to operate and continue operating after its occurrence, with perhaps a brief shutdown for a safety inspection to confirm that no damage occurred. The results of the PSHA indicate that the mean recurrence interval of the OBE is 475 years. That is, the OBE represents the ground motions having a 10 percent probability of exceedance within a 50-year period.

The larger SSE event represents the level of ground shaking that should not damage the vital, safety-related components of a facility to the extent that they could not function. Such an event might, for example, crack walls, damage the control building, and warp pipelines requiring the facility to shut down for repairs, but it would not cause the LNG storage tanks to fail. The results of the PSHA indicate that the mean recurrence interval of the SSE is 4,975 years. That is, the SSE represents the ground motions having a 1 percent probability of occurrence within a 50-year period.

Detailed seismic design criteria for the proposed LNG terminal site were analyzed and the response spectra were determined for horizontal and vertical components of motion and damping ratios ranging from 0.5 percent to 20 percent. In general, the seismic hazard analysis indicates horizontal PGAs of 0.44 g for the OBE and 0.88 g for the SSE, with vertical components of motion approximately equal to two-thirds of the horizontal component. It is useful to note that the OBE would produce a horizontal PGA of approximately twice that of the 1933 earthquake that caused heavy damage in Long Beach; therefore, the 1933 event would not have caused any significant damage to the LNG terminal facilities.

<u>POLB Seismic Design Criteria</u> – The POLB considers two earthquake levels in the design of shoreline structures in its jurisdiction: the larger Contingency Level Earthquake (CLE) and the lesser Operating Level Earthquake (OLE). The CLE represents the level of ground shaking at which shoreline structures should not fail, whereas the OLE event represents the level of ground shaking after which these structures should remain functional. In terms of the ability of a facility to withstand an earthquake, the CLE could be viewed as roughly equivalent to the NFPA-defined SSE, and the OLE could be viewed as roughly equivalent to the NFPA-defined OBE. However, the POLB's CLE is probabilistically defined as an earthquake with a mean recurrence interval of 475 years, the same return period as the NFPA OBE.

To derive the ground motions associated with the CLE, the ground motions developed in accordance with NFPA 59A (2001) were further analyzed using more conservative procedures compatible with procedures used in other recent POLB projects (e.g., the adjacent Pier T Marine Terminal project and the Piers G and J Marine Terminal project in the Southeast Basin) (URS, 2004). Based on this analysis, the horizontal PGA for the CLE was determined to be 0.52 g, a more conservative result than the 0.44 g determined for the NFPA-design level earthquake with the same return period (the OBE). The ground motions predicted for the larger SSE event remained essentially unchanged at 0.88 g.

The relationship between the Richter magnitude and PGA is complex; therefore, it is not possible to assign a specific magnitude to the earthquake that would cause OBE- and SSE-level ground

movements. URS (2005) has suggested that the SSE equates to a Richter magnitude M7.9 on the Palos Verde and Newport-Inglewood faults, and a magnitude M6.6 earthquake on the THUMS-HB fault, but cautions that smaller earthquakes could cause equivalent ground movements. However, as indicated by the 4,975-year return period for the SSE, it is highly unlikely that earthquakes such as these would occur during the 50-year operating life of the facility.

The POLB asked SES to estimate how large an earthquake would be needed to cause the LNG storage tanks to fail. Analyses by ARUP (2005) and Mitsubishi Heavy Industries (2005) estimated that an earthquake of M9.0 on the Palos Verde fault or M7.5 on the THUMS-HB fault would be necessary to generate ground motions strong enough to rupture the tanks and release their contents. These events have estimated return intervals of approximately 15,000 years and, therefore, are extremely unlikely to occur during the 50-year life of the project. The potential impact of an earthquake-induced release from the LNG storage tanks is discussed in Appendix F.

In conclusion, the seismic design criteria developed in accordance with the POLB protocol have been used in the design of the LNG tanks and other critical structures at the proposed LNG terminal site, and are being utilized by the POLB in the final design of the shoreline structures. These seismic design criteria are more stringent than the criteria specified in NFPA 59A (2001) that are required by the OPS and the FERC.

Surface Rupture

The potential for surface fault rupture to occur in the project area was assessed in accordance with the *California Board for Geologists and Geophysicists Geologic Guidelines for Earthquake and/or Fault Hazard Reports.* Based on the available data, there is no potential for surface rupture to impact the project facilities. No active surface faults are known to occur within the LNG terminal site boundaries or along the proposed pipeline routes (Dibblee, 1989; Ziony and Jones, 1989; Jennings, 1994), and the project is not within an Alquist-Priolo Earthquake Fault Zone (see figure 4.1.4-1). California has established Alquist-Priolo Earthquake Fault Zones around faults considered to have been geologically active within the Holocene (11,000 years ago to today) and that have a sufficiently well-defined surface trace and a relatively high potential for surface rupture in the event of a large earthquake. The closest designated Alquist-Priolo Earthquake Fault Zone is the Newport-Inglewood fault zone, approximately 4 miles northeast of the LNG terminal site and 1 mile northeast of the closest point along the pipeline routes.

The Palos Verdes fault has been active during the Holocene. However, the main trace of this fault is approximately 2.5 miles southwest of the project facilities, and other active secondary traces are located southwest of the main trace. Consequently, the Palos Verdes fault is not considered to pose a potential surface rupture hazard to the facilities associated with the Long Beach LNG Import Project.

The subsurface trace of the THUMS-HB fault has probably been active during the Holocene, but several USGS high resolution stratigraphic and geophysical data sets from the Los Angeles and Long Beach harbor area clearly show that the THUMS-HB fault is deeply buried and does not actually displace Holocene or Pleistocene strata (URS, 2003b). These data are further supported by geotechnical boring data from the LNG terminal site, in conjunction with other published and unpublished stratigraphic data, which did not identify any evidence of near-surface rupture (URS, 2003b). Based on the available data, the THUMS-HB fault is not considered to pose a surface rupture hazard to the proposed project facilities.

Soil Liquefaction, Settlement, and Lateral Spreading

Secondary effects triggered by strong ground shaking are often more serious than the shaking itself. Soil liquefaction is a physical process in which saturated, cohesionless soils temporarily lose their strength when subjected to strong and prolonged shaking. Soil liquefaction can lead to various ground failures including settlement and lateral spreading.

The potential for soil liquefaction to occur at the LNG terminal site was evaluated consistent with the California Division of Mines and Geology's (DMG) *Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California* (URS, 2003a). The assessment indicates that, without preventive measures, the upper 65 feet of loose to medium dense granular materials below the water table would liquefy if subjected to ground shaking from either the CLE or SSE, with maximum estimated post-earthquake settlements on the order of 19 to 25 inches, respectively. Even in the absence of seismic shaking, site soils are generally unsuitable for direct support of the proposed LNG storage tanks and other major structures, with the anticipated heavy loads causing settlements exceeding the specified settlement tolerances for the project (see section 4.2.2).

Existing shoreline structures at the LNG terminal site consist of a cellular steel sheet pile bulkhead along the south side of the site and a rock dike with a pile-supported concrete wharf along the west side of the site. Analysis by SES and the POLB suggests that the existing shoreline structures would suffer moderate to extensive structural damage and that lateral soil spreading primarily toward the shoreline structures would occur to varying degrees depending on the level of ground shaking at the site. In general, the lateral stability of site soils during seismic events would be achieved by strengthening the existing shoreline structures and improving the ground between the shoreline structures and the LNG storage tanks. The necessary reinforcement work would be the responsibility of the POLB. As discussed in section 2.3.1.2, the POLB is evaluating three different options for strengthening the shoreline structures to ensure that they would support the LNG tanks and other terminal structures if subjected to the ground shaking that could occur at the site.

Due to its ductility, welded steel pipe is able to withstand the effects of liquefaction. Therefore, loss of load-bearing strength due to liquefaction along the proposed pipeline routes is not considered to pose a significant hazard to the pipelines.

Tsunamis

Tsunamis are long-period oceanic waves generally caused by seismic activity. The magnitude of the potential hazard is a function of the coastline configuration, sea floor topography, individual wave characteristics, magnitude of the initiating event, and distance and direction from the source.

The largest recorded tsunami in the Long Beach or Los Angeles harbor areas had a run-up height in the 5-foot range. This tsunami was the result of the 1960 Chile earthquake of M_W 9.5, the largest earthquake ever recorded. Smaller tsunamis were also recorded in the area from 1812 to 1975 (McCulloch, 1985).

Various estimates of tsunami run-up heights, primarily from distant sources, have been developed for the project area. Synolakis (2003) estimated a 100-year run-up height of 8 feet and a 500-year run-up height of 15 feet for the POLB area. More recently, Borrero et al. (2005) estimated that a tsunami of approximately 13 feet could occur near the LNG terminal site as the result of a large, submarine landslide located 10 miles southwest of the LNG terminal site.

The highest reported tide in Long Beach Harbor was +7.54 feet MLLW and the mean high water level (the average of all high tides) is +4.71 feet MLLW. The base elevation of the LNG terminal would be +20 feet MLLW and the elevation at the top of the security barrier wall surrounding the LNG tanks would be approximately +40 feet MLLW. Based on these elevations, the LNG terminal site would not be flooded by the 100-year tsunami described by Synolakis (2003), even if it were to occur in conjunction with the highest recorded tide for Long Beach Harbor. The LNG terminal site also would not be flooded by the 500-year tsunami described by Synolakis (2003) or by the locally sourced tsunami described by Borrero, et. al., (2005), even if these events occurred in conjunction with the mean high tide. The LNG terminal site could experience 2.5 feet of flooding if the 500-year tsunami were to occur in conjunction with the highest tide recorded in Long Beach Harbor; however, the security barrier wall would prevent the LNG tanks from being flooded.

The potential damage that a tsunami could cause while an LNG ship is at berth would depend on the height of the tsunami and tide. The shoreline structures and unloading equipment are designed to operate within a range of motion that includes the 8-foot extreme tidal range in Long Beach Harbor plus the LNG vessel's change in draft of some 30 feet as a result of unloading. Therefore, a smaller moderate tsunami occurring at low tide would have little effect on an LNG ship at berth. In the case of the 500-year (15-foot) tsunami, serious damage to a ship could only occur if the ship happened to be at berth when the tsunami arrived and the motion of the ship caused enough mooring lines to break to allow the ship to be thrown against the wharf. Alternatively, a vessel that happened to be transiting in the West Basin could be thrown against the LNG vessel at berth. The LNG marine transport safety record suggests that the risk of a significant LNG spill due to such collisions is low. Since 1959, two collisions of LNG ships with fixed objects and eight collisions with other ships have occurred in or near ports. None of these incidents resulted in any release of cargo [Quest Consultants, Inc. (Quest), 2005]. A detailed discussion of LNG ship standards and design features is presented in section 2.1.2. The safety record of LNG shipping is discussed in section 4.11.7.3.

The December 24, 2004 Sumatra M_W 9.3 earthquake generated a devastating tsunami that claimed hundreds of thousands of lives and caused damage and destruction in many coastal areas bordering the Indian Ocean. The EIA (2005) reported that the largest energy facility in the area affected by the tsunami, Indonesia's PT Arun LNG facility in Banda Aceh, Sumatra, was not damaged by the tsunami. The maximum runup height observed at Banda Aceh was approximately 30 feet. At an oil transfer facility approximately 30 miles to the east of Banda Aceh, the bulk oil storage tanks remained in good condition after the tsunami, although one tank was moved off its foundation by the force of the 16-foot waves. A tanker was unloading oil at the time the tsunami struck, but the crew apparently managed to control the ship and move it offshore. EIA (2005) also notes that Australia's North West Shelf project reported only a minor delay in the loading of an LNG tanker.

Due to the low likelihood of a significant tsunami occurring during the operating life of the LNG terminal (especially in conjunction with a high tide), the ability of the berthing structure and unloading equipment to operate within a range of water levels, and the construction of the LNG ships and engineered safety controls on the unloading equipment, the potential tsunami hazard at the LNG terminal site and along the pipeline routes is very low.

Based on the Intergovernmental Panel on Climate Change (2001), the global sea level rise is expected to be 2 to 4 inches over an assumed 50-year operating life of the project. This amount would not be significant in the context of daily tidal changes and would not affect the tsunami hazard analysis for the project.

4.1.4.2 Subsidence

Extraction of hydrocarbons from the Wilmington Anticline has resulted in subsidence of the overlying land surface in the area. Minor amounts of regional subsidence, related to groundwater extraction and possibly natural basin-sediment consolidation, were also noted as early as 1928. Between 1929 and 1967, approximately 29 feet of total subsidence was recorded over the eastern end of Terminal Island, near the project's proposed HDD entry points on the south side of the Cerritos Channel. The LNG terminal site has experienced historical subsidence of approximately 8 to 14 feet and approximately 10 to 29 feet of total subsidence has occurred along the proposed pipeline routes.

Beginning in the 1950s, millions of tons of land-based and dredged materials were placed in the subsided areas and secondary injection of water into the oil-depleted zones was initiated to reduce the rate of subsidence. Subsidence was largely arrested by the 1970s, and some areas have since experienced slight rebound. Water for secondary injection is obtained from local groundwater resources. One of the water injection wells, located approximately 75 feet to the east of the proposed LNG terminal site, pumps water from a depth of approximately 90 feet for injection into oil-producing zones at depths of typically more than 1,000 feet (URS, 2003b).

As discussed in section 4.1.3.1, there is current oil production in the project area. The balance of oil production and water injection is monitored by the City of Long Beach, Department of Oil Properties (DOP), which is charged with bi-annual surveys to measure and record subsidence and/or rebound in the area. In its report *Elevation Changes in the City of Long Beach, November 2001 to January 2003*, the DOP states that less than 0.05 feet of subsidence occurred over all of Pier T during the reporting period. As mandated by the 1958 California Subsidence Act, oil receipts fund the land surveys and water injection wells, thereby ensuring future subsidence control.

4.1.4.3 Impact and Mitigation

Seismic Hazards

Seismic activity could potentially damage the LNG terminal site facilities, shoreline structures, and pipeline and electric distribution facilities through strong shaking or secondary ground deformation such as liquefaction, shaking-induced settlement, or lateral spreading. As discussed in section 4.1.4.1, the potential for tsunamis or surface rupture to affect the project facilities is very low and, therefore, no specific mitigation is proposed.

The seismic risk to the facility is attributable to ground motions induced by earthquakes. The project facilities would be designed to meet or exceed the seismic design criteria of NFPA 59A and the more stringent criteria of the POLB. The facilities would also comply with the seismic design provisions of the California Building Code, of which some of the more notable requirements include design procedures for seismic isolation systems and additional requirements for liquefaction mitigation foundations and superstructure-to-foundation connections. By complying with these applicable codes and design criteria, the facility could operate after all but the most extreme earthquake scenarios. Even in the unlikely event of the SSE level earthquake (with a return period of 4,975 years), the vital, safety-related components of the facility would function. Five foundation options to avoid liquefaction-related damage and to meet the stringent static settlement criteria for the LNG storage tank and other major structures were evaluated (URS, 2003a, 2004). In general, SES plans to construct the LNG storage tanks and other heavy load and critical structures on driven pile foundations, subject to final geotechnical assessment and final engineering designs. The current design calls for either concrete or tubular steel piles to be driven to depths of approximately 90 to 120 feet into the competent marine sand unit that exists beneath the shallower fill and fine-grained estuarine deposits at the site. The upper 5 to 15 feet of fill and soil may

also be removed from beneath the LNG tanks and replaced with engineered fill to increase lateral pile stability. A reinforced concrete base slab foundation would be constructed on the piles on which the LNG storage tanks would be built with seismic isolators or a flexible foundation to reduce horizontal seismic load.

The POLB has assessed the existing shoreline structures and is evaluating three options to strengthen the shoreline and related structures as needed to support the upland loads generated by the LNG storage tanks, other heavy load structures, and loads imposed by seismic events. The options vary in the degree to which the west wharf structure would be repaired or replaced, but all of the alternatives would include construction of in-water rock buttresses along the western and southern berth frontages, and the installation of approximately 3,380 stone columns between the shoreline structures and the security barrier wall. An additional approximately 2,000 stone columns would be installed between the security barrier wall and the LNG storage tanks. These remedial actions would be designed to provide ample static support to the LNG terminal structures and to limit the horizontal displacement of the shoreline structures to acceptable limits during predicted levels of earthquake-induced shaking.

Due to their linear extent and ductility, the proposed pipelines would be less susceptible to damage from strong shaking and liquefaction. If seismic-induced liquefaction were to occur along the pipeline routes, the pipelines could float up to just below the ground surface. This could require their reburial, but would not cause a rupture and, therefore, would not be a catastrophic event. The pipelines would be constructed, maintained, and operated in accordance with all applicable federal, state, and local regulations, which would further reduce the potential effects of seismic activity. Seismic activity is not expected to adversely affect the electric distribution facilities**.**

The potential impact of seismic-related damage on the project facilities would be further reduced by active and passive fail-safe design in loading equipment, process equipment, piping, and controls; operator training; and emergency response planning (see section 2.7).

In conclusion, a detailed analysis prepared by SES in support of its application resulted in seismic design criteria that meet the POLB requirements and exceed the OPS and the FERC requirements as specified in NFPA 59A (2001). The Agency Staffs reviewed the current engineering designs for the LNG storage tanks and other critical terminal structures. These designs are of sufficient detail to demonstrate that the project facilities would withstand the seismic hazards that could affect the site when they are constructed to the specifications of the plans. To ensure that final engineering designs meet or exceed applicable seismic standards, SES would provide the final plans to the FERC and the POLB for review and approval before construction. The POLB would construct the shoreline structures to meet the stringent seismic design criteria developed for the site, and stone columns would be installed between the shoreline structures and the LNG storage tanks thereby providing the required lateral support to limit displacement and minimize stress and strain levels well within the design limits of the LNG storage tanks and other heavy load structures in the event of an earthquake. Implementation of approved final designs for the LNG tanks, shoreline structures, and other critical structures at the LNG terminal would reduce the potential effects of seismic hazards to less than significant levels.

Subsidence

Regional subsidence due to ongoing hydrocarbon production is already effectively monitored and controlled and, therefore, would not affect construction or operation of the project. Underground piping associated with the water injection system could potentially be encountered during project construction. SES would identify all underground piping in the construction area and would either move or protect the piping during construction by exercising due care and standard construction methods. Any damage to underground water piping would be repaired immediately. Implementation of these measures and the

continued operation of the ongoing subsidence control program would reduce potential impacts associated with subsidence to less than significant levels.

4.1.5 Paleontological Resources

The majority of the project would be constructed in a previously developed portion of the Port that is largely underlain by deep, man-placed fill materials, with unconsolidated fluvial and alluvial deposits beneath the northern extent of the pipelines. Therefore, no undisturbed fossils are present near the ground surface in the project vicinity and fossil-bearing rock units would not be encountered during construction of the proposed facilities, including excavation for the pipelines. The Long Beach LNG Import Project would have no impact on paleontological resources.

4.2 SOILS AND SEDIMENTS

4.2.1 Significance Criteria

Impacts on soils and sediments would be considered significant if project construction or operation would:

- increase erosion rates or reduce soil productivity by compaction or soil mixing to a level that would prevent successful rehabilitation and eventual reestablishment of vegetative cover to the recommended or preconstruction composition and density; or

- increase exposure of human or ecological receptors to potentially hazardous levels of chemicals or explosives due to the disturbance of contaminated soils or sediments, or due to the discharge or disposal of clean material into soils or sediments containing hazardous materials.

4.2.2 Soil Resources

4.2.2.1 Environmental Setting

As discussed in section 4.1.2.1, the facilities associated with the Long Beach LNG Import Project would be primarily located within a highly developed portion of the POLB. The LNG terminal site and proposed pipeline routes from MPs 0.0 to 1.4 are underlain by deep fill materials. Surficial deposits from MPs 1.4 to 3.8 of the pipeline routes consist of soft clay, silt, silty sand, and sand of distal fan deposits associated with the active Los Angeles River system. Older alluvial deposits, generally comprising dense to very dense sand and silty sand, are present at the surface from MPs 3.8 to 4.6 of the C_2 pipeline route. There are no hydric soils or prime farmland soils on the LNG terminal site or along the route of the proposed pipeline and electric distribution facilities. Much of the project area is currently covered by asphalt or concrete and does not support vegetation. The temporary construction laydown and worker parking area is graveled. Vegetation in the area is limited to common weed species (see section 4.4.2).

Soil Limitations

Based on site-specific exploratory drilling, cone penetration tests, seismic velocity surveys, and geotechnical laboratory testing, it was determined that fill materials at the LNG terminal site would not provide adequate support to meet the stringent static settlement criteria for the LNG storage tanks or other heavy load structures (URS, 2003a). It is estimated that total static settlement of the LNG storage tanks, if founded on existing fill materials, would be about 3 feet near the perimeter of the tanks and about 5 feet near the center of the tanks. The resulting differential settlement of about 2 feet far exceeds the 5-inch settlement tolerance criterion for the LNG storage tanks.

Fill materials and native soils along the route of the proposed pipeline and electric distribution facilities are expected to provide adequate static support to these facilities.

Potentially Contaminated Soils

No indications of potential soil contamination were observed in the field during the geotechnical exploration of the LNG terminal site, and no petroleum contamination was detected by laboratory analysis in a sample of the drill cuttings derived from the geotechnical soil borings (URS, 2003a). However, due to historic petroleum production, other industrial activity, and former naval operations at the LNG terminal site, the potential exists for contaminated soils to be at the site.

According to the POLB, petroleum-impacted soil could be encountered at any location on Pier T (Houston, 2003). Specific areas of previously documented soil contamination in the area include IR Sites 11, 12, and 13, which were identified by the Navy during closure of its Long Beach Complex. IR Sites 11 and 12 are located just to the north of the LNG terminal site and would be crossed by the pipelines. IR Site 13 is partially located beneath the northeast portion of the LNG terminal site. After investigating these areas, the Navy recommended no further action for contaminated soils in IR Sites 11 and 13 (Department of the Navy/City of Long Beach, 1998). The Navy is preparing a proposed plan for the IR sites that would recommend restricting future use of these sites to commercial or industrial uses only. No active remediation is planned; however, if the POLB or its tenants excavate hazardous substances, the excavated materials would need to be disposed of properly after appropriate notification to the DTSC and coordination with the Navy and the Base Reuse and Closure regulators. The Navy also removed an underground storage tank from the southwest corner of the LNG terminal site. According to the POLB, the Navy cleaned up the site to levels that protect the health of site workers and the environment (Houston, 2003).

A search of available environmental records was also conducted to identify known and potential hazardous waste sites in the vicinity of the proposed project facilities (see section 4.5.4). Because of the activities described above, the former Long Beach Naval Shipyard and Station is listed as a hazardous waste site. Several hazardous waste sites have been identified within 0.25 mile of the pipeline routes and electric distribution facilities; however, none of these sites would be crossed by the proposed facilities (see table 4.5.4-1).

Ordnance

The Navy reported that no evidence was found to indicate that ordnance or munitions were ever handled at the former Long Beach Complex (Department of the Navy/City of Long Beach, 1998). No ordnance has been discovered on the proposed site, nor has ordnance been discovered on any other upland areas of the naval complex during their redevelopment. However, some ordnance has been discovered in the West Basin during dredging (see section 4.2.3.2).

4.2.2.2 Impact and Mitigation

Because of the highly developed, industrial nature of the area and the presence of mostly fill materials under the majority of the project facilities, the project would not reduce soil productivity by compaction or soil mixing; reestablishment of vegetative cover is not an objective of the project given its industrial nature. However, construction of the project facilities would temporarily expose the fill materials on the affected portion of Terminal Island and the native soils at the end of the pipeline routes to the effects of wind, rain, and runoff, which could cause erosion and sedimentation in the area. Erosion control measures proposed for the Long Beach LNG Import Project are detailed in SES' Sediment Control Plan that is included in its SWPPP (see Appendix B). A detailed discussion of the SWPPP is presented in section 4.3.3.2. Some of the pertinent measures in the Sediment Control Plan include:

- assignment of an EI to oversee and ensure compliance with the SWPPP, the Sediment Control Plan, and applicable permit requirements;

- specific planning and construction procedures such as the use of temporary silt fences around work areas, control of sediment tracking onto area streets, and phased grading schedules that would limit ground disturbance and prevent sediments from leaving the construction work area and entering the harbor;

- post-construction cleanup of all construction debris unless the POLB approves otherwise; and

- post-construction monitoring and limited regrading to correct any drainage problems resulting from construction activities.

Following construction, the site would be final graded and cleaned up. Some areas would be seeded and mulched; the remainder would be covered with gravel, asphalt, and concrete. Implementation of the measures in SES' Sediment Control Plan would reduce erosion impacts to less than significant levels.

Existing soils at the LNG terminal site are not capable of adequately supporting the LNG storage tanks or other heavy load structures. As a result, SES proposes to install deep-driven pile foundations beneath the LNG storage tanks and other heavy load structures to meet the stringent static-settlement criteria for the structures at the LNG terminal (see section 4.1.4). As described in section 4.1.4.3, installation of the piles may include the replacement of 5 to 15 feet of existing fill material beneath the LNG tanks with engineered fill that would be obtained from a licensed facility. Excavating 15 feet of material from beneath both tanks would generate approximately 90,000 cubic yards of soil. Other soil improvements at the site would include the installation of approximately 3,380 stone columns to depths of 60 to 80 feet bgs between the shoreline structures and the security barrier wall and an additional approximately 2,000 stone columns to a depth of 60 feet bgs between the security barrier wall and the LNG storage tanks. The installation of the stone columns would generate approximately 86,500 cubic yards of soil. If the excavated fill and soil derived from installation of the stone columns are determined to be clean, they would be re-used at an approved location, most likely within the POLB. Procedures for handling and disposal of contaminated materials are discussed below. Implementation of approved designs for soil improvements would mitigate the impacts associated with geotechnical soil limitations at the LNG terminal site to less than significant levels.

In addition to excavation for the soil improvements, construction of the project would involve excavation for the LNG spill impoundment systems and other utilities and foundations at the LNG terminal site, and trenching for the pipeline and electric distribution facilities. Contaminated soil and other hazardous materials could be encountered during any of these activities. If hazardous substances are encountered during construction, SES would notify the POLB. SES, in consultation with the POLB, would comply with all applicable environmental regulations. Before construction, SES and the pipeline contractor(s) would submit work plans that outline appropriate environmental site investigation and remediation activities to the appropriate agencies for approval. The work plans would include a site-specific Health and Safety Plan, Sampling and Analysis Plan, Project Contractor Quality Control Plan, and an Environmental Protection Plan that would also include a Waste Management Plan. The Environmental Protection Plan would identify the applicable regulatory oversight agencies and their permit authorities. The Health and Safety Plan would address potential contaminant exposure concerns applicable to site workers and the adjacent environment. The Health and Safety Plan would include the following measures:

- Workers would stop activities and leave the contaminated area immediately.

- The Chief Inspector would be notified of the contamination. The Chief Inspector would ensure that the area is secured to keep workers clear. Once the area is secure, the Chief Inspector would notify construction management personnel and the SES-designated Environmental/Safety Coordinator.

- The Environmental/Safety Coordinator would make the applicable agency notifications and obtain the necessary regulatory approvals and permits. The Environmental/Safety Coordinator would work with the SES Environmental Compliance Department (ECD) to determine the type(s) of contaminants present, including arranging for a hazardous waste contractor to sample the affected material as necessary. Once the contaminants have been identified, the Environmental/Safety Coordinator would coordinate the proper disposal of the material with the ECD as described in SES' Spill Procedure included in its SWPPP (see Appendix B).

- The Environmental/Safety Coordinator would communicate safety concerns to the Chief Inspector and construction management personnel and would ensure that the Chief Inspector informs contractors, inspectors, and other personnel of any hazard and the appropriate worker safety requirements.

- Construction management personnel would coordinate the activities of all parties to rectify the situation safely and in compliance with all applicable regulations.

Implementation of these measures would reduce impacts associated with a discovery of contaminated soils or other hazardous materials to less than significant levels.

Spills or leaks of fuels, lubricants, or other hazardous substances during construction and/or operation of the project could also have an impact on soils. This potential impact is expected to be minor, however, because of the typically low frequency, volume, and extent of spills or leaks, and because of the hazard detection system and other safety controls designed to prevent or contain spills and leaks at the LNG terminal site (see section 2.7). Implementation of SES' Spill Procedure included in its SWPPP would further reduce the likelihood of a significant spill or leak occurring during construction or operation of the project, and would reduce the impact of any spill or leak that may occur. As a result, impacts on soils associated with a hazardous spill or leak would be less than significant. A detailed discussion of the measures included in SES' Spill Procedure is presented in section 4.3.2.2.

4.2.3 Sediments

4.2.3.1 Environmental Setting

Up to approximately 175,000 cubic yards of sediments would be dredged from the West Basin of Long Beach Middle Harbor to accommodate the LNG ships. An additional 100,000 to 300,000 cubic yards of sediments would be dredged to install the rock buttresses necessary to reinforce the shoreline structures. The only other waterbodies that could be impacted by the project are the Cerritos and Dominguez Channels. As discussed in section 4.3.3.2, SES would install the natural gas and C_2 pipelines beneath the Cerritos Channel using the HDD method, which involves installing the pipe by drilling from bank to bank at depths ranging from 33 to 50 feet below the deepest part of the channel. The C_2 pipeline would be installed across the Dominguez Channel on existing pipe racks. Therefore, sediments within the Cerritos and Dominguez Channels would not be affected by the project.

The Navy and the POLB have conducted physical and chemical analysis of the sediments in the West Basin. In general, these studies found that the West Basin sediments consist of sand, fine silts, and clays. Metals, pesticides, polychlorinated biphenyls (PCBs), volatile organic compounds (VOC), and semi-VOC were documented in sediments throughout the West Basin, but at generally higher concentrations under piers and near sea walls than in open waters (Department of the Navy/City of Long Beach, 1998). The occurrence and distribution of contaminated sediments is not unexpected considering

the harbor's exposure to industrial and urban discharges and runoff and its somewhat restricted circulation (see section 4.3.3).

Two of the Navy's previous sediment sampling locations, Stations 27 and 28, are located on or near the footprint of the proposed ship berth and unloading facility. Contaminants were detected in sediments at both sites; the sediment contaminant levels were higher at Station 27. At Station 27, contaminants were found to exceed the Effects Range Low (ERL) and Effects Range Medium (ERM) for several metals. Copper was found approaching the ERM [220 milligrams per kilogram (mg/kg)] and levels of mercury (0.87 mg/kg), PCBs [430 micrograms per kilogram (µg/kg)], and total dichlorodiphenyltrichloroethane (DDTs) (112 µg/kg) were over the ERM (Department of the Navy/City of Long Beach, 1998).

The POLB (1998) obtained samples for physical and chemical analysis from 14 locations near the proposed ship berth and unloading facility. Four of the POLB sample sites were located along and approximately 25 feet from the existing wharf along the west side of Pier T. In these four samples, the maximum concentration of polynuclear aromatic hydrocarbons that exceeded their ERLs were: acenaphthylene (65 µg/kg), acenaphthene (46 µg/kg), fluorene (51 µg/kg), anthracene (369 µg/kg), fluoranthene (760 µg/kg), pyrene (1,010 µg/kg), benzo (a) anthracene (367 µg/kg), and chrysene (665 µg/kg). Arsenic (10 mg/kg), lead (93 mg/kg), nickel (26 mg/kg), and zinc (290 mg/kg) exceeded their ERL, and copper (295 mg/kg) and mercury (2.7 mg/kg) exceeded their ERM. One pesticide, dichlorodiphenyldichloroethylene (DDE), was found at a maximum concentration of 19.3 µg/kg, and total PCBs was at a maximum concentration of 205 µg/kg, exceeding their respective ERMs.

Although the Navy reported that no evidence was found to indicate that ordnance or munitions were ever handled at the former Long Beach Complex (Department of the Navy/City of Long Beach, 1998), recent dredging activities in the West Basin encountered ordnance.

4.2.3.2 Impact and Mitigation

The estimated duration of dredging and the placement of the rock buttresses to reinforce the shoreline structures is 8 to 10 months, and would be concurrent with other in-water construction. Disturbance of the West Basin sediments during in-water activities would temporarily resuspend sediments in the water column, which could cause turbidity. An increase in sediment and turbidity levels could adversely affect water quality and aquatic organisms. Resuspension of contaminated sediments could also impact marine organisms in the area. The POLB has recently negotiated a consent agreement with the DTSC for its concurrence with the IR Site 7 (West Basin) sediment remediation. Accordingly, the dredging associated with the project would be done only with the concurrence of the DTSC. Refer to sections 4.3.3 and 4.4.3, respectively, for a discussion of the potential impact of in-water activities on water quality and aquatic organisms and measures to avoid or reduce any potential adverse impacts associated with these activities to less than significant levels.

Disturbance of the West Basin sediments could also encounter ordnance. Any ordnance found during dredging for the proposed project would be handled in accordance with federal regulations and the POLB's procedures. In general, the POLB's procedures require that the dredging contractor stop work immediately and contact the project engineer when ordnance is found. The project engineer then contacts the Navy Explosive Ordnance Disposal office, which provides preliminary instructions to ensure the safety of the dredge crew, including possibly leaving the vessel. The Navy Explosive Ordnance Disposal office then dispatches staff to the site to pick up the ordnance. Adherence to these regulations and procedures would reduce the impact of a discovery of ordnance to less than significant levels.

4.3 WATER RESOURCES

4.3.1 Significance Criteria

Impacts on groundwater would be considered significant if project construction or operation would:

- alter the flow of groundwater to local springs or wetland areas;
- interrupt, deplete, or degrade groundwater used for private or municipal purposes; or
- result in either short-term or long-term violation of federal or state agency numerical water quality standards.

Impacts on surface waters would be considered significant if project construction or operation would:

- result in long-term detrimental alteration of harbor circulation;
- substantially degrade water quality; or
- alter channel bed armoring so it results in short- or long-term erosion.

4.3.2 Groundwater Resources

4.3.2.1 Environmental Setting

Groundwater

The West Coast sub-basin of the Los Angeles County Groundwater Basin (West Coast Basin), which is a part of the Los Angeles - Orange County Coastal Plain Aquifer System, underlies the Long Beach LNG Import Project facilities. The Coastal Plain Aquifer System extends approximately 860 square miles and consists of as many as 11 locally named aquifers, each of which consists of a distinct layer of water-bearing sand and gravel usually separated from other aquifers by clay and silt confining units. The West Coast Basin extends over 142 square miles. In descending order, the primary named aquifers that underlie the project area consist of a shallow, semi-perched unit; the Gaspur Aquifer; the Gage Aquifer; the Lynnwood Aquifer; and the Silverado Aquifer.

Semi-perched Unit – At the LNG terminal site, the shallow, semi-perched unit occurs within fill materials that extend to depths of 45 to 60 feet bgs. The semi-perched unit occurs at a depth of approximately 20 to 25 feet at the LNG terminal site and is saline in the project area due to interaction with marine waters; it is not recognized as a water-producing zone (Department of the Navy/City of Long Beach, 1998). Shallow groundwater contamination from historical Navy operations was documented at IR Site 13, located on and adjacent to the northeast corner of the LNG terminal site. Other localized sources of groundwater contamination may also be present in the area (Houston, 2003). The semi-perched unit is separated from the deeper Gaspur Aquifer by 20 to 35 feet of silt and clay estuarine deposits, which may act as a barrier to contamination transport between the shallow groundwater unit and the Gaspur Aquifer (Department of the Navy/City of Long Beach, 1998).

Gaspur Aquifer – In the project area, the Gaspur Aquifer occurs in marine sands or in onshore equivalent sand and gravel deposits at depths of 60 to 150 feet bgs (URS, 2003b). Water quality in the Gaspur Aquifer has not been tested in the immediate project area, but nearshore fresh water resources, including those in the project area, have been affected by salt water intrusion since the 1950s. Localized

areas of benzene contamination are also known to exist in the Gaspur Aquifer under the POLB (Houston, 2003). The Gaspur Aquifer is not a source of drinking water in the area, but it is used as a source of water for secondary injection into oil-producing zones at depths of more than 4,000 feet.

Gage, Lynnwood, and Silverado Aquifers – The Gage, Lynnwood, and Silverado Aquifers occur in interbedded sand, sand, and gravel units at depths ranging from approximately 150 to 1,100 feet bgs in the project area (URS, 2003b). Fresh water resources in the project area have been impacted by salt water intrusion. Further landward intrusion of salt water has been limited by a series of fresh water injection barriers and, where not impacted by salt water, the West Coast Basin aquifers are an important source of drinking water.

Sole Source Aquifers

There are no EPA-designated sole source aquifers in the project area (EPA, 2004). The State of California instituted the California Drinking Water Source Assessment and Protection (DWSAP) Program in response to the 1996 Federal Safe Drinking Water Act. As of April 2005, the state had not designated any protected aquifers or wellhead protection areas in the West Coast Basin (DWSAP, 2005).

Wells and Springs

There are no public or private drinking water wells within the LNG terminal site or the temporary construction laydown and worker parking area, nor are there any drinking water wells within 150 feet of the proposed pipeline or electric distribution facilities. Drinking water is supplied to the LNG terminal site through the POLB from the City of Long Beach Water Department. In turn, the City of Long Beach obtains its water from the Metropolitan Water District (about 56 percent) and from West Coast Basin groundwater resources (about 44 percent).

An active groundwater well is located approximately 75 feet east of the LNG terminal site. This well produces water from the Gaspur Aquifer at a depth of approximately 90 feet for secondary injection into deeper oil-producing zones to control subsidence in the area. Additional information regarding subsidence control in the area is presented in section 4.1.4.2.

No springs were identified within 150 feet of the LNG terminal site, temporary construction laydown and worker parking area, pipeline facilities, or electric distribution facilities.

4.3.2.2 Impact and Mitigation

Construction

Activities associated with construction of the proposed project facilities, including hydrostatic test water appropriation, the installation of deep-driven pile foundations and stone columns at the LNG terminal site, the HDDs of the Cerritos Channel, site excavation and dewatering, and accidental spills or leaks of hazardous materials could adversely affect groundwater quality within the project area as described below.

Hydrostatic Test Water Appropriation – Hydrostatic testing activities associated with the LNG storage tanks and natural gas and C_2 pipelines would make a one-time, temporary demand on the POLB and City of Long Beach municipal water system. Approximately 24 million gallons of water appropriated from the municipal system would be used to hydrostatically test the LNG storage tanks, about 642,000 gallons would be used to test the natural gas pipeline, and about 84,300 gallons would be used to test the C_2 pipeline.

SES would negotiate project water requirements with the City of Long Beach for appropriate fees and would ensure that the project would have no impact on water availability in the area. According to the City of Long Beach Water Department (2005), the volume of water needed to test the LNG storage tanks and pipelines does not represent a large volume to the municipal system, and no specific mitigation measures would be required. No chemicals or additives would be added to the test water and the water would be sampled before use and before discharge into the POLB storm water drainage system. Therefore, the impacts associated with hydrostatic test water appropriation would be less than significant. The impacts associated with discharge of the hydrostatic test water are discussed in section 4.3.3.2.

Installation of Deep-driven Pile Foundations – The foundation piles that SES proposes to install at the LNG terminal site are presently planned for depths of 90 to 120 feet bgs and would extend into the Gaspur Aquifer. The piles would be driven rather than excavated, which would prevent the creation of an opening for potential cross-contamination from the shallow, semi-perched unit to the deeper Gaspur Aquifer. As a result, there would be no significant impact on groundwater resources associated with the foundation piles.

Installation of Stone Columns – The stone columns that would be installed to improve soils between the shoreline structures and the LNG storage tanks would be drilled to depths of 60 to 80 feet bgs and would extend into the top of the Gaspur Aquifer. The stone columns would essentially replace finer-grained fill and estuarine deposits with coarse gravel, potentially creating a preferential pathway for cross-contamination to occur. However, in constructing the stone columns, a plug would be formed by adding cement to the gravel from the base of each column to at least 10 feet above the top of the Gaspur Aquifer, thereby preventing cross-contamination from the shallow, semi-perched unit to the Gaspur Aquifer. As a result, there would be no significant impact on groundwater resources associated with the stone columns.

HDDs of the Cerritos Channel – The Gaspur Aquifer could potentially be penetrated during installation of the natural gas and C_2 pipelines beneath the Cerritos Channel using the HDD construction method. To minimize potential impacts on local aquifers during HDD activities, SES would implement the following control measures identified in its HDD Plan (see Appendix C):

- The HDD activities would be continuously monitored by experienced personnel to minimize the potential for an inadvertent release of drilling fluid.
- The drilling fluid would not contain any toxic or hazardous materials.
- The specific weight of the drilling fluid would be closely monitored and adjusted to maintain hydraulic stability of the bore hole.
- In the event of a release of drilling fluid, drilling pressure would be reduced and operations would be suspended to assess the extent of the release and to implement other possible corrective actions.

Implementation of the HDD Plan would reduce potential impacts of the HDD crossings on local aquifers to less than significant levels. Additional information on the HDD crossings of the Cerritos Channel is presented in section 4.3.3.2.

Site Excavation and Dewatering – Underground piping associated with the water injection system could potentially be encountered during excavation. SES would identify all underground piping in the construction area and would either move or protect the piping during construction by exercising due care

and standard construction methods. Any damage to underground water piping would be repaired immediately. Therefore, construction of the project would not impact the subsidence control system.

Construction of the LNG spill impoundment systems may require dewatering of the excavation throughout the construction activity. Dewatering may also be required during excavation of fill materials from beneath the LNG tanks. All dewatered material would be evaluated for contamination prior to removal in accordance with the Health and Safety Plan and Sampling and Analysis Plan discussed in section 4.2.2.2. If sampling indicates that the dewatered material is within the pretreatment standards set by a municipal water treatment plant, the material would be hauled to that plant. If decontamination is required before hauling, SES would consult with the POLB, the RWQCB, and other applicable agencies and would apply for and abide by the terms of any necessary permits. Implementation of these measures would reduce the impacts of dewatering on groundwater resources to less than significant levels. Other excavations during construction, including for the pipelines, would be no deeper than 15 feet and would not encounter groundwater or require dewatering. All excavations would require coordination with the Navy and the Base Reuse and Closure regulators.

Accidental Spills or Leaks of Hazardous Materials – Accidental spills or leaks of hazardous materials associated with equipment failures; the refueling or maintenance of vehicles; or the storage of fuel, oil, and other fluids during construction pose a risk to groundwater resources. Spills or leaks of hazardous liquids could contaminate groundwater and affect aquifers. If not cleaned up, contaminated soils could continue to leach and add pollutants to the groundwater long after a spill has occurred. Impacts associated with spills or leaks of hazardous liquids could be avoided or minimized by restricting the location of refueling and storage facilities and by requiring cleanup in the event of a spill or leak.

SES has developed BMPs as part of its SWPPP (see Appendix B) that would minimize the likelihood and potential impact of a hazardous spill during construction of the project facilities. These BMPs are outlined in the Spill Procedure portion of the SWPPP and include:

- training of contractor personnel on the contents and requirements of the Spill Procedure;
- specifications for the storage and secondary containment of fuel and other hazardous liquids in containers;
- enclosure of painting operations to prevent drift, and prohibition of exterior painting during rainfall events;
- prohibition of machinery, vehicle, and equipment washing on the site;
- a requirement for daily inspection of vehicles, stationary equipment, secondary containment areas, and spill response areas for leaks and deterioration; and
- notification, response, and cleanup procedures in the event of a spill, including the use of absorbent materials to recover spilled liquids, the construction of earthen berms to contain spilled liquids, and the removal of impacted soil for appropriate disposal in accordance with applicable regulations.

These measures adequately address the storage and transfer of hazardous liquids and the response to be taken in the event of a spill. Implementation of SES' Spill Procedure would reduce the potential impacts on groundwater associated with a hazardous spill or leak during construction to less than significant levels.

Operation

Potential operational impacts on groundwater include an accidental spill or leak of hazardous materials during operation of the project facilities and water requirements for the LNG terminal vaporization process, firewater system, and miscellaneous potable water needs. The measures in SES' Spill Procedure described above would reduce the potential impact on groundwater associated with a hazardous spill or leak during project operation to less than significant levels. SES' operational water requirements are described below.

SES would utilize a vaporization process that would use hot water as an intermediate heat transfer fluid to supply heat to warm the LNG and convert it back to a gaseous state. Because this water would be in a closed circulation system, there would be no water intake or discharge as part of normal operation of the vaporization equipment. The closed-loop system would require a one-time purchase of 100,000 gallons of deaerated fresh water supplemented by a one-time purchase of 10,000 gallons of deaerated fresh water for makeup water.

SES would use a looped underground firewater distribution piping system serving hydrants, firewater monitors, hose reels, water spray, or deluge and sprinkler systems. A one-time purchase of 1 million gallons of fresh water would be needed to fill the firewater storage tank. After the initial fillings, an estimated 4.8 million gallons of fresh water would be needed annually to replace the firewater after the required monthly fire pump testing. An additional estimated 1.2 million gallons of fresh water would be required annually for general operation of the facility.

All of the operational water would be obtained from the POLB and the City of Long Beach municipal water system. SES would negotiate with the City of Long Beach or a local supplier to determine appropriate fees and to ensure that the project would have no impact on water availability in the area. As discussed in section 4.3.2.2, the City of Long Beach Water Department (2005) does not consider this volume of water to represent a large volume to the municipal system.

In summary, by implementing the measures described above, adverse impacts on groundwater quality and availability due to project construction and operation would be avoided or reduced to less than significant levels.

4.3.3 Surface Water Resources

4.3.3.1 Environmental Setting

Historically, Los Angeles and Long Beach Harbors consisted of marshes and mudflats with a large marshy area to the north. Water flow from the Los Angeles River formerly entered the harbors where the Dominguez Channel now drains. Near the beginning of the 20th century, channels were dredged, marshes were filled, wharves and a breakwater were constructed, and the Los Angeles River was diverted. Eventually, two more breakwaters enclosed the greater San Pedro Bay and deep entrance channels were dredged to allow for entry of ships requiring up to 70 feet of clearance. Currently, the harbors are within the Dominguez Channel Watershed. This watershed includes about 110 square miles of land in the southern portion of Los Angeles County, 96 percent of which is developed. Land within the watershed is predominantly covered by impermeable surfaces. Rather than being defined by the natural topography of its drainage area, the boundary of the Dominguez Channel Watershed is defined by a complex network of storm drains and smaller flood control channels. The Dominguez Channel extends from the Los Angeles International Airport to the Los Angeles Harbor and drains large, if not all, portions of the Cities of Inglewood, Hawthorne, El Segundo, Gardena, Lawndale, Redondo Beach, Torrance, Carson, and Los Angeles.

Long Beach Harbor is divided into Outer, Middle, and Inner harbors. The proposed LNG terminal on Terminal Island would be adjacent to the West Basin of the Middle Harbor. Ships would access the terminal by entering the harbor through Queens Gate and following the Long Beach Main Channel into the Middle Harbor. Water depths within the harbor range from about -76 feet MLLW in the Long Beach Main Channel to -50 to -55 feet MLLW in the Middle and Inner Harbors. Both the natural gas and the C_2 pipelines would cross the Cerritos Channel located within the Inner Harbor. The pipelines would be installed at the same location in two separate HDD operations. At the point of the proposed crossings, the Cerritos Channel is 820 feet across and 56 feet deep. There are already several submerged pipelines installed across the Cerritos Channel at this location. The C_2 pipeline would also cross the Dominguez Channel. The pipeline would be installed on an existing pipe bridge that spans the channel at +28 feet MLLW. No other waterbodies would be crossed by the proposed facilities. General harbor circulation patterns and water quality within the West Basin and the Cerritos Channel are discussed below. Information on sediments within the West Basin and Cerritos Channel is included in section 4.2.3.

General Harbor Circulation Patterns

Currents in Long Beach Harbor are driven primarily by tides and wind. There is a general influx of water through Queens Gate and Angels Gate (the main entrance to the POLA), and an outflux at the eastern end of Long Beach Harbor. The tides are mixed semidiurnal, with two unequal high tides and two unequal low tides every 25 hours. Tidal height and velocities vary with the moon phase.

Surface water circulation in the Outer Harbor is clockwise, moving from the Los Angeles Main Channel to the Navy Mole, and there is a counter-clockwise eddy at a depth of 20 feet (POLB, 2003a). Tidally driven circulation fluctuates, with less mixing in the Inner Harbor than in the Outer Harbor. The greatest flushing rates occur at the harbor entrances and the lowest flushing rates occur in the Cerritos Channel and the Middle Harbor (URS, 2003). Maloney and Chen (1974) reported estimates for flushing rates of the entire harbor complex at about 90 tidal cycles.

Surface water circulation within the West Basin is primarily driven by the tides. Ebb currents flow out of the West Basin through the Long Beach Main Channel opening between the end of the Navy Mole and Pier F during periods of falling tides. Conversely, flood currents flow into the West Basin through the same opening during periods of rising tides. The velocities of tidal currents within the West Basin are generally less than 0.1 foot/second (Los Angeles Contaminated Sediments Task Force, 2003).

Water Quality

Water quality within the harbor is affected by combinations of hydrology, currents, storm water runoff, industrial discharges, ship traffic, and dredging activities. Discharges into the harbor complex include once-through cooling water from the Long Beach Generating Station in the Back Channel of the Inner Harbor and wastewater discharge in the Los Angeles Outer Harbor from the Terminal Island Treatment Plant. Non-point or diffuse sources that carry contamination into the harbor complex include aerial fallout, surface runoff, advective transport, and boating/shipping activities.

MEC Analytical Systems, Inc. (MEC) collected water quality data from 32 monitoring stations throughout the general project area as part of a study entitled *Ports of Long Beach and Los Angeles Year 2000 Biological Baseline Study of San Pedro Bay* (MEC, 2002). Generally, dissolved oxygen (DO) concentrations, acidity/alkalinity (pH) levels, salinity conditions, and water temperatures were within normal ranges for estuarine and near-coastal waters of the region. Although water clarity (measured as a percentage of light transmittance) was within ranges expected for coastal ports and harbors, water clarity within the study area was found to be generally lower than typical open coastal waters. In particular,

water clarity in bottom waters within the ports was lower than that of surface and mid-depth waters. These lower transmissivity values were attributed to the resuspension of bottom sediments due to natural processes such as currents or human activities, including dredging/disposal and propeller wash from large ships.

The POLB conducted water quality monitoring in 1999 and 2000 during dredging operations at the Pier T Marine Terminal adjacent to the LNG terminal site [MBC Applied Environmental Sciences (MBC), 2001a and 2001b]. Water quality parameters including depth, DO, pH, and percent light transmittance were measured weekly during dredging operations. Water quality parameters measured monthly included total suspended solids (TSS) and chemistry analysis. Results showed that DO averaged between 7 and 8 milligrams per liter and ambient low DO conditions occurred in the West Basin whether or not dredging was occurring. Dredging affected light transmission at monitoring stations within 300 feet of the dredging operations. Substantial decreases in light transmission in the water column were often observed and were likely the result of sediments disturbed during dredging (dredge plume). These areas were generally confined to the bottom few meters of the water column. There was no indication that TSS values within 300 feet of dredge sites were significantly elevated during dredge activities (MBC, 2001a and 2001b). The five metals detected throughout the dredge surveys (arsenic, copper, lead, selenium, and zinc) were also detected during the pre-dredge survey. The other analytes detected during the surveys (polychlorinated aromatic hydrocarbons) were found at very low concentrations, close to detection limits. Concentrations in the harbor were well below the EPA standard levels. PCBs and DDT were not detected during any surveys (MBC, 2001a and 2001b).

Regulatory Requirements

The HDDs of the Cerritos Channel, installation of the C_2 pipeline on the pipe bridge over the Dominguez Channel, reinforcement of the shoreline structures, construction of the LNG ship berth and unloading facility, and dredging would be regulated by the ACOE under section 10 of the Rivers and Harbors Act and section 404 of the CWA. Section 10 of the Rivers and Harbors Act regulates any work or structures that potentially affect the navigable capacity of the waterbody. Section 404 of the CWA regulates the discharge of dredged or fill material into waters of the United States.

In addition to the ACOE's permitting responsibilities, a CWA section 401 water quality certification or California Water Code Waste Discharge Requirements (WDR) permit would need to be obtained from the RWQCB for the dredging activities.

Hydrostatic test water and storm water discharges are also regulated activities in California. SES would need to obtain a General NPDES Permit and WDR permit for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties from the RWQCB; an NPDES General Permit for Storm Water Discharges Associated with Construction Activity would need to be obtained from the CSWRCB.

4.3.3.2 Impact and Mitigation

Construction

Activities associated with construction of the project facilities, including reinforcement of the shoreline structures, construction of the LNG ship berth and unloading facility and associated dredging, the HDDs of the Cerritos Channel, installation of the C_2 pipeline over the Dominguez Channel, hydrostatic test water discharge, storm water runoff, and accidental spills or leaks of hazardous materials could adversely affect surface water quality and/or water circulation within Long Beach Harbor as described below.

Reinforcement of the Shoreline Structures, Construction of the LNG Ship Berth and Unloading Facility, and Associated Dredging – Reinforcement of the shoreline structures and construction of the LNG ship berth and unloading facility would involve permanent in-water structures (e.g., mooring and breasting dolphins, unloading platform, rock buttresses). Given the low tidal velocities and existing water circulation patterns within the West Basin, these new structures are expected to have only a minor impact on water circulation in localized areas in the immediate vicinity of the new structures at Pier T and are not expected to have a measurable impact on the general water circulation patterns within the West Basin.

To safely accommodate the largest LNG ships expected to use the LNG terminal, the POLB would dredge the ship berth area on the west side of Pier T to a depth of -55 feet MLLW. Current water depths adjacent to Pier T range from -46 feet to -53 feet MLLW. To achieve a uniform depth of -55 MLLW at the LNG ship berth would require the removal and disposal of up to approximately 175,000 cubic yards of sediments. Additionally, installation of the rock buttresses at Berth T-126 and Berth T-124 would require the dredging of between 100,000 and 300,000 cubic yards of sediments depending on the west wharf improvement and rock buttress configuration option chosen.

Potential impacts on water quality from the dredging activities would primarily result from resuspension of sediments into the water column, which could cause increased TSS levels and decreased water clarity. In addition, the abundance of fine, organically enriched sediments within the work area would make resuspension of contaminated sediments into the water column a possibility (see section 4.2.3). Past dredging experience within the area has shown that impacts on water quality are relatively short term and localized. For example, TSS values within 300 feet of dredge sites near Pier T were not significantly elevated during dredging activities (MBC, 2001a and 2001b). Part of the reason for this is that the slow currents in the Middle Harbor (and the West Basin specifically) minimized the extent that suspended sediments were transported from the dredged area. Additionally, conducting dredging operations in a manner that is consistent with the requirements of the ACOE's section 404 and the RWQCB's WDR permits as described below minimizes impacts on water quality.

A standard provision of the ACOE's section 404 permit specifies BMPs that must be followed to minimize impact on waters of the United States. For example, these BMPs limit the amount of water and dredged material that would flow over the sides of the barge(s) used to transport dredged materials. These BMPs include time restrictions on flow back of dredged water and materials from the barge at the dredging site and load level restrictions to preclude spillage of water and dredged materials during transit and at the disposal site. Another standard provision of the section 404 permit requires the POLB to prepare a Dredge and Disposal Plan for submission to the ACOE at least 15 days before initiation of any dredging activities. The Dredge and Disposal Plan would include:

- a list of all vessels, major dredging equipment, and electronic positioning systems or navigation equipment that would be used for dredging and disposal operations, including the capacity, load level, and acceptable operating sea conditions for each dredge or disposal barge;

- a detailed description of the dredging and disposal operation, including a schedule and detailed pre-and post-construction monitoring plan;

- a predredging bathymetric condition survey that depicts the entire dredging area, the dredging design depth, overdredge depth, and side-slope ratio as well as the total quantity of dredged material to be removed from the dredging and side-slope areas; and

- a debris management plan to prevent disposal of large debris at the disposal location.

A standard provision of the RWQCB's WDR permit requires that the dredging, excavation, or disposal of dredge materials shall not cause any of the following conditions in the receiving waters:

- the formation of sludge banks or deposits of waste origin that would adversely affect the composition of the bottom fauna and flora, interfere with fish propagation or deleteriously affect fish habitat, or adversely change the physical or chemical nature of the bottom;

- turbidity that would cause a substantial visible contrast with the natural appearance of the water outside the immediate area of operation. This is interpreted as increases in turbidity that exceed 20 percent of the background levels at control sites;

- discoloration or visible material, including oil and grease, either floating on or suspended in the water or deposited on beaches, shores, or channel structures outside the immediate area of operation;

- objectionable odors emanating from the water surface;

- depression of DO concentrations below 5.0 milligrams per liter at any time outside the immediate area of operation; or

- any condition of pollution or nuisance.

The RWQCB's WDR permit would also establish a monitoring and reporting program that the POLB would follow to ensure that significant levels of contaminants would not be released to the harbor waters or adversely affect beneficial uses of the harbor.

Some of the sediments that would be dredged are expected to contain contaminants. Therefore, the POLB currently plans to dispose of the sediments at a confined disposal site previously approved for contaminated materials within Long Beach Harbor (e.g., ITS Slip fill, East Basin Slip 1 fill, or upland site). The POLB could propose to dispose of uncontaminated dredged materials at an unconfined aquatic location (i.e., Western Anchorage Temporary Sediment Storage Site). In order to determine disposal site suitability, the POLB would prepare and implement a Sampling and Analysis Plan in accordance with the three-tiered testing protocols in the EPA/ACOE Inland Testing Manual. Based on the results of the tiered testing protocols, the ACOE would review and approve or deny the use of an unconfined aquatic location, or alternately approve the POLB's request to take the materials to a confined or upland site.

The POLB would have a dredging operations inspector present at all times to ensure compliance with all relevant permit conditions during dredging and disposal operations. Implementation of the POLB's Dredge and Disposal Plan and disposal of all sediments at approved sites would reduce impacts on water quality associated with the in-water work to less than significant levels.

<u>HDDs of the Cerritos Channel</u> – To minimize impacts on the Cerritos Channel, the proposed natural gas and C_2 pipelines would be installed under the waterbody using the HDD construction method. This technique would involve drilling pilot holes from one side of the channel to the other and then enlarging the holes through successive reamings until the holes are large enough to accommodate the pipes. Pipe sections long enough to span the crossing would be fabricated on the opposite side of the channel and then pulled through the drilled holes. Current information indicates that the substrate of the Cerritos Channel is conducive to the HDD construction method given that two 24-inch-diameter pipelines have previously been installed at the proposed crossing location and a 36-inch-diameter pipeline was

recently installed under the channel just west of the Heim Bridge (about 1 mile west of the proposed crossing location) using the HDD technique without incident.

The natural gas and C_2 pipelines would be installed as two separate HDDs. The HDDs of the Cerritos Channel would be approximately 2,700 feet in length. The pipelines would be installed a maximum of 50 feet below the deepest part of the channel bottom or about 90 feet bgs, which is well below the existing submerged pipelines across the channel. SES proposes to set up the drill rig for the HDDs at the Long Beach Generating Station, about 1,000 feet from the southern edge of the Cerritos Channel. The drills would exit on the north side of the channel about 300 feet from the water's edge. The drilling operations would be confined to a 200-foot by 200-foot temporary extra workspace at the HDD entry sites and a 100-foot by 100-foot temporary extra workspace at the HDD exit sites. The pipe strings would be laid out on the north side of the Cerritos Channel along Carrack Avenue. Because the natural gas and C_2 pipelines would not be constructed concurrently, no additional staging areas would be necessary. The use of the HDD construction method would avoid the need to trench through the waterbody and would eliminate equipment disturbance within the waterbody. As a result, there would be no alterations to armoring of the bed or banks of the Cerritos Channel that could result in short- or long-term erosion.

The HDD process uses a drilling fluid to seal the walls of the drillhole, cool and lubricate the drill bit, and transport the drill cuttings back to the beginning of the drillhole. The drilling fluid proposed for use during the HDD crossings of the Cerritos Channel would be a non-toxic mixture of bentonite clay and water with no additives. If the use of additives becomes necessary, the proposed additives would be submitted to the POLB, the Cities of Long Beach and Los Angeles, and the ACOE for approval before use.

Depending on the subsurface conditions along the drill paths, it is possible that some of the drilling fluid could be inadvertently released into the Cerritos Channel during the drilling operation. Unlike a fresh water environment, the high salt concentration in sea water would result in rapid flocculation of the solid particles in any drilling fluid released into the channel. The flocculated particles would settle to the channel bottom quite rapidly, resulting in negligible dispersal of the drilling fluid in the water column down current of the site where the fluid is released.

SES prepared an HDD Plan (see Appendix C) to minimize impacts associated with an inadvertent release of drilling fluid. The HDD Plan includes a description of:

- the HDD construction process;
- monitoring procedures;
- containment and control measures to be implemented in the event there is an inadvertent release of drilling fluid in a waterway or on land;
- procedures for notifying officials in the event of an inadvertent release of drilling fluid;
- measures for the storage of lubricants and fluids to be used during the HDD process;
- hazardous materials contingency plans; and
- abandonment measures to be followed in the event problems are encountered during the HDD process.

The HDD Plan does not, however, address the steps that would be taken if an existing submerged pipeline is hit during the HDD operations. Therefore, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall revise its HDD Plan to describe the procedures that would be followed if an existing submerged pipeline is encountered during the HDD operations. SES shall file the revised HDD Plan with the FERC and the POLB for the review and written approval of the Director of the Office of Energy Projects (OEP) and the POLB Director of Planning <u>before construction</u>.**

SES would obtain a section 10 permit from the ACOE for the crossings of the Cerritos Channel and adhere to its terms and conditions. Adherence to the measures included in the ACOE permit and implementation of SES' revised HDD Plan would reduce the potential impacts associated with the HDD crossings of the Cerritos Channel to less than significant levels.

<u>Installation of the C_2 Pipeline Over the Dominguez Channel</u> – To minimize impacts on the Dominguez Channel, the C_2 pipeline would be installed on an existing pipe bridge that spans the channel at +28 feet MLLW. The only potential impact on water quality from this aerial crossing would occur as a result of an accidental spill or leak from construction equipment (see discussion of accidental spills or leaks below).

A section 10 permit would be obtained from the ACOE for the aerial crossing of the channel. Adherence to the measures included in the ACOE permit would reduce the potential impacts associated with the crossing of the Dominguez Channel to less than significant levels.

<u>Hydrostatic Test Water Discharge</u> – As discussed in section 4.3.2.2, the 24.7 million gallons of water needed for hydrostatic testing of the LNG storage tanks and pipelines would be obtained from the POLB and City of Long Beach municipal water system. Discharge of the hydrostatic test water would make a one-time, temporary demand on the POLB storm water drainage system. The POLB's storm water drainage system outfalls to surface water resources in the Port.

SES would obtain a General NPDES Permit and WDR permit for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties from the RWQCB and adhere to its terms and conditions. No chemicals or additives would be added to the test water and the test water would be sampled before use and before discharge. Following testing, the water would be discharged into the POLB storm water drainage system. Because the storm water drainage system outfalls ultimately flow into surface waters in the Port, the addition of this volume of fresh water could temporarily reduce salinity concentrations at the outfall locations. This influx of fresh water to the storm water system would be similar to that of a heavy rain during a storm event. SES would coordinate with the POLB to ensure necessary storm drain capacity exists for storm events during discharges of hydrostatic test water so as not to exceed the capacity of the system. Implementation of these measures would reduce impacts associated with hydrostatic test water discharges on surface waters to less than significant levels.

<u>Storm Water Runoff</u> – Storm water runoff associated with the proposed project could affect water quality within the POLB. SES has prepared a draft site-specific SWPPP for the Long Beach LNG Import Project (see Appendix B) in accordance with the CSWRCB's NPDES General Permit for Storm Water Discharges Associated with Construction Activity. This plan would apply to the entire construction work area, including the temporary construction laydown and worker parking area and barges. Some of the

pertinent measures in the SWPPP that would be implemented during construction of the proposed project include:

- using erosion and sediment controls (e.g., sandbags, silt fence, sediment basins);
- sweeping entrances and exits to minimize offsite tracking of sediments;
- minimizing the area of exposed soils during construction and paving areas of exposed soils after construction is completed to keep the site stabilized;
- implementing waste management control procedures to keep the site clean and reduce the potential for non-hazardous and potentially hazardous waste from coming in contact with storm water or non-storm water discharges;
- routing all storm water associated with the proposed project towards the POLB's existing storm water drainage system and permitted outfalls; and
- requiring at least one EI to be responsible for ensuring compliance with the requirements of the SWPPP as well as other environmental permit and approval conditions.

SES would file its final site-specific SWPPP with the FERC and the POLB for approval before construction. Implementation of the measures in SES' SWPPP would avoid or minimize impacts on water quality associated with storm water runoff during construction. As such, impacts on water quality as a result of stormwater runoff during construction would be reduced to less than significant levels.

Accidental Spills or Leaks of Hazardous Materials – Despite BMPs (e.g., secondary containment, vehicle maintenance procedures, berming, etc.), spills, leaks, or accidental releases of fuels, lubricants, or other hazardous substances during construction of the proposed project could adversely affect water quality. However, implementation of the measures in SES' Spill Procedure described in section 4.3.2.2 and included in Appendix B would reduce the potential impact on surface water resources associated with a hazardous spill or leak during construction to less than significant levels.

Operation

Operational impacts on water quality include the potential to contribute additional pollutants to the waterbody via accidental spills or leaks of hazardous materials, storm water runoff, or an LNG spill. There would be no intake or discharge of sea water during operation of the proposed project facilities. As discussed in section 4.3.2.2, operational water requirements for the proposed project facilities would be obtained from municipal sources.

Accidental Spills or Leaks of Hazardous Materials – Implementation of the measures in SES' Spill Procedure would reduce the potential impacts on surface water resources associated with a hazardous spill or leak during project operation to less than significant levels.

Storm Water Runoff – Once construction has been completed, activities at the LNG terminal site would have an ongoing potential to cause pollution via storm water runoff. BMPs consisting of permanent features and operational practices designed or implemented to minimize the discharge of pollutants in storm water or non-storm water flows from the LNG terminal site would be implemented by SES in accordance with its SWPPP once construction is completed and the facility is operational. Some of these operational BMPs would include:

- use of a spill prevention and containment plan that would describe specific procedures for planning and prevention, personnel training, container storage and secondary containment structures, leak and structural integrity inspections, fuel and hazardous material handling, spill handling, and material disposal;

- proper disposal and/or recycling of waste materials at licensed facilities;

- avoidance of practices where used water that has been in contact with pollutants flows directly into the storm drain system;

- maintenance of the existing storm drain system;

- keeping pollutants off of surfaces that are exposed to storm water; and

- installation of treatment controls such as on-site retention/detention basins and catch basin filters where necessary to remove pollutants from storm water before it enters the storm drain system.

Implementation of the measures in the SWPPP would reduce impacts on water quality associated with storm water runoff during operation to less than significant levels**.**

4.3.4 Wetlands

A review of National Wetlands Inventory maps, confirmed by field reconnaissance, shows no wetlands within 150 feet of the LNG terminal site, temporary construction laydown and worker parking area, pipeline facilities, or electric distribution facilities. Therefore, construction and operation of the proposed project would have no impact on wetland resources.

4.4 BIOLOGICAL RESOURCES

4.4.1 Significance Criteria

Impacts on biological resources would be considered significant if project construction or operation would:

- substantially affect local resident or migratory fish and wildlife populations, including any rare or endangered species, or the habitats, including EFH, that support those populations; or

- result in a long-term reduction or alteration of unique, rare, or special concern vegetation types (e.g., riparian vegetation) or natural communities.

4.4.2 Terrestrial Resources

The terrestrial environment within the POLB and the surrounding cities is highly developed, and a majority of the area is paved or occupied by buildings. Terrestrial vegetation in the project area consists of weeds and ornamental plants, all of which are common in industrialized areas of southern California (Department of the Navy, 1997). Weed species may include telegraph weed, horse weed, Russian thistle, tree tobacco, and mustard. Ornamental species may include fan palms, carob trees, coral trees, Indian laurel, and eucalyptus. No fresh water wetlands; native terrestrial habitats; or plants of federal, state, regional, or local concern are currently known to occur on the proposed LNG terminal site, construction laydown and worker parking area, along the route of the pipelines and electric distribution facilities, or in the nearby area.

Due to the highly developed nature of the POLB and the lack of vegetative habitats, the terrestrial environment in the project area supports few wildlife species. Feral cats, Norway rats, and common house mice are prevalent throughout the project area. Common urban bird species expected along the pipeline routes include the American crow, rock dove (pigeon), mourning dove, European starling, and house sparrow. Birds closely associated with the marine environment are discussed in section 4.4.3.2. Federal and state-listed threatened or endangered bird species that could be expected to occur intermittently within and near the project area include the California brown pelican, California least tern, and American peregrine falcon. These species are discussed in detail in section 4.4.4.1.

Construction and operation of the proposed project could directly and indirectly impact terrestrial plant and wildlife species. Any individual plants growing within the LNG terminal site and receiver sites located at the end of each of the pipeline routes would be permanently removed. Plants removed from the construction work area for the pipelines and electric distribution facilities would be allowed to naturally revegetate. The proposed project would not result in a long-term reduction or alteration of unique, rare, or special concern vegetation types or natural communities. Wildlife would be impacted through disturbance and displacement; however, individuals in the area are acclimated to the industrial nature of the POLB, routinely experience disturbance associated with Port activities, and would likely relocate into adjacent habitats. The proposed project would not have a measurable impact on the local populations of any plant or wildlife species. As a result, the overall impact on terrestrial vegetation and wildlife resources from construction and operation of the proposed project would be less than significant.

4.4.3 Marine Resources

The Los Angeles and Long Beach Harbors were originally an estuary of the Los Angeles River, with additional fresh water flow from the San Gabriel River to the east. The natural mudflats and

marshlands provided habitat for birds, fish, and invertebrates. The barrier beach of Rattlesnake Island served as nesting habitat for terns and shorebirds. However, development of the harbors through dredging, filling, and channelization has altered the local estuarine physiography and habitats over the past 100 years. The Los Angeles and Long Beach Harbors lack the characteristics associated with typical estuaries because there is no distinctive salinity gradient; very little sandy beach and shallow water habitat and virtually no saltmarsh habitat remain; and expanding deep water habitat and increased amounts of substrates available for sessile and fouling organisms (i.e., bulkheads, shoreline breakwaters, riprap, and pier pilings) have altered benthic habitats.

The existing marine environment and potential impacts associated with the proposed project on marine organisms, water-associated birds, and EFH assessment are discussed below. Much of the information on the existing environmental conditions in the project area comes from a biological baseline study entitled *Ports of Long Beach and Los Angeles Year 2000 Biological Baseline Study of San Pedro Bay* (MEC, 2002).

4.4.3.1 Marine Organisms

Environmental Setting

Typical of an industrial harbor, the major marine habitats found in Long Beach Harbor include the water column, low-relief sediment bottom, and fabricated or high-relief solid substrates (i.e., wooden and concrete pilings, steel sheet pile and concrete bulkheads, riprap, and rock dikes). Information on sediments and surface water quality is included in sections 4.2.3 and 4.3.3, respectively. Marine organisms found in the project area include marine vegetation, benthic organisms, fish, and marine mammals.

Marine Vegetation – For purposes of this discussion, macroalgae and eelgrass are referred to jointly as marine vegetation. Although Long Beach Harbor is highly developed, consisting primarily of harbor-related structures such as navigation markers, docks, containment booms, piers, and ship hulls support macroalgal communities. Common species within these communities include sargassum, giant kelp, feather boa kelp, turf and short-foliose red algae, and green algae (MEC, 2002). Eelgrass communities, which are considered sensitive and are protected by both federal and state agencies, exist in certain intertidal and subtidal areas. However, the nearest significant area of eelgrass is located near Pier 300 in Los Angeles Harbor, about 1 mile west of the proposed LNG terminal site. A small patch of eelgrass (probably a single plant) has been identified along the shoreline of Pier A at Berth A88 in the Cerritos Channel.

Benthic Organisms – Benthic organisms, many of which are not mobile or are of limited mobility, live within, on, or associated with the sediment or substrate. Benthic organisms living in the substrate, especially in a soft sea bottom, are identified as infauna. Benthic organisms living on the substrate or on other organisms are identified as epifauna. Further distinction is made between epifauna living above the low tide mark (intertidal), therefore living partly above water and partly below depending on the tide, and epifauna living completely submerged under water (subtidal). The following discussion divides benthic organisms into two categories: benthic infauna and rocky intertidal/subtidal epifauna.

Benthic infauna, the macroscopic animals that live in the top layers of sediment on the ocean floor include polychaetes, mollusks, and crustaceans. These species serve as food for larger invertebrates (e.g., epibenthic crabs) or demersal fish (e.g., white croaker, queenfish). The distribution of benthic infauna depends on interacting sediment and other environmental variables (e.g., water depth and circulation). For example, the grain size of the sediment determines a variety of infaunal habitat characteristics including abrasion, amount of interstitial water, ease of burrowing, and materials for tube

or burrow construction. Within Long Beach Harbor there is generally a gradient of increasing habitat quality from the Inner to the Outer Harbors. The Inner Harbor is characterized by high silt and clay sediments with some accumulation of industrial and domestic wastes. These habitat conditions correspond to relatively low species diversity. The Outer Harbor is characterized by assemblages of benthic infaunal species associated with relatively high quality habitats. Areas that have recently been dredged have similar species assemblages as non-dredged areas, but there are generally fewer species and a lower abundance of individuals within a species, indicating that the recently dredged areas are still in the colonization phase.

Rock or concrete habitats occupy much of the shoreline in Long Beach and Los Angeles Harbors (e.g., cement pilings or slabs, rock breakwaters, riprap-armored shorelines), extending from the upper intertidal zone to the subtidal zone. The upper and lower intertidal zones in the West Basin consist of large cement slabs, while cement slabs and rocks make up the substrate in the subtidal zone. The upper and lower intertidal zones in the Cerritos Channel consist of small boulders, 1 to 2 feet in diameter, and the subtidal zone is characterized by silt with shell hash and a few rocks. These hard substrates, as well as pier/bulkhead pilings, provide intertidal and subtidal habitats for as many as 265 species of both attached and mobile invertebrates. The West Basin has relatively high numbers of the Mediterranean mussel, the clam (*Lasaea subviridis)*, and the brittlestar. Other intertidal and subtidal epifauna that occur in the project area include barnacles, limpets, chitons, snails, and sea anemones.

Fish – Approximately 130 species of fish are known to inhabit or frequent the waters of the Los Angeles and Long Beach Harbors; 60 to 70 of those species are considered common (POLB, 2003a). The most common fish species within the West Basin include the northern anchovy, California grunion, chub mackerel, jack mackerel, sardine, topsmelt, and widely distributed queenfish and specklefin midshipman. In comparison with other areas in Los Angeles and Long Beach Harbors, the West Basin has a relatively high number of white croaker (MEC, 2002). Based on recent survey data, the relative abundance of fish is dependent on the season, with fish being the most abundant during the summer. Juveniles are more common from samples in the Inner and Middle Harbors compared to the Outer Harbor. The northern anchovy supports a commercial bait fishery in the Los Angeles and Long Beach Harbors, as does the Pacific sardine. Generally, recreational fishing in the Los Angeles and Long Beach Harbors is discouraged because of heavy metal contamination of certain species of fish. Commercial and recreational fishing are not allowed in the West Basin of the Middle Harbor. EFHs of managed species are further discussed in section 4.4.3.3.

Marine Mammals – No cetaceans (whales and dolphins) regularly inhabit the harbor (MEC, 2002). However, occasionally individuals or small groups of common and Pacific white-sided dolphins have been reported within the harbor waters, and three or four California grey whales are sighted annually in or near the Outer Harbor. Two species of pinnipeds, the California sea lion and harbor seal, are relatively common within the harbor. These species are most abundant on the breakwaters and foraging in the outer portions of the harbor. All marine mammals are fully protected under the Marine Mammal Protection Act (see section 4.4.4.7). No marine mammals are expected to use the project site except for occasional foraging (POLB, 2003a).

Impact and Mitigation

Activities associated with construction of the facilities include dredging, reinforcement of the shoreline structures, and construction of the LNG ship berth and unloading facility. Noise and the accidental release of hazardous materials associated with these activities could impact marine organisms that occur in the project area within Long Beach Harbor. Overall, none of these impacts would substantially affect local resident or migratory marine organisms and, as such, are not considered significant as discussed below.

The dredging of approximately 275,000 to 475,000 cubic yards of sediments to prepare the LNG ship berth and reinforce the shoreline structures would destroy the benthic infauna of the dredged sediments and temporarily displace mobile organisms, such as fish. In addition to the direct disturbances to the bottom substrates, dredging activities would temporarily increase turbidity and the presence of suspended sediments in the water column, which could indirectly affect marine organisms. Temporary increases in turbidity and suspended sediment loads may expose organisms to contaminated sediments or result in decreased feeding rates and increased metabolic costs in some benthic invertebrates. In some cases, disturbed sediments settling out of the water column could smother benthic organisms. Mobile vertebrates and invertebrates may temporarily move away from the construction area in response to elevated turbidity or reduced oxygen levels. However, many vertebrate and invertebrate predators would quickly return to the disturbed area to feed on benthic species exposed or killed by dredging activities. The benthic community outside the dredge area and local turbidity levels would be expected to return to baseline conditions following the completion of construction activities. Benthic communities in the dredge area could take up to 3 years to recolonize.

The area affected by these suspended sediments would be dependent on the local currents and the particle size of the sediments (e.g., heavier particles settle out of suspension more quickly). As described in section 4.3.3.2, previous studies conducted in 1999 and 2000 during dredging activities at the Pier T Marine Terminal adjacent to the proposed project site found no indication that TSS values within 300 feet of the dredge sites were significantly elevated during dredging activities (MBC, 2001a and 2001b). In addition, monitoring of larger dredging projects within San Pedro Bay (e.g., Pier T, Pier 400) has shown that turbidity associated with dredging is short term and localized and that compliance with the requirements of the ACOE's section 404 permit and the RWQCB's WDR permit results in minimal turbidity.

Benthic organisms characterizing this area are dominated by species generally reported to be able to recolonize adjacent areas within 6 to 36 months following severe physical disruptions, such as dredging (Soule, 1976; POLB, 2003a; Reish, 1957; Harbors Environmental Projects, 1976). The timing of dredging may affect recolonization. For example, peak reproduction has been found to occur in spring and again in late summer to early fall. A study of benthic recolonization in Los Angeles Harbor between 1978 and 1986 to 1987 indicated no long-term effect from dredging (MEC, 1988).

The short-term loss of benthic organisms in a small portion of the harbor is generally recognized as an insignificant impact on aquatic resources. For previous larger dredging/landfill projects (e.g., Pier J South and Pier 400) the wildlife resource agencies with jurisdiction [i.e., the U.S. Fish and Wildlife Service (FWS), NOAA Fisheries, and the CDFG] recognized the short-term nature of the construction impacts. Additionally, benthic communities would be expected to repopulate following the completion of construction activities. Therefore, the overall impact of dredging associated with the proposed project on marine organisms would be less than significant.

Additionally, activities associated with the reinforcement of the shoreline structures and construction of the LNG ship berth and unloading facility could directly affect benthic and fish species during the removal or installation of any in-water structures (e.g., pilings, underwater rock buttress). Individuals of non-mobile species attached to hard substrates that are removed or covered would suffer mortality. Because these species are relatively widespread throughout the harbor and would recolonize new hard substrates within 2 to 3 years, these impacts would be less than significant.

Ship traffic and various construction or maintenance activities create a relatively "noisy" underwater environment within Long Beach Harbor. Research suggests that some marine organisms exhibit avoidance behaviors in response to noise from ship engines (International Council for the Exploration of the Sea, 1995). As such, project vessels (LNG ships, tugs, construction barges) operating

within Long Beach Harbor could create sounds that lead to responses in fish. Additionally, specific construction activities (e.g., driving steel piles) could also generate underwater sound pressure waves that potentially kill, injure, or cause a behavioral change in fish in the immediate vicinity of the construction activities (NOAA Fisheries, 2003). Given the abundance of fish in the harbor despite continuous maritime activity, marine organisms found in the project area have generally adapted to these "noisy" conditions. Accordingly, the impacts of construction on fish populations are considered insignificant.

There is also the potential for spills, leaks, or accidental releases of potentially hazardous materials to occur during construction of the proposed project. A discharge of hazardous materials into harbor waters could result in a significant impact on benthic invertebrates attached to the shoreline substrates. To minimize the potential for accidental releases of hazardous materials, construction of the proposed project would be conducted in accordance with SES' Spill Procedure included as part of its SWPPP (see discussion in section 4.3.2.2 and Appendix B). The Spill Procedure specifies BMPs that would minimize the chances of a spill and, if a spill were to occur, minimize the chances of the spill reaching a waterbody. Additionally, the Spill Procedure includes measures to minimize impacts if a spill does occur and reaches a waterbody. Implementation of SES' Spill Procedure would reduce impacts on marine organisms associated with a hazardous spill or leak to less than significant levels.

Several agencies expressed concern that operation of the LNG terminal would require the withdrawal and discharge of significant volumes of water from and to the harbor as part of the vaporization process and that this could impact some marine organisms (e.g., adult, juvenile, or larval fish). Vaporizers that use sea water were considered as an alternative to the ones proposed by SES, but were not considered appropriate for this proposed project (see section 3.6). Hot water pumped through coils in a natural gas-fired heat exchanger would be used as an intermediate transfer fluid to supply heat for LNG vaporization. This process would occur in a closed circulation system so no water intake or discharge would occur during normal operations. In addition, as described in section 2.7.1.4, the firewater supply and distribution system at the LNG terminal is intended to be run on fresh water from the POLB and the City of Long Beach municipal water system and would not require the intake of sea water. Therefore, the vaporization and firewater systems for the proposed project would not adversely affect marine organisms.

The LNG ships associated with the proposed project could import or export exotic species into or out of Long Beach Harbor. LNG ships would arrive at the LNG terminal fully loaded with LNG from locations throughout the Pacific region. To maintain a constant draft during the unloading operation, the LNG ship would bring on ballast water (about 8 to 18 million gallons, depending on the size of the ship) during transfer of its LNG cargo and retain this ballast water until after the LNG ship departs the harbor. The absence of ballast water discharges within the harbor would decrease the potential for importing an exotic species.

Construction of the pipelines would not impact marine organisms because in-water disturbances would be avoided by using the HDD method to cross the Cerritos Channel and an above-water pipe rack at the Dominguez Channel (see section 4.3.3.2).

4.4.3.2 Water-Associated Birds

About 100 bird species, including some federally and state-listed threatened or endangered species (see section 4.4.4), use habitats within Los Angeles and Long Beach Harbors for foraging, breeding, and/or nesting. About 70 percent of these birds are water-associated. The most abundant are western gulls, Heermann's gulls, elegant terns, federally and state-listed least terns, federally and state-listed California brown pelicans, western grebes, Brant's cormorants, and surf scoters. Riprap habitats associated with breakwaters tend to have the highest densities of birds in the harbors.

Dredging and construction activities associated with the Long Beach LNG Import Project would affect water-associated birds through disruptive noise and/or temporary loss or degradation of foraging habitats in the marine waters of the West Basin. Birds found in the area are acclimated to these types of activities and would use similar habitats in adjacent areas. Due to the temporary nature of the disruption, the overall impact on water-associated bird resources would be less than significant.

A nesting colony of black-crowned night herons is located at Gull Park on the Navy Mole near the mouth of the West Basin. This location, constructed in 1998 as mitigation for removal of nesting trees at the Long Beach Naval Station, was a successful mitigation site because the herons had accepted it as a rookery. During surveys in 2000 and 2001, biologists observed black-crowned night herons throughout the Los Angeles and Long Beach Harbors concentrated in the West Basin during the spring months. Peak numbers of individuals occurred in the rookery during May and June (MEC, 2002). More recent surveys have seen a marked decline in the number of individuals, possibly as a result of an ongoing groundwater remediation project being conducted onsite by the Navy. The black-crowned night heron rookery is located about 1,500 feet from the LNG terminal site, across open water. The rookery would not be directly affected by construction or operation of the proposed project because the project would be some distance away and would involve port-related activities that the birds are accustomed to. Indirect impacts such as noise and/or temporary loss or degradation of foraging habitat would be similar to those for other water-associated bird species and would be less than significant.

A scoping comment was received regarding the effects of additional light and glare associated with the project on migratory bird mortality. Construction of the proposed project would result in an incremental increase in ambient nighttime light levels at the proposed project site. While limited information exists on the specific effects of artificial light on birds and other wildlife, it is understood that artificial light can result in general disruptions in daily (i.e., nocturnal) activity cycles, behaviors, and/or migratory movements. Birds and other wildlife can also be indirectly impacted through alterations to habitats and effects on prey species. As natural habitats continue to be fragmented by development, additional sources of artificial light may exacerbate impacts on wildlife. However, the proposed project would not create a significant new source of light or glare that would adversely affect nighttime views in the area (see section 4.5.6). Because most of the facilities in the ports of Long Beach and Los Angeles are lit at night for safety, the project would only incrementally add to the existing source of light in the area. Therefore, light or glare created by the project would not have an adverse impact on birds or other wildlife.

4.4.3.3 Essential Fish Habitat Assessment

The MSA (Public Law 94-265 as amended through October 11, 1996) was established, along with other goals, to promote the protection of EFH in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. EFH is defined in the MSA as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

Section 302 of the MSA establishes eight regional fishery management councils. Among other responsibilities, these councils develop management plans for each fishery that requires conservation and management. Section 303(a)(7) of the MSA requires that these fishery management plans describe and identify EFH. The proposed project would be constructed and operated within the region of the Pacific Fishery Management Council (PFMC). The PFMC has published two amendments to its fishery management plans to address EFH in the project area. Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan, published in the Federal Register on September 10, 1999 (64 FR 49092) addresses groundfish (PFMC, 1998a). Amendment 8 to the Northern Anchovy Fishery Management

Plan, published in the Federal Register on December 15, 1999 (64 FR 69888) addresses coastal pelagic species (PFMC, 1998b).

Federal agencies that authorize, fund, or undertake activities that may adversely impact EFH must consult with NOAA Fisheries. Although absolute criteria have not been established for conducting EFH consultations, NOAA Fisheries recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as NEPA, the Fish and Wildlife Coordination Act, the ESA, and the Federal Power Act in order to reduce duplication and improve efficiency [Title 50 CFR Part 600.920(e)]. Generally, the EFH consultation process includes the following steps:

1) Notification – The action agency should clearly state the process being used for EFH consultations (e.g., incorporating EFH consultation into an EIS, section 10 permit, etc.).

2) EFH Assessment – The action agency should prepare an EFH Assessment that includes both identification of affected EFH and an assessment of impacts. Specifically, the EFH should include:

   - a description of the proposed action;
   - an analysis of the effects (including cumulative effects) of the proposed action on EFH, the managed fish species, and major prey species;
   - the federal agency's views regarding the effects of the action on EFH; and
   - proposed mitigation, if applicable.

3) EFH Conservation Recommendations – After reviewing the EFH Assessment, NOAA Fisheries should provide recommendations, if necessary, to the action agency regarding measures that can be taken by that agency to conserve EFH.

4) Agency Response – Within 30 days of receiving the recommendations, the action agency must respond to NOAA Fisheries. The response must include a description of measures proposed by the agency to avoid, mitigate, or offset the impact of the activity on EFH.

The FERC proposes to consolidate EFH consultations for the proposed project with the interagency coordination procedures required under NEPA. Therefore, the FERC is requesting consideration of this draft EIS/EIR as the FERC's EFH Assessment for the proposed project. A discussion of EFH for the managed species in the region (i.e., coastal pelagic and Pacific groundfish species) and control measures and management practices that would mitigate potential EFH impacts is presented below.

Managed Species in Long Beach Harbor

Consultation with NOAA Fisheries identified the proposed project area as designated EFH for the Coastal Pelagics and Pacific Groundfish Management Plans. Fourteen of the 86 species managed under these two plans are known to occur in Long Beach Harbor and could be affected by the proposed project (see table 4.4.3-1).

Amendment 8 to the Northern Anchovy Fishery Management Plan defines coastal pelagic species as those that occur in the water column and are not associated with the bottom. The four finfish managed

under this amendment and potentially affected by the proposed project include: northern anchovy, Pacific sardine, Pacific (chub) mackerel, and jack mackerel (see table 4.4.3-1).

TABLE 4.4.3-1

Managed Fisheries Potentially Affected by the Long Beach LNG Import Project

Common Name	Scientific Name	Comments
Coastal Pelagics		
Northern Anchovy	*Engraulis mordax*	Abundant in harbor. Most common species in harbor; adults and larvae present.
Pacific Sardine	*Sardinops sagax*	Abundant in harbor. Predominantly adults present.
Pacific (chub) Mackerel	*Scomber japonicus*	Abundant in harbor. One of top 10 most common species in deeper portions of the harbor.
Jack Mackerel	*Trachurus symmetricus*	Abundant in harbor. One of top 10 most common species in deeper portions of the harbor.
Pacific Groundfish		
English Sole	*Pleuronectes vetulus*	Rare in harbor. Adults present.
Pacific Sanddab	*Citharichthys sordidus*	Uncommon in harbor. Adults present.
Leopard Shark	*Triakis semifasciata*	Species reportedly commonly taken by sport fishermen in harbor; rare from harbor beach seines. Adults present.
Bocaccio	*Sebastes paucispinis*	Uncommon to rare in harbor. Juveniles found in kelp around breakwater.
California Scorpionfish	*Scorpaena gutatta*	Common in harbor. Adults found in rock dikes and breakwater during the day, soft bottom at night.
Cabezon	*Scorpaenichthys marmoratus*	Common on hard substrates in harbor. Adults present.
California Skate	*Raja inorata*	Uncommon in harbor.
Lingcod	*Ophiodon elongates*	Rare in harbor, uncommon offshore.
Black Rockfish	*Sebastes melanops*	Uncommon in southern California.
Olive Rockfish	*Sebastes serranoides*	Common in harbor. Juveniles found in kelp around breakwater.

Among the coastal pelagic species, the northern anchovy is the most abundant species in the Los Angeles and Long Beach Harbors, accounting for approximately 40 percent of the fish collected by otter trawl and 70 percent of the individuals collected in lampara nets (MEC, 2002). This species supports a commercial bait fishery in the harbor. The Pacific sardine, which comprises 4 percent of the pelagic fish collected in Long Beach Harbor, also supports a commercial bait fishery (MEC, 2002). The other two coastal pelagic species (Pacific mackerel and jack mackerel) are frequently encountered in the harbor but are not considered major components of the ichthyofauna. None of the coastal pelagic species is known to spawn in the harbor, but northern anchovy larvae are an important component of the ichthyoplankton (MEC, 2002). Little difference was observed in lampara fish catch between the Inner and Outer Harbor areas, indicating that pelagic schooling fish species range in high abundance throughout the harbor complex.

Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan identifies 82 species of groundfish (defined as "fish species that live on or near the bottom, often called bottomfish") that are found along the west coast of the United States. Ten of the 82 species are known to occur in the Los Angeles and Long Beach Harbors (see table 4.4.3-1).

Among the groundfish, the California scorpionfish is reportedly common in Long Beach Harbor. It is associated with rock substrates, such as dikes and breakwaters, and is rarely collected in nets, but night observations by divers suggest it is very abundant. The other nine species of managed groundfish that exist in the Los Angeles and Long Beach Harbors are rarely or infrequently collected in the project area (POLB, 2003a). None of the Pacific groundfish species is known to spawn in the harbor area.

Potential Impacts and Mitigation

Potential impacts on EFH for coastal pelagic and groundfish species include direct and indirect impacts on water quality and marine substrates from the reinforcement of the shoreline structures, dredging activities, and construction of the LNG ship berth and unloading facility. This could include disturbance or replacement of bottom substrates, turbidity caused by dredging, and introduction of chemical contaminants from construction and support vessels (see section 4.4.3.1). Additionally, operation of the facility could potentially impact EFH through accidental spills or leaks of hazardous materials, storm water runoff, or an LNG spill (see section 4.3.3.2).

Implementation of the control measures and management practices proposed by SES or required by the regulatory agencies would serve to avoid or minimize impacts on EFH from any of the construction or operation activities. These measures and practices include:

- minimizing temporary impacts associated with dredging through adherence to the measures included in the ACOE's section 404 permit and the RWQCB's WDR permit (see section 4.3.3.2);
- implementing the BMPs in the POLB's Dredge and Disposal Plan during dredging operations (see section 4.3.3.2);
- implementing SES' SWPPP to avoid or minimize the release of sediments into the West Basin during construction and operation of the LNG terminal (see section 4.2.2.2 and Appendix B);
- implementing the special precautions outlined in SES' Spill Procedure to reduce the potential for surface water contamination from hazardous materials (see section 4.3.3.2 and Appendix B);
- using the HDD construction method to install the natural gas and C_2 pipelines under the Cerritos Channel (see section 4.3.3.2);
- installing the C_2 pipeline on an existing pipe rack across the Dominguez Channel (see section 4.3.3.2); and
- immediately implementing measures to contain, collect, and cleanup an inadvertent release of drilling fluid as detailed in SES' HDD Plan (see section 4.3.3.2 and Appendix C).

Although disturbance of an estimated 11.9 acres of sea floor and the temporary resuspension of sediments into the water column during dredging activities could potentially adversely affect EFH (resulting in avoidance by adults and some loss of larval northern anchovy in the immediate vicinity of the dredging activity), implementation of the control measures and management practices listed above would serve to avoid or minimize impacts on EFH. Additionally, construction impacts would be temporary and turbidity levels would return to baseline conditions following construction. Therefore, the overall impacts of the proposed project on coastal pelagic and groundfish EFH would be less than significant and no additional mitigation measures would be necessary.

SES submitted information about the proposed project and potential impacts on EFH to NOAA Fisheries on November 25, 2003. NOAA Fisheries determined that activities associated with the proposed project would result in temporary and minor impacts on EFH and that the impacts would be

minimized by adherence to ACOE and RWQCB permit stipulations. Based on this EFH analysis, the FERC staff concurs with NOAA Fisheries and finds that construction and operation of the proposed project, with implementation of the measures and practices described above, would comply with the intent and degree of protection afforded to the species listed in table 4.4.3-1 and their designated EFH under the MSA.

4.4.4 Threatened and Endangered Species

Federal and state regulations protect a number of species that potentially occur in the project area. With assistance from SES, the Agency Staffs informally consulted with the FWS, NOAA Fisheries, and the CDFG to assess impacts on special status species. None of these agencies identified any particular concerns based on the description of the proposed project. Threatened and endangered species observed or that have the potential to occur in the proposed project area are listed in table 4.4.4-1 and discussed in detail below.

TABLE 4.4.4-1

Threatened and Endangered Species Observed or Possibly Occurring in the Long Beach LNG Import Project Area

Common Name	Scientific Name	Status [a]	Observed or Possibly Expected
American Peregrine Falcon	*Falco peregrinus anatum*	SE	Nesting observed on Terminal Island periodically; uses trees near the project area as perches.
California Brown Pelican	*Pelecanus occidentalis californicus*	FE/SE	Forages in the West Basin.
California Least Tern	*Sterna antillarum browni*	FE/SE	Nests on Terminal Island; forages in the harbor.
Western Snowy Plover	*Charadrius alexandrinus nivosus*	FT/CSC	No recent nesting in the area; low potential for occurrence.
Green Sea Turtle	*Chelonia mydas*	FT	Possible use of the harbor.
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	FT	Possible use of the harbor.
Loggerhead Sea Turtle	*Caretta caretta*	FT	Possible use of the harbor.
Leatherback Sea Turtle	*Dermochelys coriacea*	FE	Possible use of the harbor.

[a] Status:
U.S. Fish and Wildlife Service and NOAA Fisheries:
FE = Endangered. In danger of becoming extinct throughout all or a significant portion of its range.
FT = Threatened. Likely to become endangered in the foreseeable future in the absence of special protection.
California Department of Fish and Game:
SE = Endangered. In serious danger of becoming extinct throughout all or a significant portion of its range.
CSC = California Species of Special Concern. Sufficient information exists that warrants concern over species status and may warrant future listing as threatened or endangered.

4.4.4.1 Federal Threatened and Endangered Species

Section 7 of the ESA, as amended, requires a federal agency to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of a federally listed endangered or threatened species, or result in the destruction or adverse modification of the designated critical habitat of a federally listed species. The federal action agencies are required to consult with the FWS and NOAA Fisheries to determine whether any federally listed or proposed listed endangered or threatened species or any of their designated critical habitats are found in the vicinity of the proposed project, and to determine the proposed action's potential effects on those species or critical habitats. Seven species listed as federally threatened or endangered potentially occur in the project area. The California brown pelican, California least tern, and leatherback sea turtle are federally listed endangered species and the western snowy plover, green sea turtle, olive Ridley sea turtle, and loggerhead sea turtle

are federally listed threatened species. Both the FWS and NOAA Fisheries provided comments indicating that federally listed threatened or endangered species would not likely be adversely affected by the proposed project (Fancher, 2004; TRC Environmental Corporation, 2003). The FERC staff concurs with these determinations. The listed species that potentially occur in the project area are discussed below.

California Brown Pelican

The California brown pelican is a coastal bird that commonly occurs within 12 miles of shore, but is also observed up to 100 miles from the coast. It feeds mostly in shallow estuarine waters on northern anchovy and other small fish, as well as crustaceans and carrion. The range of the California brown pelican includes the west coast of North America as far north as British Columbia. This species makes extensive use of roosting sites such as rocky cliffs, jetties, sand spits, offshore sand bars, mudflats, and islets. The California brown pelican nests along the Pacific coast in southern California from the Channel Islands southward along the Baja California coast and in the Gulf of California to coastal southern Mexico. Although the California brown pelican does not nest within the Los Angeles and Long Beach Harbors, this area, particularly the outer breakwater and open water, provides roosting and feeding habitat (MEC, 2002). A majority of the pelicans observed in the area were roosting along the riprap of the outer breakwater.

California brown pelicans use the docks and shoreline riprap of the West and Southeast Basins and the Outer Harbor to rest, but do not rely on these areas for breeding, nesting, or feeding. Construction and operation of the proposed project could potentially disturb this species through temporary loss or degradation of foraging habitat, temporary turbidity in the marine waters, and disruptive noise. However, their continued abundance in the harbor indicates that California brown pelicans have generally acclimated to POLB operations, including pile-driving, construction, and dredging activities, all of which occur frequently in the harbor. Consequently, construction and operation of the Long Beach LNG Import Project would not likely adversely affect the California brown pelican.

California Least Tern

The California least tern inhabits seacoasts, beaches, bays, estuaries, lagoons, lakes, and rivers, and rests on sandy beaches, mudflats, and salt-pond dikes. This species typically preys on northern anchovy, topsmelt, killifish, mosquitofish, shiner surfperch, and mudflat gobies in areas with water less than 20 feet deep. This species usually occurs singly or in small loose groups when it is not breeding, but migrates in larger flocks. The California least tern's nesting range is along the Pacific coast from southern Baja California to San Francisco Bay. Least terns usually arrive in California in April and depart in August. They nest in colonies near the coast on undisturbed, bare, or sparsely vegetated flat substrates with loose, sandy substrate. Development and recreational use have largely eliminated the natural nesting habitats of this species. Typical nesting sites are now on isolated or specially protected sand beaches or on natural or artificial open areas in remnant coastal wetlands, and are typically located near estuaries, bays, or harbors where small fish are abundant. California least terns have traditionally foraged in the shallow water habitat west of the Navy Mole in Long Beach Harbor.

The California least tern may occasionally fly over the project area when foraging. However, area waters are not designated as essential foraging habitat. Construction and operation of the proposed project could potentially disturb this species through temporary loss or degradation of foraging habitat, temporary turbidity in the marine waters, and disruptive noise. However, the project would not result in the permanent loss or degradation of existing habitats or significantly increase existing noise levels during construction and operation. Consequently, construction and operation of the Long Beach LNG Import Project would not likely adversely affect the California least tern.

Western Snowy Plover

The western snowy plover inhabits beaches; dry mud or salt flats; and sandy shores of rivers, lakes, and ponds. Outside of the breeding season, individuals are usually found on islands and on the coast from Oregon south to Guatemala. The western snowy plover nests along the Pacific coast north to southern Washington and south to Baja California, being most numerous from San Francisco Bay south. This species nests on undisturbed, flat ground on broad open beaches or salt or dry mud flats where vegetation is sparse or absent. Nesting occurs between April 1 and September 15. Western snowy plovers forage primarily on the wet sand at the beach-surf interface, feeding on small crustaceans, marine worms, insects, and amphipods. Due to the lack of suitable nesting and foraging habitat, there is low potential for the western snowy plover to occur in the project area. Therefore, there would be no effect on the western snowy plover from construction and operation of the Long Beach LNG Import Project.

Sea Turtles

Four species of sea turtles potentially occur in or near the entrances to Long Beach Harbor, including the green, olive Ridley, loggerhead, and leatherback sea turtles. Green and olive Ridley sea turtles inhabit tropical regions of the Pacific, Indian, and Atlantic Oceans; the loggerhead sea turtle is found in temperate and subtropical waters throughout most of the world; and the leatherback sea turtle is primarily found in the open ocean, but occasionally is seen in inshore waters. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska. Olive Ridley sea turtles range from the west coast of California south to Chile. Loggerhead sea turtles inhabit an enormous range from north to south but are rare or absent far from mainland shores. Leatherback sea turtles range as far north as Alaska and as far south as the southern tip of Africa. All four sea turtle species nest on beaches and lay eggs multiple times per nesting season. However, none of the species are known to nest at or near the proposed project area due to the lack of suitable nesting habitat. These sea turtle species are highly migratory and utilize coastal waters for foraging and migratory habitat during certain stages of their life history.

Construction would not likely affect sea turtles because of their rarity at the project site. While entering and exiting Long Beach Harbor, the LNG ship traffic necessary for operation of the proposed project could potentially disturb threatened and endangered sea turtle species in the immediate area. However, sea turtles are only infrequently observed near the harbors in San Pedro Bay. Furthermore, the LNG ship traffic for this project would represent only a 4 percent increase in ship traffic levels and, therefore, would not significantly increase the ship traffic that already exists in Long Beach Harbor (see section 4.7.3.2). Consequently, there would be no effect on the green, olive Ridley, loggerhead, or leatherback sea turtle species from the Long Beach LNG Import Project.

4.4.4.2 State Threatened and Endangered Species

California has its own Endangered Species Act (CESA) that protects and promotes the recovery of state-listed endangered and threatened species. Similar to the ESA, the CESA requires that state agencies consult with the CDFG to ensure that actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in destruction or adverse modification of essential habitat. The FERC and the POLB have consulted with the CDFG and included an assessment of potential impacts on state-listed endangered or threatened species in this draft EIS/EIR. Three state-listed endangered species, the American peregrine falcon, the California brown pelican, and the California least tern, have been identified as potentially occurring in the proposed project area. The California brown pelican and the California least tern are also federally listed species and are discussed in section 4.4.4.1. The American peregrine falcon is discussed below.

American Peregrine Falcon

The range of the American peregrine falcon includes most of California, except deserts, during its migrations and in the winter. American peregrine falcons are primarily found near large bodies of water where they feed on water birds. The California breeding range, which has been expanding, now includes the Channel Islands, the coast of southern and central California, and inland and northern coastal mountains. Nesting sites are typically on ledges of large cliff faces, but some pairs nest on city buildings and bridges. Nesting and wintering habitats are varied and can include the following: wetlands, woodlands, other forested habitats, cities, agricultural areas, and coastal habitats. American peregrine falcons forage regularly in Los Angeles and Long Beach Harbors, and several pairs of peregrine falcons regularly nest within the ports of Los Angeles and Long Beach and their vicinity. This presence indicates that the birds are acclimated to construction and operation activities in the port complex.

Construction and operation of the Long Beach LNG Import Project could disturb the American peregrine falcon through temporary loss or degradation of foraging habitat and disruptive noise from construction and operation of the project facilities. However, peregrine falcons in the project area have become acclimated to POLB operations, including construction and dredging activities as evidenced by their continued use of the local bridges for nesting. In addition, the proposed project would not result in the permanent loss or degradation of existing foraging habitat or significantly increase existing noise levels during construction and operation. Therefore, impacts on the American peregrine falcon would be less than significant.

4.5 LAND USE, RECREATION, AND VISUAL RESOURCES

4.5.1 Significance Criteria

Impacts on land use would be considered significant if project construction or operation would:

- be inconsistent with existing zoning regulations;
- result in activities conflicting with existing surrounding uses; or
- create conflicts between the project and state goals and objectives of the PMP, as amended (see section 1.4).

Impacts on recreation would be considered significant if project construction or operation would:

- threaten the viability of a recreational resource, prohibit access to recreational resources, or cause termination of a recreational use.

Impacts on visual resources would be considered significant if project construction or operation would:

- dominate the viewshed from sensitive locations and change the character of the landscape both in terms of physical characteristics and land uses;
- block or alter an important/valued view for sensitive viewers or have a substantial, adverse effect on a scenic vista; or
- create a new source of substantial light or glare that would adversely affect day or nighttime views in the area.

4.5.2 Land Use and Ownership

The Long Beach LNG Import Project would be located in a highly urbanized area of Los Angeles County, California. The LNG terminal facilities, the temporary construction laydown and worker parking area, a portion of the pipeline facilities, and the electric distribution facilities would be located within the boundaries of the POLB. The pipeline facilities would also be located within the Cities of Long Beach, Los Angeles, and Carson. A total of 88.0 acres of land would be affected during construction of the Long Beach LNG Import Project (56.9 acres for the LNG terminal facilities, 30.1 acres for the pipeline facilities, and 1.0 acre for the electric distribution facilities). Of the 88.0 acres of land affected by construction of the project, 37.0 acres would be permanently affected during operation of the project facilities (32.1 acres associated with the LNG terminal, 3.9 acres associated with the pipelines, and 1.0 acre associated with the electric distribution facilities).

4.5.2.1 LNG Terminal Facilities

The LNG terminal would be located on a portion of Pier T, designated Berth T-126 within Terminal Island Planning District 4 of the POLB. Terminal Island is a manmade island that has been constructed and expanded since the early 1900s through various reclamation projects. The island is composed entirely of fill soils that range in thickness from 45 to 55 feet. Permitted uses within Terminal Island Planning District 4 include primary POLB facilities, hazardous cargo facilities, Port-related uses, navigation, ancillary POLB facilities, federal uses, oil production, and utilities.

The LNG terminal site would occupy about 25 acres of the 288 acres associated with Pier T. As discussed in section 1.2.2, SES would have to obtain a lease from the BHC to build and operate the project.

Pier T is located within a former United States naval complex that included the Long Beach Naval Station, Navy Mole, and Naval Shipyard. The Naval Station and Navy Mole were closed in 1994 and the Naval Shipyard was closed about 3 years later. The 25-acre site is currently paved with concrete and/or asphalt and includes two abandoned buildings. In recent years one of the buildings has been used by the City of Long Beach to house firefighting equipment and for other miscellaneous uses. The POLB would demolish the buildings on the site and remove the pavement prior to SES' initiation of activities associated with the proposed project (see section 2.1.1).

The entire 25-acre site would be used for construction and operation of the LNG terminal facilities. In addition to the 25-acre site on land, a 200-foot-wide by 1,150-foot-long area would be dredged for the ship berth and unloading facility adjacent to Pier T. These dredging activities would result in about 5.3 acres of disturbance to the sea floor within the West Basin. Of these 5.3 acres, the ship berth and unloading facility would permanently occupy about 0.5 acre. Two additional areas along the western and southern edges of Pier T would be dredged to reinforce the shoreline structures. These areas would be 150 feet wide by 250 feet long and 180 feet wide by 1,400 feet long for a total disturbance to the sea floor of 6.6 acres during both construction and operation. However, no new land would be created.

A 16-acre site located on Pier T about 1 mile northwest of the LNG terminal site would be used for temporary construction laydown, staging, storage, and worker parking. The laydown area is graveled and includes a rail spur along the northern border of the site that extends to the LNG terminal site. Although the laydown area is located within the City of Los Angeles, the parcel is owned by the POLB.

In addition to the temporary laydown area on land, construction materials would be shipped by barge to the LNG terminal site. An estimated four to six barges would be moored around the LNG terminal site at various times during construction of the LNG storage tanks. These barges would provide about 4 acres of additional temporary extra workspace.

Table 4.5.2-1 summarizes the acres of each land use that would be affected by construction and operation of the proposed LNG terminal facilities.

TABLE 4.5.2-1

Area (Acres) Affected by Construction and Operation of the Proposed LNG Terminal

	Industrial [a]		Open Water [b]		Total	
Facility	Const.	Oper.	Const.	Oper.	Const.	Oper.
LNG Terminal Site	25.0	25.0	0.0	0.0	25.0	25.0
Ship Berth and Unloading Facility	0.0	0.0	5.3	0.5	5.3	0.5
Reinforcement of the Shoreline Structures	0.0	0.0	6.6	6.6	6.6	6.6
Temporary Laydown and Worker Parking Area	16.0	0.0	0.0	0.0	16.0	0.0
Temporary Barges	0.0	0.0	4.0	0.0	4.0	0.0
Total	41.0	25.0	15.9	7.1	56.9	32.1

[a] Industrial land includes previously developed areas associated with the POLB.

[b] Open water includes those portions of the West Basin disturbed by construction and operation of the ship berth and unloading facility and dredging to reinforce the shoreline structures.

All of the land and marine uses immediately adjacent to the LNG terminal facilities are associated with the industrial activities of the ports of Long Beach and Los Angeles. Surrounding land uses on Pier T include the containerized cargo facility of Total Terminals Inc./Hanjin Shipping Company (TTI/Hanjin), the liquid bulk facility of BP ARCO (crude oil and petroleum products), the breakbulk facilities of the Pacific Coast Recycling Company (metal and steel recycling), and the lumber and lumber products facilities of the Fremont Forest Group Corporation and the Weyerhauser Company. The TTI/ Hanjin facilities occupy most of Pier T along Ocean Boulevard. Generalized land uses within 2 miles of the LNG terminal site include a mix of industrial and commercial interspersed with high density residential (see section 4.5.3). Operation of the LNG terminal facilities is not expected to interfere with any activities on adjacent berths.

The LNG terminal would be an industrial use that generally conforms to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans and would be consistent with existing surrounding uses. However, an amendment to the PMP would be necessary to accommodate the LNG facility because LNG is not an expressly identified "hazardous cargo" as permitted within Terminal Island Planning District 4 (see section 1.4.3).

4.5.2.2 Natural Gas and C_2 Pipelines and Associated Aboveground Facilities

The proposed natural gas pipeline would be 2.3 miles long and would be constructed and operated by SES. A total of about 1.6 miles of the pipeline would be located within the POLB (0.9 mile in the Terminal Island Planning District 4 and 0.7 mile in the Northwest Harbor Planning District). The remaining 0.7 mile would be within the boundaries of the City of Los Angeles. The entire pipeline route would cross heavily disturbed, industrialized areas associated with the POLB and surrounding areas. The majority of the land crossed by the pipeline is owned by the POLB (1.7 miles or 74 percent). The remaining 0.6 mile of land (26 percent) is privately owned. The privately owned parcels consist of about 1,000 feet (0.2 mile) in the Long Beach Generating Station (formerly the Edison Power Station) and about 2,400 feet (0.4 mile) in SCE's transmission line right-of-way. In general, the entire pipeline route would be located adjacent to or within existing utility or road rights-of-way.

The proposed C_2 pipeline would be 4.6 miles long and would be constructed and operated by ConocoPhillips. The first 2.3 miles of the pipeline would follow the same route as the natural gas pipeline. The remaining 2.3 miles would be located within the Cities of Los Angeles (1.4 miles) and Carson (0.9 mile). The majority of the pipeline route would be located adjacent to or within existing utilities and there are no schools or day care facilities in the area. Within the City of Los Angeles, the pipeline would cross land owned by the POLA in the Wilmington area. As discussed in section 1.4.5, the POLA indicated that it is currently investigating the feasibility of developing an ICTF on a portion of the property crossed by the proposed C_2 pipeline. The POLA also stated that any pipeline constructed within an ICTF would need to be designed to handle railroad loads. SES would need to acquire the necessary right-of-way permits from the POLA in order to cross this property and those permits would specify construction standards.

For the portion of the pipelines on private land, SES and/or ConocoPhillips would need to acquire an easement or property to construct and operate the proposed facilities. The easement would convey both temporary (for construction) and permanent rights-of-way and give the right to construct, operate, and maintain the pipeline facilities. An easement agreement between a company and a landowner typically specifies compensation for losses resulting from construction, including losses of non-renewable and other resources, damages to property during construction, and restrictions on existing uses that would not be permitted on the permanent right-of-way after construction.

Land use impacts associated with the pipelines would include the disturbance of existing land uses within the construction right-of-way during construction and retention of a new permanent right-of-way for operation of the pipelines. Of the 2.3 miles associated with the natural gas pipeline, 1.4 miles (61 percent) would be constructed using a 50-foot-wide construction right-of-way. The remaining 0.9 mile would be constructed using the HDD method (0.5 mile or 22 percent) or using a 30-foot-wide construction right-of-way (0.4 mile or 17 percent). Following construction, a 4-foot-wide permanent right-of-way would be retained for operation and maintenance of the pipeline. Similarly, construction of the C_2 pipeline would require a 30- to 50-foot-wide construction right-of-way and an approximately 4-foot-wide permanent right-of-way. The C_2 pipeline would be installed across the Dominguez Channel on an existing pipe bridge.

In addition to the construction right-of-way, two temporary extra workspaces would be used to facilitate the HDD crossing of the Cerritos Channel associated with both the proposed natural gas and C_2 pipelines. A 200-foot by 200-foot temporary extra workspace would be used at the HDD entry location at MP 0.6 and a 100-foot by 100-foot temporary extra workspace would be used at the HDD exit location at MP 1.1. No new access roads would be required and pipe would be stored offsite or in the temporary construction laydown area associated with the LNG terminal. There are no residences closer than 500 feet from either of the pipeline routes.

The aboveground facilities associated with the natural gas pipeline would include a meter station, odorization system, and pig launcher at the beginning of the pipeline route (MP 0.0) and a pig receiver at the end of the pipeline route (MP 2.3). The meter station, odorization system, and pig launcher would be located on a 150-foot by 150-foot site located within the 25-acre LNG terminal facility site. The pig receiver would be constructed on a 75-foot by 150-foot site in an industrial area at the end of the pipeline where it interconnects with the SoCal Gas system.

The aboveground facilities associated with the C_2 pipeline would include a meter station and pig launcher at the beginning of the pipeline route (MP 0.0) and a pig receiver at the end of the pipeline route (MP 4.6). The meter station and pig launcher would be located adjacent to the meter station and pig launcher associated with the natural gas pipeline within the 150-foot by 150-foot site at the LNG terminal facility. The pig receiver would be constructed on a 100-foot by 150-foot fenced site within the LARC.

Construction of the pipeline facilities would affect a total of about 30.1 acres of land, consisting of 10.9 acres for the facilities associated with the natural gas pipeline and 19.2 acres for the facilities associated with the C_2 pipeline. Industrial land would be the only land use affected by construction of the pipeline facilities. An easement would exist across the Cerritos Channel but the open water would not be affected during operation of the pipelines. Table 4.5.2-2 summarizes the acres of each land use that would be affected by construction and operation of the proposed pipeline facilities.

Of the 30.1 acres of land affected by construction of the pipeline facilities, about 1.4 acres would be retained for operation of the natural gas pipeline facilities and 2.5 acres would be retained for operation of the C_2 pipeline facilities. The land retained as permanent right-of-way for the pipelines would be allowed to revert to former use; however, certain activities such as the construction of aboveground structures would be prohibited within the permanent right-of-way. The pig launcher and receiver sites would be fenced and precluded from future development; however, each would be located within existing or proposed industrial facilities. The remaining 26.2 acres used for temporary construction right-of-way and temporary extra workspace would be allowed to revert to prior uses following construction with no restrictions.

The pipeline facilities would be an industrial/utility use that is consistent with existing surrounding uses and conforms to the overall goals of the current PMP, local zoning ordinances, and

relevant regional plans. As a result, impacts on land use associated with the pipeline facilities would be less than significant.

TABLE 4.5.2-2

Area (Acres) Affected by Construction and Operation of the Proposed Pipeline Facilities

	Industrial [a]		Open Water [b]		Total	
Facility	Const.	Oper.	Const.	Oper.	Const.	Oper.
Natural Gas Pipeline Facilities						
Pipeline Right-of-Way [c]	9.5	0.8	0.0 [d]	0.3 [d]	9.5	1.1
Temporary Extra Workspace						
HDD Entry Workspace	0.9	0.0	0.0	0.0	0.9	0.0
HDD Exit Workspace	0.2	0.0	0.0	0.0	0.2	0.0
Temporary Extra Workspace Subtotal	1.1	0.0	0.0	0.0	1.1	0.0
Aboveground Facilities						
Pig Launcher [e]	0.0	0.0	0.0	0.0	0.0	0.0
Pig Receiver	0.3	0.3	0.0	0.0	0.3	0.3
Aboveground Facilities Subtotal	0.3	0.3	0.0	0.0	0.3	0.3
Natural Gas Pipeline Facilities Subtotal	10.9	1.1	0.0	0.3	10.9	1.4
C_2 Pipeline Facilities [f]						
Pipeline Right-of-Way [g]	17.8	1.9	0.0 [d]	0.3 [d]	17.8	2.2
Temporary Extra Workspace [h]						
HDD Entry Workspace	0.9	0.0	0.0	0.0	0.9	0.0
HDD Exit Workspace	0.2	0.0	0.0	0.0	0.2	0.0
Temporary Extra Workspace Subtotal	1.1	0.0	0.0	0.0	1.1	0.0
Aboveground Facilities						
Pig Launcher [e]	0.0	0.0	0.0	0.0	0.0	0.0
Pig Receiver	0.3	0.3	0.0	0.0	0.3	0.3
Aboveground Facilities Subtotal	0.3	0.3	0.0	0.0	0.3	0.3
C_2 Pipeline Facilities Subtotal	19.2	2.2	0.0	0.3	19.2	2.5
Total	30.1	3.3	0.0	0.6	30.1	3.9

[a] Industrial land includes previously developed areas associated with the POLB.

[b] Open water includes the crossings of the Cerritos Channel.

[c] Based on a 50-foot-wide construction right-of-way from MPs 0.0 to 0.6 and MPs 1.5 to 2.3 and a 30-foot-wide construction right-of-way from MPs 1.1 to 1.5. Operation acreage based on a 4-foot-wide permanent right-of-way in all areas.

[d] The pipeline would be installed across the Cerritos Channel (MPs 0.6 to 1.1) using the horizontal directional drill construction method (see sections 2.3.2 and 4.3.3.2). As a result, no impacts on open water would occur during construction. A 4-foot-wide permanent easement would be obtained across the channel for operation of the pipeline; however, no impacts on open water would occur.

[e] The pig launcher would be located within the proposed LNG terminal facility. No additional land would be required.

[f] The first 2.3 miles of the C_2 pipeline would follow the same route as the proposed natural gas pipeline; however, the two pipelines would be constructed at different times. Therefore, the acreage presented includes the entire 4.6 miles of the C_2 pipeline.

[g] Based on a 30- to 50-foot-wide construction right-of-way and a 4-foot-wide permanent right-of-way.

[h] The same workspace utilized for the HDD of the Cerritos Channel associated with the natural gas pipeline would be used for the C_2 pipeline.

4.5.2.3 Electric Distribution Facilities

SCE would install 0.8 mile of electric distribution lines to provide 66 kV service to a new substation (the Sound Substation) that would be located within the LNG terminal boundaries at the northern end of the site. Approximately 4,160 circuit feet of overhead 954 spaced aerial cable (SAC) on 10 tubular steel poles would be installed. The first 830-foot-long extension would connect along the APL

Substation tap along Pier T Avenue, going westerly to the new Sound Substation, and requires the installation of one new pole switch. This extension would require about 0.2 acre of land for construction and operation. The remaining 3,300-foot-long extension would connect along the Dock Substation tap along Seaside/Ocean Boulevard, going southerly to the new Sound Substation, and requires the installation of one new pole switch. About 0.4 acre of land would be required for construction and operation of this extension.

In addition, the SES project load would require upgrading the 66 kV line between the Long Beach Generating Station and the formed tap point. This upgrade would require the replacement of 2,100 circuit feet of existing 653 KCMIL aluminum steel-reinforced conductor with new 954 SAC conductor. In order to support the heavier conductors, five wood poles along Pier T Avenue to the Sound Substation tap point would be reframed. These activities would require about 0.3 acre of land during construction and operation. It would also be necessary to relocate one existing pole-mounted switch to an existing wood pole before the Sound Substation tap point and reframe one additional wood pole in the APL Substation leg to accommodate the relocated pole-mounted switch. These poles would affect a total of 0.1 acre of land during construction and operation.

In total, construction and operation of the electric distribution facilities would affect about 1.0 acre of industrial land. The electric distribution facilities would be an industrial/utility use that is consistent with existing surrounding uses and conforms to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans. As a result, impacts on land use associated with these facilities would be less than significant.

4.5.3 Existing Residences and Planned Developments

All of the land and marine uses immediately adjacent to and within 1 mile of the proposed project facilities are associated with the industrial activities of the ports of Long Beach and Los Angeles or the Cities of Long Beach, Los Angeles, and Carson. No permanent residences are located within the POLB or POLA. Generalized land uses between 1.0 and 2.0 miles from the LNG terminal facilities include a mix of industrial and commercial land interspersed with high density residential land. The closest potential residences are in a recreational vehicle park about 1.3 miles east-northeast of the LNG terminal site and possibly live-aboard boats at two marinas in the East Basin of the Cerritos Channel between 1.2 and 1.6 miles northwest of the LNG terminal. These distances are well outside the thermal and dispersion exclusion zones for the site (see section 4.11.5).

The project would not conflict with any approved residential or commercial development plans; however, there are several reasonably foreseeable or planned industrial projects that have been identified by the POLB within the Port that may occur within the same time period as construction of the proposed project. In addition, the POLA indicated in a comment letter that it is currently investigating the feasibility of developing an ICTF on a portion of property crossed by the proposed C_2 pipeline. Section 4.12 includes a description of these planned projects and an analysis of potential cumulative effects when considered in conjunction with the Long Beach LNG Import Project.

4.5.4 Hazardous Waste Sites

A search of available environmental records was conducted to identify hazardous waste sites in the vicinity of the proposed project facilities. The Long Beach Naval Shipyard and Station are listed as hazardous waste sites. The Navy also documented soil contamination in the area during closure of its Long Beach Complex (see section 4.2.2.1). Hazardous waste sites within 0.25 mile of the pipeline routes and electric distribution facilities are listed in table 4.5.4-1. Because none of these sites would be crossed by the proposed facilities, Phase I Environmental Assessments were not conducted.

TABLE 4.5.4-1

Listed Hazardous Waste Sites Within 0.25 Mile of the Long Beach LNG Import Project Facilities

Facility/Location	Database [a]	Distance and Direction from the Pipeline(s)
Natural Gas Pipeline and C_2 Pipeline (MPs 0.0 to 2.3)		
Ship Cape Inscription No. 56949, Naval Station Mole Pier	RCRIS, FINDS	1,070 feet south
Freemont Forest Products, 800 Pier T	UST	1,203 feet southeast
Ship Cape Isabel No. 577636, Naval Station Mole Pier	RCRIS, FINDS	954 feet southeast
Tidelands Oil Production, 552 Pier T	CHMIRS, FINDS	599 feet east
SGL Carbon Composites Inc., HITC, 415 Pier T Avenue	RCRIS, FINDS	809 feet east
Pacific Coast Recycling, Inc., 482 Pier T Avenue, Berth 11	RCRIS, FINDS	809 feet east
Pier E Naval Complex	CHMIRS	217 feet east
300 Skipjack Road	RCRIS	217 feet east
Long Beach Naval Shipyard	NOTIFY 65	181 feet west
300 Pier E Avenue, Berth 121	RCRIS	181 feet west
Weyerhauser Company	UST	786 feet east
Arco Marine Terminal	UST	786 feet east
BP Berth 121, 300 Pier T Avenue	RCRIS, FINDS	786 feet east
Seaside at Skipjack	RCRIS	258 feet west
2600 Seaside Blvd.	CHMIRS	545 feet east
2701 W. Seaside Blvd.	RCRIS	545 feet east
2675 Seaside Blvd.	RCRIS	545 feet east
Long Beach Naval Station	CERLIS, RCRIS-SQG	545 feet east
Long Beach Generating Station, 2665 Seaside Blvd.	CORTESE, LUST, CHMIRS, HIST, UST, EMI	991 feet east
1939 Edison Way	UST	424 feet east
2410 Pier B Street	CHMIRS	291 feet east
BP Wilmington Calciner	RCRIS, CHMIRS	963 feet east
Big J Tire, 2603 E. Anaheim Street	FINDS	719 feet west
Waterman Supply Co., Inc., 2821 E. Anaheim Street	CERCLIS, FINDS	336 feet west
Southern California Gas Co., Anaheim/Hopson	Unknown	132 feet east
George Auto Wrecking, 819 N. Foote Avenue	CERCLIS, FINDS	444 feet west
Apple Auto Dismantling, 2701 E. Anaheim Street	CERCLIS	444 feet west
Port of Long Beach, 3001 W. Anaheim Street	Unknown	202 feet east
2442 E. Anaheim Street	CHMIRS	1,514 feet west
BP Wilmington Calciner, 1775 Carrack Avenue	RCRIS	1,514 feet west
Ace Roll Off Rubbish Service, 2521 E. I Street	RCRIS	1,514 feet west
Roger R. Goldsmith Truck Vacuum, 903 MacDonough Avenue	RCRIS	1,514 feet west
Moreco, 912 MacDonough Avenue	RCRIS	1,514 feet west
BKK Corp. Wilmington Transfer Station, 3031 E. I Street	RCRIS	1,514 feet west
Debris lot, 926 MacDonough Avenue	CERCLIS-NFRAP	1,514 feet west
Azteca Auto Dismantling, 910 N. Foote Avenue	CERCLIS, FINDS	238 feet west
E&G Auto Dismantling, 902 N. Foote Avenue	CERCLIS, FINDS	238 feet west
Intersection of I Street and Paul Jones Street	CHMIRS	961 feet east
C_2 Pipeline (MPs 2.3 to 4.6)		
916 Farragut Avenue	RCRIS	77 feet west
Petroleum Sediment Disposal, 923 N. Farragut Avenue	RCRIS, FINDS	77 feet west
Chico's Auto Wrecking, 926 N. Farragut Avenue	CERCLIS, FINDS	77 feet west
Jerren Marine/Triple Transport, 3030 E. I Street	FINDS	580 feet east
Falcon Refuse Center, 3031 E. I Street	CHMIRS, CORTESE, NOTIFY 65, LUST, BEP	580 feet east
RC Baxter JR, Inc., 1000 Ushing Avenue	RCRIS, FINDS	549 feet west

TABLE 4.5.4-1 (cont'd)

Listed Hazardous Waste Sites Within 0.25 Mile of the Long Beach LNG Import Project Facilities

Facility/Location	Database [a]	Distance and Direction from the Pipeline(s)
Concrete Coating and Restoration, 1003 N. Foote Avenue	FINDS	72 feet west
Enviro Ecology, 1001 N. Foote Avenue	CERCLIS, FINDS	72 feet west
Acta South; 1002, 1008, 1033, and 1044 Farragut Avenue	CASLIC, CERCLIS, FINDS	72 feet west
California Sulphur Co., 2509 E. Grant Street	RCRIS, LUST, FINDS	824 feet west
California Carbon, 2825 E. Grant Street	CERCLIS-NFRAP, WMUDS/SWAT	426 feet east
2400 East Pacific Coast Highway	RCRIS	64 feet east
Union Carbide Corp./Praxair Inc. Plant 861, 2300-2301 E. Pacific Coast Highway	CERCLIS-NFRAP, RCRIS, CHMIRS, LUST, CORTESE, UST, FINDS	482 feet west
2401 East Pacific Coast Highway	RCRIS	767 feet west
Valero Wilmington Asphalt Plant, 1651 Alameda Street	TSCA	1,297 feet south
Berwind Railway Service Co., 24899 S. Alameda Street	FINDS	327 feet west
Arco Products Co., 23800 S. Alameda Street	Unknown	238 feet west
23500 Alameda Street	RCRIS, CHMIRS	117 feet north

[a]
- BEP: Bond Expenditure Plan information comes from the California Department of Toxic Substances Control (DTSC), which is the State of California's equivalent to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program.
- CASLIC: California Spills, Leaks, Investigation, and Cleanup Program information comes from the California Regional Water Quality Control Board. The program deals with site investigation and corrective action involving sites not overseen by the Underground Storage Tank (UST) Program and the Well Investigation Program.
- CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System contains data on potentially hazardous waste sites that have been reported to the U.S. Environmental Protection Agency by state, municipalities, private companies, and private persons pursuant to section 103 of the CERCLA.
- CHMIRS: California Hazardous Material Incident Report System contains information on reported hazardous material incidents (i.e., accidental releases or spills).
- CORTESE: Identifies public drinking water wells with detectable levels of contamination, hazardous substance sites selected for remedial action, sites with known toxic material identified through the abandoned site assessment program, sites with underground storage tanks having a reportable release, and all solid waste disposal facilities from which there is known migration.
- FINDS: The Facility Index System contains both facility information and pointers to other sources of information that contain more detail.
- HAZNET: These data are extracted from the copies of hazardous waste manifests received each year by the DTSC.
- LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the State Water Resources Control Board's Leaking Underground Storage Tank Information System.
- NFRAP: No further remedial action planned.
- NOTIFY 65: Notify 65 records contain facility notifications about any release that could impact drinking water and thereby expose the public to a potential health risk. The data come from the State Water Resources Control Board's Proposition 65 database.
- RCRIS-SQG: Resource Conservation and Recovery Information System includes selective information on sites that generate, transport, store, treat, and/or dispose of hazardous waste as defined by the Resource Conservation Recovery Act (RCRA).
- SWF/LF: The Solid Waste Facilities/Landfill Sites records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. The data come from the Integrated Waste Management Board's Solid Waste Information System database.
- TSCA: Toxic Substances Control Act.
- UST: The UST database contains registered USTs. USTs are regulated under Subtitle I of the RCRA.
- WMUDS: Waste Management Unit Database System.

Contaminated soils associated with these or other undocumented hazardous waste sites could be encountered during construction of the proposed facilities. As discussed in section 4.2.2.2, SES and the pipeline contractor(s) would develop procedures that would outline appropriate environmental site investigation and remediation activities and submit them to the appropriate agencies for approval before construction. Additional details on contaminated soils and sediments near the proposed facilities and on SES' proposed control measures are provided in sections 4.2.2 and 4.2.3, respectively.

4.5.5 Recreation and Special Interest Areas

San Pedro Bay and limited areas surrounding the POLB are used for a variety of onshore and offshore recreational activities. Offshore recreational activities are primarily associated with widespread use of Long Beach Harbor and San Pedro Bay by local residents and tourists on charter fishing and sightseeing boats. Recreational boats use the waterway to Queens Gate to access and exit the area and use San Pedro Bay inside the breakwater as a cruising area. High density commercial fishing does not occur within the approaches to the POLB or within the Port limits; however, as described in sections 4.4.3.1 and 4.4.3.3, Long Beach Harbor supports commercial bait fisheries for the northern anchovy and Pacific sardine. Onshore recreational facilities are primarily located at the Long Beach Shoreline Marina and Rainbow Harbor, which are more than 1.5 miles east of the proposed LNG terminal site.

Recreational boating and associated offshore recreational activities such as fishing are not allowed within the West Basin, which immediately surrounds the LNG terminal site. In general, fishing in the Los Angeles and Long Beach Harbors is discouraged because of heavy metal contamination of certain fish species. Outside the West Basin and Middle Harbor, San Pedro Bay experiences heavy recreational traffic with pleasure craft and small ships common within and around Queensway Bay. There are two marinas in the City of Long Beach within the vicinity of the proposed project: Rainbow Harbor/Rainbow Marina (1.7 miles east) and Long Beach Shoreline Marina (1.9 miles east). Rainbow Harbor has 12, 150-foot-long docks for commercial vessels, which predominantly provide charter services for fishing, whale watching, and sightseeing. There are also a number of vendors who rent boats and personal watercraft from Rainbow Harbor. Rainbow Marina has 103 slips for commercial and recreational vessels and a 200-foot-long dock for day guests. Long Beach Shoreline Marina has 1,844 slips for recreational boaters. Charter fishing boats and whale watching tours also depart from Queens Wharf, which is located 1.5 miles northeast of the LNG terminal site. There are also two marinas in the East Basin of the Cerritos Channel between 1.2 and 1.6 miles northwest of the LNG terminal site in the City of Los Angeles.

The closest onshore recreational facilities are located over 1 mile from the LNG terminal site. These facilities include the Queen Mary, the Long Beach Aquarium of the Pacific, Shoreline Village, Shoreline Park, Rainbow Harbor Esplanade, the Long Beach Shoreline Marina, and the Long Beach Convention and Entertainment Center. There are also a number of community and neighborhood parks in the area; however, there are no community or neighborhood parks within the POLB. Table 4.5.5-1 lists the recreational areas located within a 2-mile radius of the LNG terminal site.

TABLE 4.5.5-1

Recreational Areas Within a 2-Mile Radius of the LNG Terminal Site

Name of Facility	Type of Facility	Location	Distance and Direction from LNG Terminal Site
Los Angeles River Bikeway (LARIO)	Bike Path	East of Los Angeles County Flood Control Channel Long Beach	1.2 miles northeast
Cerritos Channel/East Basin Marinas	Commercial and Recreational Marinas	Cerritos Channel Los Angeles	1.2 to 1.6 miles northwest
Golden Shore RV Resort/ Marine Reserve	RV Park/Marine Reserve	101 Golden Avenue Long Beach	1.3 miles east
Catalina Landing	Events Arena/Cruise Terminal	320 Golden Shore Boulevard Long Beach	1.5 miles east
Cesar Chavez Park	Community Park	401 Golden Avenue Long Beach	1.5 miles northeast
Long Beach Aquarium of the Pacific	Aquarium	100 Aquarium Way Long Beach	1.5 miles east
Queens Wharf (Pier C, Berth 55)	Commercial Pier with Charter Boat Services	555 Pico Avenue Long Beach	1.5 miles northeast
Shoreline Park	Community Park	Aquarium Way and Shoreline Drive Long Beach	1.5 miles east
Victory Park	Green Space	Ocean Blvd. (Alamitos to Magnolia) Long Beach	1.6 miles northeast
Rainbow Harbor	Commercial Marina and Public Dock	429 N. Shoreline Drive Long Beach	1.7 miles east
Rainbow Harbor Esplanade	Shopping/Restaurants	429 N. Shoreline Drive Long Beach	1.7 miles east
Lincoln Park	Civic Center	Pacific and Broadway Long Beach	1.8 miles northeast
Shoreline Village/Marina	Shopping/Restaurants	429 Shoreline Village Drive Long Beach	1.8 miles east
Queen Mary	Hotel/Restaurant/Museum	1126 Queens Highway Long Beach	1.8 miles east
Carnival Cruise Terminal	Cruise Terminal	231 Windsor Way Long Beach	1.9 miles east
Long Beach Shoreline Marina	Recreational Marina	450 E. Shoreline Drive Long Beach	1.9 miles east
Drake Park	Neighborhood Park	951 Maine Avenue Long Beach	2.0 miles northeast
Long Beach Convention and Entertainment Center	Convention Center	300 E. Ocean Boulevard Long Beach	2.0 miles northeast
Rainbow Lagoon	Community Park	Pine and Shoreline Avenue Long Beach	2.0 miles east

Although the Long Beach area provides several opportunities for recreational activities, the immediate area surrounding the LNG terminal site, pipelines, and electric distribution facilities does not provide for recreational activities due to the industrial nature of the Port and the adjacent area to the north. Because the facilities associated with the Long Beach LNG Import Project would be located more than 1 mile from the nearest onshore recreational area, no impacts on these areas are anticipated during construction of the proposed facilities. The delivery of construction materials by barge to the LNG terminal site would not affect recreational use of San Pedro Bay because the traffic would be similar to current levels of ship traffic to and from the POLB and would occur within established shipping lanes and navigation areas. Construction of the Long Beach LNG Import Project would not threaten the viability of a recreational resource, prohibit access to recreational resources, or cause termination of a recreational use. As a result, impacts on recreational resources associated with construction of the project facilities would be less than significant.

Operation of the proposed project facilities would not affect onshore recreational sites because of the industrial nature of the POLB and the adjacent area to the north and the distance between the facilities and the nearest onshore recreational area. Minor delays to recreational boats could occur on days when an LNG ship arrives at the LNG terminal. SES estimates that LNG ships would arrive at the terminal up to 120 days per year. The Coast Guard, with the assistance of the POLB, would enforce a moving security zone for arriving LNG ships (see section 4.11.7.2). Other vessels, including recreational boats, would be prohibited within the security zone during the arrival of LNG ships. These effects would be temporary and minimized by the fact that the LNG ships would use established commercial shipping lanes that currently accommodate about 6,170 inward and outward vessel movements per year and the Coast Guard and HSC currently require ships entering and leaving the POLB to maintain a minimum separation distance of 500 yards (see section 4.7.3). Any impacts would also be minimized by the fact that recreational boating is not allowed within the West Basin. Accordingly, operation of the Long Beach LNG Import Project would not threaten the viability of a recreational resource, prohibit access to recreational resources, or cause termination of a recreational use. As a result, operation of the project facilities would not have a significant impact on recreation and special interest areas.

A scoping comment was received from the Los Angeles County Beaches & Harbor Department about potential impacts on Cabrillo Beach. Cabrillo Beach is located near the west end of the Los Angeles breakwater about 5 miles southwest of the proposed project facilities. Outer Cabrillo Beach is a popular recreational area that attracts more than 1 million visitors annually. Recreational activities in the area include beach going, surfing, fishing, boating, and windsurfing. There is also a marine museum that offers educational opportunities to visitors in the area. Because the project facilities would be located within a previously developed area of the POLB several miles from Cabrillo Beach, no impacts on recreational activities at Cabrillo Beach are anticipated. In addition, the overall visual assessment rating of the proposed facilities from Cabrillo Point (adjacent to Cabrillo Beach) was rated as low (see section 4.5.6). A discussion of safety-related issues associated with the Long Beach LNG Import Project is presented in section 4.11.

4.5.6 Visual Resources

As previously discussed, the LNG terminal site is currently unoccupied, with the exception of two abandoned buildings that would be demolished before construction of the LNG facilities. To the south and west the site is bordered by the West Basin. East of the site is a lumber storage area and the BP ARCO unloading terminal. To the north and west of the site is the TTI/Hanjin container cargo facility and Ocean Boulevard.

In the immediate vicinity and up to a 1-mile radius around the LNG terminal site, there are numerous container cargo facilities and associated cranes, piers, and storage tanks; a waste-to-energy plant; a satellite launching facility; the Long Beach Generating Station; and other POLB facilities. In addition to the Port infrastructure, the area between 1 and 2 miles from the LNG terminal site includes a portion of the City of Long Beach and its downtown area with commercial, recreational, and tourist facilities. Beyond the 2-mile and out to a 5-mile radius are the communities of San Pedro, Wilmington, and Signal Hill with high-density residential, commercial, and industrial land uses.

Topography in the project area is generally flat to gently sloping with little vegetation. Topography rises from essentially sea level to elevations in excess of 400 feet in San Pedro and in the vicinity of Signal Hill.

A Visual Impact Assessment was conducted to determine the potential impacts on visual resources associated with the LNG terminal facilities. The assessment conducted is in conformance with the POLB's protocols for assessing visual impacts. Representative viewing points (i.e., key observation points) were identified to a distance of about 5 miles from the LNG terminal site using aerial

photography, published literature, and field reconnaissance. The representative viewing points were identified to characterize the visibility of the proposed facility and its impact on potential viewers and the landscape in which it would be constructed and operated. The types of viewing points included in the assessment consisted of locations with concentrations of viewers such as on major roadways or in housing developments, visually sensitive land uses such as parks and recreation areas, culturally sensitive locations such as historic sites or areas to which citizens have an emotional attachment, and places designated as having scenic importance such as highways and overlooks. The potential visibility of the LNG terminal, the number of viewers, and the landscape quality were assessed from each of the viewing points, as described below.

- Viewers were considered by selecting assessment points with concentrations of viewers or locations that may be visually sensitive. The type of viewer, number of viewers, duration of view, competing tasks (e.g., driving), competing objects (e.g., buildings) and viewing experiences were all included in the assessment of impacts on viewers.

- Visibility of the LNG terminal was assessed by determining how much of the two LNG storage tanks and other facilities could be potentially viewed (i.e., dominance of the LNG storage tanks in the landscape), the distance of the viewer from the tanks and the scale from which it would be viewed, and other features in the landscape and their predominance relative to the dominant features. The LNG storage tanks, which would be the tallest of the terminal facilities, would be about 176 feet tall and 255 feet wide.

- Landscape quality was evaluated from each viewing point in terms of landform elements, vegetation, water, manmade features, and adjacent scenery.

The representative viewing points used in the Visual Impact Assessment are shown on figure 4.5.6-1. Because the LNG terminal site is located within the highly developed POLB, views from many locations would be either fully or partially screened by the numerous container cargo storage areas, buildings, cranes, ships, elevated highways, and other Port-related facilities. Visibility of the site is greatest from elevated locations such as bridges, taller buildings, distant hillside residential areas, and the open water of San Pedro Bay.

Table 4.5.6-1 summarizes the visual impact from several locations surrounding the proposed LNG terminal site. Visual simulations from the points with an overall moderate rating are shown on figures 4.5.6-2, 4.5.6-3, and 4.5.6-4. To address a scoping comment received from the Los Angeles County Beaches & Harbor Department, a visual simulation is also provided from Cabrillo Point (see figure 4.5.6-5).

Construction and operation of the LNG terminal facilities would have a permanent impact on visual resources. In particular, as figures 4.5.6-2 through 4.5.6-5 show, the tanks would be tall in relation to the surrounding structures. Although there are a substantial number of potential mobile and stationary viewers and visibility is high in some locations (e.g., Queensway Bridge), the LNG facilities would be seen in the context of the existing industrial facilities at the POLB and would not adversely affect the viewshed from sensitive locations or change the character of the landscape in terms of either physical characteristics or land uses. In addition, the LNG facilities would not block or alter an important/valued view or have an adverse effect on a scenic vista. The overall visual impact associated with the LNG terminal facility was rated moderate to low and the existing POLB facilities would screen, backdrop, and otherwise minimize the overall visual impact of the LNG storage tanks to less than significant levels.

TABLE 4.5.6-1

Visual Impact Summary for the LNG Terminal Facility Associated with the Long Beach LNG Import Project

Reference Point [a]	Viewing Point Location	Viewer Rating [b]	Visibility Rating [c]	Landscape Quality Rating [d]	Overall Rating
4a	Shoreline Park	M	L	M	M
4b	Shoreline Park Northwest of Queensway Bridge	L	M	M	M-L
6	Queen Mary	H	L	M	L
26	Queensway Bridge	M	M-H	L	M
27	Vincent Thomas Bridge/Ocean Boulevard	M	M-L	L	M-L
29	Ken Mallory Harbor Regional Park	M-L	L	M	L
30	Cabrillo Point	M-H	L	M	L
31	Belmont Shore	M-H	L	M-H	L
33	Fire Station/Mole Pier Entrance	M	H	M-L	M
35a	Ocean Boulevard West	M	M	L	M-L

[a] Reference points are shown on figure 4.5.6-1.

[b] A high viewer rating means that many viewers would see the LNG terminal facilities and that the views are visually sensitive. A low viewer rating means that few viewers would see the LNG terminal facilities and that the views are not visually sensitive.

[c] A high visibility rating means more visibility factors are affected that result in the LNG terminal facilities being more visible. A low visibility rating means there are few visibility factors affected, resulting in the LNG terminal facilities being less visible.

[d] A high landscape quality rating means that the landscape being viewed contains elements of landform, vegetation, water, and/or manmade features that are distinctive within the 5-mile radius. Low landscape quality ratings imply the view contains less distinctive elements.

H = High
M = Moderate
L = Low

The lighting associated with the LNG terminal facility would create a new source of light in the area. SES would install high-pressure sodium lighting at all outdoor locations, including the process unit, LNG storage tanks, truck loading facilities, ship unloading facilities, building exteriors, and roadways. To the extent practical, SES would use high-mast lighting with supplemental lighting to alleviate shadows. All lighting fixtures would be approved for the area classification in which they would be installed. Although the LNG terminal would create a new source of light in the area, it would be part of the overall industrial lighting in the Port area and would not be a substantial source of light or glare that would adversely affect day or nighttime views. Most of the facilities within the ports of Long Beach and Los Angeles are lit at night for safety and these lights form part of the visual character of the area. The proposed project would only incrementally add to this existing source of light in the area. Therefore, impacts associated with the lighting at the proposed LNG terminal facility would be less than significant.

The pipeline facilities would be constructed underground within heavily industrialized areas of the POLB and the POLA, and the Cities of Los Angeles, Long Beach, and Carson. Impacts on visual resources during construction of the pipelines would be limited to the heavy equipment used to install the pipe. This equipment would be similar to other heavy machinery used within the POLB and surrounding industrial areas and would not cause any additional impacts on visual resources. There would be no effect on visual resources during operation of the pipelines. Construction and operation of the aboveground facilities associated with the pipelines and the electric distribution facilities would have a permanent impact on visual resources; however, these facilities would be relatively minor and would be seen in the context of the existing industrial facilities at the POLB and the LARC. As a result, impacts on visual resources associated with these facilities would be less than significant.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-59
Figure 4.5.6-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

29018301NRGINC-10 REV.02/25/04

4-70

Figure 4.5.6-2
Long Beach LNG Import Project
Visual Simulation from Shoreline Park

29018301NRGINC-11 REV.02/25/04

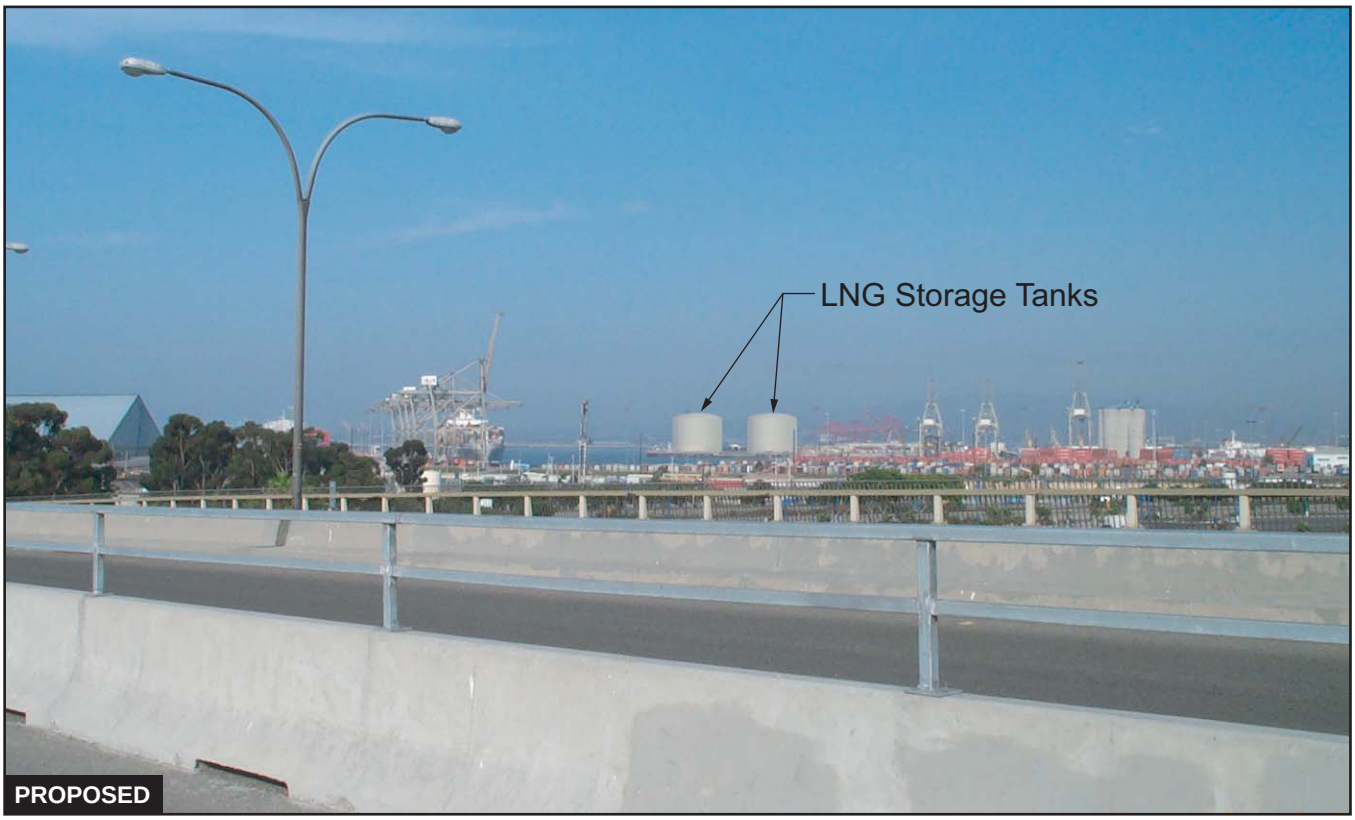


Figure 4.5.6-3

Long Beach LNG Import Project

Visual Simulation from Queensway Bridge

29018301NRGINC3-05 REV.04/26/05

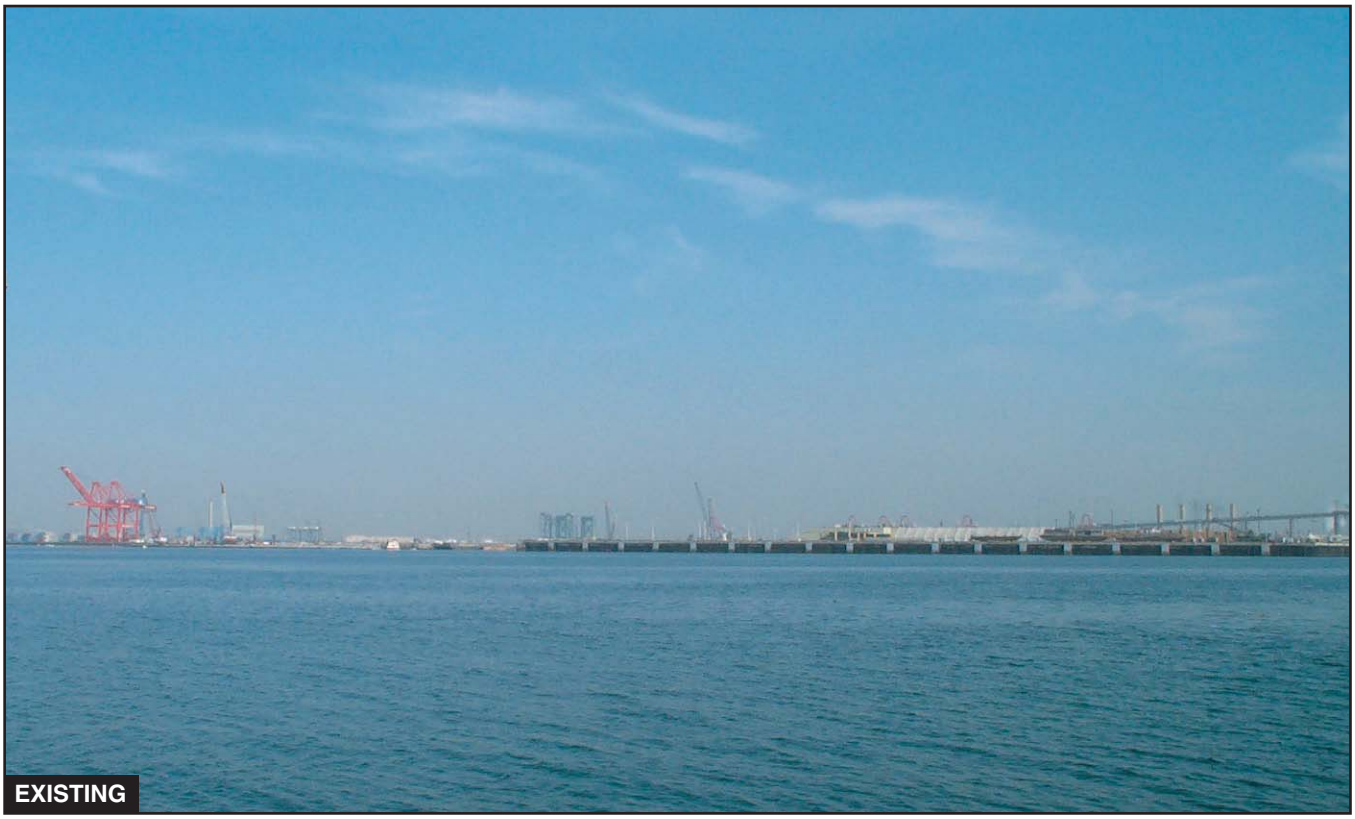


Figure 4.5.6-4

Long Beach LNG Import Project

Visual Simulation from the Fire Station/Mole Entrance

29018301NRGINC3-09 REV.06/16/05

Figure 4.5.6-5
Long Beach LNG Import Project
Visual Simulation from Cabrillo Point

4.6 SOCIOECONOMICS

4.6.1 Significance Criteria

A socioeconomic impact would be considered significant if project construction or operation would:

- cause a permanent population increase of 3 percent or more in a county affected by the project;
- cause the vacancy rate for temporary housing to fall to less than 5 percent;
- increase the short- or long-term demand for public services in excess of existing and projected capabilities;
- create demands that exhaust or exceed the capacity of existing utilities and service systems; or
- result in any racial, ethnic, or socioeconomic group bearing a disproportionate share of adverse impact.

4.6.2 Population

Table 4.6.2-1 provides a summary of selected population statistics for the State of California, Los Angeles County, and the Cities of Long Beach, Los Angeles, and Carson. Statistics are also provided for Orange County because of its close proximity to the project facilities. In 2000, the population of the City of Long Beach (461,522), the City of Los Angeles (3,694,820), and the City of Carson (89,730) accounted for 45 percent of the total population of Los Angeles County (9,519,338). The Cities of Long Beach, Los Angeles, and Carson experienced population increases of about 7.5, 6.0 percent, and 6.7 percent respectively, between 1990 and 2000. This population increase is similar to that of Los Angeles County as a whole (7.4 percent), but is significantly less than that of Orange County (18.1 percent). The City of Long Beach has the highest population density in the project area (8,391.0 people per square mile), which is significantly higher than the county average (2,344.2 people per square mile).

TABLE 4.6.2-1

Existing Population Conditions in the Long Beach LNG Import Project Area

	Population			Population Density [a]	
State/County/City	1990	2000	Percent Change	1990	2000
CALIFORNIA	29,760,021	33,871,648	13.6	190.8	217.2
Los Angeles County	8,863,164	9,519,338	7.4	2,182.5	2,344.2
City of Long Beach	429,433	461,522	7.5	7,807.8	8,391.0
City of Los Angeles	3,485,398	3,694,820	6.0	7,415.7	7,861.0
City of Carson	83,995	89,730	6.7	4,426.2	4,762.2
Orange County	2,410,556	2,846,289	18.1	3,055.2	3,605.6

[a] Persons per square mile, based on population and area size: California (155,959 sq. mi.), Los Angeles County (4,061 sq. mi.), City of Long Beach (55 sq. mi.), City of Los Angeles (470 sq. mi.), City of Carson (19 sq. mi.), and Orange County (789 sq. mi.).

Sources: U.S. Department of Commerce, Bureau of Census, 1990 Census of Population and Housing Characteristics, 2000 Census of Population and Housing Characteristics, 2000 Profile of General Demographic Characteristics, Income and Poverty Status in 1989 (1990 data set), (www.census.gov).

SES estimates that the peak construction workforce would be about 404 workers during months 32 and 33 of the total 48-month construction period (see section 4.6.3). The majority of the construction workforce would be available within the Los Angeles and Orange County labor pool; however, some specialized LNG construction personnel may need to be obtained from outside the local labor pool. These workers could include supervisors and other specialized LNG personnel who would temporarily relocate to the project area.

Project-area population impacts are expected to be temporary and proportionally small. The total population change would equal the total number of non-local construction workers, plus any family members accompanying them. Assuming that 50 percent of the peak workforce relocates to Los Angeles County, the total increase in population would be about 586 or 202 workers accompanied by about 384 family members (based on the 2000 average of 2.9 persons per household in Los Angeles County). This temporary increase would not constitute a significant impact on population.

SES estimates employing a total of 60 full-time workers to operate the project facilities. Only six of these positions are expected to be obtained from outside the Los Angeles or Orange County areas. In addition, SES estimates that an additional 160 full-time workers would be employed by others to support the project operations; however, the workers for these indirect full-time jobs (e.g., truck drivers, tug boat crewmen, ship workers) are expected to be obtained entirely from the local area. The addition of six non-local, permanent employees to the project area would equal less than a 1 percent permanent increase in the population of either Los Angeles or Orange Counties. As a result, impacts on the local population associated with operation of the Long Beach LNG Import Project would be less than significant.

4.6.3 Economy and Employment

Education, health, and social services and the manufacturing industry are the largest economic sectors in the project area (see table 4.6.3-1). The top four employers in the City of Long Beach are the Long Beach Unified School District (11,096 employees); Boeing (10,500 employees); the City of Long Beach (5,942 employees); and California State University, Long Beach (5,609 employees) (City of Long Beach, 2003).

The 2000 civilian labor force in the City of Long Beach was 209,485, which is down 1 percent from 1990. This downward trend was also found in the Cities of Los Angeles and Carson and Los Angeles County. Only Orange County showed an increase in the workforce of 4 percent between 1990 and 2000. Unemployment rates increased by 0.7 percent in the City of Carson, 0.9 percent in the City of Los Angeles, and 2.5 percent in the City of Long Beach between 1990 and 2000. Unemployment rates also increased at the county level during that 10-year period (0.2 percent in Orange County and 0.8 percent in Los Angeles County). With the exception of Orange County, the unemployment rate in the project area was higher than the state average of 7 percent in 2000. Per capita income in 2000 ranged from $17,107 in the City of Carson and $20,671 in the City of Los Angeles to $20,683 in Los Angeles County and $25,826 in Orange County. In the project area, only Orange County's per capita income was higher than the state average in 2000 ($22,711).

TABLE 4.6.3-1

Existing Socioeconomic Conditions in the Long Beach LNG Import Project Area

State/ County/City	Per Capita Income		Civilian Labor Force		Unemployment Rate (percent)		Top Two Major Industries	
	1990	2000	1990	2000	1990	2000	1990	2000
CALIFORNIA	$16,409	$22,711	14,922,811	15,829,202	6.6	7.0	Retail trade, Manufacturing - durable goods	Education, health and social services Manufacturing
Los Angeles County	$16,149	$20,683	4,538,364	4,312,264	7.4	8.2	Retail trade, Manufacturing - durable goods	Education, health and social services Manufacturing
City of Long Beach	$15,639	$19,040	211,638	209,485	6.9	9.4	Manufacturing - durable goods, Retail trade	Education, health and social services Manufacturing
City of Los Angeles	$16,188	$20,671	1,822,849	1,690,316	8.4	9.3	Retail trade, Manufacturing - durable goods	Education, health and social services Manufacturing
City of Carson	$13,749	$17,107	44,252	40,514	7.2	7.9	Manufacturing - durable goods, Retail trade	Education, health and social services Manufacturing
Orange County	$19,890	$25,826	1,357,847	1,411,901	4.8	5.0	Retail trade, Manufacturing - durable goods	Manufacturing, Education, health and social services

Sources: U.S. Department of Commerce, Bureau of Census, 2000 Profile of General Demographic Characteristics, Income and Poverty Status in 1989 (1990 data set), 2000 Profile of Selected Economic Characteristics, 1990 Labor Force Status and Employment Characteristics, (www.census.gov).

SES anticipates that construction of the facilities would take about 48 months and would employ a peak workforce of 404 around months 32 and 33 of construction. Table 4.6.3-2 lists the worker classifications as a percent of the total workforce. As discussed in section 4.6.2, the majority of the construction workforce would be local hires, depending on union agreements and the methods the contractor uses to hire subcontractors. All of the trades are expected to be available from the local labor pool. The indirect workforce would include supervisors and other specialized LNG construction personnel who may need to be obtained from outside the local labor pool and would temporarily relocate to the project area. The support staff includes administrative and other support personnel that are expected to be available from the local labor pool. SES estimates the total construction payroll would be about $100.6 million.

Of the 60 full-time workers SES would hire to operate the project facilities, about 54 workers are expected to be from the local area. In addition, SES estimates that an additional 160 full-time workers would be employed by others to support the project operations for a total of 220 full-time jobs. The workers for these indirect full-time jobs are expected to be obtained entirely from the local labor pool. As a result, construction and operation of the Long Beach LNG Import Project would have a beneficial impact on the local economy and employment. An estimate of the amount of tax revenues generated during construction and operation of the project is presented in section 4.6.8.

Scoping comments were received about possible effects on jobs and commerce, including commercial fishing, caused by shipping delays when an LNG ship is present within the POLB. Delays to other vessels associated with the arrival or departure of an LNG ship are expected to be minor and would not have an impact on jobs or commerce within the POLB. A detailed discussion of marine transportation and the effects of LNG ship arrivals and departures on ship traffic within the Port is presented in section 4.7.3.

TABLE 4.6.3-2

Construction Workforce Classifications for the Long Beach LNG Import Project

Worker Classification	Percent of Total Workforce
Trades	
Concrete	20
Iron Worker	18
Laborers	13
Painters/Insulators	12
Piping	4
Equipment Operator	3
Truck Driver	3
Electrical	2
Rigger	2
Carpenters, rebar, concrete finishers	<1
Mechanical	<1
Trades Subtotal	77
Indirect	9
Support Staff	14
Total	100

Comments were also received about the potential economic impact of a closure of the POLB due to disruption of the LNG terminal by either natural disaster or terrorism. A discussion of hazards that would result from an accidental or intentional (e.g., terrorist-induced) release of LNG or other hydrocarbons in or near SES' proposed LNG import terminal is presented in section 4.11 and Appendix F. The economic effects of a closure of the POLB due to a disruption of the LNG terminal cannot realistically be analyzed quantitatively. In general, however, the extent of impacts associated with a closure of the POLB would be a function of the duration of the closure and the capacity of other ports along the west coast to compensate for the closure. In September 2001, ports along the west coast closed due to a labor lockout. This event provides insight into the possible economic effects associated with a closure of the POLB. Initial estimates during the west coast labor lockout were that the nation was losing $1 billion a day; however, most industry observers thought that the relatively short duration of the lockout (10 days) resulted in a much lower impact (i.e., around several hundred million dollars a day at most).

Most of the economic impacts associated with the west coast lockout were in the form of increased inventory carrying costs by shippers who were delayed in receiving their cargo, product spoilage, and lost salaries for the International Longshore and Warehouse Union (ILWU) (although overtime paid later probably offset this loss). It should be emphasized, however, that the lockout extended to the entire west coast and opportunities for diversion of discretionary cargo were relatively constrained (all-water through the Panama or Suez Canals). For a scenario in which a closure would only affect the POLB, there would be many more opportunities to divert non-local cargo. For example, the ports of Seattle/Tacoma and Oakland could handle much of the diverted cargo during the short term. In addition, if the POLA were still operating, it could increase local cargo handling during a closure of the POLB. The likely scenario associated with a closure of the POLB would be that many transpacific services would adjust their rotation and call at Seattle/Tacoma or Oakland first to discharge the intermodal cargo and then call at the POLA to deliver primarily local cargo. Although there would be some delays, the west coast port system could handle a short-term closure of the POLB. According to the POLB, the Port would have to be closed for an extended period of time before significant economic impacts would occur.

4.6.4 Housing

Housing statistics are presented in table 4.6.4-1. The City of Long Beach has the highest owner and rental vacancy rates in the project area (2.2 percent and 4.2 percent, respectively) and when compared to the state averages (1.4 percent and 3.7 percent, respectively). The rental vacancy rate in the City of Los Angeles is lower than the state average but the owner vacancy rate is higher than the state average. In the City of Carson, both the owner and rental vacancies rates are lower than the state average. Median gross monthly rent is lowest in the City of Long Beach.

TABLE 4.6.4-1

1990 and 2000 Housing Characteristics in the Long Beach LNG Import Project Area

	Owner Occupied (percent)		Renter Occupied (percent)		Owner Vacancy (percent)		Rental Vacancy (percent)		Median Value, Owner Occupied Units		Median Gross Monthly Rent	
State/County/City	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
CALIFORNIA	55.6	56.9	44.4	43.1	2.0	1.4	5.9	3.7	$195,500	$211,500	$561	$747
Los Angeles County	48.2	47.9	51.8	52.1	1.9	1.6	5.9	3.3	$226,400	$209,300	$570	$704
City of Long Beach	41.0	41.0	59.0	59.0	1.7	2.2	7.4	4.2	$222,900	$210,000	$551	$639
City of Los Angeles	39.4	38.6	60.6	61.4	1.8	1.8	6.6	3.5	$244,500	$221,600	$544	$672
City of Carson	79.0	77.9	21.0	22.1	1.1	1.1	4.5	2.6	$188,100	$183,200	$648	$754
Orange County	60.1	61.4	39.9	38.6	1.8	0.9	6.6	3.0	$252,700	$270,000	$728	$923

Source: U.S. Department of Commerce, Bureau of the Census, 1990 Census of Population and Housing, 2000 General Population and Housing Characteristics (www.census.gov).

Temporary housing availability varies seasonally within the project area. Temporary housing is available in the form of daily, weekly, and monthly rentals in motels, hotels, campgrounds, and rooming houses. Because of the urban and highly developed nature of the project area, there are numerous temporary housing facilities within commuting distance to the POLB. For example, in 2000, Los Angeles County had 137,135 vacant housing units, including 56,089 units available for rent and 13,565 units available for seasonal, recreational, or occasional use (U.S. Department of Commerce, 2000a). The City of Long Beach alone has over 5,000 hotel and motel rooms.

Assuming that 50 percent of the peak workforce relocates to the project area and local construction workers do not require housing, up to 202 housing units may be required. Given the vacancy rates, the number of rental housing units in the area, and the number of hotel/motel rooms and other temporary housing available in the project area, the construction workforce should not encounter difficulty in finding temporary housing. Only six housing units would be required to accommodate the permanent employees that would be obtained from outside the Los Angeles or Orange County areas. Construction and operation of the Long Beach LNG Import Project would not cause the vacancy rates for temporary housing to fall to less than 5 percent because the vacancy rates in the project area are currently already below 5 percent. Construction and operation of the project would not significantly change the vacancy rates in the project area. As a result, the Long Beach LNG Import Project would not have a significant impact on housing in the project area.

4.6.5 Public Services

A wide range of public services and facilities are offered in the Cities of Long Beach and Los Angeles. Services and facilities include full-service law enforcement, paid fire departments, emergency response services, and hospitals. The City of Carson does not have its own fire or police departments; these services are provided by Los Angeles County.

Three public safety agencies provide emergency response service to the City of Long Beach and the POLB. They include the Long Beach City Fire Department (LBFD), the Long Beach Police Department (LBPD), and the Coast Guard District 11. The city also has informal mutual aid agreements with the County of Los Angeles and the City of Los Angeles, and can receive assistance under California's Master Mutual Aid Plan if an emergency incident is beyond the capability of the local resources.

The LBPD has one main police station and three division substations. It employs over 900 sworn officers. The LBFD consists of about 500 personnel, of which 402 are assigned various emergency response duties. The remaining personnel are assigned to support functions. The LBFD would be responsible for an initial public safety response to a product release, fire, or medical emergency at the LNG terminal facility.

The LBFD has a total of 23 fire stations that house 22 engine companies, 4 truck companies, 18 paramedic capable resources (8 of which are transport capable ambulances), 3 airport crash/rescue vehicles, 1 foam apparatus, 6 fire and lifeguard boats, and 4 beach rescue units. In 2002, the LBFD handled a total of 54,436 responses, most of which were medical (35,956) and fire (5,653) related. When last rated by the Insurance Service Organization (ISO), the LBFD earned a Class 1 rating that signifies exemplary fire protection (ISO, 2003).

The City of Long Beach is divided into three geographic areas or districts for the administration of emergency responses. District 1 serves the downtown area and the POLB. District 1 resources include eight fire stations strategically located throughout the POLB and the downtown area with eight fire engines, four paramedic rescue ambulances, two truck companies, two fireboats, and one technical rescue vehicle. Fifty-two personnel staff the District 1 facilities on a daily basis. Fire Station 24, currently located at the LNG terminal site, would be relocated to a new site less than 1 mile away. Three other District 1 fire stations are within 4 miles of the LNG terminal site and another three stations are within 5 miles. Additional nearby resources include the City of Los Angeles Fire Department (LAFD) Task Force 38, which is within 4 miles of the LNG terminal site and LAFD Task Force 48 and Hazardous Materials Company 48, which are located within 6 miles of the site.

There are three major hospitals in the City of Long Beach: Long Beach Memorial Hospital, Pacific Hospital of Long Beach, and the St. Mary Medical Center. Long Beach Memorial Hospital is the second largest private hospital on the west coast with 726 beds, 1,200 physicians, and 3,500 employees. The Pacific Hospital of Long Beach is a full service, teaching hospital with 208 beds and over 700 employees. The St. Mary Medical Center has 539 beds, 1,249 employees, and 157 medical staff.

Because the non-local workforce would be small relative to the current population, construction of the project facilities would not impact the local community facilities and services such as police, fire, and medical services. The City of Long Beach has adequate infrastructure and community services to meet the needs of the non-local workers that would be required for the project. Other construction-related demands on local agencies could include increased enforcement activities associated with issuing permits for vehicle load and width limits, local police assistance during construction at road crossings to facilitate traffic flow, and emergency medical services to treat injuries resulting from construction accidents.

LNG would be a new product to the POLB; therefore, it also would be new to the local fire and emergency response services. Although the LBFD has experience responding to and effectively handling emergency incidents involving bulk petroleum facilities and transport ship-related incidents at the POLB, specialized training may be necessary for local fire services to properly understand the risks associated with LNG. The National Association of State Fire Marshals (NASFM), the OPS, and the OEP are developing an LNG safety training module that will be added to the existing firefighter safety program material. The intention is to educate and train the local fire services in the risks associated with LNG so that they will be positioned to take a leadership role in further educating emergency first responders in the communities they serve.

SES is working with local emergency providers to develop procedures to handle potential fire emergencies at the LNG terminal site and on LNG ships. The procedures would be included in an Emergency Response Plan for the facility. Additional information on emergency response procedures is provided in section 4.11.9. SES assisted the Fire Prevention Bureau of the LBFD with the selection of a third-party consultant to help the department conduct technical reviews of the facility's procedures and has also offered to provide funding for a plan check/inspection position within the Fire Prevention Bureau. In addition, SES is working with the LBFD to provide hazard control and firefighting training that is specific to LNG and LNG vessels. SES would fund a live-fire training session and demonstration for LBFD personnel at the proposed terminal site. SES has also offered to sponsor and conduct a familiarization tour of an LNG facility similar to the proposed project. In addition, SES has committed to funding all necessary security/emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs. To allow the FERC and the POLB the opportunity to review the plan, the Agency Staffs will recommend to their respective Commissions that SES file its comprehensive plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies concurrent with its submission of the Follow-on WSA to the FERC staff (see section 4.11.7.4). The LBFD's experience, extensive and comprehensive training in petroleum and shipboard firefighting, in addition to the training specific to LNG that would be provided by SES and SES' commitment to fund emergency management equipment and personnel costs should adequately equip the LBFD to handle any type of emergency at the proposed LNG terminal facility.

Overall, construction and operation of the proposed project would not result in an increase in the short- or long-term demand for public services in excess of existing and projected capabilities.

4.6.6 Utilities and Service Systems

The cities in the project area have extensive and well established utilities and service systems. Construction and operation of the Long Beach LNG Import Project could affect the existing electric, water, storm water, and solid waste disposal systems in the project area. The project could also affect existing pipelines located within the construction work area.

The project power supply would be purchased from SCE, which is the public electric power supplier. In order to serve the LNG terminal, SCE would install 0.8 mile of electric distribution lines to provide 66 kV service to a new substation located within the terminal boundaries (see sections 2.1.4 and 4.5.2.3). Emergency power would be provided by a backup internal combustion engine generator. An uninterruptible power supply system would be provided and the plant electrical system would be furnished with automatic start and transfer devices to ensure that a loss of power would immediately start the emergency power generator.

Construction and operation of the project would require water for several activities, including hydrostatic testing, operation of the vaporization equipment, filling of the firewater storage tank, and monthly testing of the fire pumps (see section 4.3.2.2). Water would be supplied to the LNG terminal by the POLB from the City of Long Beach Water Department. In turn, the City of Long Beach is supplied by the Metropolitan Water District (about 56 percent) and by local groundwater supplies from the West Coast Basin (about 44 percent), which is part of the Coastal Plain Aquifer System. According to the City of Long Beach, the water requirements for the project would not exceed existing water supplies and would not require the construction of new or expanded water facilities (see section 4.3.2.2).

The storm water drainage system would be installed so that surface water and spills from flammable liquids would drain to designated areas for safe containment and disposal. A system of trenches directed to a spill containment sump would be installed within the process area, while a system of swales, ditches, and culverts would be installed throughout the rest of the facility that connects to the existing POLB storm water drainage system. The project is not expected to exceed existing wastewater capacity or require the construction of new or expanded wastewater treatment or storm water drainage facilities beyond those at the LNG terminal site.

The materials dredged from the West Basin during preparation of the ship berth and reinforcement of the shoreline structures would be disposed of at an approved site, most likely within the POLB. Spoil generated during construction of the LNG terminal, pipelines, and electric distribution facilities would also be hauled and disposed of at approved sites. The solid waste disposal needs during operation of the project would be modest and would be accommodated by existing recycling programs and landfills. The project would comply with federal, state, and local statutes and regulations related to wastewater and solid waste disposal and would not have significant impacts on these resources.

SES and the pipeline contractor(s) would participate in the "One-Call" system to ensure that existing pipelines are located before construction and, if necessary, relocated out of the construction work area. The pipeline contractor(s) would also work with the DOGGR, SCE, and other POLB tenants to protect existing utilities and other facilities.

Overall, construction and operation of the proposed project would not create demands that exhaust or exceed the capacity of existing utilities and service systems.

4.6.7 Property Values

The LNG terminal facilities associated with the Long Beach LNG Import Project would be located within an industrial area under the jurisdiction of the POLB. The natural gas and C_2 pipelines would also be located in areas designated for industrial use. The nearest potential residences are in a recreational vehicle park about 1.5 miles east-northeast of the LNG terminal site and possibly live-aboard boats at two marinas in the East Basin of the Cerritos Channel between 1.2 and 1.6 miles northwest of the LNG terminal. As a result, the project would not have an adverse impact on property values. As discussed in section 4.5.2.2, the pipelines would cross two privately owned parcels within the POLB and others outside of the POLB. No impacts on the property values for these parcels are anticipated because they already contain industrial facilities or are located in areas designated for industrial use.

4.6.8 Tax Revenues

Construction and operation of the Long Beach LNG Import Project would have a beneficial impact on local tax revenue. Revenue from sales tax would be greater during construction based on the temporary influx of workers to the area. The project would generate a construction payroll of about $100.6 million over the 48-month construction period.

During operation of the project, the payroll would be about $3.7 million annually for the 60 full-time employees. The project would generate an estimated $9.2 million in state, county, and local taxes per year. The $9.2 million is based on an estimated $6.6 million in income taxes (includes the 60 full-time employees as well as workers employed by others to support the project operations and income taxes on the product throughput), $2.2 million in property taxes, and $400,000 in sales taxes. Of the $9.2 million in tax revenues, about $3.8 million would be paid to the City of Long Beach, $2.1 million would be paid to local schools, $1.5 million would be paid to the County of Los Angeles, $920,000 would be paid to the State of California, and $900,000 would be paid to a special district. This increase in tax revenue would be permanent.

4.6.9 Environmental Justice

Executive Order 12898 on Environmental Justice recognizes the importance of using the NEPA process to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The provisions of Executive Order 12898 apply equally to Native American programs. The EPA provides guidance on determining whether there is a minority or low income community to be addressed in a NEPA analysis. Minority population issues must be addressed when they comprise over 50 percent of an affected area or when the minority population percentage of the affected area is substantially greater than the minority percentage in the larger area of the general population. Low income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty.

A scoping comment suggested that the project's exclusion zone boundaries should be used to identify environmental justice boundaries. The exclusion zone boundaries extend outside of the LNG terminal site but are within the area immediately surrounding the site within the boundaries of the POLB (i.e., the exclusion zone boundaries do not extend outside of the Port) (see section 4.11.5). This environmental justice analysis includes not only the census tracts within the exclusion zone boundaries but also the census tracts within approximately 2 miles of the LNG terminal site (see figure 4.6.9-1 and table 4.6.9-1). The data from the study area census tracts were compared to data for the Cities of Long Beach, Los Angeles, and Carson and Los Angeles and Orange Counties (see table 4.6.9-2).

The LNG terminal site and electric distribution facilities would be located in census tract 5756. The natural gas and C_2 pipelines would be located in census tracts 5756 and 2947 and the C_2 pipeline would also be located in census tracts 2941.20 and 5439.04. There are no residential neighborhoods within census tracts 5756, 2947, or 5439.04. Residential neighborhoods do appear to exist within census tract 2941.20; however, the proposed C_2 pipeline would not cross these neighborhoods. Established residential neighborhoods border the POLB to the north and east (census tracts 5753, 5754.01, 5754.02, 5755, 5758.01, 5758.02, 5758.03, 5759.01, 5759.02, 5760, 5761, 5762, 5763, 5766.01) and the POLA to the northwest (census tract 2961).

As shown in table 4.6.9-1, Caucasians were the largest population group in 18 of the 19 census tracts, ranging from 22 percent (census tract 5753) to 70 percent (census tract 5761). Census tract 5756 has a larger percentage of African Americans (24 percent) than Caucasians (17 percent). Caucasians were also the largest population group in the surrounding cities (ranging from 26 percent in Carson to 47 percent in Los Angeles) and counties (49 percent in Los Angeles County and 65 percent in Orange County). Generally, the identified study area census tracts had a higher percentage population of African Americans, other races, and Hispanics and a lower percentage of Asians than the Cities of Long Beach and Los Angeles and Los Angeles and Orange Counties. In total, the non-Caucasian population in the study area census tracts constitutes about 64 percent of the total population. Therefore, the study area is considered a minority community based on its aggregate minority population.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-73
Figure 4.6.9-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

TABLE 4.6.9-1

Population Statistics for the Census Tracts Surrounding the Long Beach LNG Import Project

Census Tract	Total Population	Racial/Ethnic Group, 2000 Census (percent)						Median Household Income (1999)	Families Below Poverty (percent)
		Caucasian	African American	Native American and Alaskan Native Persons	Asian	Persons Reporting Some Other Race	Persons of Hispanic or Latino Origin[a]		
2941.20 [b]	2,529	31	10	1	2	56	86	$42,109	28
2947 [c]	3,270	34	6	1	2	58	84	$21,914	40
2961	1,434	47	24	2	3	24	38	$31,500	0
5439.04 [b]	4,426	28	12	1	10	48	70	$43,102	22
5753	4,981	22	20	1	17	39	54	$20,571	35
5754.01	5,476	28	9	1	5	56	79	$19,789	47
5754.02	3,758	25	11	1	5	57	76	$19,841	51
5755	252	36	8	1	3	52	63	$13,750	77
5756 [d]	46	17	24	2	2	47	40	$152,338 [e]	NA
5758.01	2,721	31	4	1	1	62	87	$23,750	46
5758.02	5,433	33	10	1	5	52	76	$19,349	50
5758.03	2,968	39	17	1	11	32	49	$17,109	43
5759.01	3,825	30	22	1	7	39	53	$25,898	34
5759.02	5,108	42	19	1	7	31	39	$23,170	33
5760	445	49	19	0	8	23	29	$28,750	0
5761	2,669	70	10	1	7	12	17	$29,004	14
5762	5,652	40	19	2	3	37	52	$16,739	31
5763	8,912	28	19	2	12	38	55	$21,336	37
5766.01	4,395	61	14	1	6	19	22	$31,426	15

[a] Hispanics may be of any race and are also included in other applicable race categories.

[b] Crossed by the C_2 pipeline.

[c] Crossed by the natural gas and C_2 pipelines.

[d] The proposed LNG terminal and electric distribution facilities would be located within this census tract and the natural gas and C_2 pipelines would also cross this census tract.

[e] Median income is not representative of the area because it includes activities associated with the POLB.

Source: U.S. Department of Commerce, Bureau of the Census, 2000 Census of Population and Housing (www.census.gov).

NA = Not applicable.

TABLE 4.6.9-2

Population Statistics for the Cities and Counties Surrounding the Long Beach LNG Import Project

State/County/City	Racial/Ethnic Group, 2000 Census (percent)						Median Household Income (1999)	Families Below Poverty (percent)
	Caucasian	African American	Native American and Alaskan Native Persons	Asian	Persons Reporting Some Other Race	Persons of Hispanic or Latino Origin[a]		
CALIFORNIA	60	7	1	11	17	32	$47,493	14
Los Angeles County	49	10	1	12	40	28	$42,189	14
City of Long Beach	45	15	1	12	31	22	$37,270	19
City of Los Angeles	47	11	1	10	41	30	$36,687	18
City of Carson	26	25	1	22	18	35	$54,886	9
Orange County	65	2	1	13	26	19	$58,820	7

[a] Hispanics may be of any race and are also included in other applicable race categories.

Source: U.S. Department of Commerce, Bureau of the Census, 2000 Census of Population and Housing (www.census.gov).

Median household income ranged from $13,750 (census tract 5755) to $43,102 (census tract 5439.04) in the study area census tracts. By comparison, other median household income in the project area ranged from $36,687 (City of Los Angeles) to $58,820 (Orange County). The same trend was apparent in the number of families below poverty where the study area census tracts ranged from 0 percent (census tracts 2961 and 5760) to 77 percent (census tract 5755) and the general project area ranged from 7 percent (Orange County) to 19 percent (City of Long Beach).

The proposed project would result in impacts on air quality from several criteria air pollutants during operation, even after the implementation of control and mitigation measures. These impacts would affect the environmental justice study area census tracts; however, all populations within these areas would be affected equally. A Health Risk Assessment was conducted to evaluate the potential for impacts on human health associated with air toxics (see section 4.9.7). The assessment concluded that the impact of the Long Beach LNG Import Project on human health risks would be less than significant; however, toxic air pollutants resulting from the project would likely contribute to an existing cumulatively significant air quality impact in the south-central Los Angeles area, the harbor area, and near freeways (see section 4.12).

Potentially significant impacts associated with geologic hazards would occur at the LNG terminal site but would not affect the existing seismic risks to offsite facilities or structures. Seismic activity could potentially damage the LNG terminal site facilities, shoreline structures, and pipeline and electric distribution facilities; however, the project facilities would be designed to meet or exceed the seismic design criteria of NFPA 59A, the more stringent criteria of the POLB, and other applicable codes (e.g., the California Building Code). Implementation of approved final designs for the LNG tanks, shoreline structures, and other critical structures at the LNG terminal would reduce the potential effects of seismic hazards to less than significant levels (see section 4.1.4).

Significant impacts on biological resources would be reduced to less than significant levels through the implementation of control measures (see section 4.4). In addition, none of these impacts would occur on resources beyond the Port's boundaries. Although traffic generated during project construction would result in temporary adverse impacts on project area roadways, it is not expected that such impacts would affect the environmental justice study area census tracts (see section 4.7.2). The project is not expected to result in a substantial increase in the potential for incidents that would cause serious injury or death to members of the public. Furthermore, project construction would provide some short-term job opportunities. The only long-term socioeconomic effect of the project is likely to be beneficial, based on the increase in local tax revenues.

Executive Order 12898 also emphasizes the importance of providing opportunities for community input in the NEPA process. As part of the Pre-Filing Process, the FERC and the POLB worked with SES to develop a public outreach plan for issue identification and stakeholder participation. As part of the outreach plan, the mailing list for the project was initiated. The mailing list was updated and expanded when the FERC's and the POLB's NOI/NOP was issued and when the POLB's first Supplemental NOP was issued. The mailing list was also expanded when SES modified its proposal to manage NGL and when the POLB's second Supplemental NOP was issued, and has been continually updated during the EIS/EIR process. All affected landowners, as identified by SES, received the notices about the project without any distinction based on minority or income status. Native American groups identified as having an interest in the project area also received the notices about the project. The distribution list for this draft EIS/EIR included federal, state, and local agencies; elected officials; environmental and public interest groups; Native American tribes; affected landowners; Port tenants; intervenors to the FERC's proceeding; local libraries and newspapers; and other interested parties (i.e., miscellaneous individuals who provided scoping comments or asked to be on the mailing list). A formal notice indicating that the draft EIS/EIR is available for review and comment was published in the Federal Register, posted in the Los Angeles

County Clerk's office in California, and sent to the remaining individuals on the mailing list. The distribution list for the draft EIS/EIR and formal notice is in Appendix A.

SES sponsored two public workshops in the Long Beach area to inform agencies and the general public about LNG and the proposed project and provide them an opportunity to ask questions and express their concerns. The FERC and the POLB held a public scoping meeting to provide affected landowners; Port tenants; federal, state, and local government agencies; elected officials; environmental and public interest groups; Native American tribes; and other interested individuals an opportunity to comment on the project. The date and location of the scoping meeting was published in local area newspapers. Section 1.3 further describes the public notification and participation process. Section 4.8.4 describes contacts with Native American tribes that traditionally occupied the project area.

In summary, the Long Beach LNG Import Project would not result in disproportionately high and adverse human health or environmental effects on minority and/or low income communities or Native American tribes.

4.7 TRANSPORTATION

4.7.1 Significance Criteria

Impacts on vehicular traffic at an intersection would be considered significant if:

- the following impact thresholds for the City of Long Beach would be exceeded:

  a. the volume-to-capacity (V/C) ratio would change on a facility operating at a level of service (LOS) A, B, C, or D to LOS E or F; or

  b. the V/C ratio would increase by 0.02 or more on a facility operating at LOS E or F.

- the following impact thresholds for the POLA/City of Los Angeles would be exceeded:

  a. the V/C ratio would increase by 0.04 or more on a facility operating at LOS C (>0.70 – 0.80);

  b. the V/C ratio would increase by 0.02 or more on a facility operating at LOS D (>0.80 – 0.90); or

  c. the V/C ratio would increase by 0.01 or more on a facility operating at LOS E or F (>0.90).

The Los Angeles County CMP indicates that impacts on freeway traffic would be considered significant if:

- the demand-to-capacity (D/C) ratio would increase by 0.02 or more on a facility operating at LOS F.

Impacts on marine vessel transportation would be considered significant if project construction or operation would:

- cause an increase in traffic that would result in congestion within the harbor and/or if the capacity for maritime commerce to operate efficiently and safely would be exceeded.

Impacts on air transportation would be considered significant if project construction or operation would:

- result in a permanent change in air traffic patterns.

4.7.2 Ground Transportation

4.7.2.1 Environmental Setting

Roadways/Intersections

Regional access to the proposed LNG terminal site on Pier T is provided by a network of freeway and arterial facilities (see figure 4.7.2-1). The freeways include the Harbor Freeway (Interstate 110), the Long Beach Freeway (Interstate 710), and the Terminal Island Freeway (State Route 47 and State Route 103), while the arterial street network includes Ocean Boulevard/Seaside Avenue, Pier S Avenue, Henry Ford Avenue, Alameda Street, Anaheim Street, and the Pacific Coast Highway (State Route 1).

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-78
Figure 4.7.2-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

The Harbor and Long Beach Freeways are north-south highways that extend from the Port area to downtown Los Angeles. Both freeways have six lanes in the vicinity of the harbor and widen to eight lanes to the north. The Terminal Island Freeway extends from Terminal Island across the Heim Bridge and terminates at Willow Street. It is six lanes wide between Ocean Boulevard and Anaheim Street, where it narrows to four lanes.

The key access streets in the area are Harbor Scenic Drive, Ocean Boulevard/Seaside Avenue, Pier S Avenue, and Pier T Avenue. Curbside parking is prohibited on all of these streets. Ocean Boulevard/Seaside Avenue, a six-lane street, is the primary east-west arterial to the north of the project site. Seaside Avenue is within the City of Los Angeles and Ocean Boulevard is within the City of Long Beach. The remaining streets have two lanes in each direction at most locations.

Peak hour traffic volume data for the roadways in the project area were collected to quantify the existing traffic conditions. Peak hour traffic counts at the project area intersections were conducted in 2004. Appendix D contains the peak hour volumes.

Thirteen key intersections were selected for detailed analysis based on a review of previous Port-related environmental documentation and estimated travel patterns for the proposed project. These locations, identified on figure 4.7.2-1 and listed in table 4.7.2-1, were analyzed to determine their LOS during the morning and evening peak hours on a typical weekday. Peak hours at the intersection were analyzed from 8 to 9 a.m. and from 4 to 5 p.m.

TABLE 4.7.2-1

Study Intersections

Intersection	Type
1. Terminal Island Freeway Northbound On-Ramp and New Dock Street/Pier S Access Road	All-way stop-controlled intersection
2. Terminal Island Freeway Southbound Off-Ramp and New Dock Street	Stop controlled on minor street only
3. Terminal Island Freeway and Ocean Boulevard (existing and future configuration analyzed for respective scenarios)	Signalized intersection
4. Pier S Avenue and Ocean Boulevard (existing and future configuration analyzed for respective scenarios)	Signalized intersection
5. Pier S Avenue and New Dock Street	Signalized intersection
6. Pier S Avenue and SERRF Driveway	Stop controlled on minor street only
7. Navy Way and Seaside Avenue (existing and future configuration analyzed for respective scenarios)	Signalized intersection
8. Henry Ford Avenue and Terminal Island Freeway On/Off Ramps	Signalized intersection
9. Henry Ford Avenue and Anaheim Street	Signalized intersection
10. Henry Ford Avenue and Deni Street	Signalized intersection
11. Anaheim Street and Alameda Street	Signalized intersection
12. Pacific Coast Highway and Alameda Street east on Alameda Street	Signalized intersection [a]
13. Pacific Coast Highway and Alameda Street north on Pacific Coast Highway	Signalized intersection [a]

[a] Analyses assume two intersections due to grade separation of Pacific Coast Highway and Alameda Street per current design plans.

LOS is a qualitative indication of an intersection's operating conditions as represented by traffic congestion and delay and V/C ratio. For signalized intersections, it is measured from LOS A (little or no delay/congestion) to LOS F (intersection failure/gridlock), with LOS D (V/C of 0.90) typically considered to be the threshold of acceptability. The relationship between V/C ratio and LOS for signalized intersections is provided in table 4.7.2-2.

TABLE 4.7.2-2

Relationship Between the Volume-to-Capacity Ratio and Level of Service for Signalized Intersections

Volume-to-Capacity Ratio	Level of Service	Traffic Conditions
0 to 0.60	A	Little or no delay/congestion
> 0.60 to 0.70	B	Slight congestion/delay
> 0.70 to 0.80	C	Moderate delay/congestion
> 0.80 to 0.90	D	Significant delay/congestion
> 0.90 to 1.00	E	Extreme congestion/delay
1.00 +	F	Intersection failure/gridlock

For signalized intersections the LOS values were determined by using the Intersection Capacity Utilization methodology in Long Beach and the Critical Movement Analysis methodology in Los Angeles. A capacity value of 1,600 vehicles per hour per lane was used (2,880 for dual left turn lanes). Trucks use more roadway capacity than automobiles because of their size and acceleration capabilities; therefore, a passenger car equivalent factor of 1.1 was applied to tractors, 2.0 was applied to chassis, and 2.0 was applied to the container truck volumes for the LOS calculations.

Stop-controlled intersections were analyzed using methodologies contained in the Highway Capacity Manual in which LOS is based on average vehicular delay (Transportation Research Board, 2000). Highway links were assessed, assuming a per lane capacity of 2,000 vehicles per hour. The relationship between delay and LOS for stop-controlled intersections (two-way and multi-way stops) is provided in table 4.7.2-3.

TABLE 4.7.2-3

Relationship Between Delay and Level of Service for Stop-Controlled Intersections (Two-Way and Multi-Way Stops)

Intersection Level of Service	Average Delay (seconds/vehicle)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

Freeway segments were analyzed in compliance with the Los Angeles County CMP. The CMP uses a D/C ratio to determine LOS. The relationship between the D/C ratio and the LOS for freeway segments as identified in the CMP is provided in table 4.7.2-4.

TABLE 4.7.2-4

Relationship Between the Demand-to-Capacity Ratio and the Level of Service for Freeway Segments

Freeway Level of Service	Demand-to-Capacity Ratio
A	0.01-0.35
B	0.36-0.54
C	0.55-0.77
D	0.78-0.93
E	0.94-1.00
F	>1.00

Based on peak hour traffic volumes, the average intersection delays and corresponding LOS have been determined and are summarized in table 4.7.2-5. As shown in table 4.7.2-5, two of the existing

study intersections currently operate at LOS E or F while the remaining study intersections operate at LOS D or better during the peak hours. The locations at LOS E or F are:

- Terminal Island Freeway and Ocean Boulevard
- Pier S Avenue and Ocean Boulevard

TABLE 4.7.2-5

Existing Intersection Level of Service Analysis

Intersection	2003 Existing Conditions			
	Morning Peak Hour		Evening Peak Hour	
	LOS	V/C or Delay	LOS	V/C or Delay
1. Terminal Island Freeway Northbound On-Ramp and New Dock Street/Pier S Access Road [a]	A	8	B	12
2. Terminal Island Freeway Southbound Off-ramp and New Dock Street [b]	B	12	B	11
3. Terminal Island Freeway and Ocean Boulevard (existing configuration) [c]	F	1.114	F	1.284
4. Pier S Avenue and Ocean Boulevard (existing configuration) [c]	D	0.847	E	0.914
5. Pier S Avenue and New Dock Street [c]	A	0.261	A	0.219
6. Pier S Avenue and SERRF Driveway [b]	B	11	B	10
7. Navy Way and Seaside Avenue [c]	B	0.659	B	0.601
8. Henry Ford Avenue and Terminal Island Freeway On/Off Ramps [c]	A	0.234	A	0.366
9. Henry Ford Avenue and Anaheim Street [c]	A	0.592	C	0.767
10. Henry Ford Avenue and Deni Street [c]	A	0.261	A	0.487
11. Anaheim Street and Alameda Street [c]	A	0.558	C	0.785
12. Pacific Coast Highway and Alameda Street east on Alameda Street [c, d]	B	0.614	C	0.704
13. Pacific Coast Highway and Alameda Street north on Pacific Coast Highway [c, d]	A	0.421	A	0.555

[a] All-way stop-controlled intersection; weighted average delay for entire intersection reported.
[b] Stop controlled on minor street only; delay for most constrained approach is reported.
[c] Signalized intersection.
[d] Analyses assume two intersections due to grade separation of Pacific Coast Highway and Alameda Street per current design plans.
LOS = Level of Service.
V/C = Volume-to-Capacity Ratio.
Delay = Seconds per vehicle.

4.7.2.2 Project Impacts

Access to the Pier T LNG terminal site would be via Pier T Avenue/Seaside Boulevard.

Construction Impacts (Year 2010)

Cumulative Base Traffic – The POLB and POLA have cargo and traffic projections for the year 2010, the closest base year to the estimated project completion year. The construction analysis is based upon the absolute peak workforce, which would not actually occur in 2010. Hence, the use of this base year produces a conservative traffic impact analysis for construction because the cumulative/background traffic growth is overstated, and the traffic impact criteria are based upon future base traffic conditions. The year 2010 is also used for the operation scenario.

The year 2010 baseline includes all sources of traffic and future growth within and adjacent to the POLB/POLA. Within the Ports' districts, the Ports' year 2010 cargo forecast of 19.7 million twenty-foot

equivalent units (TEUs) were allocated to all container terminals. Future growth in non-container terminal traffic as documented in the POLB/POLA Transportation Study (2001) was also included. The year 2010 baseline traffic volumes also include growth in non-Port traffic through the use of the SCAG's regional model. Additionally the SCAG's model was adjusted to incorporate those proposed/planned developments that were not accurately accounted for in the original SCAG model forecasts. The use of the SCAG model to account for subregional and regional traffic growth beyond the general proximity of the project site is an accepted practice by agencies/jurisdictions. The SCAG model is used for the region's federally required Regional Transportation Plan (RTP), as well as the SIP and the South Coast Air Basin's (SCAB) AQMP.

The Ports' cumulative traffic was estimated and assigned to the roadway system using trip generation rates and the POLB/POLA Transportation Study model.

To accurately forecast future baseline traffic conditions, it is necessary to include planned roadway/rail improvements. Planned and funded roadway/rail improvements that will be in place by 2010 include: the widening of Henry Ford Avenue between Anaheim Street and Alameda Street; the widening of Alameda Street between Henry Ford Avenue and the Pacific Coast Highway; the State Route 47/Henry Ford Avenue/Ocean Boulevard Interchange; and planned City of Los Angeles Department of Transportation (LADOT) improvements at the intersection of Alameda Street and Anaheim Street. The effect of these improvements on lane configurations and LOS can be seen in the LOS worksheets included in Appendix D.

Project Traffic – There would be temporary adverse impacts on project area roadways during site preparation and construction. The duration of construction for the LNG terminal is estimated to be 48 months. During this time, traffic would be generated by trucks transporting materials and equipment to and from the laydown area and project site as well as trucks transporting materials directly to the project site. The designated construction laydown area is located at the northwest quadrant of the Pier S Avenue and Ocean Boulevard intersection (see figure 2.1-1). Driveway access to the laydown area is located along Pier S Avenue. Also, construction worker trips would occur during the construction period.

All construction workers would park adjacent to the laydown area. The construction workers would then be transported via buses to the project site on Pier T. The expected hours of work are 7 a.m. to 3:30 p.m. The absolute peak workforce of 404 was used in this analysis. This peak workforce would occur for 2 months only: months 32 and 33. To emphasize the conservative analysis that was conducted, the following are additional statistics for the workforce projections: average monthly workforce of 252 (62 percent of peak); median workforce of 280 (69 percent of peak); and 85th percentile of 364 (90 percent of peak), which would be only exceeded in 5 months out of 48. Ride-sharing to the worker parking area was not assumed for the workforce, which renders the analysis even more conservative. In summary, 404 auto trips would occur between 6 and 6:30 a.m. (inbound to the laydown/worker parking area), and 4 to 4:30 p.m. (outbound from the laydown/worker parking area). The analysis is conservative in yet another way because the peak hour traffic from all other sources (ports and non-ports) that was used in the analysis was for the 8 to 9 a.m. hour. The cumulative traffic between 6 and 7 a.m. would be much lower. Hence, the analysis overstates the roadway operating conditions and potential impacts. Moreover, it is conceivable that there could be no impacts during the 6 to 7 a.m. hour. Transport of the construction workers between the laydown/worker parking area and the project site would generate 46 bus trips per day (23 in and 23 out) during the most active construction period. It is estimated that 16 bus trips would occur between 6 and 7 a.m., 16 bus trips between 3 and 4 p.m. (assuming 50 people per bus, about 8 bus trips would be required to/from the laydown/worker parking area and the project site), and 14 bus trips between 7 a.m. and 3 p.m (miscellaneous trips). The distribution/travel routes for construction traffic to/from the laydown/worker parking area and the project site were assumed as follows: 50 percent via

Interstate 710, 25 percent via Interstate 110, and 25 percent via State Route 47. This distribution was developed using data from the POLB/POLA Transportation study and the SCAG regional model.

The transporting of construction equipment and materials would generate approximately 676 daily truck trips (338 in and 338 out) during the most active construction period. Table 4.7.2-6 provides the breakdown of the construction-generated daily and peak hour trips. Table 4.7.2-7 provides intersection LOS for the future conditions with and without the proposed construction traffic for the LNG terminal, and also the change in V/C ratio (delay). The analysis shows that the project construction worker and truck and material haul trips would result in a temporary, short-term significant impact at the following intersections:

- Navy Way and Seaside Avenue – evening only; and
- Henry Ford Avenue and Anaheim Street – evening only.

TABLE 4.7.2-6

Trip Generation Summary for the Long Beach LNG Import Project LNG Terminal Construction Scenario

		Morning Peak Hour			Evening Peak Hour		
Vehicles	Daily Trips	In	Out	Total	In	Out	Total
Direct to Project Site							
Trucks (Concrete and Miscellaneous)	108	5	5	10	5	5	10
Trucks (Rock Haul)	528	22	22	44	22	22	44
To Laydown Site							
Autos (Construction Worker)	808	404	0	404	0	404	404
Trucks (Materials and Equipment)	20	1	1	2	1	1	2
Laydown Site to Project Site							
Bus (Construction Worker)	46	8	8	16	8	8	16
Trucks (Materials and Equipment)	20	1	1	2	1	1	2
Total	1,530	441	37	478	37	441	478

Operation Impacts

Project Traffic – Traffic generated by the project was estimated to determine potential impacts of the project on study area roadways. Table 4.7.2-8 provides the project-generated daily and peak hour trips on a typical weekday. The Long Beach LNG Import Project terminal would operate 24 hours a day with four shifts. Employees would generate 120 trips per day or 30 trips per shift. There would be a maximum of 40 LNG truck trips per day.[2] To be conservative, and not knowing at this time the exact shift times, shift changes were assumed to coincide with the analyzed peak hours. As previously discussed, primary access to the LNG terminal site would be via Pier T Avenue/Seaside Boulevard.

[2] To be conservative, 20 LNG trucks or 40 LNG truck trips per day were used in the traffic analysis; however, only 16 LNG trucks (32 LNG truck trips) are anticipated.

TABLE 4.7.2-7

Future 2010 Long Beach LNG Import Project LNG Terminal Construction Scenario - Intersection Level of Service

Intersection	Future 2010 Base				Future 2010 with LNG Terminal Construction				Significant Impact (Yes/No)
	Morning Peak Hour		Evening Peak Hour		Morning Peak Hour		Evening Peak Hour		
	LOS	V/C or Delay	LOS	V/C or Delay	LOS	V/C or Delay	LOS	V/C or Delay	
1. Terminal Island Freeway Northbound On-Ramp and New Dock Street/Pier S Access Road [a]	A	9	B	11	A	9	B	13	No
2. Terminal Island Freeway Southbound Off-Ramp and New Dock Street [b]	B	11	B	12	B	12	B	13	No
3. Terminal Island Freeway and Ocean Boulevard [c]	A	0.578	C	0.721	B	0.649	C	0.733	No
4. Pier S Avenue and Ocean Boulevard [c]	B	0.649	B	0.678	C	0.717	C	0.747	No
5. Pier S Avenue and New Dock Street [c]	A	0.266	A	0.301	A	0.312	A	0.323	No
6. Pier S Avenue and Depot/SERRF Driveway [b]	A	10	B	11	C	18	B	14	No
7. Navy Way and Seaside Avenue [c]	E	0.934	F	1.033	E	0.937	F	1.060	Yes (evening)
8. Henry Ford Avenue and Terminal Island Freeway On/Off Ramps [c]	A	0.597	B	0.667	B	0.637	B	0.667	No
9. Henry Ford Avenue and Anaheim Street [c]	C	0.729	E	0.930	C	0.760	E	0.973	Yes (evening)
10. Henry Ford Avenue and Deni Street [c]	A	0.374	A	0.374	A	0.399	A	0.399	No
11. Anaheim Street and Alameda Street [c]	A	0.540	B	0.608	A	0.540	B	0.608	No
12. Pacific Coast Highway and Alameda Street east on Alameda Street [c, d]	B	0.669	B	0.667	B	0.669	B	0.667	No
13. Pacific Coast Highway and Alameda Street north on Pacific Coast Highway [c, d]	A	0.596	B	0.686	A	0.600	B	0.699	No

[a] All-way stop-controlled intersection; weighted average delay for entire intersection reported.
[b] Stop controlled on minor street only; delay for most constrained approach is reported.
[c] Signalized intersection.
[d] Analyses assume two intersections due to grade separation of Pacific Coast Highway and Alameda Street per current design plans.
LOS = Level of Service.
V/C = Volume-to-Capacity Ratio.
Delay = Seconds per vehicle.

Operation Impacts – Table 4.7.2-9 provides intersection LOS forecasts for the future conditions with and without the proposed LNG terminal on Pier T. As shown in table 4.7.2-9, the project would not result in a significant impact on traffic at any of the study intersections.

TABLE 4.7.2-8

Trip Generation Summary for the Long Beach LNG Import Project LNG Terminal Operation Scenario

Vehicles	Average Daily Trips	Morning Peak Hour			Evening Peak Hour		
		In	Out	Total	In	Out	Total
Autos	120	15	15	30	15	15	30
LNG Trucks	40	1	1	2	1	1	2
Total	160	16	16	32	16	16	32

TABLE 4.7.2-9

Future 2010 Long Beach LNG Import Project LNG Terminal Operation Scenario – Intersection Level of Service

Intersection	Future 2010 Base				Future 2010 with LNG Terminal Construction				Significant Impact (Yes/No)
	Morning Peak Hour		Evening Peak Hour		Morning Peak Hour		Evening Peak Hour		
	LOS	V/C or Delay	LOS	V/C or Delay	LOS	V/C or Delay	LOS	V/C or Delay	
1. Terminal Island Freeway Northbound On-Ramp and New Dock Street/Pier S Access Road [a]	A	9	B	11	A	9	B	11	No
2. Terminal Island Freeway Southbound Off-Ramp and New Dock Street [b]	B	11	B	12	B	11	B	12	No
3. Terminal Island Freeway and Ocean Boulevard [c]	A	0.578	C	0.721	A	0.580	C	0.724	No
4. Pier S Avenue and Ocean Boulevard [c]	B	0.649	B	0.678	B	0.650	B	0.679	No
5. Pier S Avenue and New Dock Street [c]	A	0.266	A	0.301	A	0.266	A	0.301	No
6. Pier S Avenue and Depot/SERRF Driveway [b]	A	10	B	11	A	10	B	11	No
7. Navy Way and Seaside Avenue [c]	E	0.934	F	1.033	E	0.935	F	1.034	No
8. Henry Ford Avenue and Terminal Island Freeway On/Off Ramps [c]	A	0.597	B	0.667	A	0.598	B	0.667	No
9. Henry Ford Avenue and Anaheim Street [c]	C	0.729	E	0.930	C	0.731	E	0.932	No
10. Henry Ford Avenue and Deni Street [c]	A	0.374	A	0.374	A	0.375	A	0.375	No
11. Anaheim Street and Alameda Street [c]	A	0.540	B	0.608	A	0.540	B	0.608	No
12. Pacific Coast Highway and Alameda Street east on Alameda Street [c, d]	B	0.669	B	0.667	B	0.669	B	0.667	No
13. Pacific Coast Highway and Alameda Street north on Pacific Coast Highway [c, d]	A	0.596	B	0.686	A	0.597	B	0.686	No

[a] All-way stop-controlled intersection; weighted average delay for entire intersection reported.

[b] Stop controlled on minor street only; delay for most constrained approach is reported.

[c] Signalized intersection.

[d] Analyses assume two intersections due to grade separation of Pacific Coast Highway and Alameda Street per current design plans.

LOS = Level of Service.

V/C = Volume-to-Capacity Ratio.

Delay = Seconds per vehicle.

Congestion Management Program Analysis

According to the CMP, Traffic Impact Analysis Guidelines, a traffic impact analysis is required at the following:

- CMP arterial monitoring intersections, including freeway on- or off-ramps, where the proposed project would add 50 or more trips during either the morning or evening weekday peak hours; and

- CMP freeway monitoring locations where the proposed project would add 150 or more trips in one direction during either the morning or evening weekday peak hours.

The closest CMP arterial monitoring station to Pier T is Alameda Street/Pacific Coast Highway. It should be noted that according to the CMP requirements, this intersection would not need to be analyzed because less than the threshold number of trips would be added. However, to be conservative in the assessment of potential impacts, this intersection was analyzed. The LOS results in table 4.7.2-9 indicate that this CMP intersection would not be significantly impacted by the project. The closest freeway monitoring stations include Interstate 710 at Willow Street and Interstate 110 at C Street. Per CMP guidelines, an increase of 0.02 or more in the D/C ratio with a resulting LOS F is deemed to be a significant impact. The results of the analysis indicate that the construction and operation scenarios for the proposed LNG terminal would not result in an impact on either of the CMP freeway monitoring locations because less than 150 trips would be generated during the morning or evening peak hours. No other CMP system impacts would result from the project.

Transit Impacts

Although the proposed LNG terminal on Pier T would result in additional on-site employees, the increase in work-related trips using public transit would be negligible. Consequently, additional demand on local transit services would be insignificant.

4.7.2.3 Mitigation

Construction

As previously explained, the construction analysis is conservative and overstated. To mitigate the short-term impacts during the evening peak hour, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall require that the construction workforce work 6 a.m. to 2:30 p.m. instead of 7 a.m. to 3:30 p.m.**

To assess the effectiveness of the shift change, the 2 to 3 p.m. hour was analyzed, which is also the highest truck peak hour in the Ports. Under this shift schedule, all of the buses are assumed to travel from the Pier T site to the worker parking area between 2:30 and 3 p.m. Also, it was assumed that all of the workers would depart from the parking area before 3 p.m. This approach for the new shift produces a conservative analysis, as some of the trips may in fact occur after 3 p.m.

The 5 to 6 a.m. hour was not analyzed because no impacts are expected. The following briefly summarizes the qualitative analysis conducted to make this assessment:

- There would be no significant construction impacts during the morning commute period.

- Area-wide traffic volumes are very low between 5 and 6 a.m. Recent traffic counts on Ocean Boulevard, the heaviest traveled Ports' area arterial street, indicates that the 5 to 6 a.m. volume is about 50 percent and 40 percent of the 6 to 7 a.m. and 8 to 9 a.m. hours, respectively. Additionally, with the recent implementation of the terminal extended hours program (PierPass), hoot shifts (3 to 8 a.m.) have been eliminated. As a result, there is currently very limited truck traffic between 5 and 6 a.m.

A LOS analysis was conducted to assess the potential impacts of the construction worker shift change. Table 4.7.2-10 provides the intersection LOS results. With the shift change, the impact at the intersection of Navy Way/Seaside Avenue would be removed but the temporary impact at the Henry Ford Avenue/Anaheim Street intersection would remain between 2 and 3 p.m.

TABLE 4.7.2-10

Future 2010 Long Beach LNG Import Project LNG Terminal Construction Mitigation Scenario – Intersection Level of Service (Mid-Day Peak Hour)

Intersection	Future 2010 Base		Future 2010 with LNG Terminal Construction		Significant Impact (Yes/No)
	LOS	V/C or Delay	LOS	V/C or Delay	
1. Terminal Island Freeway Northbound On-Ramp and New Dock Street/Pier S Access Road [a]	B	12	B	14	No
2. Terminal Island Freeway Southbound Off-Ramp and New Dock Street [b]	B	14	B	15	No
3. Terminal Island Freeway and Ocean Boulevard [c]	C	0.776	C	0.788	No
4. Pier S Avenue and Ocean Boulevard [c]	B	0.688	C	0.757	No
5. Pier S Avenue and New Dock Street [c]	A	0.280	A	0.344	No
6. Pier S Avenue and Depot/SERRF Driveway [b]	B	10	B	12	No
7. Navy Way and Seaside Avenue [c]	C	0.743	C	0.770	No
8. Henry Ford Avenue and Terminal Island Freeway On/Off Ramps [c]	B	0.615	B	0.656	No
9. Henry Ford Avenue and Anaheim Street [c]	E	0.930	E	0.973	Yes
10. Henry Ford Avenue and Deni Street [c]	A	0.377	A	0.402	No
11. Anaheim Street and Alameda Street [c]	A	0.484	A	0.484	No
12. Pacific Coast Highway and Alameda Street east on Alameda Street [c, d]	C	0.716	C	0.716	No
13. Pacific Coast Highway and Alameda Street north on Pacific Coast Highway [c, d]	B	0.657	B	0.684	No

[a] All-way stop-controlled intersection; weighted average delay for entire intersection reported.
[b] Stop controlled on minor street only.
[c] Signalized intersection.
[d] Analyses assume two intersections due to grade separation of Pacific Coast Highway and Alameda Street per current design plans.
LOS = Level of Service.
V/C = Volume-to-Capacity Ratio.
Delay = Seconds per vehicle.

The Henry Ford Avenue/Anaheim Street intersection currently operates at a LOS D or better during the typical commute and truck peak hours in the Ports. When intersections are operating at a LOS D or better, improvements are not usually warranted, unless a significant safety hazard exists. Because this impact would be temporary (and the analysis is conservative as previously described), the Port would reassess the LOS and the need for improvements in consultation with the LADOT prior to construction commencing. If the intersection is still operating at a LOS D or better between 2 and 3 p.m., improvements may not be warranted or required by the LADOT.

Another issue to be considered in determining whether or not improvements would be appropriate or warranted is the State Route 47 Expressway Truck Project, proposed by the Alameda Corridor Transportation Authority and CalTrans. This project consists of a four-lane roadway elevated over Henry Ford Avenue and Alameda Street between the Heim Bridge (also proposed to be replaced as part of the project) and Pacific Coast Highway. This improvement project is proposed to be completed by 2011, and if it were completed before the opening of the LNG terminal, then Henry Ford Avenue/Anaheim Street would operate at a LOS C or better, and the improvements described below would not be needed. The status of the State Route 47 Expressway would be considered and discussed with the LADOT before commencement of construction.

However, if the LADOT requires improvements, the following are two options for the Henry Ford Avenue/Anaheim Street intersection:

- Re-stripe the eastbound approach to provide three through lanes. This is consistent with the eastbound departure, which currently has three lanes. Parking is currently prohibited on the eastbound side of Anaheim Street west and east of the intersection. Also, re-stripe the westbound approach to provide two through lanes and a shared through/right turn lane. Re-stripe the westbound departure to provide a third through lane that would merge just prior to Cristobal Avenue. Parking is currently prohibited on the north (westbound) side of Anaheim Street east of Henry Ford Avenue, and during both the morning (7 to 9 a.m.) and afternoon (4 to 6 p.m.) peak hours west of Henry Ford Avenue. The westbound departure re-striping would require either the temporary or permanent removal of two, unmarked parking spaces just west of Cristobal Avenue, which serve a fast food restaurant. This would not cause any impacts because the restaurant has ample off-street parking. The resultant LOS with this improvement would be LOS D (V/C of 0.845); and/or

- Re-stripe the northbound approach to provide two through lanes and a shared through/right turn lane. Also re-stripe the northbound departure to provide the third through lane that would merge just prior to I Street. This would require a parking prohibition on the east (northbound) side of Henry Ford Avenue between Anaheim Street and I Street. However, no impacts would occur because this curb face is not used for parking because the fronting lot is vacant. The resultant LOS with this improvement would be LOS D (V/C of 0.886).

Implementation of the mitigation measures described above would reduce the impacts of the project on ground transportation to less than significant levels.

4.7.3 Marine Transportation

4.7.3.1 Environmental Setting

In total, the POLB has some 17 miles of berthing frontage for commercial vessels with 157 named berths. There are 77 deep-water berths and all berths lie within 4.5 nautical miles (nm) of the open sea. Containers are the primary cargo moving through the Port with major container terminals at Piers A, F, G, J, and T, as well as a proposed development at Pier S. Bulk oil and products cargo are located at Piers B, C, and T and dry bulk cargo at Pier F. The other cargoes moving through the POLB include refrigerated cargo at Pier E, forest products at Piers D and T, and scrap metal recycling and export at Pier T.

Commercial ship traffic generally approaches the POLB from the northwest passing north of Catalina Island and from the south passing east of the island using established commercial shipping lanes. Vessels enter the area through Queens Gate, a 1,200-foot-wide opening into San Pedro Bay between the Long Beach and Middle breakwaters. To access Pier T, vessels travel northwest within the Long Beach Main Channel into the Middle Harbor. Pier T is located within the West Basin of the Middle Harbor. Commercial traffic passes east of Pier T to the container, tanker, and other berths of the East Basin and Back Channel. Tankers chartered by the Navy occasionally use the West Basin to access its fuel pier on the Navy Mole. Container traffic also enters the West Basin to access a recently opened container terminal at Pier T. The general arrangement of the POLB is shown on figure 4.7.3-1.

There are no commercial anchorages located within the West Basin but two anchorages are located within the breakwater and precautionary area of the Port. There is one anchorage area to the east of the channel and one to the west. The anchorage to the east has 18 locations and there are 7 to the west. There are 28 commercial anchorages located within the enclosed waters of San Pedro Bay (16 to the east and 12 to the west of the channel). Additional anchorages are located in open water outside of the Queens Gate entrance.

High density commercial fishing does not occur within the approaches to the POLB or within the Port limits. There are two marinas in the City of Long Beach located east of the harbor limit and several marinas in the East Basin of the Cerritos Channel. Recreational boats use the waterway to Queens Gate to access and exit the area and use San Pedro Bay inside the breakwater as a cruising area. There is very little recreational traffic inward of the cut at Pier F and recreational boating is not allowed within the West Basin of the Middle Harbor.

Vessel traffic in the San Pedro Bay area is controlled through a single VTS located at Point Fermin to the west of the ports of Long Beach and Los Angeles. The purpose of the VTS is to enhance safe, environmentally sound, and efficient maritime transportation. Once a vessel enters Queens Gate, the responsibility for vessel traffic management is transferred from the VTS to the Long Beach pilot service. The Long Beach pilot service is managed by Jacobsen Pilots from its control station at Pier F. A detailed description of the VTS and the pilot service is provided in section 4.11.7.

Information on ship calls (i.e., a visit to the Port that combines arrival, time at berth, and departure) and ship movements (i.e., a single transit inwards from the sea, a shift within the Port, or a departure transit) within the POLB is maintained by both the Marine Exchange and Jacobsen Pilots. The Marine Exchange records ship calls for both the POLA and POLB. Jacobsen Pilots records ship movements within the POLB.

Current Traffic Levels

The POLB currently experiences about 3,085 ship calls, which result in about 6,170 inward and outward ship movements per year. An additional 2,230 internal movements where vessels shift berth or location within the Port were recorded in 2004. Between 8 and 39 ship movements per day can occur within the Port, with an average of 20 ship movements per day. The majority of ship movements to and from the berths are completed in 2 hours or less and very few movements are greater than 3 hours in duration. The present level of ship movements has been sustained over the previous 5 years. The pilot service and tug assistance can routinely handle up to 25 ship movements per day and can handle peaks of 30 to 40 ship movements per day.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-90
Figure 4.7.3-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Future Traffic Levels

The demand for containerized cargo capacity is expected to increase to between 5,200 and 7,600 ship calls in 2020. This would result in between 10,400 and 15,200 inward and outward ship movements in 2020, which would translate to one ship movement every 50 minutes (low estimate) or 35 minutes (high estimate). The ability of the POLB to handle increasing numbers of ships associated with various trades depends on the capacity of primary and secondary factors that can limit vessel traffic. Primary factors are those features of the Port that cannot be changed, or can be changed or modified only with very high capital expenditure, including the breakwater entrance, channel depth, channel geometry, and/or environmental conditions. Secondary factors are those features of the Port that can be changed or modified at modest capital or operational expenditure, including pilotage and towage services. Of the primary factors, the breakwater entrance is wide enough to accept two-way traffic and is unlikely to be a constraint on capacity. The water depth in the outer harbor is about 70 feet and in the inner basins is about 40 to 60 feet.

4.7.3.2 Impact and Mitigation

The Long Beach LNG Import Project would generate a maximum of 120 ship calls and 240 ship movements within the POLB each year. This would typically mean the addition of one ship movement per day on up to 240 days of the year or possibly two ship movements in the event of a rapid discharge call with arrival, discharge, and departure occurring during one calendar day.

While SES anticipates receiving LNG vessels with capacities up to 145,000 cubic meters for the foreseeable future, the terminal is being designed to accommodate vessels with capacities ranging between 75,000 and 208,000 cubic meters. Based on a typical Port transit speed of 6 knots, the transit time through the Port to the terminal would be about 2 hours, regardless of the vessel size. The time required to unload the LNG cargo would range between 6 and 18 hours based on the vessel's LNG capacity. An LNG vessel with a capacity of 145,000 cubic meters would take approximately 12 hours to unload.

The increase in ship traffic associated with the LNG terminal could cause congestion within the harbor and/or conflicts with other commercial interests if an LNG ship arrival or departure delays the movement of another vessel, either due to scheduling or traffic management resulting in slow speed or waiting time. A Shipping Study was conducted to determine the effects of LNG-related ship traffic on POLB operations. This study is available for viewing on the FERC Internet website and at the POLB offices in Long Beach.[3] The results of the study are summarized below.

The Shipping Study identified the Middle Harbor as an area of potential congestion and/or delay during an LNG ship turn or swing on its inward or outward transit. The addition of a maximum of 120 ship calls and 240 ship movements per year would represent around a 4 percent increase over the total current levels of ship traffic and about 2 percent of the total projected levels in 2020. The 240 ship movements added to the existing 1,800 ship movements in the Middle Harbor would result in about a 12 percent increase over 2004 figures. Estimated delay times were analyzed using a triangular distribution in a Monte Carlo simulation over 10,000,000 iterations, equivalent to the maximum 240 ship movements per year over 30 years. On the occasion when an LNG ship is to move at about the same time as another vessel, the potential delay is almost zero if the traffic is well scheduled, about 10 minutes if the LNG ship is not turning/swinging, and a maximum of 30 minutes if it is turning/swinging in the Middle Harbor. In

[3] This study is included as Appendix 11-2 of Resource Report 11 on the FERC Internet website (http://www.ferc.gov). Using the "eLibrary" link, select "General Search" from the eLibrary menu and enter the docket number excluding the last three digits in the "Docket Number" field (i.e., CP04-58). Be sure to select an appropriate date range. Copies are also available for viewing at the POLB's offices at 925 Harbor Plaza, Long Beach, California.

total, there is a 10 percent probability that any delay would be less than 5 minutes and 90 percent probability that any delay would be less than 22 minutes.

It is possible that the container ships would take commercial priority and any delay would then fall on the LNG ships. However, if delays were experienced by other ships, the delays are expected to be temporary and of short duration. In addition, SES would participate with the Coast Guard in the development of procedures to reduce impacts on marine transportation, including implementation of an LNG Vessel Operation and Emergency Contingency Plan that would provide the basis for operation of LNG ships within the POLB (see section 4.11.7). As a result, ship traffic associated with the Long Beach LNG Import Terminal would not cause significant vessel traffic congestion within the harbor and would not exceed the capacity for maritime commerce to operate efficiently and safely within the POLB.

Several scoping comments were received about the potential effects of the security zone that would be enforced around the LNG ships on other commercial vessels, including commercial fishing, within the POLB. The Coast Guard, with the assistance of the POLB, would enforce the Title 33 CFR Part 165.1151 moving security zone of 1,000 yards ahead and 500 yards on each side and astern of the LNG ships. The Coast Guard and the HSC already require ships moving within the precautionary area (i.e., the area extending 8 nm south of the Queens Gate entrance to the southern marine traffic separation scheme and 10 nm to the southwest to the western marine traffic separation scheme) and inside the breakwaters of the POLB to maintain a minimum separation distance of 500 yards. The additional 500 yards enforced ahead of an LNG ship should not cause any significant impacts on other commercial vessels within the POLB. In addition, because high density commercial fishing does not occur within the approaches to the POLB or within the Port limits, no impacts on the commercial fishing industry are anticipated. Additional information on marine safety procedures within the POLB and specific LNG ship safety procedures is presented in section 4.11.7.

There would be no impact on ship traffic within the Cerritos Channel because the pipelines would be installed under the channel using the HDD construction method. There would be no impact on ship traffic within the Dominguez Channel because ships do not use the portion of the channel that would be crossed by the C_2 pipeline and the pipeline would be installed on an existing pipe bridge.

4.7.4 Air Transportation

4.7.4.1 Environmental Setting

The Long Beach Airport is located about 5.7 miles north-northeast of the LNG terminal site. This is a centrally located alternative airport for travel in and out of Los Angeles and north Orange County. The airport is serviced by a number of carriers that offer daily flights to major cities throughout the United States. The Long Beach Airport has two north-south runways, two west-east runways, and a northwest-southeast runway.

The Los Angeles International Airport is located about 17.0 miles north-northwest of the LNG terminal site and is one of the busiest airports in the United States. All of the runways trend west-east.

4.7.4.2 Impact and Mitigation

The two LNG storage tanks would be the tallest and most prominent structures associated with the Long Beach LNG Import Project and would be among the largest structures in the Long Beach area. Each tank would be about 255 feet wide and 176 feet tall. By comparison, the cranes used to unload the container ships on Piers A, T, E, and J in the POLB and throughout the POLA are between 250 and 300 feet tall. Because the LNG storage tanks would be no taller than the cranes currently operating at the ports, the project would not result in a permanent change in air traffic patterns or affect current or future operations at either the Long Beach or Los Angeles International Airports.

4.8 CULTURAL RESOURCES

4.8.1 Significance Criteria

Impacts on cultural resources would be considered significant if project construction or operation would result in an unresolvable adverse effect on the characteristics that contribute to the eligibility of a historic or prehistoric property for the National Register of Historic Places (NRHP) (for federal undertakings) or the California Register of Historical Resources (CRHR) (for purposes of the CEQA). In addition, under the CEQA impact on some cultural resources besides those listed or eligible for listing on the CRHR must also be considered.

Adverse effects may include, but are not limited to, the following:

- physical destruction of or damage to all or part of the property (historic resource);
- change in the character of the property's use or of physical features within a property's setting that contribute to its historic significance (e.g., by isolating the property from its setting); and
- introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significance.

4.8.2 Regulatory Requirements

4.8.2.1 Federal

The FERC is responsible for complying with section 106 of the NHPA, which requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. The procedures for complying with section 106 are outlined in the ACHP's regulations (Title 36 CFR Part 800). The effects of the project on properties of traditional religious and cultural importance to Native Americans must also be considered in accordance with section 101 (d)(6) of the NHPA and the American Indian Religious Freedom Act. The FERC meets its responsibilities in consultation with the State Historic Preservation Office (SHPO). SES, as a non-federal party, is assisting the FERC in meeting its obligations under section 106 and the implementing regulations in Title 36 CFR Part 800.

In evaluating cultural resources, several criteria are considered. First, significant cultural resources (as defined for federal undertakings) include those prehistoric and historic sites, districts, buildings, structures, and objects, as well as properties with traditional religious or cultural importance to Native Americans or other groups, that are listed, or are eligible for listing, on the NRHP (historic properties) according to the criteria outlined in Title 36 CFR Part 60.4. Second, cultural resources that do not meet the NRHP criteria but may qualify as a unique characteristic of an area are considered under the NEPA.

4.8.2.2 CEQA

The POLB is responsible for complying with all provisions of the CEQA covering cultural resources, including CEQA sections 21083.2 and 21084.1, and section 15064.5 of the *Guidelines for Implementation of the CEQA*. The POLB meets its responsibilities in consultation with the SHPO.

Cultural resources include prehistoric and historic-period archaeological sites, districts, and objects; standing historic structures, buildings, districts, and objects; and locations of important historic events or sites of traditional/cultural importance. CEQA section 15064.5 indicates a project may have a significant environmental effect if it causes "substantial adverse change" in the significance of a historical resource. A historical resource is considered significant if it meets the criteria for listing on the CRHR as defined in section 15064.5(a)(1) through (a)(4).

The POLB is also required to take into account the effect on properties that meet the definition of a unique archaeological resource in CEQA section 21083.2. Under the CEQA, archaeological resources are sometimes treated differently than "historical resources." Thus, it is important to first determine whether certain archaeological sites are "historical resources" for purposes of the CEQA. An archaeological resource is considered a historical resource when it is listed, or determined eligible for listing, on the CRHR, included in a local register of historical resources, or identified as significant in a historical resource survey. For archaeological resources that are not "historical resources," it must then be determined if they are "unique" archaeological resources according to Public Resources Code 21083.2(g). The distinction may be important because mitigation measures sometimes differ for archaeological and historical resources.

4.8.3 Cultural Resources Assessment

As part of its applications, SES provided the FERC and the POLB with its cultural resources assessment of the project area, including its literature review and the status of previous cultural resources surveys. In addition, SES provided its initial contacts with the SHPO and Native American tribes (see section 4.8.5) and its Unanticipated Discovery Plan (see section 4.8.4). In October 2004, SES provided additional information regarding its proposed C_2 pipeline.

SES' literature review indicated that previous surveys and evaluations conducted for the decommissioning of the Long Beach Naval Shipyard during the 1990s identified no NRHP-eligible structures or archaeological resources on the LNG terminal site. Nine previously recorded cultural resources sites were identified within 1 mile of the LNG terminal site, the natural gas pipeline route, the portion of the C_2 pipeline route adjacent to the natural gas pipeline route, the construction laydown and worker parking area, and the electric distribution facilities. Six of these cultural resources are located more than 500 feet from the project facilities and would not be affected by construction or operation of the project. One resource, the dry dock hanger used to house Howard Hughes' Flying Boat H-K 1 after its flight in 1947, no longer exists, having been dismantled in 1981. Therefore, this cultural resource would not be affected. One resource, consisting of two abandoned oil wells located within 150 feet of the proposed electric distribution lines, was recommended as not eligible for listing on the NRHP. The remaining site, the Edison Power Station (now known as the Long Beach Generating Station) and associated transmission towers, was recommended as eligible for listing on the NRHP. The power station has been decommissioned. Although the transmission towers are still in operation, construction and operation of the project facilities would avoid the NRHP-eligible portions of the towers. In addition, three previously recorded cultural resources were identified within 0.25 mile of the portion of the C_2 pipeline route that would not be adjacent to the natural gas pipeline route. Two of these resources are located more than 500 feet from the project facilities and would not be affected by construction or operation of the project. The remaining resource, the Kinder Morgan Tank Storage Terminal, is located adjacent to the proposed C_2 pipeline route and was recommended as not eligible for listing on the NRHP.

The pipeline and electric distribution facilities would be constructed in areas that have undergone extensive previous disturbance. Accordingly, the Agency Staffs have determined that no surveys would be required because the likelihood that cultural resources would be encountered is considered low.

SES would use a previously disturbed area within the POLB as a laydown and worker parking area during construction. The area is graveled and would not require subsurface disturbance. Accordingly, no cultural resources surveys would be required for the use of this area.

In-water activities associated with the project would consist of reinforcement of the shoreline structures, construction of the ship berth and unloading facility, and associated dredging adjacent to Pier T within the West Basin. The area has been dredged multiple times within the past 100 years and there are no recorded underwater cultural resources present. Accordingly, no underwater cultural resources surveys would be required for the in-water activities adjacent to Pier T.

Cultural resources that are eligible for listing on the NRHP are also eligible for listing on the CRHR. The POLB has reviewed the remaining cultural resources (i.e., the Edison Power Station and towers) and determined that the project would have no effect on these historical resources under the CEQA. In addition, sites that are not eligible for listing on the NRHP may be eligible for listing on the CRHR. The POLB has reviewed the resources consisting of two abandoned oil wells and the Kinder Morgan Tank Storage Terminal that are not eligible for listing on the NRHP and determined that these resources are not eligible for listing on the CRHR. No unique archaeological resources were discovered during previous surveys.

In letters dated January 9, 2004 and April 20, 2005, the SHPO commented that no historic properties would be affected by the originally proposed project and the proposed C_2 pipeline. The FERC and the POLB concur.

4.8.4 Unanticipated Discoveries

SES prepared an Unanticipated Discovery Plan to be used during construction. The plan describes the procedures that would be employed in the event previously unidentified cultural resources or human remains are encountered during construction. The procedures in the Unanticipated Discovery Plan differ whether the find is a cultural resource or human remains. In the event a new cultural resource is discovered, procedures would include: stopping work in the vicinity of the find; examination of the find by a qualified archaeologist; documentation of the find to determine its significance; providing an initial discovery report to the FERC, the POLB, and the SHPO that includes recommendations for further work; and procedures to resume work after any required testing or mitigation is complete. The procedures to be followed in the event that human remains are discovered would be similar to those described above, but would also include additional consultations with the Native American Heritage Commission (NAHC) and Native American tribes that are identified by the NAHC. In a letter dated January 9, 2004, the SHPO accepted the Unanticipated Discovery Plan. The FERC reviewed the plan and requested revisions; SES provided a revised plan, which the FERC and the POLB find acceptable.

4.8.5 Native American Consultation

SES contacted 15 Native American tribes[4] who were identified by the California NAHC as potentially having knowledge of cultural resources in the project area. SES sent initial consultation letters to the 15 tribes on September 19, 2003. These letters described the project and provided the tribes with the opportunity to comment on the project and its potential impacts on traditional cultural properties and

[4] Coastal Gabrieleno Diegueno (Jim Velasques), Samuel H. Dunlap, Gabrielino Band of Mission Indians of California (Susan Frank), Gabrielino Tongva (Craig Torres), Gabrielino Tongva Indians of California Tribal Council (Robert F. Dorame, Chairperson), Gabrielino/Tongva Council/Gabrielino Tongva Nation, Gabrieleno/Tongva Tribal Council (Anthony Morales, Chairperson), Ish Panesh United Band of Indians (John Valenzuela), Island Gabrielino Group (John Jeffredo), Juaneno Band of Mission Indians (Anita Espinoza), Juaneno Band of Mission Indians (Sonia Johnston, Chairperson), Juaneno Band of Mission Indians Acjachemen Nation (David Belardes, Chairperson), Juaneno Band of Mission Indians Acjachemen Nation (Damien Shilo, Chairman), Los Angeles City/County Native American Indian Commission, and Ti'At Society (Cindi Alvitre).

historic properties. Only the Gabrieleno/Tongva Tribal Council responded. The Tribal Council Chairperson (Anthony Morales) indicated that Native American human remains have previously been discovered in deposits that were considered disturbed, inquired whether a Native American or archaeological monitor would be present during construction, and requested continued consultation regarding the project.

On December 8, 2003, SES sent follow-up letters to tribes that had not yet responded to its initial consultation letter. No responses have been received. On February 18, 2005, SES sent a follow-up letter to the NAHC regarding the C_2 pipeline. The NAHC responded on February 18, 2005 that a records search of the sacred land file had not identified the presence of Native American cultural resources in the vicinity of the proposed project. In addition, on February 21, 2005, SES sent follow-up letters to the tribes regarding the C_2 pipeline. No responses have been received. SES stated that it would conduct follow-up telephone contacts with the tribes in the event no responses are received. SES' continued cooperation with these tribes should address any tribal issues associated with the proposed project.

4.8.6 Impact and Mitigation

The FERC and the POLB, in consultation with the SHPO, have determined that there would be no impact on any properties listed, or eligible for listing, on the NRHP or the CRHR or on any unique archaeological resources for the proposed project; therefore, no mitigation would be required.

4.9 AIR QUALITY

4.9.1 Significance Criteria

Impacts on environmental air quality levels would be considered significant if:

- the project construction or operational emissions would exceed the significance thresholds for criteria air pollutants listed in the SCAQMD *CEQA Air Quality Handbook* (see table 4.9.1-1);
- the project would contribute to a new violation, or worsen an existing violation, of an ambient air quality standard;
- the cancer risk significance threshold listed in the SCAQMD *CEQA Air Quality Handbook* would be exceeded (see table 4.9.1-2);
- the cancer burden and noncancer risk significance thresholds listed in the SCAQMD Rule 1401 would be exceeded (see table 4.9.1-2);
- the project would not comply with the SCAQMD requirement of consistency with new control measures contained in the 2003 AQMP;
- the project would not comply with the federal requirement of the applicable SIP as defined in section 176(c) of the federal CAA Amendments of 1990; or
- the project would create objectionable odors that affect a substantial number of people.

TABLE 4.9.1-1

SCAQMD Emission Significance Thresholds for Criteria Air Pollutants

			Emission Rate				
Emission Type	Emission Period	Units	NO_x	ROC	PM_{10}	SO_x	CO
Project Construction	Daily	pounds per day	100	75	150	150	550
	Quarterly	tons per quarter	2.5	2.5	6.75	6.75	24.75
Project Operations	Daily	pounds per day	55	55	150	150	550

Source: SCAQMD *CEQA Air Quality Handbook*, 1993.

TABLE 4.9.1-2

SCAQMD Significance Thresholds for Toxic Air Contaminants

Health Risk Criterion	Significance Threshold
Individual Lifetime Cancer Risk	10 in 1 million (1×10^{-5})
Cancer Burden	0.5
Acute Noncancer Health Hazard Index	1.0
Chronic Noncancer Health Hazard Index	1.0

Source: SCAQMD Rule 1401.

4.9.2 Environmental Setting

4.9.2.1 Topography and Climate

The POLB is located in San Pedro Bay in the southwestern portion of the SCAB (see figure 4.9.2-1). The climate in the project area is classified as a Mediterranean type of air mass, which is characterized by warm, rainless summers and mild, wet winters. The regional climate is complex and the major influences are the Eastern Pacific High (a strong persistent area of high atmospheric pressure over the Pacific Ocean), topography, and the moderating effects of the Pacific Ocean. Seasonal variations in the position and strength of the Eastern Pacific High are a key factor in weather changes in the area.

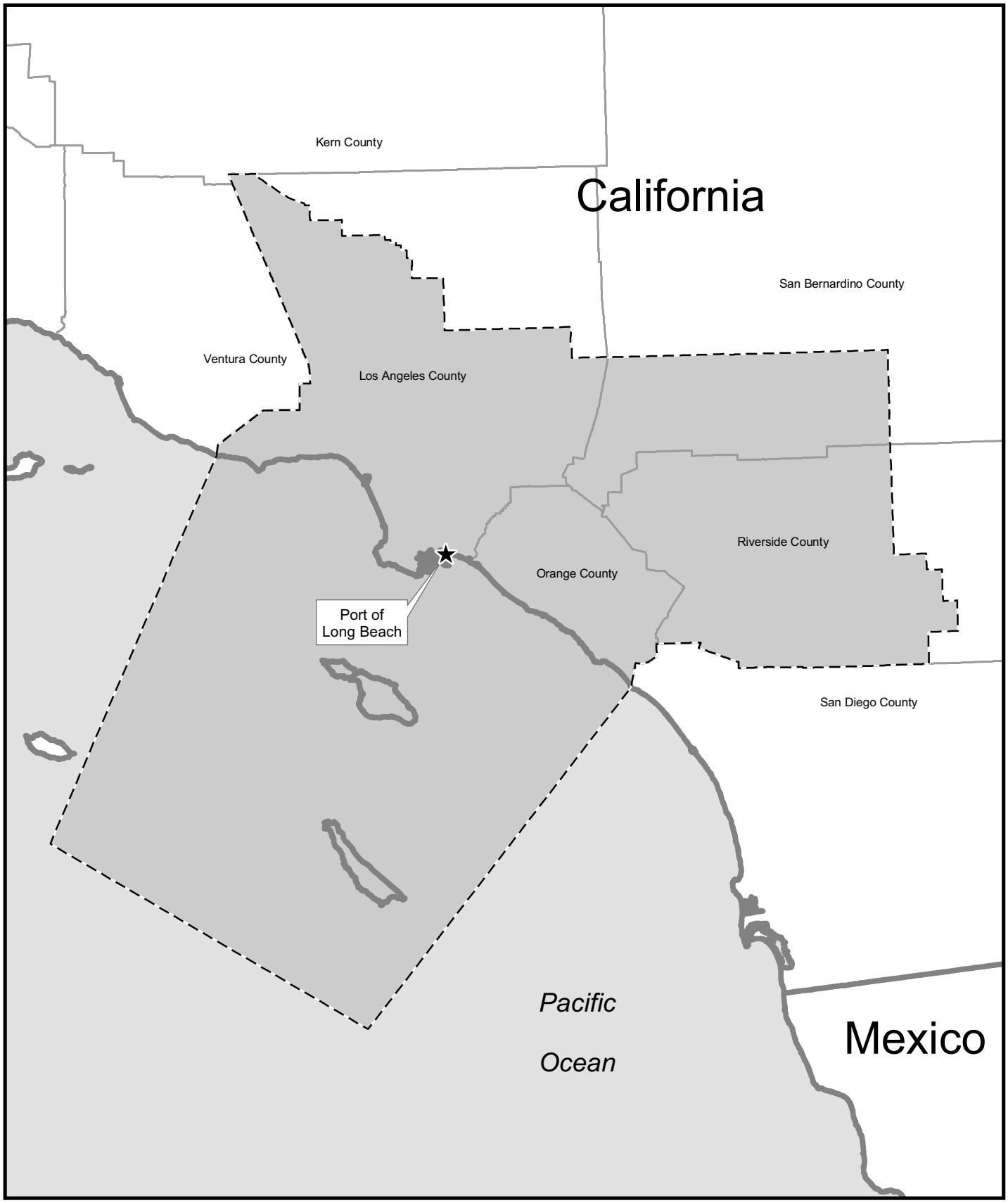
The Eastern Pacific High attains its greatest strength and most northerly position during the summer, when it is centered west of northern California. In this location, it effectively blocks and shelters southern California from the effects of cooler polar storm systems. However, large-scale atmospheric subsidence associated with the Eastern Pacific High produces an elevated temperature inversion along the West Coast. Inversions of this type are typically shallow from 1,000 to 2,500 feet above msl during the summer. The inversion limits vertical mixing of the atmosphere and essentially traps air pollutants in the lower atmosphere. The mountain ranges that surround the LA Basin constrain the horizontal movement of air and also inhibit the dispersion of air pollutants out of the region. These two factors, combined with the air pollution sources of over 15 million people, are responsible for the high pollutant conditions that can occur in the SCAB during the summer months. In addition, the warm temperatures and high solar radiation during the summer months promote the formation of ozone, which is at its highest levels during the summer.

During the fall and winter months, the Eastern Pacific High can combine with high pressure over the continent to produce light winds and extended inversion conditions in the region, creating stagnant atmospheric conditions that often result in adverse pollutant concentrations in the SCAB. However, some dispersion relief may occur under these conditions as excessive high pressure builds up in the Great Basin region to produce a “Santa Ana” condition. A Santa Ana condition is characterized by warm, dry, northeast winds in the SCAB and offshore regions. The presence of Santa Ana winds often ventilates the SCAB of air pollutants and assists in movement and dispersion of those air pollutants.

A sea breeze regime prevails within the project area for most of the year, particularly during the spring and summer months, as a result of the Eastern Pacific High and a thermal low pressure system in the desert interior to the east. These sea breezes are a diurnal occurrence and assist in increasing atmospheric pollutant dispersion. Sea breezes within San Pedro Bay typically increase during the morning hours from the southerly direction and reach a peak in the afternoon as they blow from the southwest. These winds generally subside after sundown. During the colder months of the year, northerly land breezes increase by sunset and into the evening hours. Sea breezes transport air pollutants away from the coast and toward the interior regions in the afternoon hours for most of the year, which may concentrate atmospheric pollutants near the mountains where they become trapped due to topographic effects.

4.9.2.2 Ambient Air Quality

The EPA has established the NAAQS for several common air pollutants, known as criteria pollutants. Criteria pollutants include ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), SO_2, PM_{10}, particulate matter having an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$), and lead. The NAAQS were set at levels the EPA believed were necessary to protect human health and welfare. For most pollutants, maximum concentrations may not exceed the NAAQS more than once per year and they may never exceed the annual NAAQS.



South Coast Air Basin

County Boundary

0 10 20 30 Miles

Figure 4.9.2-1
Long Beach LNG Import Project
South Coast Air Basin

Similarly, the CARB has established the California Ambient Air Quality Standards (CAAQS), which are generally more stringent and include more pollutants than the NAAQS. Maximum pollutant concentrations may not equal or exceed the CAAQS.

The SCAQMD operates numerous ambient air monitoring stations within the SCAB. The monitoring station closest to the proposed project facilities is at the Long Beach Airport, located approximately 5.7 miles to the north-northeast. This station is considered to be the most representative of the project area. Table 4.9.2-1 compares monitoring data measured between 1999 and 2002 at the Long Beach Airport station to the NAAQS and CAAQS.

TABLE 4.9.2-1

Maximum Pollutant Concentrations Measured at the Long Beach Airport Monitoring Station

				Highest Monitored Concentration [b]			
Pollutant	Averaging Period	NAAQS	CAAQS [a]	1999	2000	2001	2002
Ozone (ppmv)	1 hour	0.12	0.09	**0.13** [c]	**0.12** [c]	0.09	0.08
	8 hours	0.08	NA	0.08	0.080	0.070	0.065
CO (ppmv)	1 hour	35	20	7	10	6	6
	8 hours	9	9	5.4	5.8	4.7	4.6
NO_2 (ppmv)	1 hour	NA	0.25	0.15	0.14	0.13	0.13
	Annual	0.053	NA	0.0342	0.0313	0.0308	0.03
SO_2 (ppmv)	1 hour	NA	0.25	0.05	0.05	0.05	0.03
	24 hours	0.14	0.04	0.011	0.014	0.012	0.008
	Annual	0.03	NA	0.0027	0.0015	NA	NA
PM_{10} ($\mu g/m^3$)	24 hours	150	50	**79.0** [d]	**105.0** [d]	**91.0** [d]	**74** [d]
	Annual arithmetic mean	50	20	**38.9**	**37.6**	**37.4**	**35.9**
$PM_{2.5}$ ($\mu g/m^3$)	24 hours	65	NA	**66.9** [e]	**81.5** [e]	**72.9** [e]	62.7
	Annual arithmetic mean	15	12	**21.5**	**19.2**	**21.4**	**19.5**
Lead ($\mu g/m^3$)	30 days	NA	1.5	0.06	0.05	0.05	0.03
	Calendar quarter	1.5	NA	0.05	0.04	0.04	0.02
Sulfates ($\mu g/m^3$)	24 hours	NA	25	13.7	**26.7** [f]	15.9	17.8

[a] CAAQS have also been established for vinyl chloride, hydrogen sulfide, and visibility reducing particles; however, these pollutants are not monitored at the Long Beach Airport station.

[b] Exceedances of the standards are highlighted in bold.

[c] The national 1-hour ozone standard was exceeded on 1 day in 1999. The state 1-hour ozone standard was exceeded on 3 days in 1999 and 3 days in 2000.

[d] The state 24-hour PM_{10} standard was exceeded on 13 of 59 sampled days in 1999, 12 of 57 sampled days in 2000, 10 of 59 sampled days in 2001, and 5 of 58 sampled days in 2002.

[e] The national 24-hour $PM_{2.5}$ standard was exceeded on 1 of 148 sampled days in 1999, 4 of 304 sampled days in 2000, and 1 of 317 sampled days in 2001.

[f] The state 24-hour sulfates standard was exceeded on 1 day in 2000.

ppmv = parts per million by volume
$\mu g/m^3$ = micrograms per cubic meter
NA = Not applicable
Source: SCAQMD (www.aqmd.gov).

As shown in table 4.9.2-1, recent ambient air concentrations at the Long Beach Airport exceeded the standards for ozone, PM_{10}, and $PM_{2.5}$. This is consistent with most of the monitoring stations in the SCAB. The sulfates standard was also exceeded on 1 day over the past 3 years. No standards were exceeded for the remaining monitored pollutants.

Although there are no NAAQS or CAAQS for reactive organic compounds (ROC) or NO_x (one component of which is NO_2), these pollutants are regulated because they are precursors to ozone; that is, they react to form ozone in the presence of sunlight through a complex series of photochemical reactions.

4.9.2.3 Attainment Status

The EPA designates all areas of the United States according to whether they meet the NAAQS. A non-attainment designation means that a primary NAAQS has been exceeded more than once per year in a given area. The SCAB was designated as an "extreme" non-attainment area for the 1-hour ozone standard until the standard was revoked by the EPA on June 15, 2005. The EPA currently designates the SCAB as a "serious" non-attainment area for both CO and PM_{10} but is considering reclassifying the SCAB as attainment for CO because it is currently meeting the standards. In July 1997, the EPA established a new federal 8-hour standard for ozone and revised the NAAQS for particulate matter to add new standards for $PM_{2.5}$. On April 15, 2004, the EPA designated the SCAB as a "severe" non-attainment area for the 8-hour ozone standard and on April 5, 2005 the SCAB was designated as a non-attainment area for $PM_{2.5}$. The SCAB is designated in attainment of the NAAQS for SO_2, NO_2, and lead. Similarly, the CARB designates areas of the state according to whether they meet the CAAQS. A non-attainment designation means that a CAAQS has been exceeded more than once in 3 years. The CARB currently designates the SCAB as an "extreme" non-attainment area for ozone, a "severe" non-attainment area for CO, and a non-attainment area for PM_{10}. The SCAB is in attainment of the CAAQS for SO_2, NO_2, lead, and sulfates; and unclassified for all other pollutants.

4.9.2.4 Air Quality Management Plan

In federal non-attainment areas, the CAA requires preparation of a SIP that details how the state will attain the NAAQS within mandated time frames. In response to this requirement, the SCAQMD and the SCAG adopted the 2003 AQMP. The focus of the 2003 AQMP is to demonstrate attainment of the federal PM_{10} standard by 2006 and the federal 1-hour ozone standard by 2010, while making expeditious progress toward attainment of state standards. Although the EPA revoked the 1-hour ozone standard on June 15, 2005, the existing SIP's control measures and budgets developed to demonstrate attainment with the 1-hour standard are still applicable to sources in the SCAB. A SIP demonstrating attainment with the 8-hour ozone standard will be developed and adopted by the SCAQMD and the CARB and submitted to the EPA for approval by June 15, 2007. Because the SCAB is on the verge of attaining the federal CO standard, the AQMP also replaces the 1997 attainment demonstration for the federal CO standard and provides a basis for a maintenance plan for CO in the future (SCAQMD, 2003a).

4.9.2.5 Toxic Air Contaminants

Toxic air contaminants are present in the atmosphere in trace concentrations but are not regularly monitored in the SCAB. Most of the available monitoring data for toxic air contaminants were generated during the Multiple Air Toxics Exposure Study in the SCAB (MATES II Study) that was conducted in 1997 (SCAQMD, 1999). The key air toxic contaminants monitored in the MATES II Study are presented in table 4.9.2-2.

The MATES II Study found that the average carcinogenic (i.e., cancer) risk throughout the SCAB from exposure to toxic air contaminants is about 1,400 in 1 million ($1{,}400 \times 10^{-6}$). At the monitoring station closest to the project area, the MATES II Study estimated the cancer risk to be approximately 1,200 in 1 million ($1{,}200 \times 10^{-6}$). The MATES II Study found that mobile sources (e.g., cars, trucks, trains, ships, aircraft) were the largest contributors to this risk. About 70 percent of the risk was attributed to diesel particulate emissions, 20 percent to other toxics associated with mobile sources (e.g., benzene,

1,3-butadiene, formaldehyde), and 10 percent to stationary sources (e.g., dry cleaners and chrome plating operations).

TABLE 4.9.2-2

Key Air Toxic Contaminants Monitored in the MATES II Study and their Contribution to the Ambient Cancer Risk

Toxic Air Contaminant	Risk Contribution (percent) [a]
Diesel particulate	72.0
1,3-butadiene	8.4
Benzene	6.5
Formaldehyde	2.0
Hexavalent chromium	1.8
Perchloroethylene	0.8
Para-Dichlorobenzene	0.7
Acetaldehyde	0.6
Methylene chloride	0.2
Nickel	0.2
Trichloroethylene	0.1

[a] Based on an eight station average from the MATES II Study.

A regional modeling study was also conducted as part of the MATES II Study. The results of the modeling study suggest that the basin-wide cancer risk level may be 16 percent lower than the corresponding risk levels estimated from the regional monitoring sites. According to the SCAQMD, the results of the modeling study also indicate that higher risk levels occur in the south-central Los Angeles area, the harbor area, and near freeways.

The MATES II study identified long-term downward trends of cancer risk levels in the SCAB and specifically in Long Beach, with a decrease of approximately 50 percent in toxic levels from 1990 to 1997. Diesel particulate matter was identified as the most significant contributor to the predicted cancer risks, with southern California having a decrease of approximately 32 percent in elemental carbon (a surrogate for diesel particulates) from the early 1980s to the early 1990s (POLB, 2002).

4.9.2.6 Baseline Site Emissions

The proposed LNG terminal site is currently paved with concrete and asphalt and contains two abandoned buildings. As a result, baseline emissions at the project site are assumed to be zero.

4.9.2.7 Sensitive Receptor Locations

When assessing air quality, it is important to consider the impacts on individuals especially sensitive to air pollution, such as children, the elderly, and the infirm. Sensitive receptors could be present at residences, schools, daycare centers, convalescent homes, and hospitals. The nearest sensitive receptors to the project facilities are potential residences in a recreational vehicle park about 1.3 miles east-northeast of the LNG terminal site, possible live-aboard boats at two marinas in the East Basin of the Cerritos Channel between 1.2 and 1.6 miles northwest of the LNG terminal site, and Edison Elementary School about 1.9 miles northeast of the LNG terminal site. Figure 4.9.2-2 shows the locations of the nearest sensitive receptors to the project facilities. Detailed results of a Health Risk Assessment of the project's potential toxic air contaminant emissions on the SCAB and nearby sensitive receptors are presented in section 4.9.7.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-103
Figure 4.9.2-2

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

4.9.3 Applicable Air Quality Regulations

Federal, state, and local air quality regulations that apply to the Long Beach LNG Import Project are described below.

4.9.3.1 Federal Regulations

The EPA implements and enforces the requirements of many federal environmental laws. The federal CAA of 1970, amended in 1977 and most recently in 1990, provides the EPA with the legal authority to regulate air pollution from stationary and mobile sources. The federal regulations potentially applicable to equipment that would be used to construct and operate the proposed project are described below.

Mobile Source Regulations

Title II of the CAA Amendments of 1990 contains provisions relating to highway and off-road mobile sources. Regulations aimed at reducing pollution from heavy-duty diesel engines, including marine and locomotive engines, that have been promulgated or proposed include:

- Title 40 CFR Parts 69, 80, and 86, Final Rule, Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements – This rule requires a reduction in emissions from on-road diesel engines and establishes sulfur limits for diesel fuel. Currently, the requirements are for new engines only and the standards will begin to take effect in model year 2007. Although the emissions standards are for new engines only, the reduced sulfur diesel fuel, which is required to have a sulfur content less than 0.05 percent [500 parts per million by weight (ppmw)], a limit that is to be lowered to 15 ppmw starting in June 2006, would also reduce particulate and sulfur oxides (SO_x) emissions from existing diesel engines.

- Title 40 CFR Parts 9 and 69 et al., Final Rule, Control of Emissions of Air Pollution from Non-road Diesel Engines and Fuel – This rule requires emissions reductions from non-road diesel engines by establishing emissions limits and sulfur content limits. This rule targets agricultural equipment, construction equipment, and other non-road diesel engines. As with the previous rule, the reduced sulfur fuel would lower emissions from existing diesel engines even though the emissions limits would only apply to new engines.

- Title 40 CFR Parts 92 and 94, Proposed Rule, June 2004 – The EPA published an Advanced Notice of Proposed Rulemaking for New Locomotive and Marine Compression-Ignition Engines Less than 30 Liters per Cylinder, which requires emissions reductions from these types of engines. Engines less than 30 liters per cylinder and greater than 5 liters per cylinder are referred to as Category 2 engines. Category 2 engines are often used to propel tugboats, fishing vessels, and smaller cargo vessels. If promulgated, the emissions standards would begin to take effect in model year 2008, phasing in over a number of years.

- Title 40 CFR Parts 9 and 94, February 2003, Final Rule – This rule targets marine compression-ignition engines at or above 30 liters per cylinder. These engines are referred to as Category 3 marine engines. Category 3 engines are very large engines used for propulsion on deep sea vessels. New engines manufactured in 2004 must meet the emissions standards in this rule. There are no fuel standards in this rule and the

emissions standards are not as stringent as Category 1 and Category 2 engines. Category 3 engines often burn residual oils and bunker fuel with a very high sulfur content, making emissions reductions more difficult.

Title V Operating Permits Program

The Title V Operating Permits Program (CAA §501 et seq., 42 USC §7661; 40 CFR Part 70) requires issuance of operating permits that identify all applicable federal performance, operating, emissions monitoring, recordkeeping, and reporting requirements. The Title V requirements in the SCAB are implemented at the local level (i.e., through the SCAQMD) with federal oversight and, therefore, also require identification of applicable SCAQMD rules. New facilities in the SCAB are subject to Title V requirements if they have the potential to emit 10 tons per year (tpy) or more of NO_x, among other thresholds. The proposed LNG terminal would be subject to the Title V Operating Permits program because operating emissions of both NO_x and ROC would exceed the 10 tpy major source threshold. As a result, SES would be required to apply for and obtain a Title V operating permit and adhere to specific standards as well as monitoring/testing, recordkeeping, and reporting requirements specified within the permit.

Chemical Accident Prevention/Risk Management Plan

The chemical accident prevention provisions codified in Title 40 CFR Part 68 are federal regulations designed to prevent the release of hazardous materials in the event of an accident and minimize potential impacts if a release does occur. The regulations contain a list of substances and threshold quantities for determining applicability to stationary sources. If a stationary source stores, handles, or processes one or more substances on this list in a quantity equal to or greater than specified in the regulations, an RMP must be prepared and submitted for the facility. If a facility does not have a listed substance on site, or the quantity of a listed substance is below the applicability threshold, an RMP does not have to be prepared. In the latter case, the facility still must comply with the requirements of the general duty provisions in section 112(r)(1) of the 1990 CAA if there is any regulated substance or other extremely hazardous substance on site.

Stationary sources are defined in Title 40 CFR Part 68 as any buildings, structures, equipment, installations, or substance-emitting stationary activities that belong to the same industrial group, which are located on one or more contiguous properties, which are under the control of the same person (or persons under common control), and from which an accidental release may occur. However, the definition also states that the term "stationary source" does not apply to transportation, including storage incidental to transportation, of any regulated substance or any other extremely hazardous substance. The term "transportation" includes transportation subject to oversight or regulation under Title 49 CFR 192, 193, or 195 or a state natural gas or hazardous liquid program for which the state has in effect a certification to the DOT under Title 49 USC section 60105.

Two substances on the federal list of regulated substances, aqueous ammonia planned for use in the SCR of NO_x emissions from the water heaters and methane (the primary component of natural gas) in the LNG, would be stored in quantities potentially exceeding their listed threshold quantities of 20,000 and 10,000 pounds, respectively. However, based on the definitions of "stationary source" and "transportation," an RMP would be required for the storage of aqueous ammonia and not for the methane contained in the LNG stored incidental to transportation. For the storage of methane, the facility would have to comply with the general duty provisions of the 1990 CAA as discussed above.

The RMP would include an off-site consequence analysis of the complete instantaneous failure of the largest storage container under regulatory-required meteorological conditions. A release from

multiple containers would be considered if the failure of one container had the potential to compromise other containers due to close proximity. The RMP would also include a prevention program that details safety precautions and maintenance and monitoring requirements as well as an emergency response program. The emergency response program identifies the procedures to be implemented to inform the public and response agencies should an accident occur.

Conformity of General Federal Actions

A conformity analysis must be conducted by the lead federal agency if a federal action would result in the generation of emissions that would exceed the conformity threshold levels (*de minimis*) of the pollutant(s) for which an air basin is in non-attainment. According to section 176(c)(1) of the CAA (Title 40 CFR section 51.853), a federal agency cannot approve or support any activity that does not conform to an approved SIP. Conforming activities or actions should not, through additional air pollutant emissions:

- cause or contribute to new violations of the NAAQS in any area;
- increase the frequency or severity of any existing violation of any NAAQS; or
- delay timely attainment of any NAAQS or interim emission reductions.

In the SCAB, the general conformity rule applies to projects with emissions that exceed 25 tpy of NO_x or ROC, 70 tpy of PM_{10}, or 100 tpy of CO or $PM_{2.5}$. A conformity analysis must show that the emissions would conform to the currently applicable SIP and would not reduce air quality in the air basin, which can be demonstrated through offsets, SIP provisions, or modeling.

4.9.3.2 State Regulations

The CARB implements and enforces the requirements of many federal environmental laws as well as its own parallel legislation that is often more stringent than federal laws. This legislation includes the air toxics and accidental release prevention provisions.

Air Toxic "Hot Spots" Information and Assessment Act (ATIAA) – The ATIAA was adopted in 1987 (California Health & Safety Code §44300 to 44384; 17 CCR §93300 to 93347) to supplement the Toxic Air Contaminant Identification and Control Act by requiring development of a statewide inventory of air toxics emissions from stationary sources. The AITAA is implemented at the local level with state oversight.

Facilities with toxic air emissions that are deemed to pose a significant health risk must issue notices to the exposed population. In 1992, the California legislature amended the AITAA to require facilities with toxic air emissions that are deemed to pose a significant health risk to implement RMPs.

California Accidental Release Prevention Program (CalARP) – The CalARP (California Health & Safety Code §22531 to 25543; 19 CCR §2735.1 to 2785.1) includes the requirements of the federal RMP with state additions. The Long Beach LNG Import Project would be subject to the CalARP because of its large storage capacity of aqueous ammonia for use in the SCR of NO_x emissions from the water heaters. The storage of natural gas incidental to transportation is not regulated under the CalARP; therefore, the LNG storage tanks would not be subject to this requirement.

The POLB has an RMP that is applicable to the proposed project. The RMP reinforces the requirements of the federal and California RMP regulations to analyze risks to the local population and other resources from the potential release of toxic, flammable, and explosive substances (see section 4.9.3.3).

Chapter 10 - Mobile Source Operational Controls, Article 1 - Motor Vehicles, Division 3. Air Resources Board, Title 13, California Code of Regulations – This regulation limits the amount of time a vehicle with a gross weight exceeding 10,000 pounds can idle when within 100 feet of a restricted area. Restricted areas include real property zoned for individual or multi-family housing. The purpose of this rule is to reduce public exposure to diesel particulate matter and other air contaminants.

4.9.3.3 Local Regulations

In the SCAB, the SCAQMD regulates stationary sources of air pollution through its administration of rules and regulations. The following SCAQMD rules and regulations are potentially applicable to the Long Beach LNG Import Project:

- Rule 201 - Permit to Construct – Stationary emission sources at the project site (such as the vaporization equipment and associated piping) cannot be constructed without first obtaining a permit from the SCAQMD.

- Rule 203 - Permit to Operate – Stationary emission sources at the project site (such as the vaporization equipment and associated piping) cannot be operated without first obtaining a permit from the SCAQMD.

- Rule 219 - Equipment Not Requiring a Written Permit Pursuant to Regulation II - Rule 219 lists equipment that is not subject to a permit. This rule often contains exemptions for miscellaneous small equipment (e.g., fork lifts and small combustion engines).

- Rule 403 - Fugitive Dust – This rule prohibits emissions of fugitive dust from any active operation, open storage pile, or disturbed surface area that remains visible beyond the emission source property line. A person conducting active operations shall utilize one or more of the applicable best available control measures to minimize fugitive dust emissions from each fugitive dust source type. During project construction, best available control measures identified in the rule would be required to minimize fugitive dust emissions from proposed earth-moving and grading activities.

- Rule 431.1 - Sulfur Content of Gaseous Fuels – This rule sets limits for the sulfur content of gaseous fuels (e.g., ethane fuel and natural gas) used and/or distributed. The project would be subject to this rule because the facility would revaporize the LNG for sale as natural gas.

- Rule 463 - Storage of Organic Liquids – Rule 463 sets requirements for tank roof seals, inspections, recordkeeping, and reporting. This rule applies to any aboveground stationary tank that stores organic liquids and has a capacity of more than 19,815 gallons. The proposed LNG storage tanks are larger than 19,815 gallons and would be subject to the requirements of this rule. This rule includes a self-inspection program that requires facility personnel to be trained and certified by the SCAQMD to perform and report the self inspections.

- Rule 466 - Pumps and Compressors – Rule 466 sets requirements for pump and compressor leakage limits, inspections, and recordkeeping. This rule would apply to the pumps and compressors at the proposed LNG terminal.

- Rule 466.1 - Valves and Flanges – Rule 466.1 sets requirements for valve and flange leakage limits, inspection, and recordkeeping. This rule would apply to the valves and flanges associated with the equipment at the proposed LNG terminal.

- Regulation XIII - New Source Review Requirements – Stationary sources of non-attainment criteria pollutants, or their precursors, can only be permitted by application of Lowest Achievable Emission Rate (LAER) control technology and elimination through offsets of at least an equal amount of the same pollutant or its precursors. Offsets are intended to ensure that no increase in net emissions occurs. In the SCAB, federal LAER control technology is labeled by the SCAQMD as Best Available Control Technology (BACT).

- Rule 1401 - New Source Review of Toxic Air Contaminants – A stationary source of toxic air contaminant emissions cannot receive a permit to operate unless an analysis shows that human health risk impacts are less than SCAQMD thresholds.

- Regulation XX - New Source Review for the Regional Clean Air Incentives Market (RECLAIM) – RECLAIM requires industries and businesses to cut their emissions by a specific amount each year. Businesses that exceed their reduction targets can trade their credits on the open market. RECLAIM applies to facilities with NO_x or SO_x emissions that exceed 4 tpy.

- Regulation XXX - Title V Permits – This regulation incorporates the requirements of the federal Title V operating permit program with state additions.

4.9.4 Construction Impacts and Mitigation

Construction of the Long Beach LNG Import Project would occur over a 48-month period and would consist of the following activities:

- site preparation and materials and equipment delivery;

- dredging to prepare the ship berth, reinforcement of the shoreline structures, and construction of the ship berth and unloading facility;

- excavation, ground stabilization, and foundation installation;

- construction of the LNG storage tanks, vaporization equipment, pumps, compressors, buildings, and other plant equipment;

- construction of a natural gas pipeline and a C_2 pipeline and associated aboveground facilities; and

- installation of electric distribution facilities.

Construction emissions would be caused by:

- construction equipment tailpipe emissions of criteria pollutants such as NO_x, ROC, PM_{10}, $PM_{2.5}$, SO_x, and CO;

- fugitive dust; and

- tailpipe emissions from worker commuter vehicles and material supply trucks.

A variety of construction equipment would be used at the project site, including dump trucks, pile drivers, bulldozers, graders, cranes, forklifts, generators, dredging equipment, and welding machines. Most of the equipment would be powered by diesel engines. Fugitive dust (PM_{10}) would be generated by earth-moving activities (such as grading or trenching), windblown dust on disturbed areas, and the movement of vehicles over paved and unpaved surfaces.

Worker commuter vehicles and material supply trucks, powered by gasoline and diesel engines, would arrive and depart from the LNG terminal periodically generating NO_x, ROC, PM_{10}, $PM_{2.5}$, SO_x, and CO.

Throughout the construction period, emissions would vary according to the intensity of each construction activity and the number of overlapping construction activities. Emissions would reach their peak about 2 years into the construction period, during simultaneous construction of the LNG storage tanks, physical plant, vaporizers, and ship berth and unloading facility. To compare to the SCAQMD significance thresholds, peak daily and peak quarterly criteria pollutant emissions were estimated for the sources of construction emissions (see tables 4.9.4-1 and 4.9.4-2, respectively). The estimated emissions in tables 4.9.4-1 and 4.9.4-2 take into account the implementation of several control measures as described below.

TABLE 4.9.4-1

Peak Daily Construction Emission Rates Associated with the Long Beach LNG Import Project

	Emission Rate (pounds per day)					
Emission Source/Thresholds	NO_x	ROC	PM_{10}	$PM_{2.5}$ [a]	SO_x	CO
Onsite Sources [b]						
Welding Machines	110	12	10	10	8	129
Electric Generators	37	4	4	4	3	44
Onsite Materials Trucks	14	2	1	1	1	14
Construction Equipment (e.g., cranes, front-end loaders)	217	20	14	14	16	101
Construction Equipment (marine dredges)	21	2	1	1	2	21
Fugitive Dust [c]	0	0	476	476	0	0
Subtotal – Onsite Sources	399	40	506	506	30	309
Offsite Sources						
Materials Trucks (e.g., cement, rebar)	96	7	2	2	1	48
Workers (commuting)	49	49	3	3	0.3	459
Miscellaneous Deliveries (e.g., sanitation supplies)	3	0.3	0	0	0	3
Subtotal – Offsite Sources	148	56	5	5	1.3	510
Total Project Emissions	547	96	511	511	31	819
SCAQMD CEQA Significance Thresholds	100	75	150	150	150	550
Exceedance of Threshold	Yes	Yes	Yes	NA	No	Yes

[a] To be conservative, $PM_{2.5}$ emissions have been assumed to be equal to the estimated PM_{10} emissions.

[b] Includes construction of the pipelines.

[c] Fugitive dust emission estimates are based on the implementation of proposed control measures included in a comprehensive dust control program required by SCAQMD Rule 403.

NA = Not applicable. There is no CEQA significance threshold for $PM_{2.5}$.

TABLE 4.9.4-2

Peak Quarterly Construction Emission Rates Associated with the Long Beach LNG Import Project

Emission Source/Thresholds	Emission Rate (tons per quarter)					
	NO_x	ROC	PM_{10}	$PM_{2.5}$ [a]	SO_x	CO
Onsite Sources [b]						
Welding Machines	3.6	0.4	0.4	0.4	0.3	4.3
Electric Generators	1.2	0.1	0.1	0.1	0.1	1.4
Onsite Materials Trucks	0.5	0.1	0.0	0.0	0.0	0.5
Construction Equipment (e.g., cranes, front-end loaders)	7.2	0.6	0.5	0.5	0.5	3.3
Construction Equipment (marine dredges)	0.6	0.1	0.0	0.0	0.0	0.5
Fugitive Dust [c]	0.0	0.0	15.7	15.7	0.0	0.0
Subtotal - Onsite Sources	13.1	1.3	16.7	16.7	0.9	10.0
Offsite Sources						
Materials Trucks (e.g., cement, rebar)	3.2	0.2	0.1	0.1	0.0	1.6
Workers (commuting)	1.6	1.6	0.1	0.1	0.0	15.2
Miscellaneous Deliveries (e.g., sanitation supplies)	0.1	0.0	0.0	0.0	0.0	0.1
Subtotal - Offsite Sources	4.9	1.8	0.2	0.2	0.0	16.9
Total Project Emissions	18.0	3.1	16.9	16.9	0.9	26.9
SCAQMD CEQA Significance Thresholds	2.5	2.5	6.75	6.75	6.75	24.75
Exceedance of Threshold	Yes	Yes	Yes	NA	No	Yes

[a] To be conservative, $PM_{2.5}$ emissions have been assumed to be equal to the estimated PM_{10} emissions.
[b] Includes construction of the pipelines.
[c] Fugitive dust emission estimates are based on the implementation of proposed control measures included in a comprehensive dust control program required by SCAQMD Rule 403.
NA = Not applicable. There is no CEQA significance threshold for $PM_{2.5}$.

SCAQMD Rule 403 requires the implementation of BMPs throughout the construction period to minimize the generation of fugitive dust. The comprehensive dust control program proposed for the Long Beach LNG Import Project includes the following measures:

- construction equipment and vehicles would operate at the lowest practical speed (e.g., less than 15 mph);
- vehicle movement on the site would be on paved areas as much as possible;
- unpaved areas where construction equipment is operating would be watered frequently enough to prevent a visible plume from soil entrainment;
- exits from the construction work area would have a transition ramp with wheel washers, bumps, or other methods to minimize track-out of soil from the site; and
- soil piles and other open soil areas not being actively used would be treated with dust control measures or have their moisture levels controlled to eliminate wind-induced dust emissions.

The fugitive dust emissions reported in tables 4.9.4-1 and 4.9.4-2 take this dust control program into account. No additional control measures are available for fugitive dust emissions.

To reduce project construction emissions from onsite diesel-fueled combustion equipment, SES' contract specifications would require that all off-road diesel-fueled equipment powered by compression ignition engines meet or exceed the Tier III NO_x, VOC, and CO emission standards and Tier II particulate

matter emission standards for units rated 37 to 560 kilowatts (kW) (49.6 horsepower (hp) to 751 hp), and Tier II NO_x, VOC, CO, and particulate matter emission standards for units rated less than 37 kW and greater than 560 kW in accordance with table 1 of Title 40 CFR Part 89.112. For all other equipment, contract specifications would require that the newest equipment in the construction contractors' fleets be used to take advantage of the general reduction in emission factors that occurs with each model year.

In addition, the following control measures would be implemented in accordance with the POLB's air quality requirements and construction standards:

- dredging contractors would be required to use electric-powered dredges for all hydraulic dredges and ultra-low sulfur or emulsified diesel in all other types of dredges;
- concurrent use of equipment would be minimized by construction phasing or other approved method;
- equipment would be turned off when not in use;
- construction activities would be suspended during Stage II smog alerts;
- bare ground surfaces would be watered before grading activities begin and at least twice each day thereafter;
- no soil excavation or hauling would occur when wind speeds exceed 25 mph;
- disturbed surface areas not under active construction would be treated with a soil stabilizer to minimize erosion; and
- vehicular activity on unpaved surfaces would be restricted and vehicles would not exceed 15 mph on those surfaces.

Additional offsite construction emissions would be generated from workers commuting to the project site and equipment/material shipments to the site or to the temporary laydown and worker parking area by road, rail, or barge. The construction workforce would be relatively small (peak of about 404 workers) and would primarily consist of workers from within the Los Angeles and Orange County labor pool. The workers would commute to the temporary laydown and worker parking area on Ocean Boulevard and would then be transported to the site via buses.

As shown in tables 4.9.4-1 and 4.9.4-2, total project construction emissions would exceed the SCAQMD significance thresholds for all criteria pollutants except SO_x on a peak daily and quarterly basis even after the implementation of control measures. Therefore, construction of the project would have a temporary but significant impact on ambient criteria pollutant levels in the SCAB. However, SES' control measures do not include the POLB standard mitigation measure that requires all contractors to use ultra-low sulfur or CARB-approved alternative diesel fuel in all diesel-powered equipment used onsite. SES has also not committed to using alternative-fuel buses to transport workers to and from the temporary laydown and worker parking area. Therefore, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall:**

  a. require all contractors to use ultra-low sulfur or CARB-approved alternative diesel fuel in all diesel-powered equipment used onsite during construction; and

b. use alternative-fuel buses to transport workers to and from the temporary laydown and worker parking area.

Although implementation of the Agency Staffs' recommended mitigation measure would reduce emissions during the construction phase of the project, impacts on air quality during construction are still expected to remain significant.

During project construction, some individuals may detect odorous emissions from diesel-powered construction equipment. Temporary exposure to the atmosphere of the dredged materials could also produce odorous emissions from the decomposition of organic matter. However, due to the temporary nature of these emissions, the relatively large distance to the nearest sensitive receptors, and the expectation that odors would be well dispersed outside of the immediate construction work area, the odor emissions during construction are not expected to create a public nuisance.

4.9.5 Operational Impacts and Mitigation

Operational emission sources would include marine vessels, vaporization equipment, fugitive process emissions, on-road vehicles, emergency generator and firewater pumps, and, ultimately, LNG consumers. There would be no emissions generated by the export C_2 heater because it would be operated via heat transfer. Emissions from LNG consumers are discussed in section 4.9.8. The remaining sources and the assumptions used to calculate the operational emissions from each source are described below.

Marine Vessels

Marine vessels used during project operation would include LNG ships, tugboats, pilot boats, and Coast Guard escort boats. The annual emission inventory accounts for 120 LNG ship arrivals, which is equivalent to 1 arrival every 3 days. Two tugboats, one pilot boat, and one Coast Guard escort boat would participate in the arrival, berthing, and departure of each LNG ship. Emissions were calculated for each ancillary vessel over the distance it would travel to meet the LNG ship. Emissions from the LNG ship were calculated for the 27 nm required by the SCAQMD (2003b). The one-way distance traveled by the other vessels would be 5.6 nm for the pilot boat and first tugboat, 2.6 nm for the second tugboat, and 6 nm for the Coast Guard escort boat.

The unloading of each LNG ship at berth (vessel activities during that period are referred to as hotelling) would typically require 6 to 12 hours; however, to be conservative an 18-hour hotelling duration was assumed. During unloading, emissions would be generated from the ship's main boilers as they produce steam to provide auxiliary power to pump LNG and to run the ship's lights and other utilities.

SES proposes that during hotelling, the LNG ships would use boil-off LNG to the maximum extent consistent with safe, reliable operation to heat their boilers and produce steam for propulsion and auxiliary power; the remainder of the fuel would be residual fuel oil No. 6. The tugboats, pilot boats, and Coast Guard escort boats were assumed to use diesel fuel for the purpose of this analysis. Except for the Coast Guard escort boats, the diesel engines used in the tugs and pilot boats would be re-powered to EPA Tier 2 Standards through California's Carl Moyer Program.

Vaporization Equipment

Three direct-fired water heaters associated with the vaporization equipment would generate hot water to be used as a heat transfer medium for the LNG shell and tube vaporizers and NGL extraction system reboilers. Each heater would be rated at approximately 380 MMBtu per hour based on the fuel low heating value. Two of the heaters would operate at any one time, with the third heater on hot "pilot"

standby. The heaters would use fuel gas generated onsite as their fuel. The priority of the fuel gas system is the use of C_{3+} first, boil-off gas second, and vaporized LNG last.

Recently, new vaporization processes have been developed that primarily utilize air exchangers as a heat source and may reduce air emissions associated with these processes. This vaporization technology was analyzed as an alternative to SES' proposed vaporization process (see section 3.6). While air exchange systems have been successfully demonstrated and operated at other facilities (e.g., Dahej LNG terminal in India), the space requirements of air exchangers and back-up heaters/vaporizers appear to make this approach technically infeasible at the site proposed for the Long Beach LNG Import Project.

Fugitive Process Emissions

Natural gas (primarily methane, a greenhouse gas) and the ROC contained therein would be released in small quantities as fugitive emissions from various onsite source locations, including the LNG storage tanks and NGL recovery system. The emission rates from these fugitive sources were estimated based upon proposed equipment counts. To minimize fugitive emissions, the LNG storage tanks and associated facilities would be equipped with a vapor handling system as described in section 2.1.1.4. The vehicle fuel truck loading rack would also contain equipment and tankage to capture LNG vapor.

On-Road Vehicles

During project operation, multiple types of highway vehicles would travel to and from the project facilities to load and deliver LNG to vehicle refueling sites within the SCAB, and materials, employees, and visitors to the LNG terminal.

The LNG trailer trucks were originally assumed to be diesel-fueled even though LNG-fueled trailer trucks may become available by 2008. The activities associated with the proposed project would include loading LNG into trailer trucks owned by other companies; therefore, SES originally estimated emissions assuming it would not be able to control the type of fuel used in the truck engine. This is also the reason that the use of diesel exhaust catalytic particulate filters cannot be guaranteed by SES.

After further evaluation, SES determined that the use of LNG-fueled LNG trailer trucks would be feasible. Because SES would voluntarily implement this control measure through the contracting process, estimated emissions for LNG trailer trucks were reduced. Due to the relatively low number of daily truck and automobile trips generated by the project, the project would not cause any significant degradation to LOS in the Port area (see section 4.7.2). Therefore, project-induced local CO and PM_{10} "hot spots" at intersections affected by the project are not anticipated.

Emergency Generator and Firewater Pumps

The emergency electric generator and firewater pumps would be powered by internal combustion engines burning alternative fuels such as liquefied C_{3+}, liquefied C_2, or other clean diesel fuel. The engines would be used only when electric power is not available from the grid, for firefighting, and 0.5 hour each week for testing.

Operational Emissions

Peak daily emissions were estimated for each of the operational sources described above, and are presented in table 4.9.5-1 along with the SCAQMD significance thresholds. Annual emissions are presented in table 4.9.5-2.

Emissions were not estimated for LNG consumers in tables 4.9.5-1 and 4.9.5-2 because the project-induced replacement of gasoline- or diesel-powered vehicles with LNG-powered vehicles cannot

be accurately predicted at this time. However, the potential emissions benefits associated with the use of LNG-powered vehicles compared to their gasoline and diesel counterparts are discussed in section 4.9.8.

TABLE 4.9.5-1

Peak Daily Operational Emission Rates Associated with the Long Beach LNG Import Project

	Emission Rate (pounds per day)					
Emission Source	NO_x	ROC	PM_{10}	$PM_{2.5}$ [a]	SO_x	CO
Marine Based Operations						
LNG Ships [b] (CEQA boundary to precautionary zone)	136	2.1	32	32	432	39
LNG Ships [b] (within precautionary zone)	52	0.8	12	12	161	15
LNG Ships [b] (precautionary zone to berth)	117	1.5	32	32	445	30
LNG Ships - Hotelling [c]	379	7.6	64	64	808	129
Tugboats	74	8.3	2.6	2.6	0.1	45
Pilot Boats and Coast Guard Escort Boats	11	1.2	0.4	0.4	< 0.01	6.7
Subtotal - Marine Based Operations	769	22	143	143	1,846	265
Facility Based Operations						
Vaporization Equipment						
Water Heaters [d]	80.3	108.2	36.1	36.1	1.2	74.2
Fugitive Process Emissions						
Equipment Leaks (valves, flanges)	0	0.3	0	0	0	0
On-Road Vehicles						
LNG Trailer Trucks	5.2	4.4	0.3	0.3	0	2.1
Delivery Trucks	0.3	0.1	0.01	0.01	< 0.01	1.4
Employee and Visitor Light Duty Trucks	3.8	1.3	0.1	0.1	0.04	36.3
Emergency Equipment						
Emergency Generator	3.7	0.2	0.2	0.2	< 0.01	1.6
Firewater Pumps	3.8	0.3	0.1	0.1	0.6	0.9
Subtotal – Facility Based Operations	97	115	37	37	1.8	117
Total Project Emissions	866	137	180	180	1,848	382
SCAQMD CEQA Significance Thresholds	55	55	150	150	150	550
Exceedance of Threshold	Yes	Yes	Yes	NA	Yes	No

[a] To be conservative, $PM_{2.5}$ emissions have been assumed to be equal to the estimated PM_{10} emissions.

[b] Assumes steamship boiler uses both LNG boil-off gas and residual fuel No. 6 while underway. Emissions are within SCAQMD waters only. Maximum daily transport emissions are based on one ship arriving and departing in a single day.

[c] Assumes steamship boiler primarily uses LNG boil-off gas plus a minor quantity of residual fuel No. 6 during hotelling.

[d] The water heater emissions include BACT.

NA = Not applicable. There is no CEQA significance threshold for $PM_{2.5}$.

As shown in table 4.9.5-1, on a peak daily basis, marine vessels would be the largest contributors to the project's overall emissions of NO_x, PM_{10}, $PM_{2.5}$, SO_x, and CO. The vaporization equipment would be the largest contributor to the project's overall emissions of ROC. Total project emissions, adjusted to account for SCAQMD-required emission offsets and after implementation of proposed control measures, would exceed the daily SCAQMD significance thresholds for NO_x, ROC, PM_{10}, and SO_x. The daily emissions for CO would be less than significant.

As shown in table 4.9.5-2, on an annual basis, marine vessels would be the largest contributor to the project's overall emissions of NO_x, PM_{10}, $PM_{2.5}$, SO_x, and CO. The vaporization equipment would be the largest contributor to the project's overall emissions of ROC.

TABLE 4.9.5-2

Peak Annual Operational Emission Rates Associated with the Long Beach LNG Import Project

Emission Source	Emission Rate (tons per year)					
	NO_x	ROC	PM_{10}	$PM_{2.5}$ [a]	SO_x	CO
Marine Based Operations						
LNG Ships [b] (CEQA boundary to precautionary zone)	8.2	0.1	1.9	1.9	25.9	2.4
LNG Ships [b] (within precautionary zone)	3.1	0.1	0.7	0.7	9.6	0.9
LNG Ships [b] (precautionary zone to berth)	7.0	0.1	1.9	1.9	26.7	1.8
LNG Ships - Hotelling [c]	22.8	0.5	3.8	3.8	48.5	7.7
Tugboats	4.0	0.5	0.2	0.2	< 0.01	2.7
Pilot Boats and Coast Guard Escort Boats	0.7	0.1	0.02	0.02	< 0.001	0.4
Subtotal – Marine Based Operations	46	1.4	8.5	8.5	111	16
Facility Based Operations						
Vaporization Equipment						
Water Heaters [d]	14.7	19.7	6.6	6.6	0.2	13.6
Fugitive Emissions						
Equipment Leaks (Valves, Flanges)	0	0.05	0	0	0	0
On-Road Vehicles						
LNG Trailer Trucks	0.9	0.8	0.1	0.1	0	0.4
Delivery Trucks	0.04	< 0.01	< 0.001	< 0.001	< 0.001	0.2
Employee and Visitor Light Duty Trucks	0.7	0.2	0.02	0.02	0.01	6.6
Emergency Equipment						
Emergency Generator	0.1	< 0.01	< 0.01	< 0.01	< 0.001	0.04
Firewater Pumps	0.1	< 0.01	< 0.01	< 0.01	0.02	0.02
Subtotal – Facility Based Operations	17	21	6.7	6.7	0.2	21
Total Project Emissions	63	22	15	15	111	37

[a] To be conservative, $PM_{2.5}$ emissions have been assumed to be equal to the estimated PM_{10} emissions.

[b] Assumes steamship boiler uses both LNG boil-off gas and residual fuel No. 6 while underway. Emissions are within SCAQMD waters only. Emissions assume 120 ship calls per year.

[c] Assumes steamship boiler primarily uses LNG boil-off gas plus a minor quantity of residual fuel No. 6 during hotelling. Emissions assume 120 ship calls per year.

[d] The water heater emissions include BACT.

Criteria pollutant emissions identified in tables 4.9.5-1 and 4.9.5-2 associated with operation of the Long Beach LNG Import Project are based on reductions resulting from the implementation of the following control measures:

- LAER/BACT would be applied by SES to the stationary sources as follows:

  a. SCR technology to reduce NO_x emissions from the water heaters;

  b. oxidation catalyst, or equivalent reduction of CO and ROC emissions from the water heaters; and

  c. metal oxide absorption of sulfur compounds in C_2 removed from LNG; and

- fugitive ROC emissions from various points in the terminal would be minimized by design elements and through the implementation of a comprehensive leak detection and repair program.

Additionally, the AQMP includes control measures that are intended to be implemented by federal and state governments to reduce emissions from ships and on-road trucks. The proposed project would comply with all applicable requirements of the AQMP.

To further reduce the proposed project emissions, SES would implement the POLB air quality requirements and operational standards described below.

- All diesel-powered, non-road mobile terminal equipment would meet the emissions standards set forth in the EPA's Control of Emissions of Air Pollution From Non-Road Diesel Engines and Fuel. Future purchases of such equipment must also meet or exceed those standards.

- Where such use meets all vessel safety requirements in accordance with the SOLAS treaty or other international, federal, or state requirements, ships calling at the terminal that do not use LNG boil-off gas in the main engines for hotelling power would use fuels such as the CARB's #2 diesel, gas-to-liquid diesel, biofuels, or a marine distillate fuel (as specified by ISO 8217), in the ship's auxiliary power generator motors, or would use exhaust treatment technology. A report would be submitted quarterly to the POLB Director of Planning indicating which ships complied with this requirement and which ships did not, and for those that did not comply, the report would include the reason(s) for noncompliance.

In addition to the POLB air quality requirements and operational standards, SES would be required to implement the following control measures:

- LNG ships would generate power from combustion of boil-off LNG rather than from fuel oil if they are equipped to do so;

- LNG trailer trucks would be LNG-fueled and the LNG trailer truck engines would be turned off during onsite loading; and

- operational personnel would be encouraged to rideshare and use mass transit.

Implementation of the control measures listed above would reduce operational emissions; however, given the magnitude of the emissions, operational emissions after implementation of the control measures are expected to remain significant.

Dispersion Modeling Analysis

SCAQMD Rule 1303 requires dispersion modeling of NO_x, CO, PM_{10}, $PM_{2.5}$, and SO_2 emissions from the water heater stacks associated with the vaporization equipment to determine whether they would cause a local violation, or significantly contribute to an existing violation, of the ambient air quality standards. In accordance with the requirements, a dispersion modeling analysis was performed. The modeled concentrations at or beyond the LNG terminal property line were added to background monitored concentrations to predict total ambient concentrations. Table 4.9.5-3 presents the results of the analysis, and compares the predicted concentrations to the applicable NAAQS and CAAQS.

TABLE 4.9.5-3

Maximum Offsite Criteria Pollutant Concentrations Associated with the Long Beach LNG Import Terminal [a]

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$) [b]	Maximum Facility Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	CAAQS ($\mu g/m^3$)	Below Standard
NO_2	1-hour	282	1.6	283.6	--	470	Yes
	Annual Arithmetic Mean	64.2	0.2	64.4	100	--	Yes
CO	1-hour	11,500	2.1	11,502	40,000	23,000	Yes
	8-hour	6,444	1.2	6,445	10,000	10,000	Yes
PM_{10}	24-hour	105	0.2	105.2	150	50	No [c]
	Annual Arithmetic Mean	38.9	0.06	39	50	20	No [d]
$PM_{2.5}$	24-hour	82	0.2	82.2	65	--	No [e]
	Annual Arithmetic Mean	21.5	0.06	21.6	15	12	No [f]
SO_2	1-hour	131	0.09	131.1	--	655	Yes
	3-hour [g]	118	0.07	118.1	1,300	--	Yes
	24-hour	36.8	0.02	36.8	365	105	Yes
	Annual Arithmetic Mean	8.0	0.007	8.0	80	--	Yes

[a] Predicted maximum facility concentrations are based on impacts resulting from the water heater stacks associated with the vaporization equipment.

[b] Maximum concentrations taken from 1999-2002 Long Beach ambient monitoring data.

[c] The background concentration exceeds the CAAQS; however, the facility contribution of 0.2 $\mu g/m^3$ (24-hour average) does not exceed 2.5 $\mu g/m^3$, which is the allowable significant change according to table A-2 in Appendix A of SCAQMD Rule 1303.

[d] The background concentration exceeds the CAAQS; however, the facility contribution of 0.06 $\mu g/m^3$ (annual arithmetic mean) does not exceed 1.0 $\mu g/m^3$, which is the allowable significant change according to table A-2 in Appendix A of SCAQMD Rule 1303.

[e] The background concentration exceeds the NAAQS; however, the facility contribution would be less than 1 percent of the 24-hour standard.

[f] The background concentration exceeds the CAAQS/NAAQS; however, the facility contribution would be less than 1 percent of the annual CAAQS/NAAQS.

[g] The 3-hour concentrations listed above are proportioned from 1-hour concentrations by a factor of 0.9, in accordance with guidance from the Office of Environmental Health Hazard Assessment, California Air Resources Board, and Environmental Protection Agency.

Note: The modeled sources include the water heaters with BACT.

The maximum predicted concentrations occur near the property line, just north of the LNG terminal site. The modeled impacts from the heater stacks at the nearest sensitive receptors are much less than these maximum values, and less than significant for all modeled pollutants.

SES also conducted a dispersion modeling analysis of NO_x CO, PM_{10}, $PM_{2.5}$, and SO_2 emissions from the project as a whole. This included the emissions from the water heater stacks, marine vessels associated with the terminal operations within the SCAQMD's boundary, and idling LNG trailer trucks. Table 4.9.5-4 presents the results of this analysis, and compares the concentrations to the NAAQS and CAAQS.

TABLE 4.9.5-4

Maximum Offsite Criteria Pollutant Concentrations Associated with the Long Beach LNG Import Terminal Project [a]

Pollutant	Averaging Period	Background Concentration ($\mu g/m^3$) [b]	Maximum Project Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	CAAQS ($\mu g/m^3$)	Below Standard
NO_2	1-hour	282	166.2	448	--	470	Yes
	Annual Arithmetic Mean	64.2	2.4	67	100	--	Yes
CO	1-hour	11,500	99.2	11,599	40,000	23,000	Yes
	8-hour	6,444	15.9	6,460	10,000	10,000	Yes
PM_{10}	24-hour	105	5.2	110.2	150	50	Yes/No [c]
	Annual Arithmetic Mean	38.9	0.4	39.3	50	20	Yes/No [c]
$PM_{2.5}$	24-hour	82	5.2	87.2	65	--	No [d]
	Annual Arithmetic Mean	21.5	0.4	21.9	15	12	No [e]
SO_2	1-hour	131	196	327	--	655	Yes
	3-hour [f]	118	127	245	1,300	--	Yes
	24-hour	36.8	65.8	103	365	105	Yes
	Annual Arithmetic Mean	8.0	5.2	13.2	80	--	Yes

[a] Predicted maximum project concentrations are based on impacts resulting from the water heater stacks associated with the vaporization equipment, marine vessels associated with the terminal operating within the SCAQMD's boundary, and idling LNG trailer trucks.

[b] Maximum concentrations taken from 1999-2002 Long Beach ambient monitoring data.

[c] Although the total concentration is below the NAAQS, it is predicted to exceed the CAAQS; however, the project contribution would be approximately 10 percent of the 24-hour CAAQS.

[d] The background concentration exceeds the NAAQS; however, the project contribution would be less than approximately 8 percent of the 24-hour standard.

[e] The background concentration exceeds the CAAQS/NAAQS; however, the project contribution would be less than 3 percent of the annual NAAQS and less than 4 percent of the annual CAAQS.

[f] The 3-hour concentrations listed above are proportioned from 1-hour concentrations by a factor of 0.9, in accordance with guidance from the Office of Environmental Health Hazard Assessment, California Air Resources Board, and Environmental Protection Agency.

Note: The modeled sources include the water heaters with BACT.

Summary of Operational Impacts and Mitigation

As shown in table 4.9.5-1, the project's operational emissions would exceed the daily SCAQMD CEQA significance thresholds for NO_x, ROC, PM_{10}, and SO_x. Additionally, although dispersion modeling results for the facility vaporization equipment and the project as a whole indicate that the operation of the facility would have a minimal impact on the existing air quality in the vicinity of the proposed project area (see tables 4.9.5-3 and 4.9.5-4), the predicted impacts from operational emissions would potentially worsen an existing violation of the ambient air quality standards for PM_{10} and $PM_{2.5}$ even after implementation of all of SES' proposed control measures. Consequently, the project's impact would be considered significant for ozone (NO_x and ROC), PM_{10}, $PM_{2.5}$ and SO_x. The project's impact would not be considered significant for CO. Given the nature of the project operations, especially vessel operations, the Agency Staffs have determined that there are no additional feasible measures that would further reduce air emissions.

The replacement of diesel fuel with LNG in on-road vehicles that may occur from implementation of the proposed project could result in reductions in NO_x, PM_{10}, $PM_{2.5}$, SO_x, and CO emissions within the SCAB. Conversely, ROC emissions may increase. The increase in ROC emissions would be negated by an even greater decrease in emissions of NO_x, the other ozone precursor. These reductions could be large enough to offset the emission increases associated with the project, thereby

resulting in a net air quality benefit to the SCAB. However, an accurate estimate of the amount of diesel replacement that could be directly attributed to the proposed project is not available at this time. Section 4.9.8 describes the potential LNG consumers in greater detail.

Combustion of natural gas and diesel fuel during project operations would not generate a perceptible odor onsite or offsite. The potential for offsite odors due to the use of methyl mercaptan, an odorant to alert people to the presence of leaking natural gas, would be minimized because the odorizing equipment would be tightly sealed in a specially designed dispensing facility.

4.9.6 General Conformity Determination

As previously discussed, a conformity analysis must be conducted by the lead federal agency if a federal action would result in the generation of emissions that would exceed the conformity threshold levels (*de minimis*) of the pollutant(s) for which an air basin is in non-attainment. A conformity analysis must show that the emissions would conform to the SIP and would not reduce air quality in the air basin, which can be demonstrated through offsets, SIP provisions, or modeling. The SCAB is designated as a "severe" non-attainment area for the 8-hour ozone standard, a "serious" non-attainment area for both CO and PM_{10}, and a non-attainment area for $PM_{2.5}$. As a result, the FERC conducted a conformity analysis for the Long Beach LNG Import Project to determine if the emissions associated with the project would conform to the SIP and would not reduce air quality in the SCAB. The results of the FERC's analysis are contained in the Draft General Conformity Determination included in Appendix E.

As discussed in Appendix E, documentation supporting conformity has not been filed with the FERC. Until this information is provided by SES, the Long Beach LNG Import Project is deemed to not conform with the applicable SIP and AQMP. SES must complete a full air quality analysis and identify any mitigation requirements necessary for a finding of conformity before a determination of conformity can be made. Upon receipt of the required information from SES, the FERC staff will complete the analysis and issue a Final General Conformity Determination for the Long Beach LNG Import Project.

To allow the FERC staff to complete its analysis and issue a Final General Conformity Determination, the FERC staff **recommends that:**

- **SES shall complete a full air quality analysis and identify any mitigation requirements necessary for a finding of conformity with the applicable SIP and AQMP. SES shall file documentation supporting conformity with the Secretary of the Commission (Secretary) <u>before the end of the draft EIS/EIR comment period</u> for review and analysis in the final EIS/EIR.**

4.9.7 Health Risk Assessment

In accordance with SCAQMD Rule 1401, a Health Risk Assessment of the project's potential toxic air contaminant emissions on humans was conducted. The analysis included the inhalation exposure pathway, as well as dermal absorption; soil ingestion; water ingestion; and food ingestion via plants, animal products, and mother's milk.

The sources considered in the analysis included the water heaters associated with the vaporization equipment, hotelling emissions from the LNG ships, movement of the LNG ships within the SCAQMD's boundary, tugboats, pilot boats, Coast Guard escort boats, and idling emissions from the LNG trailer trucks that would load at the terminal. Table 4.9.7-1 presents the potential emissions of toxic air contaminants associated with combustion of natural gas or diesel fuel from these sources. Table 4.9.7-2 presents the maximum individual lifetime cancer risk and the noncarcinogenic health hazard indices for the nearest residence and for nearby workers. The excess cancer burden is also presented.

TABLE 4.9.7-1

Maximum Emission Rates of Toxic Air Contaminants

Pollutant	Emission Rate [a] Hourly (pounds per hour) [b]	Annual (pounds per year) [b]
Acetaldehyde	7.4E-04	6.5
Acrolein	6.6E-04	5.8
Ammonia	2.2 [c]	19,000
Arsenic	2.6E-04	2.3
Benzene	1.5E-03	13
Beryllium	1.2E-05	0.11
1,3-Butadiene	1.6E-04	1.4
Cadmium	9.6E-04	8.4
Chromium (hexavalent)	1.2E-03	10
Copper	8.4E-04	7.4
Dichlorobenzene	3.5E-05	0.31
Diesel exhaust particulate	3.9E-02	340
7,12-Dimethylbenz(a)anthracene	5.6E-07	4.9E-03
Ethylbenzene	1.7E-03	14
Formaldehyde	9.8E-03	86
Hexane	5.4E-02	470
Lead	5.2E-04	4.5
Manganese	5.3E-04	4.7
Mercury	2.3E-04	2.0
3-Methylcholanthrene	5.3E-08	4.6E-04
Naphthalene	3.4E-04	3.0
Nickel	7.7E-03	68
POM/PAHs [c]	3.3E-04	2.9
Benz(a)anthracene	1.8E-06	1.6E-02
Benzo(a)pyrene	1.0E-06	8.9E-03
Benzo(b)fluoranthene	1.5E-06	1.3E-02
Benzo(k)fluoranthene	1.6E-06	1.4E-02
Chrysene	1.7E-06	1.5E-02
Dibenz(a,h)anthracene	1.1E-06	1.0E-02
Indeno(1,2,3-c,d)pyrene	1.7E-06	1.5E-02
Propylene	1.9E-01	1,700
Selenium	6.8E-05	0.60
Toluene	3.3E-03	29
Vanadium	2.3E-03	20
Xylenes (mixed)	1.2E-02	100
Zinc	2.7E-02	230

[a] Very small values are presented concisely in scientific notation (e.g., the hourly rate of 1.5E-03 for benzene is equivalent to 1.5×10^{-3} or 0.0015).

[b] Water heater emission rates based upon emission factors from the EPA (1998) and communication from the SCAQMD (2003c).

[c] POM = polycyclic organic matter. PAHs = polycyclic aromatic hydrocarbons, expressed as equivalent benzo(α)pyrene, includes 7,12-dimethylbenz(a)anthracene, acenaphthene, acenaphthylene, and anthracene.

Note: Emissions are reported for the water heaters with BACT, hotelling LNG ships, movement of the LNG ships within the SCAQMD's boundary, tugboats, pilot boats, and Coast Guard escort boats, and idling emissions from the LNG trailer trucks that would load at the terminal. The tugboats, pilot boats, and Coast Guard escort boats are responsible for the diesel exhaust particulate emissions.

TABLE 4.9.7-2

Maximum Potential Health Risks Associated with the Long Beach LNG Import Project

	Carcinogenic Risk		Noncarcinogenic Risks	
Exposure Conditions	Probability	Excess Cancer Burden	Chronic Hazard Index	Acute Hazard Index
Long-Term (70-year) Exposure (Residential) [a]	1.5 in 1 million	0.003	0.002	0.002
Long-Term (46-year) Exposure (Worker) [b]	2.5 in 1 million		0.003 [c]	0.013 [d]
Significance Threshold	10 in 1 million	0.5	1.0	1.0
Significance Level	Insignificant	Insignificant	Insignificant	Insignificant

[a] Based on 24 hours per day, 365 days per year exposure at the nearest residence (Receptor No. 1751) for 70 years.

[b] Highest offsite occupational risk occurs at Receptor No. 515 just northwest of the LNG terminal site along the edge of Pier T. Worker exposure is based on 8 hours per day, 240 days per year for 46 years.

[c] Maximum non-carcinogenic chronic health hazard index occurs at Receptor No. 443 located east of the LNG terminal property boundary.

[d] Maximum non-carcinogenic acute health hazard index occurs at Receptor No. 514 located just northwest of the LNG terminal along the edge of Pier T.

Note: The Health Risk Assessment includes the water heaters with BACT, hotelling LNG ships, and idling emissions from the LNG trailer trucks that load at the terminal.

The cancer risk of 1.5 in 1 million for the nearest residence is based on an assumed continuous (24 hours per day) exposure over a 70-year lifetime. The risk of 2.5 in 1 million for a worker is based on an exposure of 8 hours per day for 46 years, in accordance with the guidance in SCAQMD Risk Assessment Procedures for Rules 1401 and 212, Version 6.0, August 18, 2000. The cancer risk at each receptor, including sensitive receptors, is less than the 10-in-1-million significance threshold established in SCAQMD Rule 1401.

Cancer burden was also calculated based on the maximum predicted cancer risk and the estimated number of persons exposed. The cancer burden is predicted to be 0.003, which is less than the significance threshold of 0.5 established in SCAQMD Rule 1401. Likewise, the maximum chronic and acute health hazard indices are predicted to be well below the significance threshold of 1.0. Therefore, the impact of the Long Beach LNG Import Project on human health risks would be less than significant.

Although the proposed project would not exceed cancer risk level significance thresholds established by the SCAQMD for toxic air pollutant health impacts, the SCAB and Port areas in particular are assumed, on the basis of the SCAQMD's MATES II Study, to suffer significant impacts related to toxic air pollutants and associated cancer risk levels. Therefore, toxic air pollutants resulting from the project would likely contribute to an existing cumulatively significant air quality impact in the SCAB (see section 4.12).

4.9.8 LNG Consumers

Consumers of the natural gas associated with the proposed project would include:

- residential, commercial, and industrial customers in the SCAB that would consume the vaporized natural gas sent from the LNG terminal to the SoCal Gas pipeline;
- the ConocoPhillips LARC would consume C_2 recovered from the LNG sent via pipeline from the LNG terminal directly to the facility; and

- LNG-powered vehicles that would purchase LNG delivered to regional vehicle refueling stations from the proposed LNG terminal.

The vaporized natural gas sent to the SoCal Gas pipeline would need to meet the SoCal Gas tariff requirements and the CPUC gas purity requirements. These requirements include limits on Btu and sulfur content. To maintain the required Btu content, the NGL recovery unit would remove a portion of the higher Btu components. The project's natural gas would have to meet the same pipeline specifications as natural gas imported from other sources; therefore, any differences in criteria pollutant or toxic air contaminant emissions on a per-volume basis are expected to be minimal.

Because there are relatively few LNG vehicle refueling stations in the SCAB, the proposed project could trigger an increased use of LNG in vehicles. This increased use of LNG could be coupled with a corresponding decrease in the use of diesel fuel or gasoline.

Possible candidates for LNG-powered vehicles in the future and the potential air quality impacts associated with the substitution of LNG for diesel or gasoline in vehicles are discussed below.

Local LNG Vehicle Fuel Use – Large numbers and concentrations of diesel-fueled vehicles (e.g., container trucks) and off-road equipment (e.g., yard hostlers) work in and around the Port district. The POLB encourages tenants to reduce mobile source diesel-fuel emissions by using alternative diesel fuels, and installing pollution control devices through the POLB's voluntary Diesel Emission Reduction Program (POLB, undated).

Additionally, the SCAQMD is proposing a Clean Fuels Program to increase the use of alternative fuels. This program has developed a set of fleet vehicle-related rules that would require several categories of fleets to acquire alternative-fuel vehicles if they have more than 14 vehicles. The SCAQMD has also entered into contracts for four LNG fueling stations (SCAQMD, 2003d), each of which must be able to provide at least 50,000 gpd.

State LNG Vehicle Fuel Use – Two thousand heavy-duty trucks in California already run on LNG. The number of LNG-fueled vehicles is expected to increase enough to demand 120,000 gpd (44 million gallons per year) in 2005, of which half would be in southern California. The CEC Transportation Fuels Office estimates that between 0.33 and 0.66 billion gallons of LNG per year would be needed by 2010 to power these vehicles. This increasing use of LNG-fueled vehicles is being encouraged by the CARB's Carl Moyer Program. The Carl Moyer Program provides funding to fleets that propose to refit their heavy-duty engines to use LNG and other alternative fuels. At this time, LNG used in California comes from eight liquefaction plants located in California and other western states. The proposed LNG terminal would be the first facility in California to import LNG rather than convert it from locally available natural gas. Five facilities in California offer LNG for vehicle use, of which only two are located in the SCAB.

National LNG Vehicle Fuel Use – The EPA promotes and expands the use of environmentally-beneficial alternative fuels and vehicles by providing the states with tools such as benefits models, SIP Credits, and the Clean Fuels Fleet Program.

Potential Regional Air Quality Impact

Determining the potential impacts or benefits of introducing LNG into the regional vehicle fleet is difficult for the following reasons:

- it is uncertain what the future demand of project-supplied LNG would be;

- it is uncertain how much of the project-supplied LNG would replace gasoline or diesel use, instead of simply replacing LNG from more distant LNG refueling stations;

- the difference in emissions between LNG vehicles versus gasoline or diesel vehicles depends on the type of vehicle, the age of the engine, and whether any emission control equipment has been installed; and

- increasingly tighter emission and fuel standards, particularly for diesel, will result in lower emissions in the future, and a gradual narrowing of the differences between diesel, gasoline, and alternative-fueled vehicle emissions.

In general, the emissions from LNG-powered vehicles are currently less than the emissions from comparable diesel-powered vehicles with the exception of ROC and methane emissions. However, the difference in PM_{10} and SO_2 emissions between LNG- and diesel-fueled vehicles would be reduced when the diesel fuel sulfur content level is reduced to 15 ppmw starting in June 2006.

LNG vehicle emissions are comparable to gasoline vehicle emissions with the exception of ROC. The ROC emissions from LNG vehicles are lower than those of gasoline vehicles because LNG vehicles do not have evaporative emissions (CARB, 2004).

SES presented an upper-limit example based on the current differences in in-use emissions between LNG and diesel-fueled trucks. For the example, SES assumed the following:

- A vehicle fleet age distribution and emissions profile used by the CARB in the EMFAC2002 emissions software, Version 2.2 for Los Angeles County for the year 2010.

- 150,000 gallons of project-supplied LNG would be made available for vehicle fuel each day or 54,750,000 gallons per year and that all of the LNG made available would replace diesel fuel.

- Heavy-duty on-road trucks get approximately 2.76 miles per gallon of LNG (Engine, Fuel, and Emissions Engineering, Incorporated, 1996), and could therefore travel approximately 530,000 miles per day on the LNG.

If LNG were used instead of diesel fuel to power these trucks based on the assumptions listed above, the resulting potential changes in regional emissions would be as follows:

- NO_x emissions would decrease by 8,528 pounds per day or 1,556 tons per year;
- ROC emissions would increase by 813 pounds per day or 148 tons per year;
- PM_{10} emissions would decrease by 51 pounds per day or 9 tons per year;
- SO_x emissions would decrease by 16 pounds per day or 3 tons per year; and
- CO emissions would decrease by 3,227 pounds per day or 589 tons per year.

It should be noted that these differences in emissions are expected to narrow considerably in future years as tighter diesel emissions standards and tighter fuel formulation standards are phased in, and diesel retrofit emission control technologies improve (CARB, 2004).

4.10 NOISE

4.10.1 Significance Criteria

Impacts on environmental noise levels would be considered significant if:

- noise attributable to the operation of the project facility would exceed a day-night sound level (L_{dn}) of 55 decibels of the A-weighted scale (dBA) at nearby noise-sensitive areas (NSAs), such as residences, schools, hospitals, or other occupied dwellings; or

- project-related noise exceeds the City of Long Beach noise threshold of 70 dBA within the Harbor District or if there is an increase in noise of more than 3 dBA in areas where ambient noise exceeds the City of Long Beach noise thresholds.

4.10.2 Environmental Setting

Project-related noise would affect the local environment during construction of the proposed project facilities and during operation of the LNG terminal. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. This variation is caused by changing weather conditions, and changing human activities. Two measures used by federal agencies to relate the time-varying quality of environmental noise to its known effect on people are the 24-hour equivalent sound level ($L_{eq(24)}$) and the L_{dn}. The $L_{eq(24)}$ is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The L_{dn} is the $L_{eq(24)}$ with 10 dBA added to nighttime sound levels between the hours of 10 p.m. and 7 a.m. to account for people's greater sensitivity to sound during nighttime hours.

The proposed project facilities would be located in a designated industrial zone within the POLB. The nearest NSAs are potential residences in a recreational vehicle park about 1.3 miles east-northeast of the LNG terminal site and possible live-aboard boats at two marinas in the East Basin of the Cerritos Channel between 1.2 and 1.6 miles northwest of the LNG terminal (see figure 4.9.2-2).

To characterize the existing sound levels in the vicinity of the proposed LNG terminal, a property boundary noise survey was conducted at two locations over three time periods during August 2003. The existing noise levels at the property boundary at these two locations are listed in table 4.10.2-1.

TABLE 4.10.2-1

Summary of Existing Property Boundary Noise Levels Near the Proposed LNG Terminal Site

Location/Parameter	August 21 - 22, 2003	August 22 - 23, 2003	August 23 - 24, 2003
Pier T East (100 feet east of the eastern property boundary)			
Existing L_{eq} (dBA)	56.1	56.4	54.0
Existing L_{dn} (dBA)	61.1	61.2	59.8
Existing Max. 1 hr. L_{eq} (dBA) [a]	60.2	63.3	57.6
Pier T North (50 feet north of the northern property boundary)			
Existing L_{eq} (dBA)	61.2	60.8	55.9
Existing L_{dn} (dBA)	64.2	63.6	61.1
Existing Max. 1 hr. L_{eq} (dBA) [a]	66.7	67.5	60.8

[a] Maximum 1 hour equivalent A-weighted sound level.

4.10.3 Regulatory Requirements

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that noise levels should not exceed an L_{dn} of 55 dBA, which is the level that protects the public from indoor and outdoor activity interference. The FERC has adopted the EPA's L_{dn} noise level standard.

FERC Guidelines

FERC guidelines (Title 18 CFR Part 380.12) indicate that L_{dn} noise levels must not exceed 55 dBA at the nearest NSA. Due to the 10 dBA nighttime penalty added before the calculation of the L_{dn}, the actual constant noise level required to produce an L_{dn} of 55 dBA is 48.6 dBA. Therefore, compliance with the FERC guidelines of an L_{dn} of less than 55 dBA at the nearest NSA requires that the facility be designed so that the continuous operational noise levels do not exceed 48.6 dBA.

City of Long Beach Municipal Code

As discussed in section 1.4.5, the City of Long Beach Municipal Code sets limits for exterior noise levels based on receiving land use districts. The project facilities would be located in an industrial land use district (District 4) associated with the POLB. In a District 4 zone, the noise limit is 70 dBA at the facility property boundary. The code also specifies a requirement that if the noise contains a steady audible tone such as a whine, screech, or hum or a repetitive noise such as hammering or riveting, the standard limit would be reduced by 5 dBA.

The City of Long Beach also prohibits the operation of equipment that creates vibrations that can be perceived by an individual on private property at the property boundary or at 150 feet if on public space or right-of-way.

4.10.4 Impact and Mitigation

Potential impacts associated with the Long Beach LNG Import Project could be caused by short-term increases in noise during construction of the project facilities and increases in noise levels associated with operation of the LNG terminal.

Construction

Construction of the project facilities would occur over a 48-month period. The soil/foundation improvement activities followed by construction of the LNG storage tanks and terminal would take place during the entire construction period. Construction of the ship berth and unloading facility would take approximately 12 months and would occur in the early portion of the project schedule. Construction of the pipelines and electric distribution facilities would take approximately 10 months and would occur toward the middle of the 48-month construction period. The noise associated with these construction activities would be intermittent, as equipment would be operated on an as-needed basis. Construction activities at the LNG terminal and along the routes of the pipeline and electric distribution facilities would generate short-term increases in sound levels during daylight hours, when construction activities would occur.

The strongest source of sound during construction would be noise associated with installing deep-driven pile foundations beneath the LNG storage tanks and other heavy load structures to meet the

stringent static-settlement criteria for the LNG storage tanks and other heavy load structures at the LNG terminal. Pile driving is estimated to produce a sound pressure level of 100 dBA at a distance of 50 feet. Noise from pile driving is impulsive in nature and rapidly decreases to below the ambient noise levels at a rate of approximately 6 dBA per doubling of distance. The shortest distance from the pile driving to the POLB property line is approximately 5,000 feet. Using the following calculation [sound pressure level 2 = sound pressure level 1 - 20 log (distance 2 / distance 1)], the estimated noise at the POLB property line due to pile driving would be 60 dBA.

The actual sound level impacts from construction activities would depend on the type of equipment used, the mode of operation of the equipment, the length of time the equipment is in use, the amount of equipment used simultaneously, and the distance between the sound source and the receptor. All of these factors would be constantly changing throughout the construction period, making the calculation of an L_{dn} or L_{eq} difficult. Assuming the pile driving is the loudest noise source, and utilizing the above noise attenuation equation, the estimated noise impact due to pile driving at the nearest NSA is 57.3 dBA. FERC does not regulate construction noise and 57.3 dBA is below the City of Long Beach noise limits, of which construction noise in the Long Beach Harbor District is exempt. Although the noise levels at the property boundary would be higher than existing noise levels, the impacts would be short term and would be contained within the industrial area immediately surrounding the LNG terminal site within the POLB. As a result, impacts on noise levels associated with construction of the proposed facilities would be less than significant.

Operation

The major noise-producing equipment associated with operation of the LNG terminal would be the boil-off gas compressors, primary and secondary booster pumps, water pumps and heaters, instrument air compressors, and fans for the heaters. All of the equipment has been specified to produce a noise level of no greater than 85 dBA at 3 feet.

Noise control measures included in the design of the LNG terminal facilities consist of buildings, barrier walls, and tanks to provide the appropriate level of noise screening.

A preliminary noise study was conducted to predict the operational noise levels at the nearest NSA and at the property boundary for comparison with existing noise levels and the FERC and City of Long Beach noise limits. A noise model was developed for the LNG terminal using SoundPlan, which is an industry accepted noise prediction model. Buildings and barriers were included in the model to estimate noise absorption and reflection associated with the LNG terminal facilities. The noise model calculations were based on the hemispherical radiation of noise from each source.

The results of the preliminary noise study indicate that the LNG terminal facilities would have a noise level impact of 55 dBA L_{dn} approximately 0.25 mile from the terminal property boundary (still within the POLB). The nearest NSAs are located over 1 mile from the property boundary. As a result, the project would be in compliance with the FERC limit of 55 dBA L_{dn} at the nearest NSAs.

The predicted property boundary noise levels were estimated to be 60 dBA, which would be less than the 70 dBA property boundary noise limit required by the City of Long Beach. As a result, the project would be in compliance with the City of Long Beach noise ordinance.

Summary

The predicted operational noise level is below the FERC limit of 55 dBA L_{dn} at the nearest NSAs. The predicted property boundary noise level is below the City of Long Beach noise limit of 70 dBA. In

addition, vibration monitoring at other LNG terminals has shown that significant vibrations are not produced by operation of the facilities. As a result, noise impacts associated with operation of the proposed LNG terminal facilities would be less than significant.

To ensure that the actual noise resulting from the operation of the LNG terminal is below the FERC limit of 55 dBA L_{dn} at any nearby NSAs and the City of Long Beach property boundary noise limit of 70 dBA, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall conduct a noise survey to verify that the noise from the LNG terminal when operating at full capacity does not exceed an L_{dn} of 55 dBA at any nearby NSAs or 70 dBA at the property boundary, and file the results of the noise survey with the FERC and the POLB <u>no later than 60 days</u> after placing the LNG terminal in service. If the noise attributable to the operation of the LNG terminal exceeds an L_{dn} of 55 dBA at any nearby NSA or 70 dBA at the property boundary, SES shall file a report on what changes are needed and shall install additional noise controls to meet these levels within 1 year. SES shall confirm compliance with the L_{dn} of 55 dBA at the nearby NSAs and 70 dBA at the property boundary requirements by filing a second noise survey with the FERC and the POLB <u>no later than 60 days</u> after it installs the additional noise controls.**

4.11 RELIABILITY AND SAFETY

This section contains both the FERC's and POLB's analyses of the safety aspects of the proposed project because the EIS/EIR is designed to meet the requirements of both NEPA and CEQA. This means that the format and type of information presented in this document differ substantially from the safety analyses that the FERC prepares for other proposed LNG terminals. There are significant distinctions between the FERC and POLB analyses that are discussed below.

The first analysis was prepared by the FERC as part of its overall NEPA review of the proposed facilities. The second analysis was prepared by the POLB to meet the requirements of the CCA, as implemented in the RMP in the PMP. The POLB's safety review is based upon a hazards analysis prepared for the POLB by Quest to comply with the RMP, which specifies that probable worst-case scenarios must be considered.

The FERC's analysis is presented in sections 4.11.2 through 4.11.9. Regarding the LNG terminal, the FERC staff performed a siting analysis, as well as an overall safety, operability, and reliability analysis. The siting analysis determines if the proposal meets the requirements of the DOT's regulations in Title 49 CFR 193 and NFPA 59A. This includes verification of: LNG impoundment capacities; equipment spacing; design spills; and thermal and flammable vapor exclusion zones. In addition, the FERC's review determines areas of hazard with respect to LNG spills from ships. Results from the ship spill analysis are estimates of consequences from a range of intentional breach scenarios that provide guidance in developing the safety and security requirements for LNG vessel transport, as well as in establishing potential impact areas for emergency response and evacuation planning.

The POLB's analysis under CEQA is included with the FERC staff's except where it differs due to the POLB's hazard assessment by Quest, which is summarized in section 4.11.10 and attached in its entirety as Appendix F. This hazards analysis considers different worst-case scenarios and reveals different consequences than does the FERC's analysis. The CCA analysis that the POLB must prepare is also based upon the Quest study in Appendix F. It is presented in section 5.0 and is termed the Application Summary Report.

The FERC staff does not agree with analyzing worst-case, high-consequence, low-probability events without accounting for the beneficial effect of preventive or mitigation measures as part of a risk management process. As a result, many of the worst-case high consequences calculated in the Hazards Analysis by Quest are not considered credible events by the FERC.

4.11.1 Significance Criteria

Impacts on public safety would be considered significant if project construction or operation would:

- result in a substantial increase in the potential for incidents that would cause serious injury or death to members of the public; or
- substantially diminish the level of fire and police services (reduction of acceptable response times).

4.11.2 LNG Import Terminal Facilities

Three federal agencies share in the oversight of the safety and security of LNG import terminals: the Coast Guard, the PHMSA of the DOT, and the FERC. The FERC authorizes the siting and

construction of LNG import terminals and is the lead federal agency under NEPA to analyze the environmental, safety, security, and cryogenic design of proposed facilities. The Coast Guard has authority over the safety of LNG vessels and the marine transfer area. The Coast Guard also has authority over the security of the LNG vessels and the entire LNG facility. The PHMSA has exclusive authority to promulgate and enforce safety regulations and standards over the onshore LNG facilities beginning at the last valve immediately before the LNG storage tank(s).

In February 2004, these three agencies entered into an Interagency Agreement to assure that they work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals, including the terminal facilities and ship operations, and to maximize the exchange of information related to the safety and security aspects of the LNG facilities and related marine operations. The Interagency Agreement ensures a seamless safety and security review by the three participating federal agencies.

The operation of the proposed LNG terminal poses a potential hazard that could affect the public safety without strict design and operational measures to control potential incidents such as accidental and intentional releases. The primary concerns are those events that could lead to an LNG spill of sufficient magnitude to create an offsite hazard.

With the exception of the October 20, 1944 fire at an LNG facility in Cleveland, Ohio, the operating history of LNG facilities in the United States has been free of LNG safety-related incidents resulting in adverse effects on the public or the environment.[5] More recently, an operational accident occurred in 1979 at the Cove Point LNG facility in Lusby, Maryland, when a pump seal failed, resulting in gas vapors entering an electrical conduit and settling in a confined space. When a worker switched off a circuit breaker, the gas ignited, resulting in heavy damage to the building and a worker fatality. Lessons learned from this accident resulted in changing the national fire codes, with the participation of the FERC, to ensure that the situation would not occur again. The proposed facilities would be designed, constructed, and operated in compliance with these codes.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria LNG liquefaction facility that killed 27 workers and injured another 56 workers. No members of the public were injured. Preliminary findings of the accident investigation suggest that a cold hydrocarbon leak occurred and was introduced to the high-pressure steam boiler by the combustion air fan. An explosion inside the boiler fire box subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquefied petroleum gas (LPG) separation equipment. Although much of the plant had been modernized in 1998-1999, the facilities in which the explosion occurred had been operating with its original equipment since start-up in 1981.

Although there are major differences between the equipment involved in the accident at Skikda and that of the proposal by SES (i.e., high-pressure steam boilers that power refrigerant compressors would not be used nor are they used at any LNG facility under FERC jurisdiction), the sequence of cascading events identifies potential failure modes that warrant further evaluation. This issue was discussed at the July 14, 2004 cryogenic design and technical review conference conducted for SES' proposed project in Long Beach, California. To ensure that all potential hazards are addressed, the FERC staff provided a recommendation in section 4.11.6 to address this issue.

[5] For a description of the incident and the findings of the investigation, see *U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944, and February 1946*.

4.11.3 LNG Hazards

LNG's principal hazards result from its cryogenic temperature (-260 ºF), flammability, and vapor dispersion characteristics. As a liquid, LNG will neither burn nor explode. Although it can cause freeze burns and, depending on the length of exposure, more serious injury, its extremely cold state does not present a significant hazard to the public, which rarely, if ever, comes in contact with it as a liquid. As a cryogenic liquid, LNG will quickly cool materials it contacts, causing extreme thermal stress in materials not specifically designed for ultra-cold conditions. Such thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These hazards, however, are not substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296 ºF) or several other cryogenic gases that are routinely produced and transported in the United States.

Methane, the primary component of LNG, is colorless, odorless, and tasteless, and is classified as a simple asphyxiant. Methane could, however, cause extreme health hazards, including death, if inhaled in significant quantities within a limited time. At very cold temperatures, methane vapors could cause freeze burns. Asphyxiation, like freezing, normally represents a negligible risk to the public from LNG facilities.

When released from its containment vessel and/or transfer system, LNG will first produce a vapor or gas. This vapor, if ignited, represents the primary hazard to the public. LNG vaporizes rapidly when exposed to ambient heat sources such as water or soil, producing 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. LNG vapors in a 5 to 15 percent mixture with air are highly flammable. The amount of flammable vapor produced per unit of time depends on factors such as wind conditions, the amount of LNG spilled, and whether it is spilled on water or land. Depending on the amount spilled, LNG may form a liquid pool that will spread unless contained by a dike.

Once a flammable vapor-air mixture from an LNG spill has been ignited, the flame front will propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. An unconfined methane-air mixture will burn slowly, tending to ignite combustible materials within the vapor cloud. Thermal radiation is the primary mechanism of heat transfer from the burning methane to an individual or structure.

LNG is not explosive as it is normally transported and stored. However, LNG vapors (primarily methane) can explode if contained within a confined space, such as a building or structure, and ignited. There is no evidence, however, suggesting that LNG is explosive in unconfined open areas. Experiments to determine if unconfined methane-air mixtures will explode have been conducted and, to date, have all been negative. Unconfined methane-air mixtures will burn but will not explode. Nevertheless, a number of experimental programs have been conducted to determine the "amount of initiator charge" required to detonate an unconfined methane-air mixture.

Over the years, various parties have occasionally expressed the energy content of an LNG storage tank or LNG ship in equivalent tons of tri-nitro toluene (TNT), as an implied measure of its explosive potential. However, such a simplistic analogy fails to consider that explosive forces are not just a function of the total energy content but also of the rate of energy release. For an explosion to occur, the rate of energy release must be nearly instantaneous, such as with a TNT charge initiated by a blasting cap. Unlike TNT or other explosives that inherently contain an oxidizer, an unconfined vapor cloud must be mixed with oxygen within the flammability range of the fuel for combustion to occur. For a large unconfined vapor cloud, the flammability range tends to exist at the mixing zone at the edges of the cloud. When ignited, flame speeds about 20 to 25 meters per second (66 to 82 feet per second) and local overpressures up to 0.2 psig have been estimated for methane rich fuels, well below the flame speeds and overpressures associated with explosion.

Rapid phase transition (RPT) can occur when a portion of LNG spilled onto water changes from liquid to gas, virtually instantaneously. Unlike an explosion that releases energy and combustion products from a chemical reaction as described above, RPT is the result of heat transferred to the liquid inducing a change to the vapor state. The rapid expansion from the liquid to vapor state can cause locally large overpressures. RPTs have been observed during LNG test spills onto water. In some test cases, the overpressures generated were strong enough to damage test equipment in the immediate vicinity of the LNG release point. The sizes of the overpressure events have been generally small, and are estimated to be equivalent to several pounds of TNT. Such a small overpressure is not expected to cause significant damage to an LNG vessel. However, the RPT may increase the rate of LNG pool spreading and the LNG vaporization rate.

4.11.4 Storage and Retention Systems

LNG storage tanks come in a variety of categories. The following are descriptions of the tank designs most commonly used worldwide:

- single containment cylindrical metal tanks (predominantly used in the United States);
- spherical storage tanks (predominantly used in LNG carriers);
- double containment cylindrical metal inner tank and metal or concrete outer tank (commonly thought of as an LNG tank with a high wall dike);
- full containment cylindrical metal inner tank and metal or concrete outer tank (Cameron/Hackberry was the first project proposing this design in the United States; Freeport LNG was the second; and currently, numerous LNG projects are proposing this type of tank design, including SES' proposal);
- prestressed cylindrical concrete tank with an internal metal membrane (membrane tank) (none in the United States); and
- cryogenic cylindrical concrete tank; internal cryogenic tank and prestressed concrete outer tank (one operational in the United States; the remainder worldwide).

These tank categories are described in Annex H of the European Standard for LNG facilities (EN 1473) and are summarized below for the LNG storage tanks commonly found in proposals before the Commission. The numbering of the tank examples discussed below is based on the numbering system used in EN 1473.

H.1 Single containment tank

> A single primary container and generally an outer shell designed and constructed so that only the primary container is required to meet the low temperature ductility requirements for storage of the product.
>
> The outer shell of a single containment storage tank is primarily for the retention and protection of insulation and to contain the purge gas pressure, but is not designed to contain refrigerated liquid in the event of leakage from the primary container.

An aboveground single containment tank shall be surrounded by a bund (dike) wall to contain any leakage. Examples of single containment tanks are given in figure H.1.

H.3 Double containment tank

A double containment tank is designed and constructed so that both the inner self supporting primary container and the secondary container are capable of independently containing the refrigerated liquid. To minimize the pool of escaping liquid, the secondary container shall be located at a distance not exceeding 6 meters from the primary container.

The primary container contains the refrigerated liquid under normal operating conditions. The secondary container is intended to contain any leakage of the refrigerated liquid, but it is not intended to contain any vapor resulting from this leakage.

Examples of double containment tanks are given in figure H.3. Figure H.3 does not imply that the secondary container is necessarily as high as the primary container.

H.4 Full containment tank

A tank designed and constructed so that both the self supporting primary container and the secondary container are capable of independently containing the refrigerated liquid stored and for one of them its vapor. The secondary container can be 1 or 2 meters distance from the primary container.

The primary container contains the refrigerated liquid under normal operating conditions. The outer roof is supported by the secondary container. The secondary container shall be capable both of containing the refrigerated liquid and of controlled venting of the vapor resulting from product leakage after a credible event. Examples of full containment tanks are given in figure H.4.

Single-, double- and full-containment LNG storage tanks have been authorized by the FERC for use at new LNG import facilities or expansions of existing terminals. To date, only single- and double-containment tanks have been constructed and operated. Although construction of full-containment tanks has not yet started in the United States, approximately 50 have been constructed worldwide. During the review of earlier proposals, a number of issues surfaced concerning the applicability of existing codes and regulations to full-containment tanks. Specifically, the term "full containment" does not appear in U.S. codes or standards for LNG facilities, including the Federal Safety Standards in Title 49 CFR Part 193, NFPA 59A, or API 620. As a result, some project proponents have made the assumption that to design and construct a full-containment tank in accordance with the European code for LNG facilities (EN 1473) will satisfy the U.S. codes and standards.

For example, it has been suggested that thermal exclusion zones are not required for a full-containment tank because EN 1473 does not consider a tank fire scenario for full-containment tanks with a pre-stressed concrete wall and concrete roof. The staffs of the FERC and the OPS do not agree because neither NFPA 59A nor Part 193 excludes full containment from thermal exclusion zone requirements. As a result, a thermal exclusion zone analysis is required for an LNG storage tank fire at the top of the secondary container (see section 4.11.5).

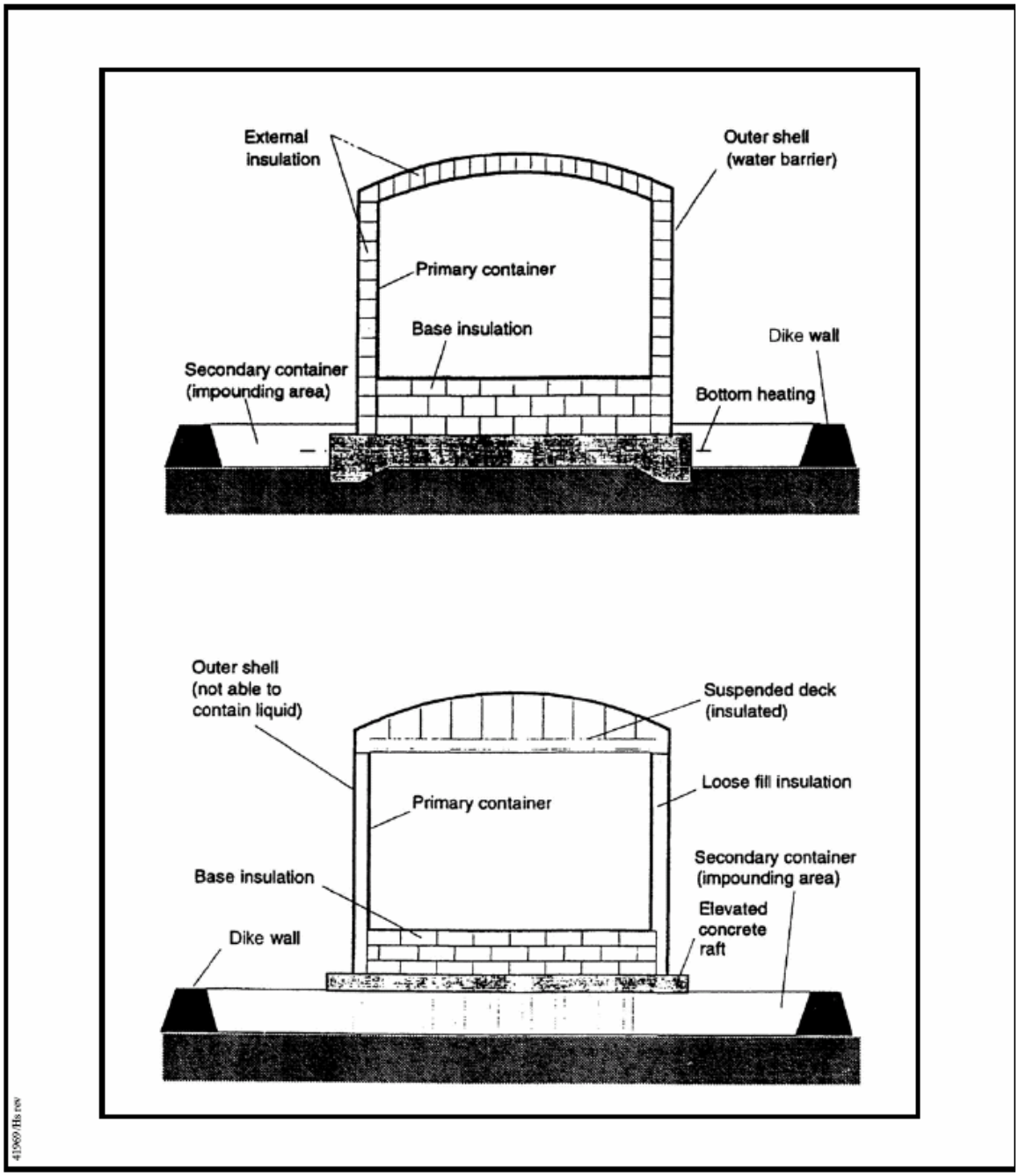


Figure H.1

Examples of Single Containment Tanks

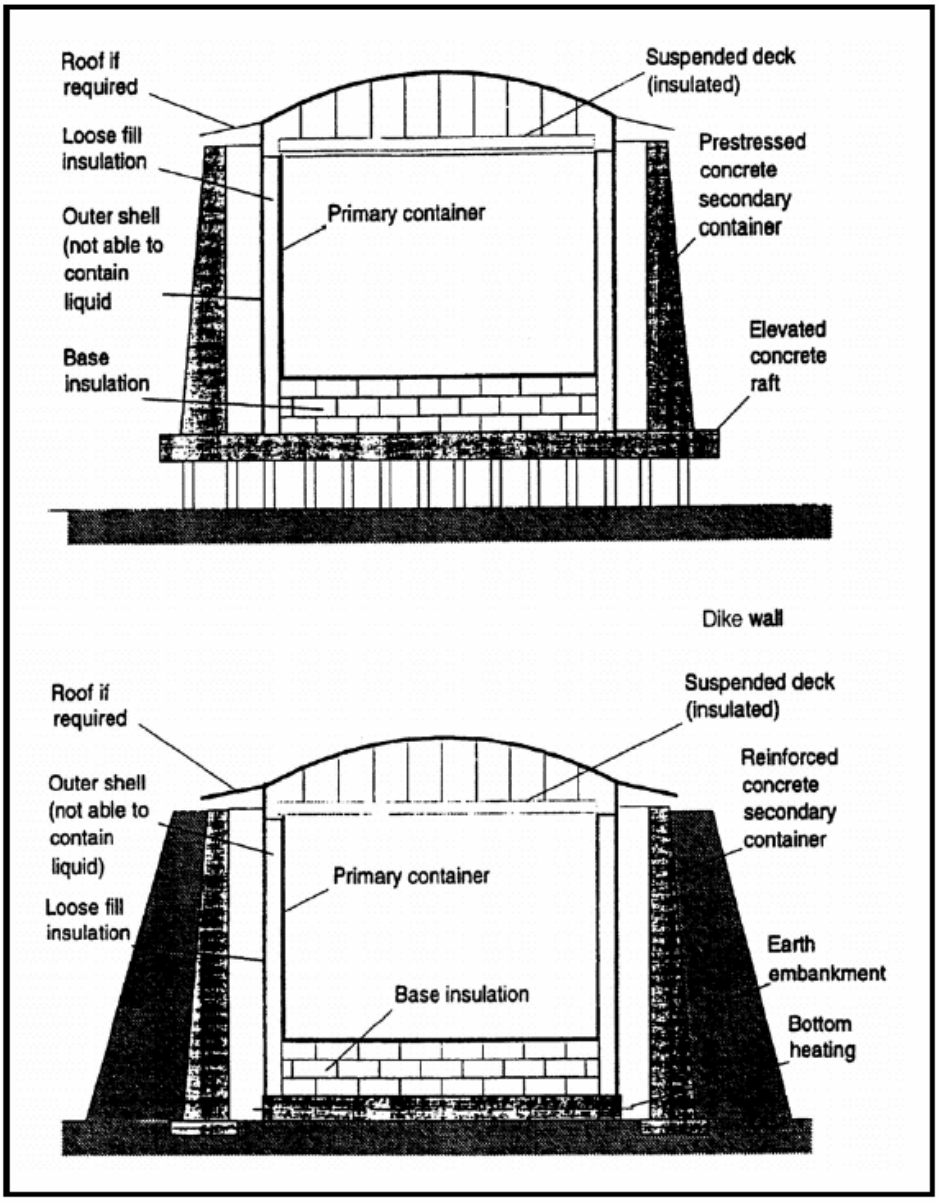


Figure H.3

Examples of Double Containment Tanks

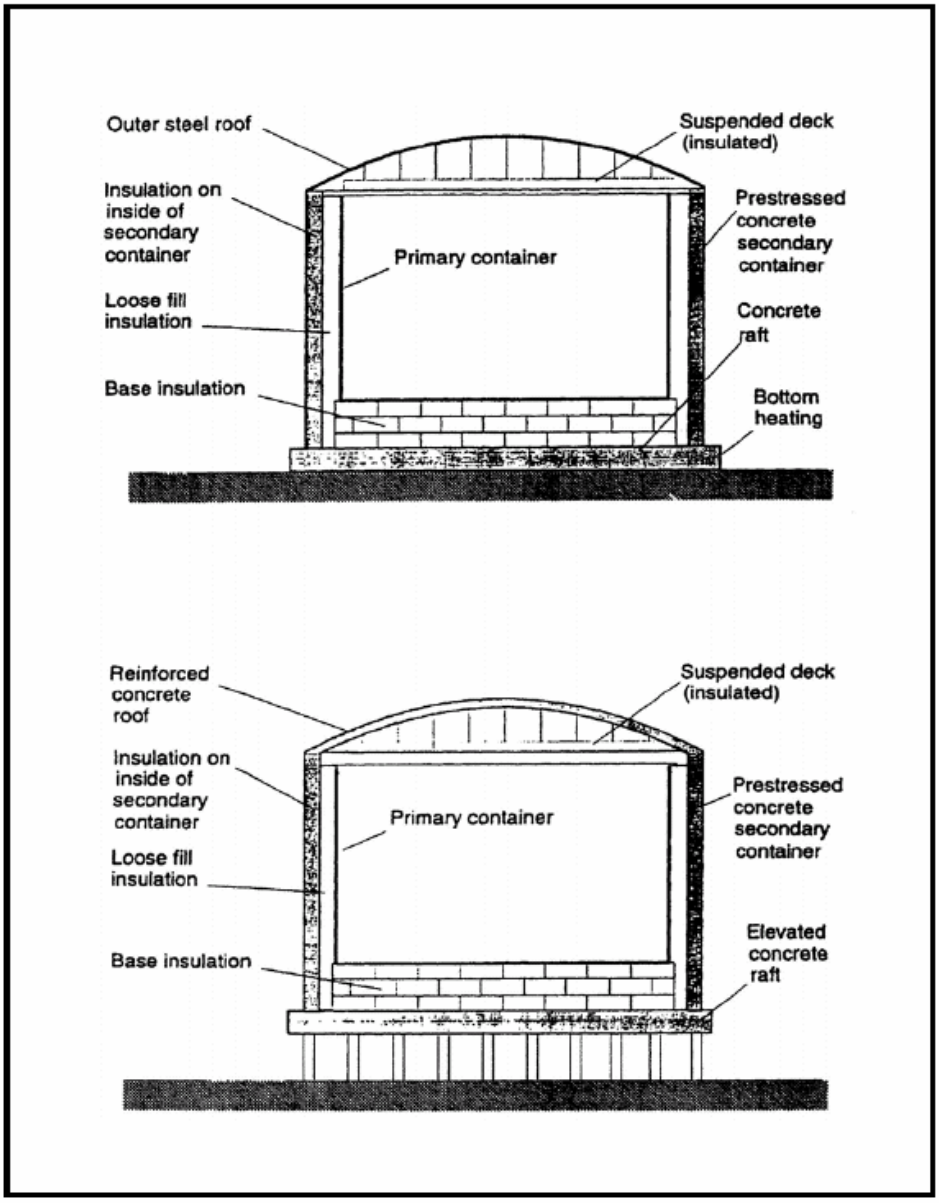


Figure H.4

SES Long Beach LNG Import Project

Examples of Full Containment Tanks

Further, EN 1473 does not specify a minimum distance to the property line for full-containment tanks because no tank fire scenario is considered. However, NFPA 59A requires a separation of 0.7 times the tank diameter from the property line. SES' proposed tank separation distance to the property line meets this separation requirement.

Another issue regarding the full-containment design is that the tank outer wall (secondary containment) serves as the impoundment, a concept allowed under Parts 193.2161 and 193.2167, and under the "exception" in figure 2.2.2.6 of NFPA 59A. A specific concern is the dual function of the concrete secondary container - it serves both the operational function of holding the insulation and gas pressure, and a safety function of containing liquid in the event of an inner tank failure. Conversely, in single- and double-containment tanks, independent systems provide operational and safety functions. While recognition must be given to the benefits of a concrete secondary container with respect to external events, such as projectiles or small aircraft, its ability to provide the dual functions while retaining its integrity has not been convincingly supported for all scenarios. This becomes increasingly important as proposed site acreage is reduced and buffer zones between adjacent properties are minimized. As such, the FERC staff considers it prudent design practice to provide some form of barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property) in the event that the storage tank primary and secondary containers fail.

Concerns have also been expressed that the barrier could be considered a containment and prohibit certain equipment being located within the barrier and/or may conflict with other parts of the various codes with respect to hazardous and electrical code classifications. Other concerns are that the barrier could be considered an impounding area that would require new thermal and vapor cloud calculations. The purpose of the barrier is to prevent liquid from flowing off the plant property, and it is not the intent to define a containment or impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements.

SES proposes to install a security barrier wall around the LNG storage tanks. The structure would have a height of 20 feet and would enclose an area approximately 805 feet by 440 feet. The structure's volumetric capacity would exceed 100 percent of a single LNG tank's maximum liquid capacity. Rainwater that collects inside the barrier wall would be drained into a sump and pumped out in accordance with Title 49 CFR Part 193.2173. This barrier would confine LNG on the project site in the event of any hypothetical catastrophic event.

4.11.5 Siting Requirements – Thermal and Vapor Dispersion Exclusion Zones

Regulatory Requirements

The LNG facilities proposed for the Long Beach LNG Import Project must comply with the siting requirements of Title 49 CFR Part 193, Subpart B. On March 30, 2000, the DOT revised Title 49 CFR Part 193 to incorporate NFPA 59A (1996 edition) into the LNG regulations. On April 9, 2004, the DOT further revised Title 49 CFR Part 193 to incorporate the 2001 edition of NFPA 59A. The following sections specifically address offsite hazards:

- **Part 193.2001, Scope of Part,** excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the marine vessel and the last manifold or valve immediately before a storage tank.

- **Part 193.2051, Scope,** states that each LNG facility designed, replaced, relocated, or significantly altered after March 31, 2000, must be provided with siting requirements in

accordance with Subpart B and NFPA 59A. In the event of a conflict with NFPA 59A, Part 193 prevails.

- **Part 193.2057, Thermal radiation protection,** requires that each LNG container and LNG transfer system have thermal exclusion zones based on three radiation flux levels in accordance with section 2.2.3.2 of NFPA 59A.

- **Part 193.2059, Flammable vapor-gas dispersion protection,** requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A.

For the following LNG facilities that are proposed in this project, the FERC staff has identified the applicable siting requirements from Part 193 and NFPA 59A:

- Two 1,006,000-barrel LNG storage tanks and one 23,901-barrel trailer truck loading LNG storage tank - Parts 193.2057 and 2059 require the establishment of thermal and flammable vapor exclusion zones for LNG tanks. NFPA 59A section 2.2.3.2 specifies four thermal exclusion zones based on the design spill and the impounding area. Sections 2.2.3.3 and 2.2.3.4 specify a flammable vapor exclusion zone for the design spill, which is determined in section 2.2.3.5.

- One marine unloading berth and a cargo transfer system consisting of four 16-inch-diameter unloading arms, and one transfer line - Parts 193.2001, 2057, and 2059 require thermal and flammable vapor exclusion zones for the transfer system. NFPA 59A does not address LNG transfer systems.

- One trailer truck loading transfer facility consisting of two loading stations - Parts 193.2001, 2057, and 2059 require thermal and flammable vapor exclusion zones for the transfer system. NFPA 59A section 2.2.3.2 specifies the thermal exclusion zone and sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spill in a transfer area.

- Six 2,500 gpm in-tank pumps (three in each tank), seven 1,830 gpm primary booster pumps, and seven 1,980 gpm secondary booster pumps - Parts 193.2057 and 2059 require thermal and flammable vapor exclusion zones. NFPA 59A section 2.2.3.2 specifies the thermal exclusion zone and sections 2.2.3.3 and 2.2.3.4 specify the flammable vapor exclusion zone based on the design spill in a process area.

- Four shell and tube vaporizers - Same requirements as for LNG pumps.

The incorporation of the NFPA 59A requirements into Title 49 CFR Part 193 has resulted in some confusion and possible misinterpretation in applying the siting requirements.

Parts 193.2057 and 2059 require exclusion zones for LNG transfer systems, which are defined to include transfer piping. However, NFPA 59A only requires exclusion zones for "transfer areas," which are defined as the part of the plant where liquids are introduced or removed from the facility such as trailer truck loading or ship unloading areas. The definition of transfer area in NFPA 59A specifically excludes permanent plant piping such as cargo transfer lines. Additionally, NFPA 59A section 2.2.3.1 (2001) specifically excludes transfer areas at the water edge of marine terminals. When the DOT incorporated NFPA 59A into its regulations, it removed the requirement for impounding systems around transfer piping (old Part 193.2149). In the preamble to the final rule, the DOT determined that the most

likely sources of leaks within LNG plants are LNG storage tanks, cargo transfer areas, and vaporizers and process equipment, which are all addressed in NFPA 59A section 2.2.1.2. The result is that while Part 193 retains exclusion zones for LNG transfer systems, neither Part 193 nor NFPA 59A requires the impoundment from which to base the calculations. The FERC staff does not believe that this was the intent, nor do they believe that omitting containment for transfer piping is a sound engineering practice. The FERC staff will continue to require containment for all LNG transfer piping within a plant site.

The incorporation of NFPA 59A also changed the way in which design spills and impoundment capacities may be determined. Under section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume during a 10-minute period from any single accidental leakage source or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the authority having jurisdiction. Similar criteria appear in section 2.2.3.5 for determining the design spill used in thermal and flammable vapor exclusion zone calculations. Prior to the incorporation of NFPA 59A, the design spill in Part 193 assumed the rupture of a single transfer pipe with the greatest overall flow capacity, for not less than 10 minutes [old Part 193.2059(d)]. As a result, the spill rate for vaporization, process, or LNG transfer areas may be assumed to be a "leakage source" rather than a full pipe rupture; however, the spill duration must be 10 minutes unless the authority having jurisdiction (i.e., the DOT OPS) determines that a shorter time is acceptable. Again, given the confusion in applying the two requirements, the FERC staff will continue to utilize the 10-minute spill criteria at the maximum flow possible for containment sizing. This will ensure that impoundments are sized for a catastrophic failure, while recognizing that less conservative spill scenarios may be appropriate for exclusion zone calculations. In giving recognition to the integrity of all-welded transfer piping, the determination of the single accidental leakage source should be based on an evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc, and any flanges that may be used at valves or other equipment, in order to determine the largest spill rate. This approach is the result of discussions with the DOT OPS concerning the basis for design spills and application to exclusion zone determinations for proposals before the Commission.

Impoundment Systems and Sizing Spills

The calculations of thermal and flammable exclusion zones for the proposed LNG facilities are based on the dimensions of the proposed impoundment systems and the spill volumes specified by Part 193 and NFPA 59A. Part 193.2181 specifies that the impoundment system serving a single LNG storage tank must have a volumetric capacity of 110 percent of the LNG tank's maximum liquid capacity. SES' proposed LNG storage tank impoundments would be the outer concrete container surrounding the inner container that holds the LNG. Each LNG storage tank's gross liquid capacity is 42,272,000 gallons. The volumetric capacity of the impoundment for each tank would be 53,177,333 gallons, which would exceed the 110 percent requirement by approximately 6,678,133 gallons. Also, SES' proposed trailer truck loading LNG storage tank impoundment would be the outer concrete container surrounding the inner container that holds the LNG. The trailer truck loading LNG storage tank's gross liquid capacity is 1,003,842 gallons. The volumetric capacity of the impoundment for the tank would be 2,108,208 gallons, which would exceed the 110 percent requirement by approximately 1,003,982 gallons.

Potential LNG spills from the ship unloading line, the two LNG storage tank withdrawal headers, and the trailer truck loading tank withdrawal header would be directed to the storage tank impoundment sump. This sump would measure 210 feet long by 25 feet wide with a depth of 17.6 feet and would have a capacity of 691,152 gallons. The sump would be located next to the unloading line pipe rack between the two storage tanks. The flow for the ship unloading line at full rate is 55,031 gpm. This would result in a 10-minute spill of 550,310 gallons. The design spill for an LNG storage tank with no penetrations below the liquid level is determined in accordance with section 2.2.3.5 of NFPA 59A and is defined as the largest flow from any single line that could be pumped into the impounding area. Each LNG storage tank

would be equipped with three in-tank pumps, individually rated for 2,500 gpm. The rupture of the in-tank pump discharge header would result in a spill rate of 7,500 gpm, which equates to a spill volume of 75,000 gallons. The trailer truck loading LNG storage tank would be equipped with two in-tank pumps (one primary and one backup), individually rated for 1,050 gpm. One in-tank pump would be used for transferring LNG to the trailer truck loading area. Rupture of the discharge piping would result in a spill rate of 1,050 gpm, which would equate to a spill volume of 10,500 gallons. The storage tank impoundment sump is adequately sized to contain these spills.

The area around the process area would be graded so that a spill would flow to a collection sump located on the west side of the process area near the midpoint of the process area. The design flow for the sendout line at full rate is 9,598 gpm. This equates to a 10-minute spill of 95,980 gallons. In the process area, this spill would be retained in a sump with the dimensions 35 feet long by 25 feet wide with a depth of 18 feet. The process area sump would have a capacity of 117,810 gallons and would accommodate this spill.

The area around the trailer truck loading area would be curbed and graded so that a spill would flow to a collection sump located next to the loading line pipe rack south of the trailer truck loading station. The design flow rate through the transfer line from the trailer truck loading LNG storage tank to the trailer truck loading area would be 1,050 gpm. This equates to a 10-minute spill of 10,500 gallons. SES' current design for the trailer truck loading area includes a sump that is 10 feet long by 10 feet wide with a depth of 18.8 feet. This sump would have a capacity of 14,062 gallons and would accommodate a 10,500-gallon spill.

Additionally, the design flow for a single trailer truck loading line at full rate is 314 gpm. This equates to a 10-minute spill of 3,140 gallons. The trailer truck loading area sump would accommodate a 10-minute spill from a single trailer truck loading line.

Table 4.11.5-1 presents the design spill sizes and impoundment system capacities.

TABLE 4.11.5-1

Impoundment Areas

Source	Spill Size (gallons)	Impoundment System	Impoundment Size (gallons)
LNG Storage Tank	42,272,000	Outer Tank Concrete Wall	53,177,333
Trailer Truck Loading LNG Storage Tank	1,003,842	Outer Tank Concrete Wall	2,108,208
Ship Unloading Line	550,310	Storage Tank Impoundment Sump	691,152
LNG Storage In-tank Pump Header	75,000	Storage Tank Impoundment Sump	691,152
Trailer Truck Loading In-tank Pump Header	10,500	Storage Tank Impoundment Sump	691,152
Process Area	95,980	Process Area Sump	117,810
Trailer Truck Loading Area	10,500	Trailer Truck Loading Area Sump	14,062

Thermal Exclusion Zone

If a large quantity of LNG is spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of thermal radiation. Exclusion distances for various flux levels were calculated according to Title 49 CFR Part 193.2057 and section 2.2.3.2 of NFPA 59A, using the "LNGFIRE III" computer program model developed by the Gas Research Institute. NFPA 59A establishes certain atmospheric conditions (0 mph wind speed, 70 °F, and 50 percent relative humidity) that are to be used in calculating the distances. However, Part 193.2057 supersedes these requirements and stipulates that the wind speed, ambient temperature, and relative humidity that produce the maximum

exclusion distances must be used, except for conditions that occur less than 5 percent of the time based on recorded data for the area. For its analysis, SES selected the following ambient conditions from the SCAQMD to produce the maximum distances: wind speed of 8 mph; ambient temperature of 40 °F; and 50 percent relative humidity. These parameters were verified by FERC staff to produce maximum distances.

Thermal radiation distances for incident flux levels ranging from 1,600 to 10,000 British thermal units per square foot per hour (Btu/ft^2-hr) were calculated for an LNG storage tank and trailer truck loading LNG storage tank fires. An incident flux level of 1,600 Btu/ft^2-hr is considered hazardous for persons located outdoors and unprotected, a level of 3,000 Btu/ft^2-hr is considered an acceptable level for wooden structures, and a level of 10,000 Btu/ft^2-hr would cause clothing and wood to ignite and is considered sufficient to damage steel structures after several minutes of exposure. Because the outer concrete tanks provides the required impounding volume for both the LNG storage tank and the trailer truck loading LNG storage tank, the area of the impoundment is the appropriate parameter for thermal exclusion zone calculations. For the LNG storage tanks, the outer concrete tank diameter (249.34 feet) was used as the pool diameter, with a flame height to the top of the outer concrete wall (137.47 feet). The target height was set at ground level (0 feet). For the trailer truck loading LNG storage tank, the outer concrete tank diameter (79.0 feet) was used as the pool diameter, with a flame height to the top of the outer concrete wall (57.5 feet). The target height was set at ground level (0 feet). Thermal radiation distances were also determined for a 1,600 Btu/ft^2-hr incident flux level centered on the tank area sump, process area sump, and the trailer truck loading area sump. The regulations only require calculation of a 1,600 Btu/ft^2-hr exclusion zone distance for these sumps.

Table 4.11.5-2 presents the maximum distances for incident flux levels as calculated by the FERC staff. These values are generally in agreement with those calculated by SES. The exclusion zones for the 10,000 Btu/ft^2-hr incident flux would not extend beyond the property line. The storage tank exclusion zone distance for the 1,600 Btu/ft^2-hr incident flux would extend outside the terminal site by approximately 438 feet to the east onto Pier T property. The exclusion zone distance for the 3,000 Btu/ft^2-hr incident flux also would extend outside the terminal site by approximately 181 feet to the east onto Pier T property. For the trailer truck loading storage tank, the exclusion zone distance for the 1,600 Btu/ft^2-hr incident flux would extend outside the terminal site by approximately 167 feet to the east onto Pier T property. The exclusion zone distance for the 3,000 Btu/ft^2-hr incident flux extends outside the terminal site by approximately 81 feet to the east onto Pier T property.

Based on the analyses of the thermal radiation from the storage tanks and the trailer truck loading storage tank, several exclusion zone distances (as required by Title 49 CFR Part 193) extend beyond the property line of the facility that can be built upon. Although no prohibited activities or buildings currently exist within these exclusion zones, according to Title 49 CFR Part 193, either a government agency or SES must be able to exercise legal control over activities in these areas for as long as the facility is in operation. The POLB owns the land surrounding the LNG terminal site but leases parcels to other tenants. In its application, SES stated that it is currently negotiating with the POLB and adjacent tenants for restrictive covenants to limit the use of the areas impacted. At this time, there is no assurance of limiting the type of activities that occur outside of the proposed terminal site within the exclusion zones. Therefore, **the FERC staff recommends that:**

- **SES shall provide <u>in its comments on the draft EIS/EIR, or in a separate document submitted at the same time</u>, evidence of its ability to exercise legal control over the activities that occur within the portions of the thermal radiation exclusion zones that fall outside the site property line that can be built upon.**

TABLE 4.11.5-2

Thermal Exclusion Zones

Source	Exclusion Area NFPA 59A Section 2.2.3.2(a)	Incident Flux (Btu/ft^2-hr) [a]	Exclusion Zone (feet) [b]	Property Line (feet)
LNG Storage Tank Impoundment	Outdoor assembly area occupied by 50 or more people	1,600	778	340
LNG Storage Tank Impoundment	Offsite structures used for occupancies or residences	3,000	521	340
LNG Storage Tank Impoundment	Property line that can be built upon	10,000	143	340
Trailer Truck Loading LNG Storage Tank Impoundment	Outdoor assembly area occupied by 50 or more people	1,600	287	120
Trailer Truck Loading LNG Storage Tank Impoundment	Offsite structures used for occupancies or residences	3,000	201	120
Trailer Truck Loading LNG Storage Tank Impoundment	Property line that can be built upon	10,000	108	120
LNG Storage Tank Impoundment Sump	Property line that can be built upon	1,600	347	517
Process Area Sump	Property line that can be built upon	1,600	174	393
Trailer Truck Loading Area Sump	Property line that can be built upon	1,600	67	105

[a] The 1,600 Btu/ft^2-hr flux level is associated with an exposed person experiencing burns within about 30 seconds. At 3,000 Btu/ft^2-hr, an exposed person would experience burns within 10 seconds; however, a wooden structure would not be expected to burn and affords protection to sheltered persons. At 10,000 Btu/ft^2-hr, clothing and wood can ignite spontaneously and the flux level is considered sufficient to damage steel structures after several minutes of exposure.

[b] Distance from the center of the LNG pool.

Vapor Dispersion Exclusion Zone

A large quantity of LNG spilled without ignition would form a flammable vapor cloud that would travel with the prevailing wind until it either dispersed below the flammable limits or encountered an ignition source. Part 193.2059 and sections 2.2.3.3 and 2.2.3.4 of NFPA 59A require that provisions be made to minimize the possibility of flammable vapors from reaching a property line that can be built upon and that would result in a distinct hazard. Part 193.2059 requires that dispersion distances be calculated for a 2.5 percent average gas concentration [½ the lower flammability limit (LFL) of LNG vapor] under meteorological conditions that result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F (the most stable situation), a wind speed of 4.5 mph, 50 percent relative humidity, and the average regional temperature (these parameters are specified by Part 193.2059). The section allows the use of the Dense Gas Dispersion Model (DEGADIS), or the FEM3A model, to compute dispersion distances. Design spills into impounding areas serving LNG containers, transfer systems, and piping are to be determined in accordance with section 2.2.3.5 of NFPA 59A. For its vapor dispersion analysis, SES selected the following ambient conditions: stability Class F, 4.5 mph wind speed, 50 percent relative humidity, and an average regional temperature of 65.3 °F (obtained from SCAQMD data).

In accordance with section 2.2.3.3 of NFPA 59A, an average concentration of methane in air of 50 percent of the LFL cannot cross the property line that can be built upon from a design spill into each tank impoundment. In this case, compliance with section 2.2.3.3 would also meet the requirements of section 2.2.3.4 of NFPA 59A.

According to table 2.2.3.5 of NFPA 59A, the design spill is the largest flow from the container (i.e., storage tank) withdrawal pumps for a 10-minute duration at full rated capacity. Potential LNG spills occurring from the three storage tank discharge headers and the ship unloading line would be directed to the storage tank impoundment sump. The largest spill from one of the three LNG in-tank pump discharge headers would be 75,000 gallons. The design spill for the marine transfer line was based on the FERC staff's evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc., which determined that a 3-inch bypass would constitute the single accidental leakage source. Using a 3-inch connection in the marine transfer line, the resulting spill would be 39,600 gallons. Therefore, the design spill for determining the vapor exclusion zone for this sump would be 75,000 gallons.

SES submitted an analysis using a cold vapor to liquid volumetric ratio of 1:235, and calculated that 2,881,100 cubic feet of cold vapor would result from the complete vaporization of a full flow rupture of the ship unloading line spill. SES asserted that because the entire volume of cold vapor would be contained by the 20-foot-high security barrier wall, occupying approximately 39 percent of the 7,392,000-cubic-foot capacity, the vapor dispersion exclusion zone would not extend beyond the terminal property line.

The effects of provisions for containing vapors as a means of mitigating flammable vapor hazards are permitted to be considered in the calculations by NFPA 59A section 2.2.3.3. However, calculations of vapor overflow rates do not account for the mixing of evolved vapor that is likely to occur over extended periods of time. This can be especially problematic for certain sump/impoundment configurations that allow for longer term vapor retention.

As a result, the FERC staff performed a supplementary vapor dispersion analysis for the design spill by conservatively assuming that no 20-foot-high security barrier wall surrounds the LNG storage tanks. SOURCE5 and DEGADIS predict 313 feet to the edge of the ½ LFL concentration envelope. The exclusion zone would not extend off site onto property that can be built upon, if all vapor retention by the security barrier wall surrounding the storage tanks was neglected. This supplementary analysis does not take into account any effects caused by topography, such as the vapor retention effects of the security barrier wall surrounding the storage tanks.

SES also performed vapor dispersion analyses for the process area sump and the trailer truck loading area sump. These sumps would receive spills from the process area and the trailer truck loading area, respectively. In accordance with table 2.2.3.5 of NFPA 59A, the design spill for these sumps would be the flow from any single accidental leakage source for 10 minutes. As previously stated, the determination of the single accidental leakage source should be based on an evaluation of all small diameter attachments to the transfer piping for instrumentation, pressure relief, recirculation, etc., and any flanges that may be used at valves or other equipment, in order to determine the largest spill rate. In its analysis, SES elected to model both the process area and the trailer truck loading area as instantaneous spills from a full pipe rupture and the resulting flow into the sumps as a worst-case scenario.

In calculating vapor dispersion from the process area sump, SES modeled an instantaneous spill from a full pipe rupture and the resulting flow into the sump. SES used a spill size of 95,976 gallons. SOURCE5 and DEGADIS predict 230 feet to the edge of the ½ LFL concentration envelope. This exclusion zone for the process area sump would not extend beyond the terminal property. In calculating vapor dispersion from the trailer truck loading area sump, SES modeled an instantaneous spill of the volume released from three trailer truck loading lines into the sump. SES used a spill size of 8,981 gallons. SOURCE5 and DEGADIS predict the ½ LFL concentration envelope would not be recorded outside of the sump.

The FERC staff performed supplementary vapor dispersion analyses modeled as continuous 10-minute spills from 4-inch- and 3-inch-diameter connections from both the process area and the trailer truck loading area, respectively. In the case of the process area sump, SOURCE 5 and DEGADIS predict 222 feet to the edge of the ½ LFL concentration envelope. This exclusion zone would not extend beyond the terminal property line onto property that can be built upon. In calculating vapor dispersion from the trailer truck loading area sump, SOURCE5 and DEGADIS predict 72 feet to the edge of the ½ LFL concentration envelope. This exclusion zone would not extend beyond the terminal property line. The FERC staff concluded that a spill of the full volume of both the process area and trailer truck loading area sumps would provide the greatest dispersion distances in each case.

4.11.6 Cryogenic Design and Technical Review

As discussed above, study and evaluation of information for the proposed design and installation of the Long Beach LNG import terminal have been performed by the FERC staff. The cryogenic design and technical review emphasizes the engineering design and safety concepts as well as the projected operational reliability of the proposed facilities. The principal areas of coverage include: materials in cryogenic environments; insulation systems; cryogenic safety; thermodynamics; heat transfer; instrumentation; cryogenic processes; and other relevant safety systems.

The design and specifications submitted for the proposed facility to date are considered to be preliminary but would be the basis for any detailed design to follow. A discussion of SES' preliminary plans for hazard detection, hazard control, firewater, emergency shutdown, and security systems is presented in section 2.7.1. A significant amount of the basic design involving final selection of equipment manufacturers, process conditions, and safety-related issues will be completed in the next phase of project development if authorization is granted by the Commission. This information would need to be submitted to the FERC staff for review and approval.

As a result of the technical review of the information provided by SES in the submittal documents, a number of concerns were identified by the FERC staff relating to the reliability, operability, and safety of the facility. In response to staff's questions, SES provided written answers prior to a site visit and cryogenic design and technical review conference for the proposed project that was held in Long Beach in July 2004. Outstanding issues that require resolution are listed below as specific recommendations. Follow up on those items requiring additional action would need to be documented in reports to be filed with the FERC. As a result, **the FERC staff will recommend to its Commission that:**

> **The following measures shall apply to the LNG terminal design and construction details. Information pertaining to these specific recommendations shall be filed with the Secretary for the review and written approval of the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to commencement of service as specified in each recommendation below. This information shall be submitted a minimum of 30 days before approval to proceed is required.**
>
> - **A complete plan and list of the hazard detection equipment shall be filed <u>prior to initial site preparation</u>. The information shall include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings shall clearly show the location of all detection equipment.**
>
> - **<u>Prior to initial site preparation</u>, SES shall file a technical review of its facility design that:**

a. **identifies all combustion/ventilation air intake equipment and the distance(s) to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and**

b. **demonstrates that these areas would be adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion equipment whose continued operation could add to or sustain an emergency.**

- **A complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment shall be filed <u>prior to initial site preparation</u>. The information shall include a list with the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings shall clearly show the planned location of all fixed and wheeled extinguishers.**

- **The <u>final design</u> of the hazard detection equipment shall identify manufacturer and model.**

- **The <u>final design</u> of the hazard detection equipment shall include redundancy and fault detection and fault alarm monitoring in all potentially hazardous areas and enclosures.**

- **The <u>final design</u> of the hazard detection equipment shall provide flammable gas and UV/IR hazard detectors with local instrument status indication as an additional safety feature.**

- **The <u>final design</u> of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment shall identify manufacturer and model.**

- **The <u>final design</u> shall include equipment and instrumentation for the measurement of translational and rotational movement of the inner vessel for use during and after cool down.**

- **The <u>final design</u> shall include a minimum of three onsite seismic instruments that would have the capability of actuating an automatic plant-wide ESD in the event of seismic activity approaching the site CLE. SES shall specify the set point to be used.**

- **In the <u>final design</u> all structures, besides the LNG storage tanks, shall be designed to withstand the effects of an OBE, as required by Title 49 CFR Part 193 and NFPA 59A (2001), and, further, the condition of these structures shall not adversely affect the stability and integrity of the tanks in the SSE event.**

- **The <u>final design</u> shall include details of the LNG tank tilt settlement and differential settlement limits between each LNG tank and piping and procedures to be implemented in the event that limits are exceeded.**

- **The <u>final design</u> shall include drawings and specifications of the piping support structure of the LNG storage tanks.**

- **The final design shall include provisions to ensure that hot water circulation is operable at all times when LNG is present in the secondary LNG booster pump discharge piping or when the temperature in the LNG inlet channel to any vaporizer is below 35 °F.**

- **The final design shall include detection instrumentation and shutdown procedures for vaporizer tube leak, shell side overpressure, or bursting disc failure.**

- **The final design shall include provisions to drain the fractionation systems to safe locations.**

- **The final design shall ensure that air gaps are installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: would continuously monitor for the presence of a flammable fluid; would alarm the hazardous condition; and would shut down the appropriate systems.**

- **The final design shall include a fire protection evaluation carried out in accordance with the requirements of NFPA 59A, Chapter 9.1.2.**

- **The final design shall include details of the shutdown logic, including cause and effect lists for alarm and shut down.**

- **The final design shall include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, cryogenic spills, and earthquake, when applicable.**

- **The final design shall include procedures for offsite contractors' responsibilities, restrictions, limitations, and supervision of the contractors by SES staff.**

- **Security personnel requirements prior to and during LNG vessel unloading shall be filed prior to commissioning.**

- **An operation and maintenance manual and safety procedure manual shall be filed prior to commissioning.**

- **Copies of the Coast Guard-approved Facility Security Plan and LNG Vessel Operation and Emergency Contingency Plan shall be filed prior to commissioning.**

- **The contingency plan for failure of the outer LNG tank containment shall be filed prior to commissioning.**

- **The final detailed drawings of the transfer line impoundment systems, including cross sections, shall be filed prior to commissioning.**

- **A copy of the criteria for horizontal and rotational movement of the inner vessel for use during and after cool down shall be filed prior to commissioning.**

- **The FERC staff and Coast Guard shall be notified of any proposed revisions to the security plan and physical security of the facility prior to commencement of service.**

- **Progress on the construction of the LNG terminal shall be reported in monthly reports filed with the Secretary. Details shall include a summary of activities, problems encountered, and remedial actions taken. Problems of significant magnitude shall be reported to the FERC within 24 hours.**

In addition, **the FERC staff will recommend to its Commission that the following measures apply throughout the life of the facility:**

- **The facility shall be subject to regular FERC staff technical reviews and site inspections on at least a biennial basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, SES shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, shall be submitted.**

- **Semi-annual operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.), and plant modifications including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boiloff rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant plant modifications proposed for the next 12 months (dates)" also shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.**

- **In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified within 24 hours and procedures for corrective action shall be specified.**

- **Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (i.e., attempts to enter site, suspicious activities) shall be reported to the FERC staff and the Coast Guard within 24 hours. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made immediately, without unduly interfering with any**

necessary or appropriate emergency repair, alarm, or other emergency procedure. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury resulting in patient hospitalization;

e. free flow of LNG for 5 minutes or more that results in pooling;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas or LNG;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas or LNG;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;

i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shut down of operation of a pipeline or an LNG facility that contains or processes gas or LNG;

l. safety-related incidents to LNG vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG

facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.

4.11.7 Marine Safety[6]

The February 2004 Interagency Agreement provides the framework for the participating agencies to work in a coordinated manner to address the full range of issues regarding safety and security at LNG import terminals. The FERC closely coordinates its pre-certificate review of a proposal with the Coast Guard, which has authority over the safety of LNG vessels and the marine transfer area as well as the security of the LNG vessels and the entire LNG facility.

The hazards associated with the marine transportation of LNG differ from land-based hazards. Whereas the land-based facilities have features to both limit the duration of LNG spills and contain credible spill volumes, any LNG spill on water may be unconfined and may vaporize rapidly due to heat input from the water.

The history of LNG shipping has been free of major incidents, and none has resulted in a significant quantity of cargo being released (see section 4.11.7.3). No incidents have occurred at existing LNG terminals during the 50 years of operation that resulted in any significant quantities of cargo being released. However, the possibility of an LNG spill from a ship over the duration of the proposed project must be considered. Historically, the events most likely to cause a significant release of LNG were a ship casualty such as:

- a vessel colliding with an LNG ship in transit;
- an LNG ship alliding[7] with the terminal or a structure in the Port;
- a vessel alliding with an LNG ship while moored at the terminal; or
- a grounding sufficiently severe to puncture an LNG cargo tank.

Since the attacks on September 11, 2001, additional risks are considered due to the possibility of a deliberate attack on an LNG ship by a terrorist group.

Any of the above events would have to occur with sufficient impact to breach the LNG ship's double hull and cargo tanks. Previous incidents with LNG ships have primarily involved grounding, and none of these have resulted in the breach of the double hull and subsequent release of LNG cargo.

The following discussion provides a chronology of the LNG ship voyage from the liquefaction facility to the import terminal, disclosing the risks at each step and how they are managed. Details and analysis are provided in subsequent sections. A detailed discussion of LNG ship standards and design features is presented in section 2.1.2.

4.11.7.1 LNG Vessels and Ocean Voyage

Imported LNG could be obtained from exporting terminals throughout the world and delivered by LNG ships to the proposed terminal. Exporting countries include Algeria, Australia, Brunei, Indonesia,

---

6 This section was written with the cooperation and assistance of the Coast Guard, Sector Los Angeles-Long Beach.

7 "Allision" is the action of dashing against or striking upon a stationary object (e.g., the running of one ship upon another ship that is docked) - distinguished from "collision," which is used to refer to two moving ships striking one another.

Malaysia, Nigeria, Oman, Qatar, Trinidad, and United Arab Emirates. In 2003, LNG imports to the United States included: 72 percent from Trinidad, 12 percent from Nigeria, 10 percent from Algeria, 3 percent from Qatar, 2 percent from Oman, and 1 percent from Malaysia. SES has indicated that the LNG for the proposed terminal would likely be imported from Pacific suppliers, which include six plants in the Pacific and four plants in the Middle East.

The LNG ships used to import LNG to the United States would be constructed and operated in accordance with the IMO's Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, the SOLAS, and Title 46 CFR Part 154, which contain the United States safety standards for vessels carrying bulk LNG. Foreign flag LNG ships are required to possess a valid IMO Certificate of Fitness and a Coast Guard Certificate of Compliance.

In 1993, amendments to the IMO's Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk require all tankers to have monitoring equipment with an alarm facility that is activated by detection of overpressure or underpressure conditions within a cargo tank. In addition, the cargo tanks are heavily instrumented, with gas detection equipment in the hold and inter-barrier spaces, temperature sensors, and pressure gauges. Fire protection must include the following systems:

- a water spray (deluge) system that covers the accommodation house control room and all main cargo valves;
- a traditional firewater system that provides water to fire monitors on deck and to fire stations found throughout the ship;
- a dry chemical fire extinguishing system for hydrocarbon fires; and
- a system for protecting machinery including the ballast pump room, emergency generators, and compressors.

As a result of the attacks on September 11, 2001, the IMO agreed to new amendments to the 1974 SOLAS addressing port facility and ship security. The International Ship and Port Facility Security Code was adopted in 2003 by the IMO. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to: prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce risk to passengers, crew, and port personnel on board ships and in port areas, for vessels and cargoes. All LNG ships as well as other cargo vessels 300 gross tons and larger and ports servicing those regulated vessels must adhere to these IMO and SOLAS standards. Some of the IMO requirements are as follows:

Ships:

- Ships must develop security plans that address monitoring and controlling access; monitoring the activities of people, cargo, and stores; and ensuring the security and availability of communications;
- Ships must have a Ship Security Officer (SSO);
- Ships must be provided with a ship security alert system. These systems transmit ship-to-shore security alerts to a competent authority designated by the Flag State Administration, which may include the company, identifying the ship, its location, and indicating that the security of the ship is under threat or it has been compromised. For the

west coast, this signal is received by the Coast Guard's Pacific Area Command Center in Alameda, California**.**

- International port facilities that ships visit must have a security plan, including focused security for areas having direct contact with ships; and

- Ships may have certain equipment onboard to help maintain or enhance the physical security of the ship.

Port facilities:

- The port facility must have a security plan and a FSO; and

- Certain security equipment may be required to maintain or enhance the physical security of the facility.

Both ships and ports must:

- Monitor and control access;

- Monitor the activities of people and cargo;

- Ensure the security and availability of communications; and

- Complete a Declaration of Security that is signed by the FSO and SSO that ensure areas of security that overlap between the ship and facility are adequately addressed.

4.11.7.2 LNG Vessel Transit in the Port of Long Beach

The POLB facilities are largely a manmade port in deep water sheltered by an extensive manmade breakwater approximately 2 nm from the previous natural shoreline. The complex of piers within the POLB has been constructed using low natural islands, by dredging, and by land reclamation. The general arrangement of the POLB is shown on figure 4.7.3-1. Current and future ship traffic levels within the POLB are discussed in section 4.7.3.1.

LNG Vessel Approach and Handling

Table 4.11.7-1 shows the relative dimensions of two of the larger LNG ships that would be used to transport LNG to the proposed LNG terminal: 125,000 to 145,000 cubic meter cargo capacity typical of ships presently in service; and 165,000 cubic meter potential cargo capacity of future ships.

TABLE 4.11.7-1

Typical LNG Ship Characteristics

Specifications	Existing Ships		Future Ships
Capacity	125,000 cubic meters	145,000 cubic meters	165,000 cubic meters
Length	950 feet	950 feet	1,000 feet
Beam	145 feet	158 feet	150 feet
Loaded Draft	38 feet	38 feet	40 feet
Hull Depth	82 feet	88 feet	100 feet
Loaded Displacement	95,000 long tons	108,500 long tons (est.)	122,000 long tons

LNG ships would approach from the ocean generally from the northwest passing north of Catalina Island or from the south passing to the east of Catalina Island. From the ocean, LNG ships would gain access to the LNG terminal site via the Queens Gate entrance, which is the opening between the Long Beach breakwater and the Middle breakwater (see figure 4.7.3-1). The marked channel at Queens Gate is about 1,200 feet wide and 76 feet deep and opens onto the enclosed waters of San Pedro Bay. To access Pier T, the LNG ships would travel northwest within the Long Beach Main Channel into the Middle Harbor. The Long Beach Main Channel is 850 feet wide and 75 feet deep. Adjacent to Pier F, the channel depth is 76 feet and the width is 400 feet. Middle Harbor depth is between 56 to 64 feet at the turning area and 1,500 feet wide. The channel bottom is generally flat and sandy. The LNG berth lies on the sheltered western side of Pier T at Berth 126 in the West Basin. There are no bridges or overhead cables over the channels from the Port entrance to Pier T. There is a subsea cable crossing area at the Queens Gate entrance in water depths of about 76 feet and a subsea cable crossing the channel between Pier F and the Navy Mole in 77 feet of water. Isolated rocks at a depth of 60 feet are outside the navigable channel before the Queens Gate entrance. The ends of the breakwaters at the entrance are also rocky. The embankments at Piers J and F and the Naval Mole bounding the channel are made of rock. These areas adjacent to the navigation channel are well marked.

Vessel traffic in the POLB is controlled through a single VTS located at Point Fermin to the west of the ports of Long Beach and Los Angeles. Ships of 300 gross tons or greater are required to report to the VTS and are monitored by radar from a point 25 nm seaward of Point Fermin. The ships report again on arriving at the boundary of the precautionary area that extends 8 nm to the south of the Queens Gate entrance. The movements of ships are monitored and coordinated by the VTS while they are underway in the area of coverage, at designated anchorages, and to the entrances of the ports. The VTS monitors vessel movements on a 24-hour basis.

The pilots within the POLB receive estimated times of arrival from the VTS and board vessels at a position approximately 2 nm south of the Queens Gate entrance. Once on board, the pilots report to the VTS. Typical transit times for inbound movement to a berth are about 1.5 to 3 hours; outbound movements are typically shorter. Once the ships enter and are inward of the Queens Gate, the responsibility for vessel traffic management transfers from the VTS to the Long Beach pilot service. The Long Beach pilot service is managed by Jacobsen Pilots, which is an independent commercial company that provides services to vessels under a contract with the POLB. Jacobson Pilots' control station is on Pier F, approximately 3,000 feet from the LNG terminal location. Jacobsen Pilots monitors traffic within the POLB 24 hours a day using radar systems and closed circuit television. The watchstanders in the pilot station have a clear view from Pier T, through the West Basin, the western inner anchorage, and the entire Long Beach Main Channel to the Queens Gate entrance.

There are 15 pilots working 3 watches with 5 pilots on duty each shift. An average of 20 vessel movements is handled by each shift on a typical day. The pilots' working hours are monitored and limited as a precaution against fatigue. The pilots are professional seafarers drawn from commercial shipping, the towage service, and naval shipping. The entry requirement is command experience and a 3-year training program. At present, 3 trainees augment the 15 full-time pilots.

One or more pilots would board the LNG vessel and direct the ship's transit in the Port and during berthing. During maneuvers, the pilot would be on board and would oversee the navigation and berthing of the ship. The vessel master would be on the bridge monitoring the pilot's commands and would retain overall responsibility for the safe navigation of the LNG ship. The Coast Guard may have a security boarding team onboard during the transit based on the current threat and risk. Other security measures during the transit would be in accordance with the measures determined in the Waterway Suitability Assessment (WSA) (see section 4.11.7.4) and as required by the Coast Guard.

The Coast Guard, VTS, and Jacobsen Pilots would determine the best time to bring the LNG ship to berth based on security concerns, impacts on other vessels, weather conditions, and other factors. Docking, LNG cargo unloading, and undocking would take less than 24 hours in most cases, weather permitting. In addition to Jacobsen Pilots, the Coast Guard would monitor the LNG vessel through the Port and while unloading cargo. The Coast Guard requires all LNG vessels to give 96-hour advance notice of arrival, including the names of crew members for which they can check among national security databases and the past five port calls. In addition, for other LNG import terminals, the Coast Guard has boarded the LNG vessel outside the entrance to conduct an inspection of the ship's safety systems and perform a security sweep. Other requirements are likely to include a security escort to the dock, establishment of a moving security zone around the vessel while en route (see figure 4.11.7-1) and during unloading operations, an inspection of the dock safety systems prior to commencing cargo transfer, and monitoring all operations until the vessel departs. Maintaining security of the dock and vessel would be the responsibility of the facility in cooperation with federal, state, and local partners as described in the Facility Security Plan (see section 4.11.8). In addition, SES is currently working with the Coast Guard to develop a WSA that will determine the appropriate safety and security measures to mitigate risks while the vessel is operating in the VTS area. The WSA is discussed further in section 4.11.7.4.

The Coast Guard has an extensive tug escort requirement. Escort tugs must be on station at the sea buoy before an incoming ship approaches the pilot operations area. The first tug is typically tethered before the ship approaches the entrance, with a second tug standing by. The second tug is then tethered once the ship clears the entrance. There are six contractors supplying tug services in the ports of Long Beach and Los Angeles. The 26-tug fleet includes both conventional tugs and highly maneuverable tractor tugs. One of the tug services, Foss Maritime, is based in the Back Channel less than 1 nm from the LNG terminal location.

It is anticipated that the pilots would normally turn the LNG ships in the West Basin on arrival and berth to the port side of the ship. The benefit of this is that the vessel would be berthed heading outwards and could depart more easily in the event of an emergency.

Weather Conditions

The weather conditions in the POLB are mild and predictable and the conditions that limit ship movements occur infrequently. The wind climate of the Port area is different from and more predictable than that offshore. In the 44-year period of record, winds of gale force have only been experienced within the POLB during the months of March and November and then for only 0.01 percent of the time. Winds of 17 knots or greater may occur about 1 to 2 percent of the time from November through May. The common diurnal wind pattern of the area is for calm and light winds in the mornings and winds of approximately 15 knots in the afternoons, occasionally gusting to 30 knots.

Adverse wave conditions are historically rare, although choppy seas can occur after a front passes. The POLB experiences occasional swell conditions from the south that are noticeable outside the entrance to the Port. Adverse wave conditions rarely occur inside the harbor because of the shelter provided by the outer breakwater and, in the case of Pier T, because of the additional shelter provided by the Navy Mole.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-153
Figure 4.11.7-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

The mean tidal range is approximately 5.5 feet, although it reaches a maximum of 8 feet several times per year. Data from the pilots indicate little tidal current and circulation current within the POLB under normal circumstances. However, current levels of 1 to 1.5 knots have been recorded at the Queens Gate entrance and outside the breakwater following high rainfall draining from the Los Angeles River flood control channel. The berth and the West Basin are separated from the outfall of the flood control by the Piers E, F, and G complex. Due to the deep water in the Port and the relatively wide channels and entrances, current effects on ship handling are only noticeable when handling very deep draft ships (62 feet) in the Back Channel. In the area of the proposed LNG ship berth the pilots report no effect when handling vessels of 40 feet draft because of the low blockage factor (ratio of the cross sectional area of the channel and the underwater cross sectional area of the ship) (Eagle Lyon Pope, 2004).

Reduced visibility due to fog and haze is a characteristic of the POLB, although it can be very localized. Records of visibility for Los Angeles show that reduced visibility can be experienced in the area during any month and can occur on several days in a month. The duration of reduced visibility is variable. The incidence of visibility of less than 0.5 mile is low, occurring on less than 1 day per month over the 44-year period of record. The closed circuit television system within the POLB is used by the pilots to determine the real extent of fog within the Port.

Guidelines for Ship Traffic

The State of California has established an HSC to develop standards of care for ensuring the safety of vessels transiting both the ports of Los Angeles and Long Beach. The California Oil Spill Prevention and Response Act of 1990 mandated the Los Angeles/Long Beach HSC. The CDFG's Office of Oil Spill Prevention and Response officially appointed the HSC on August 10, 1991.

The California Oil Spill Prevention and Response Act of 1990 required the HSC to review, evaluate, and develop a plan to address sounding checks, anchorage designations, traffic and routings from port construction and dredging projects, procedures for routing vessels during emergencies that impact navigation, communications systems, channel design plans, placement and effectiveness of navigational aids, bridge management requirements, small vessel congestion in shipping channels, determining when tankers must be accompanied by an escort tug(s), and mechanisms to ensure that the provisions of the plan are fully and regularly enforced.

The HSC has implemented a number of guidelines that govern ship movement within the POLB. These measures include: speed restrictions, transit times, pilot oversight, tug escorts, a traffic movement priority, ship spacing, weather restrictions, under keel clearance, Coast Guard or other security escort, and anchorage areas as described below. All shippers in the POLB must adhere to these guidelines.

- ***Speed Restrictions*** – Ships are encouraged to voluntarily restrict their speed to a maximum of 12 knots at 20 nm out from the Port. This speed restriction is monitored by the VTS. In practice, this means that large vessels are under speed management that allows simple control of engine revolutions and hence ship maneuvering in open water. In the precautionary area from the sea buoy inwards and within the POLB the speed restriction is a maximum of 6 knots for ships of 60,000 tons deadweight or over, and 8 knots for ships between 300 and 60,000 tons.

- ***Transit Times*** – Transit times within the POLB are not specifically limited to either day or night because the layout of the Port, navigation aids, and vessel traffic management systems make night restrictions unnecessary. Therefore, ship movements into and out of the POLB are undertaken during both daylight and night hours.

- ***Pilot Oversight*** – As discussed above, one or more pilots from Jacobsen Pilots would board the LNG vessel and direct its transit in the Port and during berthing.

- ***Tug Escorts*** – As also discussed above, the Coast Guard has an extensive tug escort requirement as part of marine safety management. There is a detailed tug force selection matrix used to ensure the correct minimum bollard pull is assigned to ships. Escort tugs must be on station at the sea buoy before an incoming ship approaches the pilot operations area. The first escort tug is typically tethered before the ship approaches the entrance, with the second tug standing by. The second tug is then tethered once the ship is inside the entrance. When ships are outbound, the tugs are typically untethered before the ship clears the Queens Gate, but stand by until the ship is clear of the entrance.

- ***Traffic Movement Priorities*** – A traffic management priority for outbound ships has been established. This is particularly relevant in the main channel where it passes at the cut between the Navy Mole and Pier F where outbound ships are required to clear the Middle Harbor before inbound vessels enter.

- ***Ship Spacing*** – At present, ships moving within the precautionary area and inside the breakwaters of the POLB are required to maintain a minimum separation distance of 0.25 nm (500 yards). This minimum spacing requirement applies to all ships operating within this area of the Port.

- ***Weather Restrictions*** – Ships are not allowed to start moving within or enter the POLB when visibility is less than three times the overall length of the ship. Movement of tankers or deep draft vessels of 45 feet or more is restricted if visibility falls below 0.75 nm. If the visibility falls below 0.5 nm, the pilot and ship's master are required to ensure that it is safe to proceed. Further, when visibility is less than 0.5 nm and ships are moving, one-way traffic management is imposed.

  The POLB and the pilots do not publish fixed operational limits for ship handling in windy conditions because each case is subject to operational review, practicality, and tug allocation. However, for large sail-area ships, such as container ships, 20 knots is a typical upper limit for wind speed for movement of these ships within the Port.

- ***Under Keel Clearance*** – The under keel clearance policy in the POLB includes complying with Coast Guard requirements (Title 33 CFR Part 157.455), which in part include discussion between the ship's master and the pilot to specify the water depths required. The static under keel clearance before roll and pitch considerations in the sector between the sea buoy and the Long Beach Main Channel (inside the entrance), at buoy 3, is a minimum of 10 percent of the ship's draft. In the channel, the required under keel clearance from inside the entrance to the berth is a minimum of 1.5 feet for ships of 75,000 tons deadweight and less, and 3 feet for larger ships. At the berth the requirement is that the vessel be afloat. An LNG ship of 145,000 cubic meters would be less than 75,000 tons deadweight and have less than a 40-foot draft. Thus, the required 10 percent (4 feet) and 1.5-foot under keel clearances would be easily attained.

- ***Coast Guard or Other Security Escort*** – For certain ships, the Coast Guard provides an escort boat to enforce a security zone around the ship. In some cases, the Coast Guard may use an escort boat from the local police department or other security source. The security zone has been defined in Title 33 CFR Part 165.1151 as a 500-yard radius around a liquefied hazardous gas ship (inclusive of LNG ships) that is moored or in the

process of mooring within the breakwater, and 1,000 yards ahead and 500 yards on each side and astern of an LNG ship that is underway either within the breakwater or in an area within 3 nm seaward of the federal breakwater. The Coast Guard may escort the LNG ships on a case-by-case basis at the discretion of the Captain of the Port. A security zone of 1,000 yards ahead and 500 yards astern and on each side of an LNG ship on an inward transit is shown on figure 4.11.7-1.

- ***Anchorage Areas*** – Ships are directed to specific anchoring points and are monitored by radar. Large ships proceeding to anchor are required to have tug assistance to ensure the anchor is dropped at the correct location. It is not anticipated that LNG ships would use an anchorage on inbound transits, except in the rare event when reduced visibility would prevent the vessel from proceeding directly to the berth.

The operational controls by the Coast Guard, VTS, and Jacobsen Pilots and the characteristics of the POLB as described above would minimize the possibility of an LNG cargo spill from groundings, collisions, and allisions.

4.11.7.3 LNG Ship Safety

Since 1959, LNG has been transported by ship without a major release of cargo or a major accident involving an LNG ship. Starting in 1971, LNG began arriving at the Distrigas of Massachusetts Corporation (Distrigas) facility in Everett, Massachusetts. To date, more than 450 cargoes, with volumes ranging from 60,000 to 138,000 cubic meters, have been delivered into the Port of Boston without incident. During 2003, a total of 506 billion cubic feet (204 cargoes) of LNG was imported into the United States. For 30 years, LNG shipping operations have been safely conducted in the United States.

The world's LNG ship fleet numbers 151, with an additional 57 ships contracted for delivery by 2006. During the last 40 years, LNG ships have made over 33,000 voyages and safely transported over 2.72 billion cubic meters of LNG. This includes over 1,500 voyages to or from U.S. ports. Currently, all of the ships in the LNG fleet operate under a foreign flag with foreign crews. A foreign flag ship must have a Certificate of Compliance inspection by the Coast Guard to ensure compliance with International safety standards.

History

During the 33,000 voyages that have been completed since the inception of LNG maritime transportation, there have been only 8 significant incidents involving LNG ships, none of which resulted in spills due to rupturing of the cargo tanks. These incidents are described below.

- ***Pollenger*** had an LNG spill onto the steel cover of cargo tank number one during unloading at Everett, Massachusetts in April 1979. The spill caused cracking of the steel plate.

- ***Mostafa Ben Boulaid*** had a check valve fail when unloading at Cove Point, Maryland in April 1979 releasing a small quantity of LNG onto the ship and causing some minor fracture of the deck plating. Activation of the ship's safety systems (i.e., the emergency shutdown system and water spray system), along with the quick response of the crew, kept the incident from propagating, thus minimizing any serious damage.

- ***El Paso Paul Kayser*** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast

tanks resulted; however, the cargo tanks were not damaged, and no cargo was released. The complete cargo of LNG was subsequently transferred to another LNG ship and delivered to its United States destination.

- ***LNG Libra's*** propeller shaft fractured while the ship was en route to Japan with a full cargo in October 1980. The ship was taken under tow, and the cargo was safely transferred to another LNG ship and delivered to its destination.

- ***LNG Taurus*** grounded in December 1980 near the entrance to Taboata Harbor, Japan. The grounding resulted in extensive bottom damage, but the cargo tanks were not affected. The ship was refloated and the cargo unloaded.

- ***Isabella*** had LNG spill onto its deck due to a cargo tank overflow in June 1985, causing severe cracking of the steelwork. The spill was attributed to a cargo valve failure during the discharge of cargo.

- ***Tellier*** was blown from its docking berth at Skikda, Algeria in February 1989 during severe winds causing damage to the loading arms and the ship and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck causing fracture of some plating.

- ***Norman Lady*** was struck by the nuclear submarine *USS Oklahoma City* while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 cubic meter LNG tanker, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull and none to its cargo tanks.

There have also been some incidents that involved the release of small quantities of LNG, such as minor leaks from seals and gaskets, some of which required that operations be temporarily stopped in order to rectify the malfunction.

Vessel Construction

In 1980, at the initial peak of LNG import activity in the United States, the Coast Guard published the report, *Liquefied Natural Gas and Liquefied Petroleum Gas – Views and Practices – Policy and Safety.* The report summarized the Coast Guard's extensive research into the safety hazards of LNG and its view that "...the nature of both LNG and LPG presents an acceptable risk for transportation in maritime commerce." This is due to the fact that LNG ships are well constructed, robust vessels designed to withstand low-energy type incidents that are prevalent in harbors and during docking operations. Moreover, safety measures, both in equipment and training, are planned and designed into these LNG ships to prevent or control all types of potential incidents.

The insulation of cargo tanks on LNG carriers is a complex assembly of many layers. The relief valve capacity for cargo tanks is designed to compensate for overpressure caused by fire. The potential that impingement by a cryogenic liquid could cause brittle fracture of the ship's hull was known to the Coast Guard in the mid-1970s when the U.S. regulations for LNG carriers in Title 49 CFR Part 154 were being developed. Accordingly, the regulations require the use of special crack-arresting steel in strategic locations throughout the vessel's hull. LNG carriers used in U.S. waters must also be constructed in accordance with the IMO Code for the Construction and Equipments of Ships Carrying Liquefied Gases in Bulk. This standard requires that the vessel inner hull adjacent to the cargo tanks be protected against

contact from liquid cargo through a combination of proper material selection, adequate insulation, and use of heating systems.

As required by the IMO conventions and design standards, hold spaces and insulation areas on an LNG carrier are equipped with gas detection and low temperature alarms. These devices monitor for leaks of LNG into the insulation between primary and secondary LNG cargo tank barriers. In addition, hazard detection systems are also provided to monitor the hull structure adjacent to the cargo tank, compressor rooms, motor rooms, cargo control rooms, enclosed spaces in the cargo area, specific ventilation hoods and gas ducts, and air locks.

LNG carriers are equipped with a firewater system with the ability to supply at least two jets of water to any part of the deck in the cargo area and parts of the cargo containment and tank covers above-deck. A water spray system is also available for cooling, fire prevention, and crew protection in specific areas. In addition, certain areas of LNG carriers are fitted with dry chemical powder-type extinguishing systems and CO_2 smothering systems for fighting fires.

Unlike many conventional crude oil tankers, all LNG ships used to deliver LNG to the proposed project would have double-hull construction, with the inner and outer hulls separated by about 10 feet. Furthermore, the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1 foot thick. As a result, many grounding incidents severe enough to cause a cargo spill on a single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG ship. A study by the Federal Power Commission (FPC), which was the predecessor to the FERC, estimated that the double bottom of an LNG ship would be sufficient to prevent cargo tank penetration in about 85 percent of the cases that penetrated a single-bottom oil tanker.

The probability of an LNG ship sustaining cargo tank damage in a collision would depend on several factors – the displacement and construction of both the struck and striking vessels, the velocity of the striking vessel and its angle of impact with the struck vessel, and the location of the point of impact. The previous FPC study estimated the additional protection afforded by the double-hull would be effective in low energy collisions; overall it would prevent cargo tank penetration in about 25 percent of the cases that penetrated a single-hull oil tanker.

In 1995, to assist the Coast Guard in San Juan, Puerto Rico, EcoEléctrica L.P. prepared an analysis of the damage that could result from an oil tanker striking an LNG ship at berth (FERC, 1996). The analysis assumed a 125,000 cubic meters LNG ship and an 82,000 deadweight ton tanker carrying number 6 fuel oil without tug assistance. The analysis determined the minimum striking speed to penetrate the cargo tanks of an LNG ship for a range of potential collision angles. The resulting minimum striking speeds are presented in table 4.11.7-2 for the two principal cargo systems.

TABLE 4.11.7-2

Minimum Striking Speed to Penetrate LNG Cargo Tanks

	Minimum Striking Speed (knots)	
Angle of Impact	Spherical Tanks	Membrane Tanks
Greater than 60 degrees	4.5	3.0
45 degrees	6.3	4.0
30 degrees	9.0	6.0
15 degrees	18.0	12.0

For membrane tanks, the critical on-beam striking speed is 3.0 knots, and for spherical tanks, the critical on-beam speed is 4.5 knots. For both containment types, lower angles of impact result in much greater minimum striking speeds to penetrate LNG cargo tanks.

In another study that appeared in the July/August 2002 issue of the "LNG Journal," the SIGTTO General Manager provided a table showing the critical speed necessary for a 20,000-ton vessel to puncture the outer hull of an LNG carrier is 7.3 knots. For a 93,000-ton ship, the impact speed is 3.2 knots. In neither case does such an impact result in damage to the LNG cargo containment system or the release of LNG.

In December 2004, the DOE released a study by Sandia National Laboratories, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water* (Sandia Report). The Sandia Report included an LNG cargo tank breach analysis using modern finite element modeling and explosive shock physics modeling to estimate a range of breach sizes for credible accidental and intentional LNG spill events. The analysis of accidental events found that groundings, collisions with small vessels, and low speed (less than 7 knots) collisions with large vessels striking at 90 degrees could cause minor ship damage but would not result in a cargo spill. This is due to the protection provided by the double-hull structure, the insulation layer, and the primary cargo tank of an LNG vessel. High speed (12 knots) collisions with large vessels striking at 90 degrees were found to potentially cause cargo tank breach areas of 0.5 to 1.5 square meters.

Hazards

In the event of a collision or allision of sufficient magnitude to rupture an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. In a grounding of sufficient magnitude to rupture an LNG cargo tank, the damage would occur under water and the potential for ignition would be less than for collisions or allisions. In this case, an LNG spill would rapidly vaporize on water and form a potentially flammable cloud. If not ignited, the flammable vapor cloud would drift downwind until the effects of dispersion would dilute the vapors below the LFL for methane. The maximum range of potentially flammable vapors (i.e., the distance to the LFL) is a function of the volume of LNG spilled, the rate of the spill, and the prevailing meteorological conditions. If the flammable vapor cloud encountered an ignition source, the cloud would burn back to the spill site.

The final EIS for the Calcasieu LNG Project in Lake Charles, Louisiana (September 1976) analyzed the maximum range of a flammable vapor cloud and hazardous radiation levels from an instantaneous one-tank spill. As was consistent with risk analyses at that time and for nearly 25 years thereafter, the instantaneous spillage of one cargo tank was considered to be the "worst-case" scenario. Physical constraints on maximum vessel speeds and maximum depths of penetration required to rupture one LNG cargo tank render the instantaneous release of more than one cargo tank to be improbable. This is not to imply that the loss of multiple cargo tanks could never occur, but that the extent of the hazard would not exceed that of the instantaneous spillage of one tank.

For an instantaneous one-tank spill with ignition, the final EIS for the Calcasieu LNG Project estimated that a hazardous thermal radiation level of 5,300 Btu/ft^2-hr would extend 3,595 feet from the center of the spill. For an instantaneous one-tank spill without ignition, the final EIS for the Yukon Pacific LNG Project (FERC, March 1995) estimated that potentially flammable vapors could travel up to 3.3 miles with a 10 mph wind and typical atmospheric stability.

In October 2001, the use of a one-tank instantaneous release as the worst-case scenario was re-examined by Quest as part of an effort by the DOE to determine the hazards associated with reopening the Distrigas LNG import terminal following the terrorist attacks of September 11, 2001. It was determined

that time-release spills through 1-meter- and 5-meter-diameter holes would more accurately simulate credible worst-case damage scenarios. Maximum flammable vapor cloud and radiation hazards were calculated for the two spill scenarios. For a spill on water with ignition, the maximum distance to a radiant flux level of 1,500 Btu/ft^2-hr was estimated to be 1,770 feet. For a spill on water without ignition, a flammable vapor cloud of 2.5 miles was estimated. In November 2003, in response to comments concerning its October 2001 study, Quest clarified that its study only applied to LNG spills resulting from a collision with a large ship in Boston's Outer Harbor where waves would restrict the spreading of LNG on water.

Since the 2001 Quest study, there has been an emergence of studies by various parties to define the worst-case scenario that would result from a deliberate, terrorist attack on an LNG vessel and the subsequent release of cargo. Distances have been estimated to range from 1,770 to 4,200 feet for a thermal radiation level of 1,500 Btu/ft^2-hr. Part of the reason for the apparent discrepancies is the lack of large-scale historical incidents and the need to extrapolate small-scale field test data to a worst-case event. This inevitably leads to differing conservative assumptions among the various parties. For example, some models calculate a time-release cargo discharge through 1-meter- or 5-meter-diameter holes, while others assume that the cargo tank empties instantaneously.

As a result, the FERC commissioned a study by ABSG Consulting Inc. (ABSG) to search and review the literature on experimental LNG spills and on consequence methodologies that are applicable to modeling incidents of LNG spills on water. Further, the goal of the study was to identify appropriate methods for estimating flammable vapor and thermal radiation hazard distances for potential LNG vessel cargo releases during transit and while at berth. The resulting study, *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, was released for public comment on May 14, 2004. On June 18, 2004, staff's responses to comments on the consequence assessment methods were issued. As discussed in greater detail in staff's responses, various components of the consequence assessment methodologies were revised based on comments received. The revised study provides the methodology for calculating: the rate of release of LNG from a cargo tank penetration for various sized holes; the spreading of an unconfined LNG pool on water for both continuous spills and rapid (nearly instantaneous) releases; the rate of vapor generation from a unconfined spill on water; thermal radiation distances for LNG pool fires on water; and flammable vapor dispersion distances.

A detailed evaluation of the consequences of a terrorist attack on a modern membrane LNG tanker was prepared by Lloyds Register North America for the Weaver's Cove LNG Project and filed under Critical Energy Infrastructure Information (CEII). The study evaluated the consequences of attacks on an LNG ship by missiles and explosives. Finite element analysis was used to evaluate the effect of various sized charges on both the outer and inner hulls. A 1-meter-diameter hole of the inner hull at the waterline was found to be the average most probable worst-case scenario for hazard consequence assessments. This finding is consistent with the attack on the double-hull oil tanker *Limberg* which caused greater than a 5-meter-diameter hole on the outer hull but only minor damage to the inner hull. A failure modes and effects analysis was used to understand internal LNG release characteristics, and a residual strength analysis was used to investigate damage scenarios for a loaded LNG ship.

As described above, the Sandia Report includes an analysis of accidental events that found that groundings and low speed collisions could result in minor ship damage but not a cargo spill; while high speed collisions could cause a 0.5 to 1.5 square meters cargo tank breach area. For intentional scenarios, the size of the cargo tank hole depends on the location of the ship and the source of the threat. Intentional breach areas were estimated to range from 2 to 12 square meters. In most cases, an intentional breaching scenario would not result in a nominal hole of more than 5 to 7 square meters, which is a more appropriate range to use in calculating potential hazards from spills. These hole sizes are equivalent to circular hole diameters of 2.5 and 3 meters.

The Sandia Report also included guidance on risk management for intentional spills, based on the findings that the most significant impacts on public safety and property exist within approximately 500 meters (1,640 feet) of a spill due to thermal hazards from a fire, with lower public health and safety impacts beyond 1,600 meters (5,250 feet). Large, unignited LNG vapor releases were found to be unlikely, but could extend to 2,500 meters (8,200 feet) for a nominal intentional spill.

Cascading damage due to brittle fracture from exposure to cryogenic liquid or fire-induced damage to foam insulation was evaluated and while possible under certain conditions is not likely to involve more than two or three cargo tanks. Cascading events are not expected to increase the overall fire hazard by more than 20 to 30 percent (1,920 to 2,080 meters) (6,300 to 6,825 feet), but would increase the expected fire duration. RPTs are possible for large spills but the effects would be localized near the spill source and should not cause extensive structural damage.

The methodology described in the ABSG study and revised in the FERC staff's responses to comments was used to calculate the thermal radiation and flammable vapor dispersion distances for several holes ranging in diameter from 1 meter to 3.9 meters. Based on the penetration of the largest cargo tank of a 140,000 cubic meter LNG ship, a potential spill of 23,000 cubic meters is estimated for the volume of LNG above the waterline. The estimated pool spread results and thermal radiation hazard distances are identified in table 4.11.7-3. Thermal radiation calculations are based on an ambient temperature of 44 ºF (obtained from National Data Buoy Center data), a relative humidity of 41 percent, and a 20 mph wind speed. Using the methodology, the FERC staff estimated distances for a nominal 2.5-meter and 3-meter diameter hole to range from 4,372 to 4,867 feet for a thermal radiation of 1,600 Btu/ft^2-hr, the level which is hazardous for persons located outdoors and unprotected, to 3,370 to 3,746 feet for 3,000 Btu/ft^2-hr, an acceptable level for wooden structures, and to 1,991 to 2,205 feet for 10,000 Btu/ft^2-hr, a level sufficient to damage steel structures after several minutes of exposure.

TABLE 4.11.7-3

LNG Spills on Water

LNG Release and Spread				
Hole Diameter	1.0 meter	2.5 meters	3.0 meters	3.9 meters
Hole Area	0.8 square meter	5 square meters	7 square meters	12 square meters
Spill Time	94 minutes	15 minutes	10.5 minutes	6.1 minutes
Pool Fire Calculations				
Maximum Pool Radius	340 feet	816 feet	936 feet	1,103 feet
Fire Duration	94 minutes	15 minutes	10.8 minutes	6.5 minutes
Distance to:				
1,600 Btu/ft^2-hr	2,212 feet	4,372 feet	4,867 feet	5,536 feet
3,000 Btu/ft^2-hr	1,726 feet	3,370 feet	3,746 feet	4,252 feet
10,000 Btu/ft^2-hr	1,051 feet	1,991 feet	2,205 feet	2,492 feet

Vapor dispersion calculations were based on an ambient temperature of 50 ºF, 50 percent relative humidity, a 4.5 mph wind speed, and atmospheric stability Class F (the most stable situation). Based on a 1-meter-diameter hole, an unignited release would result in an estimated pool radius of 420 feet. The unignited vapor cloud would extend to 9,030 feet to the LFL and 12,300 feet to ½ the LFL. It is important to identify certain key assumptions of conditions that must exist in order to achieve the maximum vapor cloud distances. First it would be necessary for an event to create a 1-meter-diameter hole by penetrating the outer hull, the inner hull, and cargo containment <u>without ignition</u>. Far more credible is that the event creating a 1-meter-diameter hole would also result in a number of ignition sources that would lead to an LNG pool fire and subsequent thermal radiation hazards. It is also unlikely

that a flammable vapor cloud could achieve its maximum distance over land surfaces without encountering an ignition source, and subsequently burning back to the source. Vapor dispersion for larger holes was not performed since, realistically, the cloud would not even extend to the maximum distance for a 1-meter-diameter hole before encountering an ignition source.

Areas of the Port along the shoreline would be within a potential transient hazard area during the LNG vessel transit, while areas around the terminal would be exposed to a potential hazard while the LNG vessel is at the dock and unloading cargo. The inbound transit through the POLB would pass other Port tenants that would be within 4,372 to 4,867 feet of the ship channel. Assuming an LNG vessel would transit within the Port at 6 knots, the adjacent Port areas would be exposed to a potential transient hazard for an estimated 19 minutes. In addition, a hazard would exist around the berth during part of the 6- to 18-hour period while the LNG vessel is at the berth and unloading cargo. The operational restrictions that would be imposed by the Coast Guard, the HSC, and Jacobsen Pilots on LNG vessel movements through this area, as well as the requirements that the Coast Guard would impose in its operating plan based on the WSA, would minimize the possibility of a hazardous event occurring along the vessel transit.

By focusing on the worst-case intentional breach scenarios for LNG transportation, there is a tendency to dismiss the potential hazards for other fuels and products commonly transported in U.S. waterways. Some of the previously identified studies that calculate long hazard distances for LNG cargo fires also estimate similarly long distances for gasoline, propane, and jet fuel cargo fires (i.e., they conclude that LNG is no more hazardous than other highly flammable cargoes). Also, it should not be assumed that the hazard distances identified are the assured outcome of an LNG vessel accident or attack, given the conservatisms in the models and the level of damage required to yield such large scale releases. Further, these estimated worst-case intentional breach scenarios should not be misconstrued as defining an exclusionary zone. Rather they provide guidance in developing the operating restrictions and mitigating strategies for LNG vessel movements in the POLB, as well as in establishing potential impact areas for emergency response and evacuation planning.

In addition to the analysis conducted by the FERC staff, the POLB commissioned a study to identify and analyze additional incident scenarios that would result from a release of LNG or other hydrocarbons in or near SES' proposed LNG import terminal. This study included an evaluation of the worst-case breach scenarios for LNG vessel transit (see section 4.11.10 and Appendix F). The study commissioned by the POLB includes some scenarios that the FERC staff does not consider credible; however, the POLB is subject to different requirements.

4.11.7.4 Requirements for LNG Ship Operations

The arrival, transit, cargo transfer, and departure of LNG ships in the POLB would adhere to the procedures of Operations and Emergency Manuals to be developed by SES in consultation with the Coast Guard Sector Los Angeles-Long Beach and in accordance with Title 33 CFR Part 127. These procedures would be developed to ensure the safety and security of all operations associated with LNG ship transit and unloading. The manuals would contain specific requirements for the LNG ship, pre-arrival notification, transit through the POLB, the waterfront facility, cargo transfer operations, Coast Guard inspection and monitoring activities, and emergency operations. The Coast Guard Sector Los Angeles-Long Beach would monitor each LNG ship in accordance with these manuals.

Some of the anticipated key provisions of the manuals would be the establishment of a moving security zone for all inbound, outbound, and moored LNG ships; and the use of a minimum of two tugs to assist in the POLB and to maneuver the ship into the berth.

The Coast Guard regulations in Title 33 CFR Part 127, apply to the marine transfer area of waterfront facilities between the LNG ship and the last manifold or valve located immediately before a storage tank. Further, Title 33 CFR Part 127 regulates the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection must comply with the regulations in Title 33 CFR Part 127. Under Title 33 CFR Part 127.019, SES would be required to submit two copies of its Operations and Emergency Manuals to the Captain of the Port.

Title 33 CFR Part 127 separates cargo transfer operations into three distinct phases: Preliminary Transfer Inspection (section 127.315); Declaration of Inspection (section 127.317); and LNG Transfer (section 127.319). These different sections require specific actions to be completed prior to and during the transfer. Additionally, there are specific actions required in the case of a release of LNG (section 127.321).

In accordance with Title 33 CFR Part 127.007, SES submitted an LOI to the Coast Guard on April 13, 2005, conveying its intention to build an LNG facility at the proposed site. On June 28, 2005, the Coast Guard published a Notice of Intent to conduct a Waterway Suitability Assessment and a Notice of a Public Meeting in the Federal Register stating its intentions to evaluate the LOI and determine the suitability of the waterway for issuance of an LOR. In addition, the Coast Guard held a public meeting on July 11, 2005 and opened a docket to take comments on the concerns relating to the safety and security of the waterway. Upon completion of its review, the Coast Guard would issue an LOR to address the suitability of the POLB for LNG transport with respect to the following items:

- density and character of marine traffic;
- locks, bridges, or other manmade obstructions;
- depth of water;
- tidal range;
- protection from high seas;
- underwater pipes and cables; and
- distance of berthed vessels from the channel.

Due to numerous planned and proposed LNG import terminals at various ports across the United States and the maritime security implications of LNG marine traffic on a port, on June 14, 2005 the Coast Guard issued a *Navigation and Vessel Inspection Circular – Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC). The purpose of this NVIC is to provide Coast Guard Captains of the Port/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic that takes into account conventional navigation safety/waterway management issues contemplated by the existing LOI/LOR process, but in addition, will also take completely into account maritime security implications. The NVIC also provides specific guidance on the timing and scope of the WSA, which will address both safety and security of the port, the LNG terminal, and the LNG ships. Preparation of this guidance was referenced in the Coast Guard's March 18, 2005 *Report to Congress on Liquefied Natural Gas Terminals*.

The WSA process addresses the transportation of LNG from an LNG ship's entrance into U.S. territorial waters through its transit to and from the LNG receiving facility, and includes operations at the vessel/facility interface. In addition, the WSA addresses the navigational safety issues and port security issues introduced by the proposed LNG operations. The Coast Guard's report on the WSA identifies the relevant safety and security issues from the broad viewpoint of impact on the entire port, as well as provides a detailed review of specific points of concern along the LNG ship's proposed transit route. If

the project is approved, the WSA will be reviewed on an annual basis and updated as needed until the facility is placed in service.

To facilitate implementation of the guidelines presented in the NVIC, the FERC staff will continue working with the Coast Guard Sector Los Angeles-Long Beach and determine how the guidance should be followed by SES.

SES is currently working with the Coast Guard and state and local officials to develop a WSA that will determine the appropriate safety and security measures to mitigate the risks while the LNG vessel is operating in the VTS area. This WSA will be conducted by SES and validated and approved by the Captain of the Port. In order to assess the suitability of the waterway for LNG marine traffic as part of its LOR process, the Coast Guard has solicited input from SES, Port stakeholders, law enforcement officials, emergency response officials, and other state and local officials. SES is preparing a Preliminary WSA that will provide an outline of the project's major impacts on the Port and serve to focus the evaluation of the suitability of the waterway for the LNG marine traffic. Afterward, SES will prepare a Follow-on WSA that will take into account the input of the participating agencies and stakeholders. It is imperative that this information be made available for consideration by the decision makers; therefore, **the FERC staff recommends that:**

- **<u>Prior to the issuance of the final EIS</u>, SES shall submit a Preliminary and Follow-on WSA to the Captain of the Port Coast Guard Sector Los Angeles-Long Beach for review and validation and provide a copy to the FERC staff.**

Once the Preliminary WSA is submitted, the Coast Guard NVIC process will be implemented by the Captain of the Port, as appropriate. After review and validation of the Follow-on WSA, the Coast Guard will submit a WSA report to the FERC staff. The findings of this report will be reviewed by the Director of OEP and implemented by SES if the project is approved.

Some commentors have expressed concern that the local community would have to bear some of the cost of ensuring the security of the LNG facility and the LNG vessels while in transit and unloading at the berth. The potential costs will not be known until the specific security needs have been identified, and the responsibilities of federal, state, and local agencies have been established in the Coast Guard's WSA. Subsequent to the Coast Guard's public meeting on July 11, 2005 to take comments on concerns relating to the safety and security of the waterway, SES committed to fund all identified necessary security/emergency management equipment and personnel costs as a result of the project**.** SES has also committed to preparing a comprehensive plan that identifies the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies. In addition, section 311 of the Energy Policy Act of 2005 stipulates that the FERC must require the LNG operator to develop an Emergency Response Plan that includes a Cost-Sharing Plan before any final approval to begin construction. The Cost-Sharing Plan shall include a description of any direct cost reimbursements to any state and local agencies with responsibility for security and safety at the LNG terminal and near vessels that serve the facility. To allow the FERC and the POLB the opportunity to review the plan, **the Agency Staffs recommend that:**

- **<u>Concurrent with the submission of the Follow-on WSA to the FERC staff</u>, SES shall file its comprehensive plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning.**

The FERC staff recognizes that the WSA would be prepared well before import operations would commence, and that the Port's overall operation/security situation may change over that time period. New Port activities may commence, infrastructure may be added, or population density may change. Improvements in technology to detect, deter, and defend against intentional acts may also be developed. Therefore, **the FERC staff will recommend to its Commission that the following measure be included as a specific condition of any approval issued by the FERC:**

- **SES shall <u>annually</u> review its WSA for the project, update the assessment to reflect changing conditions, provide the updated assessment to the Captain of the Port Coast Guard Sector Los Angeles-Long Beach for review and validation, and provide a copy to the FERC staff.**

While the LOR would address the suitability of the POLB for LNG ship transportation, it would not constitute a final authority to commence LNG operations. It is anticipated that the Coast Guard would decide on an LOR as soon as possible after the final EIS/EIR for the project is issued, or wait until after the Commission makes an overall public interest determination regarding the proposal. The Coast Guard's recommendation is subject to certain safety and security provisions, as well as SES developing an LNG Vessel Operation and Emergency Contingency Plan. This plan would be reviewed and updated as necessary to address issues specific to the POLB and the proposed LNG terminal. In addition, the Coast Guard currently enforces a security zone under Title 33 CFR Part 165.1151 for the San Pedro Bay area. This security zone would also apply to LNG vessels in transit and while docked. Only personnel or vessels authorized by the Captain of the Port would be permitted in the security zone.

4.11.8 Terrorism and Security Issues

The security requirements for the onshore component of the proposed project are governed by Title 49 CFR Part 193, Subpart J - Security. This subpart includes requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. Requirements for maintaining safety of the marine terminal are in the Coast Guard regulations in Title 33 CFR Part 127. Requirements for maintaining security of the marine terminal are in Title 33 CFR Part 105.

In the aftermath of the terrorist attacks that occurred on September 11, 2001, terrorism has become a very real issue for the facilities under the Commission's jurisdiction. The FERC, like other federal agencies, is faced with a dilemma in how much information can be offered to the public while still providing a significant level of protection to the facility. Consequently, the FERC has removed energy facility design plans and location information from its website to ensure that sensitive information filed under CEII is not readily available (RM02-4-000 and PL02-1-000 issued February 20, 2003).

Since September 11, 2001, the FERC has been involved with other federal agencies in developing a coordinated approach to protecting the energy facilities of the United States. The FERC continues to coordinate with these agencies, specifically with the Coast Guard, to address this issue. The Coast Guard now requires arriving ships to provide a 96-hour advance notice of arrival that includes key information about the vessel and its crew, which allows the Coast Guard to conduct a terrorism risk assessment and put in place appropriate mitigation before the ship reaches the ship channel. In addition, interstate natural gas companies are actively involved with several industry groups to chart how best to address security measures in the current environment. A Security Task Force has been created and is addressing ways to improve pipeline security practices, strengthen communications within the industry and the interface with government, and extend public outreach efforts.

In September 2002, the DOT's OPS issued non-public guidelines to LNG operators that direct them to develop new security procedures for onshore facilities. Operators were required to prepare a security plan within 6 months that responds to the five threat levels defined by the Office of Homeland Security. OPS conducts subsequent on-site reviews of the security procedures.

On October 22, 2003, the Coast Guard issued a series of six final rules that promulgated the maritime security requirements of the Maritime Transportation Security Act of 2002: Implementation of National Maritime Security Initiatives; Area Maritime Security; Vessel Security; Facility Security; Outer Continental Shelf Facility Security; and the Automatic Identification System. The entire series of rulemakings establishes a new subchapter H in Title 33 CFR. In support of the rulemakings, the Coast Guard applied a risk-based decision-making process to comprehensively evaluate the relative risks of various target and attack mode combinations and scenarios for those vessel types and port facilities that pose a risk of a security incident. This approach provides a more realistic estimation of risk than a simple "worst-case outcome" assessment. Risk management principles acknowledge that while risk generally cannot be eliminated, it can be reduced by adjusting operations to lower consequences, threats, or vulnerability, recognizing that it is easier to reduce vulnerabilities by adding security measures.

Terminal owners or operators subject to Title 33 CFR Part 105 are required to submit a Facility Security Assessment and Facility Security Plan to the Coast Guard Captain of the Port for review and approval 60 days prior to operations. Some of the principal owner or operator responsibilities required by the plan include:

- designating a FSO with a general knowledge of current security threats and patterns, risk assessment methodology, and the responsibility for implementing and periodically updating the Facility Security Plan and Assessment and performing an annual audit for the life of the project;

- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats, consequences of an attack, and facility protective measures;

- developing a Facility Security Plan based on the Facility Security Assessment with procedures for responding to transportation security incidents; notification and coordination with local, state, and federal authorities, preventing unauthorized access; measures and equipment to prevent or deter dangerous substances and devices; and training and evacuation;

- implementing scalable security measures to provide increasing levels of security at increasing MARSEC levels for facility access control, restricted areas, cargo handling, vessel stores and bunkers, and monitoring;

- conducting security exercises at least once each calendar year and drills at least every 3 months; and

- mandatory reporting of all breaches of security and security incidents.

In accordance with Title 33 CFR Part 105, SES would be required to submit its Facility Security Plan to the Captain of the Port at least 60 days prior to commencement of operations.

Security at the facility would be provided by both active and passive systems. The entire site would be surrounded by a protective enclosure (i.e., a fence) with sufficient strength to deter unauthorized access. The enclosure would also be illuminated with not less than 2.2 lux between sunset and sunrise.

Intrusion detection systems and day/night camera coverage would identify unauthorized access. A 20-foot-high concrete security barrier wall would be installed around the LNG storage tanks. However, SES has not indicated that it would hire a separate security staff (in addition to its permanent security staff) to conduct periodic patrols of the plant, screen visitors and contractors, and assist in maintaining security of the marine terminal during cargo unloading. In order to ensure that the responsibilities of SES' security staff would be expanded to enhance overall security, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall provide a separate 24-hours-per-day security staff and coordinate with the Coast Guard to define the responsibilities of SES' security staff in supplementing other security personnel and in protecting the LNG ships and terminal.**

In accordance with its responsibilities for land-based security under Title 33 CFR Part 105, the Coast Guard may impose additional control measures related to security (e.g., require SES to revise the design of the LNG terminal to include a removable barricade that would block access to the driveway through the security barrier wall).

Increased security awareness has occurred throughout the industry and the nation. President Bush established the Office of Homeland Security with the mission of coordinating the efforts of all executive departments and agencies to detect, prepare for, prevent, protect against, respond to, and recover from terrorist attacks within the United States. The Commission, in cooperation with other federal agencies and industry trade groups, has joined in the efforts to protect the energy infrastructure, including the more than 300,000 miles of interstate natural gas transmission pipeline and associated LNG facilities.

Safety and security are important considerations in any action undertaken by the FERC and the POLB. The attacks of September 11, 2001 have changed the way LNG terminal operators as well as regulators must consider terrorism, both in approving new projects and in operating existing facilities. However, the likelihood of future acts of terrorism or sabotage occurring at the proposed LNG import terminal, or at any of the myriad natural gas pipeline or energy facilities throughout the United States is unpredictable given the disparate motives and abilities of terrorist groups. The continuing need to construct facilities to support the future natural gas pipeline infrastructure is not diminished by the threat of any such unpredictable acts.

4.11.9 Emergency Response and Evacuation Planning

The current status of SES' coordination with local emergency providers to develop procedures to handle potential fire emergencies at the LNG terminal site and on LNG ships is discussed in section 4.6.5.

Prior to commencing service, SES would prepare emergency procedures manuals, as required by Title 49 CFR Part 193.2509, that provide for: responding to controllable emergencies and recognizing an uncontrollable emergency; taking action to minimize harm to the public including the possible need to evacuate the public; and coordination and cooperation with appropriate local officials. Specifically, section 193.2509(b)(3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…." Typically, the manuals are prepared at the later stages of the construction process and submitted to the FERC as a requirement <u>prior to</u> placing the facility in service.

While the worst-case scenarios evaluated for the onshore facility in sections 4.11.5 and 4.11.10 and for marine spills in sections 4.11.7 and 4.11.10 provide guidance on the maximum extent of potential hazards, they should not be assumed to represent the evacuation zone for <u>every</u> potential incident. As

with any other fuel or hazardous material, the actual severity of the incident would determine what area needs to be evacuated, if any, rather than a worst-case maximum zone. It is anticipated that the emergency evacuation plans would identify evacuation distances based upon increasing severity of events.

While recognizing that preparing emergency procedures typically occurs at the end of the construction phase rather than at the draft EIS/EIR stage, there remain a number of issues concerning the viability of emergency evacuation. Therefore, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall develop emergency evacuation routes for the areas along the route of the LNG vessel transit in conjunction with the local emergency officials and file the routes with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning <u>prior to initial site preparation</u>.**

In addition, section 311 of the Energy Policy Act of 2005 stipulates that the FERC must require the LNG operator to develop an Emergency Response Plan in consultation with the Coast Guard and state and local agencies. The FERC must approve the Emergency Response Plan prior to any final approval to begin construction. To satisfy this requirement, **the Agency Staffs will recommend to their respective Commissions that the following measure be included as a specific condition of any approvals issued by the FERC and the POLB:**

- **SES shall develop an Emergency Response Plan (including evacuation) and coordinate procedures with local emergency planning groups, the ports of Long Beach and Los Angeles, fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies. This plan shall include at a minimum:**

  a. designated contacts with state and local emergency response agencies;

  b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

  c. procedures for notifying residents, employees, and recreational users within areas of potential hazard;

  d. locations of permanent sirens and other warning devices; and

  e. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

  The Emergency Response Plan shall be filed with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning <u>prior to initial site preparation.</u> SES shall notify the FERC and POLB staffs of all planning meetings in advance and shall report progress on the development of its Emergency Response Plan at 3-month intervals.

4.11.10 POLB Hazards Analysis

In accordance with the CCA, the POLB prepared a PMP to implement Chapter 8 of the CCA, which contains findings and policies aimed at maximizing the use of coastal port resources and minimizing environmental impacts. The CCC subsequently found that it was necessary to incorporate safety and protection findings, declarations, and policies into the PMP. The PMP was amended to include an RMP that provides a set of technical guidelines and a structured management approach for minimization of risk as new POLB projects are developed or existing facilities are modified. The RMP requires the following parameters to be evaluated, as appropriate: radiant heat from a tank fire; radiant heat from a dike fire; blast overpressure; and flying debris. An Application Summary Report prepared in accordance with the certified PMP as amended and the CCA is included in this draft EIS/EIR (see section 5.0).

The RMP requires that a "worst-case" evaluation be prepared for all proposed projects that would involve the storage and/or transport of hazardous materials within the POLB. Once the worst case has been determined, appropriate mitigation measures can be factored in. The POLB retained Quest to identify the hazards from worst-case scenarios that may result from an accidental or intentional (e.g., terrorist-induced) release of LNG or other hydrocarbons in or near SES' proposed LNG import terminal in Long Beach Harbor.

As part of the hazards analysis, Quest was asked to complete the following five tasks:

- identify a range of potential releases that could result in the largest hazardous conditions outside the import terminal site boundary, including the following scenarios;
    - releases from an LNG storage tank caused by earthquake-induced failure, a projectile (e.g., an airplane or missile) striking one or both tanks, an explosive charge detonated adjacent to one of the tanks, or accidental or intentional release from the piping in the process area;
    - releases from an LNG ship at berth caused by a projectile (e.g., an airplane or missile) striking the ship or an explosive charge in a small boat detonated adjacent to the ship; and
    - releases from an LNG ship in transit resulting from a grounding on, or collision with, the outer breakwater or a collision with another vessel outside the breakwater;
- calculate or estimate the probability of each release event above;
- calculate the size of the hazard zones under worst-case conditions for each release event above;
- determine the impact the worst-case release events would have on adjacent industrial facilities; and
- compare the worst-case analysis for the LNG import terminal to other large-scale flammable fuel facilities.

Quest's final report titled *Hazards Analysis of a Proposed LNG Import Terminal in the Port of Long Beach, California* (POLB Quest Study) (Quest, 2005) is provided in Appendix F and summarized below.

4.11.10.1 Selection and Probability of Potential LNG Release Events

Using the detailed methodology described in Appendix F, Quest identified potential accidental and intentional release events involving the LNG terminal and LNG ships. The accidental releases covered a range of events that could occur at an LNG terminal. These accidental releases included a rupture of or release from process equipment at various locations within the LNG terminal, a release from an LNG ship collision with the breakwater or with another ship outside the breakwater, and a release from an earthquake-induced failure of an LNG storage tank. The intentional releases covered a range of possible terrorist-induced releases from the LNG terminal or an LNG ship ranging from localized damage to equipment as a result of a small explosive charge to more sophisticated and logistically challenging operations involving hijacked aircraft or ships. The specific events identified and the estimated probability of occurrence of each event are shown in table 4.11.10-1. A detailed discussion of each event identified and a description of the methodology used to derive the probability of its occurrence are provided in Appendix F.

The POLB staff reviewed each of the release events listed in table 4.11.10-1 using probability definitions developed by the LACFD (see figure 4.11.10-1). As depicted on figure 4.11.10-1, the first step in a release event evaluation is to consider whether a release is physically possible. For releases determined to be physically possible, the next step is to determine whether the release is considered credible. A release is considered credible if it would occur with a frequency greater than 1 in 1 million years; releases with frequencies less than 1 in 1 million years are considered incredible and are not further evaluated. Once an event is determined to be credible, the range of frequency is defined. Events expected to occur more than once per year are defined as frequent, events expected to occur once every 1 to 10 years are defined as periodic, and events expected to occur every 10 to 100 years are defined as occasional. Using the LACFD criteria, an event is considered possible if it could occur once every 100 to 10,000 years. An improbable event is defined by the LACFD as an event that would not occur for 10,000 years or more.

The RMP uses the term "probable" for a possible event and requires that only the worst probable events be assessed; events determined to be improbable are not assessed. Based on the chances of their occurrence, the earthquake-induced failure of an LNG storage tank and all of the terrorist-induced releases are considered improbable. These events and the consequence analysis results for each event are described in detail in Appendix F but are not considered further in the POLB staff's analysis.

Based on the chances of their occurrence, the release events that are considered possible per the LACFD criteria are a release from process equipment within the LNG terminal and a release from an LNG ship following a collision with the breakwater or with another ship outside the breakwater. These events and the consequence analysis results for each event are described in detail in Appendix F and summarized below.

TABLE 4.11.10-1

Potential LNG Release Events Evaluated and the Probability of Their Occurrence

Release Event	Estimate of Frequency of Event	Chance of Event
Accidental		
Rupture of or release from process equipment[a] within the LNG terminal, including: Rupture of process equipment – location A Rupture of process equipment – location B Rupture of process equipment – location C Rupture of process equipment – location D Rupture of process equipment – location E Release from process equipment – location F Release from process equipment – location G	~$3(10)^{-3}$ per year (Historical record of all export and import LNG terminals worldwide.)	3 chances in 1,000 per year (Note: all releases were in export terminals.)
LNG ship collision with the breakwater or with another ship outside the breakwater, including: Release from an LNG ship following a collision with the breakwater – 1 tank fails Release from an LNG ship following a collision with the breakwater – 5 tanks fail Release from an LNG ship following a collision (outside the breakwater) with another ship of sufficient size and speed – 1 tank fails Release from an LNG ship following a collision (outside the breakwater) with another ship of sufficient size and speed – 5 tanks fail	~$1(10)^{-5}$ per port call (Historical record for LNG shipping. No loss of LNG has occurred.)	1 chance in 1,000 per year (Assumes 100 LNG ship deliveries per year.)
Earthquake-induced failure of an LNG storage tank	~$5(10)^{-5}$ per year (Project evaluation of tank design and local conditions.)	5 chances in 100,000 per year
Intentional		
Release from LNG terminal or ship, including: Terrorist-hijacked airplane crashes into one or both LNG storage tanks Terrorist detonates a bomb near an LNG storage tank Terrorist fires a rocket-propelled grenade (RPG) into one or both LNG storage tanks Terrorist-hijacked airplane crashes into an LNG ship Terrorist places a boat bomb beside an LNG ship Terrorist fires a RPG into an LNG ship Terrorist-controlled ship collides with an LNG ship	~$7(10)^{-6}$ per year (Historical record of terrorist activities in the United States.)	7 chances in 1,000,000 per year (Assumes LNG terminal is as valid a "target" as previous terrorist targets.)

[a] Details of the process equipment have been removed because this information is considered Critical Energy Infrastructure Information by the FERC.

4.11.10.2 Consequence Analysis Results for Possible LNG Release Events

The consequences of an LNG release are proportional to the size of the release. The methodology used by Quest to estimate release sizes and the models and assumptions used to quantify the hazard, or hazards, of each release are described in detail in Appendix F. The potential impacts of LNG release events on humans and structures/equipment are summarized below.

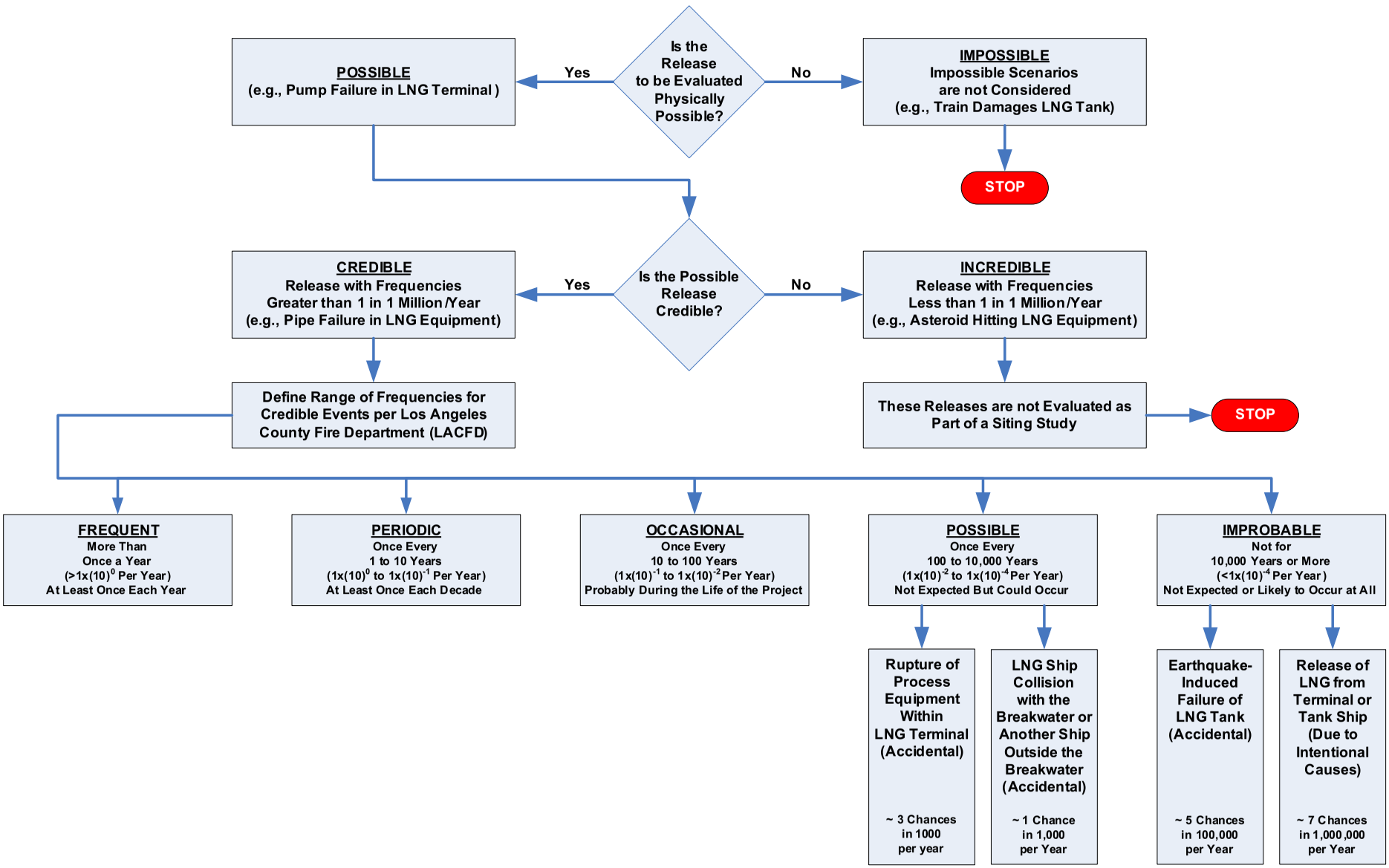


Figure 4.11.10-1
Long Beach LNG Import Project
Decision Tree for Analysis of Hazardous Material Releases

The consequence analysis performed for the proposed LNG terminal involved the evaluation of a range of refrigerated and superheated liquid releases, as well as releases of ambient temperature and cold natural gas. Each potential release could result in one or more of the following hazards:

- exposure to thermal radiation from a torch fire, which is the result of ignition of a high velocity release of natural gas, LNG, or other hydrocarbons;
- exposure to thermal radiation from a pool fire, which is the result of ignition of a pool of LNG or other hydrocarbons;
- direct contact with flames due to a flash fire, which is the result of delayed ignition of a flammable vapor cloud following a release of natural gas, LNG, or other hydrocarbons; or
- exposure to overpressure, which may be a result of delayed ignition of a flammable vapor cloud created by a release of natural gas, LNG, or other hydrocarbons.

Impact on Humans

The physiological effect of fire on humans depends on the rate at which heat is transferred from the fire to the person, and the time the person is exposed to the fire. Skin that is in contact with flames can be seriously injured even if the duration of the exposure is just a few seconds. Thus, a person wearing normal clothing is likely to receive serious burns to unprotected areas of the skin when directly exposed to the flames from a flash fire (vapor cloud fire).

People in the vicinity of a flash fire, pool fire, or torch fire, but not in contact with the flames, would receive heat from the fire in the form of thermal radiation. Radiant heat flux decreases with increasing distance from the fire, so people close to the fire would receive thermal radiation at a higher rate than people who are farther away. The ability of a fire to cause skin burns due to radiant heating depends on the radiant heat flux to which the skin is exposed, and the duration of the exposure. Thus, short-term exposure to high radiant heat flux levels can be injurious, but if a person is far enough from the fire, the radiant heat flux would be so low that it is incapable of causing injury, regardless of exposure time.

As discussed in section 4.11.5, an incident flux level of 1,600 Btu/ft^2-hr is considered hazardous for people located outdoors and unprotected. This flux level is the thermal exclusion zone defined in Title 49 CFR Part 193, through NFPA 59A. In the POLB Quest Study, this thermal exclusion zone is referred to as the radiant vulnerability zone. People located outside this area would not be at risk to the hazard level defined.

Natural gas does not explode unless it is in a confined space at a specific mixture with air and ignited. However, if it does occur, the physiological effects of overpressures depend on the peak overpressure that reaches a person. Exposure to high overpressure levels may be fatal. People located outside the flammable cloud when it ignites would be exposed to lower overpressure levels than people inside the flammable cloud. If the person is far enough from the source of the overpressure, the overpressure is incapable of causing injuries. The hazard level for an explosion overpressure is 1.0 psig. This overpressure could result in injuries to people primarily due to flying debris.

The consequence analysis results for effects on humans from each potential LNG release event listed in table 4.11.10-1 are provided in Appendix F. Appendix F also includes figures depicting the radiant vulnerability zone for each of these release events. The consequence analysis results for the

releases from the LNG terminal and ship operations that are considered possible per the LACFD criteria are presented in table 4.11.10-2. The three largest of these releases (i.e., a release from an LNG ship after a collision with another ship outside the breakwater assuming the failure of five tanks, a release from an LNG ship following a collision with the breakwater assuming the failure of five tanks, and a release from process equipment at location F) are discussed below.

As shown in table 4.11.10-2, the largest radiant vulnerability zone, 3,370 feet, would occur from a release from an LNG ship in transit following a collision with another ship of sufficient size and speed outside the breakwater. Under certain conditions, a collision could have the potential to cause a release of LNG from one or more of the cargo tanks on the LNG ship. For the worst-case scenario, it was assumed that the rate of loss of LNG from one cargo tank compromised the integrity of the inner hull and, over time, led to sequential releases from the remaining LNG cargo tanks. The failures in the subsequent tanks were assumed to be caused by cracking of portions of the inner hull, followed by tears in the membrane tanks. The subsequent failures were assumed to occur in 5-minute intervals. For a membrane tank ship with five cargo tanks, this assumption results in all five tanks releasing cargo within 20 minutes of a collision with another ship. A collision within the breakwater was not considered a credible event by Quest due to the operational controls by the Coast Guard, VTS, and Jacobsen Pilots and the characteristics of the POLB (see section 4.11.7.2).

TABLE 4.11.10-2

Consequence Analysis Results for the Possible[a] LNG Release Events - Impact on Humans

Release Event	Distance (ft) to 1,600 Btu/ft^2-hr Radiant Flux Level	Measured From	Distance (ft) to 1 psig Overpressure	Distance (ft) to LFL
Release from a rupture of process equipment – location A	280	Release Point	NA [b]	1,705
Release from a rupture of process equipment – location B	270	Release Point	320	585
Release from a rupture of process equipment – location C	530	Release Point	190	995
Release from a rupture of process equipment – location D	240	Release Point	190	545
Release from a rupture of process equipment – location E	490	Release Point	NA	400
Release from a rupture of process equipment – location F	830	Release Point	320	990
Release from a rupture of process equipment – location G	360	Release Point	320	700
Release from an LNG ship following a collision with the breakwater – 1 tank fails	2,200	Center of LNG Pool by Ship	NA	9,260 (over water)
Release from an LNG ship following a collision with the breakwater – 5 tanks fail	3,345	Center of LNG Pool by Ship	NA	19,330 (over water)
Release from an LNG ship following a collision (outside the breakwater) with another ship of sufficient size and speed - 1 tank fails	2,980	Center of LNG Pool on Water	NA	16,510 (over water)
Release from an LNG ship following a collision (outside the breakwater) with another ship of sufficient size and speed - 5 tanks fail	3,370	Center of LNG Pool on Water	NA	21,200 (over water)

[a] As defined by the Los Angeles County Fire Department.

[b] NA = Explosion overpressure level not achieved.

The radiant vulnerability zone as a result of a release from the LNG ship cargo tanks after a collision with another ship outside the breakwater is depicted on figure 4.11.10-2. This zone is in the ocean approximately 1,400 feet from the nearest land and approximately 9,000 feet from the LNG

terminal site. If ignited, the radiant heat would expose humans within this zone (e.g., recreational boaters) who are outdoors and unprotected to potential injury and death.

The creation of a large flammable cloud without ignition following a release from an LNG cargo tank following collision with another ship outside the breakwater is a credible scenario. The generation of flammable vapor over the open water, with immediate ignition sources limited to the LNG ship itself, results in a scenario where the cloud might drift some distance before encountering an ignition source. Quest calculates the maximum flammable cloud travel distance over water to be 21,200 feet. The cloud would require a little over 100 minutes to travel this distance.

The second largest radiant vulnerability zone, 3,345 feet, would occur from a release from an LNG ship following a collision with the breakwater. If the water depth at the breakwater is sufficient, the LNG ship could strike the breakwater bow first. For the worst-case scenario, it was assumed that the rate of loss of LNG from one cargo tank compromised the integrity of the inner hull and, over time, led to sequential releases from the remaining LNG cargo tanks. The failures in the subsequent tanks were assumed to be caused by cracking of portions of the inner hull, followed by tears in the membrane tanks. The initial tank failure was assumed to occur in the cargo tank nearest the bow of the ship (the point of collision with the breakwater), with the failures progressing toward the stern of the ship. The subsequent failures were assumed to occur in 5-minute intervals. For a membrane tank ship with five cargo tanks, this assumption results in all five tanks releasing cargo within 20 minutes of a collision with the breakwater. Groundings within the breakwater were not considered credible events due to the operational controls by the Coast Guard, VTS, and Jacobsen Pilots and the characteristics of the POLB (see section 4.11.7.2).

The radiant vulnerability zone as a result of a release from the LNG ship cargo tanks after a collision with the breakwater is similar to the radiant vulnerability zone that would occur from a release from an LNG ship following a collision with a ship outside the breakwater and is depicted on figure 4.11.10-2. As discussed above, this zone is in the ocean approximately 1,400 feet from the nearest land and approximately 9,000 feet from the LNG terminal site. If ignited, the radiant heat would expose humans within this zone (e.g., recreational boaters) who are outdoors and unprotected to potential injury and death.

The creation of a large flammable cloud without ignition following a release from an LNG cargo tank following a collision with the breakwater is a credible scenario. The generation of flammable vapor over the open water, with immediate ignition sources limited to the LNG ship itself, results in a scenario where the cloud might drift some distance before encountering an ignition source. Quest calculates the maximum flammable cloud travel distance over water to be 19,330 feet. The cloud would require a little over 90 minutes to travel this distance.

The largest radiant vulnerability zone from a release as a result of a rupture of process equipment, 830 feet, would occur from location F (see figure 4.11.10-3). Quest's analysis assumed a full rupture of the associated piping. If the failure was intentionally caused by an explosive device, the release would be ignited and a torch fire would result. If ignited, the radiant heat would expose humans within this zone who are outdoors and unprotected to potential injury and death. An accidental rupture of the process equipment at location F could cause a release that would not result in ignition. The fluid from the process equipment would be released under pressure and form an aerosol composed of vapor and suspended liquid droplets and virtually none of the liquid would reach the ground. Quest calculates the maximum flammable cloud travel distance for a process equipment release at location F to be 995 feet. A larger flammable cloud travel distance, 1,705 feet, would occur from a process equipment release at location A. As shown in table 4.11.10-2, the largest distance to 1.0 psig explosion overpressure for a process equipment release is 320 feet.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-176
Figure 4.11.10-2

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-177
Figure 4.11.10-3

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Impact on Structures/Equipment

One of the tasks of the POLB Quest Study was to calculate the potential impacts on adjacent industrial facilities, both current and proposed, for the potential accidental and intentional worst-case events. Facilities of particular interest are the existing oil berth at T-121 and the proposed oil berth at T-124. There is also an existing lumber business at T-122. These facilities are shown on figure 4.11.10-4.

Evaluating the impact of radiant and overpressure hazards on industrial equipment located near the LNG terminal requires the use of a different set of radiant flux and explosion overpressure levels than those used to determine impacts on humans. Title 49 CFR Part 193, through NFPA 59A, defines 10,000 Btu/ft^2-hr as the limiting heat flux at the demarcation line between land area controlled by the LNG facility and land areas controlled by other parties. The intent is to ensure that the heat flux from code-specified design spill fires would not cause failures of steel-framed buildings and similar industrial-type structures outside the LNG facility. Therefore, when analyzing the effects of worst-case fires that can be much larger than the design spill fires, it is reasonable to use 10,000 Btu/ft^2-hr as the lower limit for radiant heat flux calculations in an industrial area. Non-combustible structures outside the 10,000 Btu/ft^2-hr zone should not be heavily damaged by the fire, and those within the 10,000 Btu/ft^2-hr zone would withstand several minutes of exposure to the radiant heat before failing. Per Title 51 CFR Part 24, exposure to 10,000 Btu/ft^2-hr for 15 to 20 minutes would cause wooden buildings to ignite and exposure to 10,000 Btu/ft^2-hr for several minutes would damage steel structures. Quest selected a 2.3 psig overpressure as the lower limit for evaluating possible overpressure impacts on the adjacent industrial sites. Overpressures lower than 2.3 psig would not be expected to produce significant damage to industrial equipment.

If portions of T-124 and T-121 were exposed to radiant flux levels in excess of 10,000 Btu/ft^2-hr, flammable structures on T-124 and T-121 would be expected to ignite and ordinary storage tanks might incur a roof failure due to metal fatigue. Following a roof failure, the contents in the tank could ignite, resulting in a separate, independent fire source. The storage tanks on T-124 and T-121 are small in comparison with the size of the LNG fire being evaluated. The storage tanks would burn for a longer duration than the LNG fires, but would have significantly smaller impacts on the surroundings. The lumber on T-122 would also be expected to ignite.

The consequence analysis results for effects on structures/equipment from each potential LNG release event listed in table 4.11.10-1 are provided in Appendix F. Appendix F also includes figures depicting the radiant vulnerability zone for each of these release events. The consequence analysis results for the releases from the LNG terminal and ship operations that are considered possible per the LACFD criteria are presented in table 4.11.10-3 and discussed below.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-179
Figure 4.11.10-4

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

TABLE 4.11.10-3

Consequence Analysis Results for the Possible[a] LNG Release Events - Impact on Structures/Equipment

Release Event	Distance (ft) to 10,000 Btu/ft^2-hr Radiant Flux Level	Measured From	Distance (ft) to 2.3 psig Overpressure	Maximum Overpressure Achieved
Release from a rupture of process equipment – location A	140	Release Point	NA [b]	1.09
Release from a rupture of process equipment – location B	160	Release Point	130	3.06
Release from a rupture of process equipment – location C	360	Release Point	NA	1.86
Release from a rupture of process equipment – location D	160	Release Point	NA	1.86
Release from a rupture of process equipment – location E	400	Release Point	NA	1.09
Release from a rupture of process equipment – location F	600	Release Point	130	3.06
Release from a rupture of process equipment – location G	260	Release Point	130	3.06
Release from an LNG ship following a collision with the breakwater – 1 tank fails	990	Center of LNG Pool by Ship	NA	1.09
Release from an LNG ship following a collision with the breakwater – 5 tanks fail	1,480	Center of LNG Pool by Ship	NA	1.09
Release from an LNG ship following a collision (outside the breakwater) with another ship of sufficient size and speed – 1 tank fails	1,325	Center of LNG Pool on Water	NA	1.09
Release from an LNG ship following a collision (outside the breakwater) with another ship of sufficient size and speed – 5 tanks fail	1,495	Center of LNG Pool on Water	NA	1.09

[a] As defined by the Los Angeles County Fire Department.
[b] NA = Explosion overpressure level not achieved.

As shown in table 4.11.10-3, the largest radiant vulnerability zone, 1,495 feet, would occur from a release from an LNG ship in transit following a collision with another ship of sufficient size and speed outside the breakwater. The second largest radiant vulnerability zone, 1,480 feet, would occur from a release from an LNG ship following a collision with the breakwater. The worst-case scenario for both of these releases assumes a failure of five cargo tanks. The radiant vulnerability zone for these events is depicted on figure 4.11.10-5. This zone is in the ocean approximately 11,000 feet from the LNG terminal site. Therefore, the adjacent industrial facilities would not be impacted by a release from an LNG ship collision with another ship outside the breakwater or from an LNG ship collision with the breakwater.

The largest radiant vulnerability zone from a release as a result of a rupture of process equipment, 600 feet, would occur from location F (see figure 4.11.10-6). Because this zone does not extend to the adjacent industrial facilities, they would not be impacted by a release from a rupture of process equipment at any location.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-181
Figure 4.11.10-5

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-182
Figure 4.11.10-6

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

The majority of the releases identified by Quest resulted in vapor clouds composed primarily of methane, defined as a low reactivity material. Significant overpressures could be generated if natural gas is ignited within a confined space. As shown in table 4.11.10-3, the largest distance to 2.3 psig explosion overpressure is 130 feet. Therefore, none of the vapor cloud explosion events evaluated would result in overpressures high enough to cause a failure of the oil storage tanks proposed for T-124.

4.11.10.3 Mitigation

Release from an LNG Ship Collision with Another Ship or with the Breakwater

Outside the breakwater, there is a precautionary zone in which the speed limit is 12 knots. Ships approaching the POLB must be within the Main Channel, which is outside the breakwater, in order to enter the Outer Harbor. Ships in the Main Channel are restricted to a maximum speed of 10 knots. Within the breakwater, all ships are restricted to a maximum speed of 6 knots. If an LNG tank ship were to be struck by a small ship (e.g., 3,000 deadweight tons) moving at a speed of 6 knots, the small ship would not have sufficient momentum to penetrate the inner and outer hulls of the LNG tank ship. Thus, once inside the breakwater, a ship collision could result in a spill of LNG only if the non-LNG ship involved in the collision is a large ship, and only if the non-LNG ship is moving in a direction nearly perpendicular to the LNG ship when the collision occurs. The limited dimensions of the POLB in the area near the proposed terminal would make it very difficult for a large non-LNG ship to make the maneuvers necessary for it to strike the side of an LNG ship while moving at a speed at or above the critical speed. As discussed above, a collision within the breakwater was not considered a credible event by Quest due to the operational controls by the Coast Guard, VTS, and Jacobsen Pilots and the characteristics of the POLB (see section 4.11.7.2).

A study of the mechanics of LNG ship collisions (Greuner and Böckenhauer, 1980) concluded that if a 125,000 cubic meter LNG ship were to strike a jetty, a dangerous situation would occur only if the ship was moving at a speed of more than 10 knots at the time it hit the jetty. It is expected that LNG ships would be moving at speeds lower than 10 knots when in the vicinity of the breakwater in the POLB.

According to the Los Angeles/Long Beach Harbor Safety Plan (POLB, 2004), the vessel speed limit in the precautionary zone (outside the breakwater but inside the Sierra and Whiskey buoys) is 12 knots. The vessel speed limit in the Main Channel is 10 knots and the vessel speed limit everywhere else in the Port is 6 knots.

The POLB staff will recommend to its Commission that no additional mitigation for a release from an LNG ship collision beyond the measures recommended by the Agency Staffs (see section 4.11.7.4) is feasible.

Release from a Rupture of Process Equipment

There are no residential, visitor-serving, or recreation populations and essentially no exposed Port workers within the 1,600 Btu/ft^2-hr radiant vulnerability zone for a release from a rupture of process equipment at any location. Furthermore, the 10,000 Btu/ft^2-hr radiant vulnerability zone for a release from a process equipment rupture would not impact the adjacent industrial facilities. Therefore, the POLB staff will recommend to its Commission that no additional mitigation for a release from a rupture of process equipment beyond the measures recommended by the FERC staff (see section 4.11.6) is necessary.

4.11.10.4 Summary

The POLB Quest Study evaluated the extent of fire radiation and explosion overpressure hazards for a range of worst-case releases that included both accidental and intentional releases of flammable fluid from SES' proposed LNG terminal and LNG ship operations in the POLB. The hazards associated with the proposed LNG import terminal and LNG ship operations are common to most flammable fuel facilities worldwide.

The historical record shows that successful intentional releases of flammable fuel from events at facilities in the United States have not occurred. This finding is supported by federal reports addressing this topic that were written after the terrorist events of September 11, 2001. The federal reports do not identify flammable fuel facilities as those that could affect large numbers of the public (Belke, 2000; U.S. Army, 2001; Brookings Institution, 2002; U.S. General Accounting Office, 2003).

A full range of accidental and intentional releases of LNG, natural gas, and other flammable fluids was evaluated. The accidental releases covered a range of events that could occur at an LNG terminal. The intentional releases covered a range of possible terrorist-induced releases ranging from localized damage to equipment as a result of a small explosive charge to more sophisticated and logistically challenging operations involving hijacked aircraft or ships.

The evaluation of the accidental and intentional release scenarios found that the most likely hazard to result from any of the releases is exposure to radiant heat from a pool fire or torch fire. The potential for any of the releases to produce damaging overpressures was found to be small and localized. The potential for drifting flammable vapor clouds to travel a significant distance before being ignited was small, with the possible exception of those releases that may occur outside of the Long Beach Harbor breakwater.

Quest divided the accidental and intentional events that were evaluated into four classes. These classes are defined by the event's historical record, or in the case of an earthquake capable of failing the LNG storage tanks, the predicted frequency of such an earthquake. The four classes are listed in table 4.11.10-1. In general, the historical record of the LNG import/export industry identifies significant failures within the process area to be the most likely event of those evaluated. The second class involves an accidental release from an LNG ship. Although the historical record for LNG tank ships does contain collisions, there has not been a release of LNG during or following a collision. Thus, the probability listed in table 4.11.10-1 assumes that the next shipment of LNG results in a collision and loss of cargo. As LNG shipments continue without incident, this frequency would get smaller.

An earthquake capable of causing a failure of the LNG storage tanks is unrealistic given the chance of occurrence as identified in 4.11.10-1 (5 chances in 100,000). As defined by the LACFD criteria, an earthquake of this magnitude is considered an improbable event.

The final class of release events evaluated by Quest are those associated with intentional acts against the LNG terminal or an LNG ship. These event frequencies are based on the historical record of terrorist events in the United States and are not specific to LNG terminals. This historical record of terrorist-induced events in the United States produces a frequency that is lower than the other event frequencies identified in the POLB Quest Study. As shown in table 4.11.10-1, the chances of a successful terrorist event would be less than seven chances in a million. As defined by the LACFD criteria, all of the terrorist-induced events are considered improbable.

The potential impact on adjacent POLB facilities was evaluated for the worst-case releases in the POLB Quest Study. None of the LNG release events considered possible according to the LACFD criteria would have the potential to impact the adjacent industrial facilities.

Appendix F contains an analysis of the potential hazards associated with accidental and intentional releases from the proposed LNG import terminal in comparison with three other large flammable fuel facilities. Fire radiation impacts (pool fires and torch fires) provided the best method for comparing the impacts among the facilities. When this comparison is made, the maximum radiant impacts from the four facilities range from 595 to 8,610 feet from the fire source. In all four facilities, these worst-case radiant impacts, as defined by 1,600 Btu/ft^2-hr radiant heat flux (second degree burns), have the potential to extend past the facility property line.

Additional calculations for a range of LPG storage and transportation vessels in common use in the Long Beach area were made and are presented in Appendix F. The radiant zones were found to range from 20 to over 3,000 feet, dependent on the capacity of the vessel. These potential hazards currently exist in Long Beach on a day-to-day basis.

In the specific case of the proposed LNG import terminal in the POLB, none of the events considered possible according to the LACFD criteria have the potential to produce radiant impacts that could affect the public outside of the industrial area defined by the POLB boundary line. This is true whether the initiating event is accidental or intentional.

It should be noted that the POLB Quest Study is not a full quantitative risk analysis. Thus, not all potential events were identified, quantified, and incorporated into the study. The events evaluated in the study cover a range of the largest accidental and intentionally induced releases that could occur during the LNG terminal and ship operations. The study was not designed to be all inclusive, rather it was targeted at defining a set of representative worst-case impacts. Also, the study does not account for the mitigation strategies currently in place or planned for the proposed project.

It should also be noted that disruption of the terminal, by either natural disaster or terrorism, could cause substantial impact on the local and regional economies, but such effect cannot realistically be analyzed quantitatively. A discussion of the potential economic impact of a closure of the POLB is presented in section 4.6.3.

4.11.11 LNG Truck Safety

4.11.11.1 Proposed LNG Truck Operations

A dual LNG trailer truck loading station is proposed at the Long Beach LNG terminal. A small portion of the LNG from the NGL recovery unit would be sent to the LNG trailer truck loading facility where it would be further processed and recondensed to produce vehicle-fuel-grade LNG. The vehicle grade LNG would be stored in a 3,800 cubic meter (23,901 barrels) storage tank servicing the trailer truck loading facility. The trailer truck LNG storage tank would be similar to the two LNG storage tanks and of full containment design. An average of 16 trucks would be loaded per day for distributing LNG as vehicle fuel throughout Southern California. The nominal loading rate for the LNG is 100 gpm.

The trailer truck LNG loading facilities and storage tank would be field erected, welded, and hydrostatically tested on their foundations. They also would be equipped with multiple safety features. The trailer truck loading area would connect to a trench and spill containment sump system that would be provided in the process area to hold potential LNG spills. A hazard detection system would consist of separate detection units for combustible gas, fire, smoke, and high and low temperature and would be hard wired to the main control system for alarm and emergency shutdown. High expansion foam systems would be provided for the LNG spill containment sump. In addition, hydrants, manual monitors, automatic sweep monitors, and hose reels would be located throughout the LNG terminal

Currently, cargo entering and leaving the POLB does so by using the regional transportation system including Ocean Boulevard, and the Long Beach Freeway (Interstate 710), the Terminal Island Freeway (State Route 47 and State Route 103), and the Harbor Freeway (Interstate 110). These routes would also be utilized by the proposed LNG facility.

4.11.11.2 LNG Truck Operations in California

LNG is currently transported by truck into and throughout California. LNG is trucked into California from plants located in Wyoming, the Pacific Northwest, and Topock, Arizona. Each truckload of LNG totals between 10,000 to 12,000 gallons. Some LNG tanker trucks are equipped with vaporizers, which allow the LNG to be trucked to a site that requires temporary, supplemental natural gas for immediate use. The largest single source of LNG used in California is a plant owned by an affiliate of El Paso Natural Gas Company. This plant, located near Topock, Arizona, supplies California with approximately 29,000 gallons (3 truckloads) per day of LNG.

4.11.11.3 LNG Truck Operations in Northeastern United States

The transportation of LNG by truck began in 1971 from the Distrigas LNG import terminal in Everett, Massachusetts. Approximately 250,000 LNG trucks have been loaded at the facility through the end of calendar year 2001 (see table 4.11.11-1). For the 31-year period, this represents an annual average of 8,056 trucks per year. However, the number of LNG trailer truck loadings can vary significantly from year to year, depending on the severity of the weather and the number of LNG ship cargoes delivered to the Distrigas LNG terminal.

TABLE 4.11.11-1

LNG Trailer Truck Loadings at the Distrigas LNG Terminal

Year(s)	Trucks	Max/Year
1971-1979	43,694	
1980-1989	95,027	15,656
1990-1999	83,613	12,885
2000-2001	27,397 [a]	16,813 [a]
Total	249,731	

[a] Estimated from MMBtu truck sendout data.

LNG deliveries by truck have been made to approximately 25 facilities in the northeast, including LNG peak shaving plants, as well as to large and small satellite plants. While the majority of the deliveries are made to facilities in Massachusetts, Rhode Island, and Connecticut, more distant trips are made north to Lewiston, Maine and south to McKee City, New Jersey. The mean distance between Distrigas and the receiving plants is 70 miles.

One of the satellite facilities presently supplied by Distrigas is the KeySpan LNG plant in Providence, Rhode Island, which receives an average of approximately 1,300 LNG truck deliveries per year. Loaded LNG trucks from Everett travel south down Interstate 93 to Interstate 95, exit at Thurber's Avenue, and travel south down Allens Avenue to the KeySpan LNG facility in Providence.

Restrictions on LNG trucking have been imposed by local authorities in some areas and consist of: curfews when children are arriving or leaving school; routing to avoid congested main streets; avoiding certain bridges where a preferred alternative exists; parking restrictions; and prohibition from tunnels.

LNG truck drivers receive 1 week of training specific to LNG operations. A licensed, experienced, newly hired driver receives a 1-day classroom session and 1 day of hands-on truck yard training, followed by 3 days of on-the-road operation with a fully qualified and experienced LNG truck driver as co-pilot. The "Transgas LNG Safety Handbook" serves as the basic instructional material.

LNG Truck Accident History

While the history of LNG trucking has been free of major incidents, the possibility of an LNG truck accident over the duration of the project cannot be dismissed. Unlike conventional gasoline or oil tank trailers, LNG trailers are of a double-shell construction – an inner tank constructed of a cryogenic alloy to contain the LNG, an outer tank of carbon steel, and an evacuated annular space containing perlite insulation. Stiffening rings are incorporated into the outer shell to improve its structural strength and prevent its collapse. A typical 11,000-gallon tanker has a length of 42 feet, an inner tank diameter of 7 feet 4 inches, and an outer tank diameter of 8 feet. LNG trailer design must comply with the requirements of Title 49 CFR Part 173. Drivers must meet the training requirements in Title 49 CFR Part 172.

LNG trucks have a relatively high center of gravity compared to petroleum trucks, due to the low density of LNG and the large tank diameter. This feature increases the truck's susceptibility to over turning accidents in some situations. However, the double-shell construction provides additional damage protection to minimize the potential for a major shell failure and product release.

In 1979, the DOT sponsored a study to quantitatively evaluate the risks associated with the then-current and future levels of LNG trucking from the Distrigas import terminal in Everett. The study was in part a response to an approval by the DOE in 1978 for a three-fold increase of LNG imports at Everett. The final report, *Assessment of Risks and Risk Control Options Associated with Liquefied Natural Gas Trucking Operations from the Distrigas Terminal, Everett, Massachusetts*, was completed by Arthur D. Little, Inc. (A.D. Little) in June 1979.

The study included an evaluation of all known LNG truck accidents in the United States from 1970 through 1977, alternatives to LNG trucking, and risk control options. While the study found the risks associated with the then-current LNG trucking operations were fairly low, it presented a number of options that could reduce risk levels even further. It was estimated that the accident rate per mile could be reduced by 60 percent if these recommendations were followed. In fact, the accident rate has dropped by 80 percent.

Table 4.11.11-2 summarizes LNG truck accidents from 1970 through 1977 and 1978 through 2002. The accident rate of the second period, during which the recommendations in the A.D. Little report were adopted, decreased by approximately 80 percent compared to the first period.

TABLE 4.11.11-2

LNG Truck Accident Summary

Years	Number of Accidents	Miles Traveled (millions)	Accidents Per Year	Accidents Per Million Miles
1970-1977	13	26	1.6	0.5
1978-2002	8	81 [a]	0.3	0.1

[a] Estimated for 1995 through 2002 based on trucking levels.

Rollovers, which accounted for 76 percent (16) of the accidents over the 33-year period, are attributed to the relatively high center of gravity. Only four of the accidents resulted in a loss of product

because of the additional damage protection provided by the double-shell construction. Three of these involved relatively minor leaks from fittings or valves that were damaged in the accident. In the only accident involving tank damage, 20 percent of the cargo was spilled. None of the releases resulted in an ignition of vapors and subsequent fire. If an LNG truck accident were to occur along the truck route, the potential hazard would depend on the severity of the accident and whether the cargo tank or associated valves sustained damage. This in turn would determine if the evacuation of nearby residences or businesses was necessary as well as what radius to evacuate. From the historical data, LNG truck accidents have resulted in only minor spills without an LNG fire. According to the 2000 Emergency Response Guide, for a large spill of either LNG or LPG, both widely transported throughout New England, the initial evacuation of 0.5 mile should be considered.

Although the A.D. Little study was prepared in the late 1970s, it is a comprehensive analysis that accurately depicts the LNG trade some 25 years later for several reasons: the LNG trucking levels have remained within the maximum predicted in the report; the LNG truck routes are essentially unchanged other than minor variations to improve safety; the annual mileage has remained within the limits of the study; and the destinations are essentially unchanged (except that five satellite plants in Connecticut have been taken out of service). As a result, the conclusions on the safety of LNG truck transportation remain valid. Further, the 33 years of operation in New England without a public fatality or the ignition of LNG vapors from an LNG truck spill supports the relative safety of this mode of transportation.

4.11.12 Pipeline Facilities

The transportation of natural gas and C_2 by pipeline involves some risk to the public in the event of an accident and subsequent release of gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, and C_2 are colorless, odorless, and tasteless. They are not toxic, but are classified as simple asphyxiates, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death.

Methane has an ignition temperature of 1,000 °F and is flammable at concentrations between 5.0 percent and 15.0 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can explode. Methane is buoyant at atmospheric temperatures and disperses rapidly in air.

C_2 has an ignition temperature of 950 °F and is flammable at concentrations between 3.0 percent and 16.0 percent in air. C_2 is neutrally buoyant at atmospheric temperatures.

4.11.12.1 Safety Standards

The DOT is mandated to provide pipeline safety under Title 49, USC Chapter 601. The PHMSA, OPS administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards that set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. The PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and

monitoring functions. A state may also act as the DOT's agent to inspect interstate facilities within its boundaries; however, the DOT is responsible for enforcement action. The majority of the states have either section 5(a) certifications or section 5(b) agreements, while nine states act as interstate agents.

The DOT pipeline standards are published in Parts 190-199 of Title 49 of the CFR. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues.

Under a Memorandum of Understanding on Natural Gas Transportation Facilities (Memorandum) dated January 15, 1993 between the DOT and the FERC, the DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the DOT standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert the DOT. The Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the Commission's jurisdiction. The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards Committee, which determines if proposed safety regulations are reasonable, feasible, and practicable.

The pipeline and aboveground facilities associated with the Long Beach LNG Import Project would be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards in Title 49 CFR Part 192. These regulations, which are intended to protect the public and to prevent natural gas facility accidents and failures, include specifications for material selection and qualification; minimum design requirements; and protection of the pipeline from internal, external, and atmospheric corrosion.

The standards in the federal regulations become more stringent as the human population density increases. Part 192 also defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1 mile length of pipeline. The four area classifications are defined as follows:

- Class 1 – Location with 10 or fewer buildings intended for human occupancy.
- Class 2 – Location with more than 10 but less than 46 buildings intended for human occupancy.
- Class 3 – Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days a week for 10 weeks in any 12-month period.
- Class 4 – Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of

36 inches in normal soil and 24 inches in consolidated rock. All pipelines installed in navigable rivers, streams, and harbors must have a minimum cover of 48 inches in soil or 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve (e.g., 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, maximum allowable operating pressure, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. SES has stated that it believes its pipelines would be constructed in Class 3 locations. If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, SES would be required to reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness to comply with the DOT code of regulations for the new class location.

In 2002, Congress passed an act to strengthen the Nation's pipeline safety laws. The Pipeline Safety Improvement Act of 2002 (HR 3609) was passed by Congress on November 15, 2002, and signed into law by the President in December, 2002. As of December 17, 2004, gas transmission operators were required to develop and follow a written integrity management program that contains all the elements described in Part 192.911 and addresses the risks on each covered transmission pipeline segment. Specifically, the law establishes an integrity management program which applies to all high consequence areas (HCAs). The DOT (68 Federal Register 69778, 69 Federal Register 18228, and 69 Federal Register 29903) defines HCAs as they relate to the different class zones, potential impact circles, or areas containing an identified site as defined in Part 192.903 of the DOT regulations.

The OPS published a series of rules from August 6, 2002 to May 26, 2004 (69 Federal Register 29903), that defines HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate in 49 USC 60109 for the OPS to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of two ways. In the first method an HCA includes:

- current Class 3 and 4 locations;
- any area in Class 1 or 2 locations where the potential impact radius[8] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle;[9] or
- any area in Class 1 or 2 locations where the potential impact circle includes an identified site.[10]

In the second method an HCA includes any area within a potential impact circle that contains:

- 20 or more buildings intended for human occupancy; or
- an identified site.

[8] The potential impact radius is calculated as the product of 0.69 and the square root of the maximum allowable operating pressure of the pipeline in psi multiplied by the pipeline diameter in inches.

[9] The potential impact circle is a circle of radius equal to the potential impact radius.

[10] An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days a week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The DOT regulations specify the requirements for the integrity management plan at Part 192.911. The pipeline integrity management rule for HCAs requires inspection of the entire pipeline in HCAs every 7 years.

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under Part 192.615, each pipeline operator must also establish an emergency plan that includes procedures to minimize the hazards in a natural gas pipeline emergency. Key elements of the plan include procedures for:

- receiving, identifying, and classifying emergency events, gas leakage, fires, explosions, and natural disasters;
- establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response;
- emergency shutdown of the system and safe restoration of service;
- making personnel, equipment, tools, and materials available at the scene of an emergency; and
- protecting people first and then property, and making them safe from actual or potential hazards.

Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. SES would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

4.11.12.2 Pipeline Accident Data

Since February 9, 1970, Title 49 CFR Part 191 has required all operators of transmission and gathering systems to notify the DOT of any reportable incident and to submit a report on form F7100.2 within 20 days. Reportable incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization;
- required taking any segment of transmission line out of service;
- resulted in gas ignition;
- caused estimated damage to the property of the operator, or others, or both, of a total of $5,000 or more;
- required immediate repair on a transmission line;
- occurred while testing with gas or another medium; or

- in the judgment of the operator was significant, even though it did not meet the above criteria.

The DOT changed reporting requirements after June 1984 to reduce the amount of data collected. Since that date, operators must only report incidents that involve property damage of more than $50,000, injury, death, release of gas, or that are otherwise considered significant by the operator. Table 4.11.12-1 presents a summary of incident data for the 1970 to 1984 period, as well as more recent incident data for 1986 through 2003, recognizing the difference in reporting requirements. The 14.5-year period from 1970 through June 1984, which provides a larger universe of data and more basic report information than subsequent years, has been subject to detailed analysis, as discussed in the following sections.[11]

TABLE 4.11.12-1

Natural Gas Service Incidents by Cause

	Incidents per 1,000 miles of pipeline (percentage)	
Cause	1970-1984	1986-2003
Outside force	0.70 (53.8)	0.10 (38.4)
Corrosion	0.22 (16.9)	0.06 (23.1)
Construction or material defect	0.27 (20.8)	0.04 (15.4)
Other	0.11 (8.5)	0.06 (23.1)
Total	1.30	0.26

During the 14.5-year period, 5,862 service incidents were reported over the more than 300,000 total miles of natural gas transmission and gathering systems nationwide. Service incidents, defined as failures that occur during pipeline operation, have remained fairly constant over this period with no clear upward or downward trend in annual totals. In addition, 2,013 test failures were reported. Correction of test failures removed defects from the pipeline before operation.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.11.12-1 provides a percentage distribution of the causal factors as well as the annual frequency of each factor per 1,000 miles of pipeline in service.

The dominant incident cause is outside forces, constituting 53.8 percent of all service incidents between 1970 and 1984 and 38.4 percent between 1986 and 2003. Outside forces incidents result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage. Table 4.11.12-2 shows that, of the service incidents caused by outside forces, human error in equipment usage was responsible for approximately 75 percent of the incidents. Since April 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts. The 1986 through 2003 data show that the portion of incidents caused by outside forces has decreased to 38.4 percent (see table 4.11.12-1).

[11] American Gas Association. 1986. "An Analysis of Reportable Incidents for Natural Gas Transportation and Gathering Lines 1970 Through June 1984." NG-18 Report No. 158, Pipeline Research Committee of the American Gas Association. D.J. Jones, G.S. Kramer, D.N. Gideon, and R.J. Eiber.

TABLE 4.11.12-2 **Outside Forces Incidents by Cause (1970-1984)**	
Cause	Percent
Equipment operated by outside party	67.1
Equipment operated by or for operator	7.3
Earth movement	13.3
Weather	10.8
Other	1.5

The pipelines included in the data set in table 4.11.12-1 vary widely in terms of age, pipe diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of service incidents is strongly dependent on pipeline age. While pipelines installed since 1950 exhibit a fairly constant level of service incident frequency, pipelines installed before that time have a significantly higher rate, partially due to corrosion. Older pipelines have a higher frequency of corrosion incidents, because corrosion is a time-dependent process. Further, new pipe generally uses more advanced coatings and cathodic protection to reduce corrosion potential.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller diameter pipelines, which have a greater rate of outside forces incidents. Small diameter pipelines are more easily crushed or broken by mechanical equipment or earth movements.

Table 4.11.12-3 clearly demonstrates the effectiveness of corrosion control in reducing the incidence of failures caused by external corrosion. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, significantly reduces the rate of failure compared to unprotected or partially protected pipe. The data show that bare, cathodically protected pipe actually has a higher corrosion rate than unprotected pipe. This anomaly reflects the retrofitting of cathodic protection to actively corroding spots on pipes.

TABLE 4.11.12-3 **External Corrosion by Level of Control (1970-1984)**	
Corrosion Control	Incidents per 1,000 miles per year
None-bare pipe	0.42
Cathodic protection only	0.97
Coated only	0.40
Coated and cathodic protection	0.11

4.11.12.3 Impacts on Public Safety

The service incident data summarized in table 4.11.12-1 include pipeline failures of all magnitudes with widely varying consequences. Approximately two-thirds of the incidents were classified as leaks, and the remaining third classified as ruptures, implying a more serious failure.

Table 4.11.12-4 presents the average annual fatalities that occurred on natural gas transmission and gathering lines from 1970 to 2003.

TABLE 4.11.12-4

Annual Average Fatalities - Natural Gas Transmission and Gathering Systems [a, b]

Year	Employees	Nonemployees	Total
1970-June 1984	2.4	2.6	5.0
1984-2003 [c]	-	-	3.8
1984-2003 [c]	-	-	2.9 [d]

[a] 1970 through June 1984 - American Gas Association, 1986.

[b] DOT Hazardous Materials Information System.

[c] Employee/nonemployee breakdown not available after June 1984.

[d] Without 18 offshore fatalities that occurred in 1989 (11 fatalities resulted from a fishing vessel striking an offshore pipeline and 7 fatalities resulted from an explosion on an offshore production platform).

Fatalities between 1970 and June 1984 have been separated into employees and nonemployees, to better identify a fatality rate experienced by the general public. Of the total 5.0 nationwide average, fatalities among the public averaged 2.6 per year over this period. The simplified reporting requirements in effect after June 1984 do not differentiate between employees and nonemployees. However, the data show that the total annual average for the period 1984 through 2003 decreased to 3.8 fatalities per year. Subtracting two major offshore incidents in 1989, which do not reflect the risk to the onshore public, yields a total annual rate of 2.9 fatalities per year for this period.

The nationwide totals of accidental fatalities from various manmade and natural hazards are listed in table 4.11.12-5 in order to provide a relative measure of the industry-wide safety of natural gas pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. Nevertheless, the average 2.6 public fatalities per year is relatively small considering the more than 300,000 miles of transmission and gathering lines in service nationwide. Furthermore, the fatality rate is approximately two orders of magnitude (100 times) lower than the fatalities from natural hazards such as lightning, tornados, floods, earthquakes, etc.

TABLE 4.11.12-5

Nationwide Accidental Deaths [a]

Type of Accident	Fatalities
All accidents	90,523
Motor vehicles	43,649
Falls	14,985
Drowning	3,488
Poisoning	9,510
Fires and burns	3,791
Suffocation by ingested object	3,206
Tornado, flood, earthquake, etc. (1984 to 1993 average)	181
All liquid and gas pipelines (1978 to 1987 average) [b]	27
Gas transmission and gathering lines Nonemployees only (1970 to 1984 average) [c]	2.6

[a] All data, unless otherwise noted, reflect 1996 statistics from the U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States 118th Edition."

[b] U.S. Department of Transportation, "Annual Report on Pipeline Safety - Calendar Year 1987."

[c] American Gas Association, 1986.

The available data show that natural gas pipelines continue to be a safe, reliable means of energy transportation. Based on approximately 306,000 miles in service, the rate of public fatalities for the nationwide mix of transmission and gathering lines in service is 0.01 per year per 1,000 miles of pipeline. Using this rate, the natural gas and C_2 pipelines associated with the Long Beach LNG Import Project might result in a public fatality every 14,493 years. This would not represent a substantial increase in the potential for incidents that would cause serious injury or death to members of the public and, therefore, would not be considered significant.

4.11.13 Conclusions on Safety Issues

Much of the recent safety debate has centered on the perceived size of worst-case scenarios, the distance to various thermal radiation heat levels for LNG fires, the range of potentially flammable vapors, and the population and infrastructure that are located within the various hazard areas. These are components of a consequence analysis.

However, the evaluation of safety is more than an exercise in calculating the consequences of worst-case scenarios. Rather, safety is a determination of the acceptability of risk that considers the probability of events, the effect of mitigation, and the consequences of events.

Accidental Causes

The analysis in the previous sections has shown that based on the extensive operational experience of LNG shipping, the structural design of an LNG vessel, and the operational controls imposed by the ship's master, the Coast Guard, and local pilots, the likelihood of a cargo containment failure and subsequent LNG spill from a vessel casualty – collision, grounding, or allision – is very small. For similar reasons, an accident involving the onshore LNG import terminal or LNG trucking from the terminal is unlikely to affect the public. As a result, the risk to the public from accidental causes should be considered negligible.

Intentional Attacks

Unlike accidental causes, historical experience provides little guidance in estimating the probability of a terrorist attack on an LNG vessel or onshore storage facility. For a new LNG import terminal proposal that would store a large volume of flammable fluid near populated areas, the perceived threat of a terrorist attack is a primary concern of the local population.

However, at the national level, potential terrorist targets are plentiful, including those having national significance, those with a large concentration of the public (e.g., major sporting events, mass transit, skyscrapers, etc.), or critical infrastructure facilities. Currently, the United States has over 500 chemical facilities operating near large populations. U.S. waterways also transport over 100,000 annual shipments of hazardous marine cargo, including LPG, ammonia, and other volatile chemicals. Many of these substances pose similar hazards to those of LNG. The POLB Quest Study reported that the historical probability of a successful terrorist event would be less than seven chances in a million per year. In addition, the multi-tiered security system that would be in place for an LNG import facility in the POLB would reduce the probability of a successful terrorist event.

Risk Management

While the risks associated with the transportation of any hazardous cargo can never be entirely eliminated, they can be managed. For potential targets where the threat is perceived to be high, resources

can be directed to mitigate possible attack paths. Such efforts may deter potential attacks on one target, but shift efforts to those that are less protected. As a result, the issue is how to best direct finite resources.

For the proposed project, it may be possible to apply risk management resources to manage realistic threats; however, an even greater level of resources may be required to manage the threats as perceived at the local level. The issue for the decision makers is whether the resources required to manage the risks are justified by the benefits, while recognizing that the risks cannot be entirely eliminated.

Conclusion

The analysis concludes that none of the potential LNG release scenarios would result in a substantial increase in the potential for incidents that would cause serious injury or death to members of the public. SES' commitment to coordinate with local emergency providers and fund all project-specific security/emergency management costs would ensure that the project would not substantially reduce the level of fire and police services. Therefore, the proposed Long Beach LNG Import Project would not result in a significant impact on public safety.

4.12 CUMULATIVE IMPACTS

Both NEPA and CEQA require lead agencies to consider the cumulative impacts of their actions, including proposed projects that the lead agencies consider for authorization and actions in the region being considered or approved by other agencies. Cumulative impacts may result when the environmental effects associated with an action are superimposed on or added to either temporary or permanent impacts associated with past, present, or reasonably foreseeable future actions. Specifically, NEPA defines cumulative effects as "the impact on the environment which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (Title 40 CFR Part 1508.7). CEQA defines cumulative impacts as "two or more individual effects that, when considered together, are considerable or that compound or increase other impacts" (Public Resources Code section 15355). Although the individual impact of each separate project might not be significant, the additive effects of multiple actions could be cumulatively considerable (Public Resources Code section 15130).

Existing environmental conditions in the project area reflect changes based on past activities. Historically, the land that is now the City of Long Beach was first settled by Europeans as part of a Spanish Land Grant in 1784. Large-scale real estate development in the City of Long Beach began in the 1880s (City of Long Beach, 2005). In 1911, the POLB was established in 800 acres of mudflats at the mouth of the Los Angeles River. Since then, the Port has expanded to include more than 7,600 acres of wharves, cargo terminals, roadways, rail yards, and shipping channels. Today, the POLB is one of the world's busiest seaports (POLB, 2005). The highly urbanized environment of the project area reflects the extensive past development that has occurred in the area.

Table 4.12-1 lists the present and reasonably foreseeable future actions (projects or activities) in and near San Pedro Bay that may have a cumulative or additive impact on resources that would be affected by construction of the Long Beach LNG Import Project. Projects and activities included in this analysis are located within the ports of Long Beach and Los Angeles and the City of Long Beach. More distant projects are not assessed because their impact would generally be localized and therefore would not contribute significantly to cumulative impacts in the proposed project area. The geographic scope of the Agency Staffs' analysis varies depending on the resource being evaluated. The geographic areas are listed below in descending order of size along with the impact topics included in this analysis:

- SCAB – air quality;
- San Pedro Bay – geology, terrestrial biological resources, and marine transportation;
- ports of Long Beach and Los Angeles – soils and sediments, marine biological resources, land use, recreation, visual resources, socioeconomics, land transportation, cultural resources, noise, and reliability and safety; and
- West Basin of the POLB – water resources.

Of the 40 projects identified in table 4.12-1, 17 involve in-water activities (dredging, dike construction, and/or landfilling). The remaining 23 projects involve on-land demolition, grading, filling, paving, and other construction activities. The potential cumulative impacts associated with each resource are discussed below.

TABLE 4.12-1

Existing and/or Proposed Activities Cumulatively Affecting Resources of Concern for the Long Beach LNG Import Project

Location/Project/Activity	Description	Primary Resources Affected: Water Resources	Transportation	Air Quality	Project Status
Port of Long Beach					
Gerald Desmond Bridge Replacement Project	Replacement of an existing four-lane bridge with a new six- to eight-lane bridge to accommodate projected increases in vehicular traffic and increased ship sizes.		✓	✓	EIR/EA being prepared
Long Beach LNG Import Project (Proposed Project)	Development of a 25-acre LNG import terminal on a portion of Pier T, designated Berth T-126. Also includes pipeline, electric distribution facilities, and wharf construction.	✓	✓	✓	Subject of this document
Long Beach Naval Complex Disposal and Reuse Project	Development of a container terminal, liquid bulk facility, and satellite launch facility. Includes demolishing the buildings and removing the pavement on the proposed LNG terminal site.	✓	✓	✓	Approved project; development construction underway
Middle Harbor Terminal Redevelopment Project	Consolidation of two existing marine container terminals into one 336-acre terminal.	✓	✓		EIS/EIR being prepared
Pier A West Expansion Project	Expansion of an existing marine container terminal onto an existing oil field including remediation of soil and groundwater.		✓	✓	Conceptual project
Piers G&J Terminal Redevelopment Project	Redevelopment of two existing marine container terminals into one terminal.	✓	✓		Approved project; construction underway
Pier J South Terminal Development Project	Expansion of an existing marine container terminal.	✓	✓	✓	Conceptual project
Pier S Marine Terminal	Development of a 150-acre container terminal and rail yard.	✓	✓	✓	EIS/EIR being prepared
Pier T Liquid Bulk Terminal	Development of a portion of Pier T for an oil import terminal including storage tanks and new unloading docks in the West Basin.	✓	✓	✓	Conceptual project
IR Site 7 Remediation	Remediation of up to 800,000 cubic yards of contaminated sediments in the West Basin.	✓		✓	Proposed project
Port of Los Angeles					
Berths 97 to 109 Container Terminal	Development and operation of a container terminal at Berths 97 to 109 in the West Basin.	✓	✓	✓	EIS/EIR being prepared

TABLE 4.12-1 (cont'd)

Existing and/or Proposed Activities Cumulatively Affecting Resources of Concern for the Long Beach LNG Import Project

		Primary Resources Affected			
Location/Project/Activity	Description	Water Resources	Transportation	Air Quality	Project Status
Berths 136 to 150 Marine Terminal	Reconfiguration of wharves and backland and expansion and redevelopment of the TraPac Terminal. Element of the West Basin Transportation Improvement Program.	✓	✓	✓	Environmental analysis expected to begin fall 2005
Berths 206 to 209 Interim Reuse	Interim reuse of the former Matson Terminal. Change in tenant but no substantial change in operations.				Draft EIR completed
Cabrillo Marine Aquarium Expansion	Expansion of the existing Cabrillo Marine Aquarium.				Approved project; construction underway
Cabrillo Way Marina – Phase II	Redevelopment of old marinas and development of the backlands for commercial and recreational uses.	✓			EIR certified; construction has not begun
Channel Deepening Project	Dredging of up to 8.5 million cubic yards of sediment from the Port of Los Angeles Main Channel.	✓		✓	Approved project; dredging underway
Charter High School and Port Police Headquarters	Development of the "Port of Los Angeles High School of International Business and Maritime Studies" and a Port Police Headquarters campus.				EIR being prepared
Conoco-Phillips Marine Oil Terminal	Lease renewal for a marine oil terminal.				NOP being prepared
Crescent Warehouse Company Relocation	Relocation of the Crescent Warehouse Company's operations.				Environmental analysis underway; completion expected 2006
East Wilmington Greenbelt Community Center	Construction of a new 10,000-square-foot community building, a 25-space parking lot, and landscaped areas.				Approved project
Evergreen Backlands Improvements Project	Rehabilitation of an existing 125-acre marine terminal.				Approved project
Evergreen Expansion	Expansion of the Evergreen Terminal. Lease boundary changes, gate improvements, wharf modifications, cranes, and new buildings.	✓	✓	✓	NOP being prepared
Fishing Reef	Development of an artificial reef from construction debris south of the San Pedro Breakwater.	✓			Approved project

TABLE 4.12-1 (cont'd)

Existing and/or Proposed Activities Cumulatively Affecting Resources of Concern for the Long Beach LNG Import Project

Location/Project/Activity	Description	Primary Resources Affected: Water Resources	Primary Resources Affected: Transportation	Primary Resources Affected: Air Quality	Project Status
Intermodal Container Transfer Facility	Construction of a new Intermodal Container Transfer Facility.		✓	✓	Proposed project; feasibility of project is currently being investigated
Pacific Corridors Redevelopment Project	Commercial/retail, manufacturing, and residential developments.				Approved project; construction underway
Pacific Energy Systems, Pier 400	Construction of a crude oil receiving facility, tanks, and associated pipelines on Pier 400 of Terminal Island.	✓	✓	✓	NOI/NOP being prepared
Pasha Marine Terminal Improvements	Redevelopment of existing facilities at Berths 171 to 181 as an Omni (multi-use) terminal.				EIR being prepared
Pier 400 Container Terminal and Transportation Corridor Project	Dredging, land filling, and marine terminal construction as part of the 2020 Plan Deep Draft Navigation Improvements.	✓			Approved project; construction underway
San Pedro Waterfront Promenade	Construction of a waterfront promenade walkway along the Main Channel.				EIS/EIR being prepared
SSA Outer Harbor Fruit Facility Relocation	Relocation of an existing fruit import facility at 22nd and Miner to Berth 153.				NOP being prepared
Ultramar, Valero Lease Renewal	Lease renewal for a liquid bulk (petroleum) terminal.				NOP being prepared
Waterfront Gateway	Development of a waterfront promenade.				Negative Declaration issued
Wilmington Parkway	Realignment and widening of Harry S. Bridges Boulevard including acquisition of properties, expansion of terminal backlands, and construction of associated recreational facilities.		✓	✓	EIS/EIR being prepared
City of Long Beach					
D'Orsay Hotel Project	Development of a hotel.				Approved project; construction pending
Downtown Mall Redevelopment	Development of commercial and residential space.				Approved project; construction underway
Marriott Hotel Project	Development of a hotel.				Approved project; construction pending

TABLE 4.12-1 (cont'd)

Existing and/or Proposed Activities Cumulatively Affecting Resources of Concern for the Long Beach LNG Import Project

Location/Project/Activity	Description	Primary Resources Affected			Project Status
		Water Resources	Transportation	Air Quality	
Pike Property Development	Development of residential units and an office building or hotel.				Approved project; construction underway
The Pike at Rainbow Harbor (formerly Queensway Bay Master Plan)	Construction of Long Beach Aquarium, new urban harbor, office building, and entertainment complex.				Approved project; construction underway
Alameda Corridor Transportation Authority/California Department of Transportation					
Heim Bridge Replacement	Replacement of the seismically deficient Heim Bridge.	✓	✓		Proposed project
State Route 47 Truck Expressway	Improvement of the State Route 47 Expressway.		✓		Proposed project

4.12.1 Geology

Several of the projects listed in table 4.12-1 would affect geological resources in the San Pedro Bay area through the creation of up to 508 acres of new land for marine terminals. The new land would alter the geomorphology of the bay. A century of port development has already created several thousand acres of similar artificial land that overlies natural formations. The additional land created by these projects would only incrementally add to the existing artificial formations in the area and would not be significant. The remaining projects, including the proposed project, would redevelop existing land and would not materially alter the geologic conditions of the area or worsen existing unfavorable geologic conditions. As a result, these projects would represent an insignificant cumulative impact on geological resources.

The creation of additional land associated with the marine terminal projects and installation of the proposed LNG storage tanks on top of previously placed fill materials would create conditions that would be more susceptible to seismic hazards than natural formations because the fill materials consist of hydraulically placed fine sand and silt. This risk is inherent in the construction of such fills in a seismically active area such as southern California and would be addressed in the design process for each project. Each project would be constructed and operated in accordance with all applicable codes and regulations to minimize impacts associated with seismic hazards. A description of the design options for the proposed project is presented in section 4.1.4.3.

4.12.2 Soils and Sediments

Construction of the on-land portions of the projects identified in table 4.12-1 would expose fill materials and/or native soils to the effects of wind, rain, and runoff, which could cause erosion and sedimentation in the area. These effects would be temporary, limited primarily to the period of construction, and highly localized. Cumulative impacts on soils would only occur if other projects are constructed at the same place and time as the proposed project facilities. The demolition of buildings and the removal of pavement associated with the Long Beach Naval Complex Disposal and Reuse Project would be the only other project that would occur at the same place as the proposed project. These activities would be completed before SES' initiation of activities associated with the Long Beach LNG Import Project. In addition, all of the projects would be required to implement appropriate erosion control measures. As a result, no cumulative impacts on soils are anticipated. Disturbance of the sediments in Long Beach or Los Angeles Harbors during in-water activities would temporarily resuspend sediments in the water column, which could result in localized increases in turbidity. An increase in sediment and turbidity levels could have a cumulative impact on water quality and aquatic organisms (see sections 4.12.3 and 4.12.4, respectively).

4.12.3 Water Resources

Seventeen of the projects identified in table 4.12-1, including the proposed project, would involve in-water activities (dredging, dike construction, and/or land filling). Land filling would result in the creation of up to 508 acres of new land. The creation of new land would alter the configuration of the harbors in San Pedro Bay, which could alter water circulation. The filling activities associated with most of these projects would involve inner harbor or small shoreline fills that would not affect large-scale harbor circulation. However, some projects may have localized impacts on circulation within specific basins because they fill dead-end slips and generally decrease the amount of water area in those basins.

Construction of the Long Beach LNG Import Project would occur over a 48-month period. Construction of the other projects identified in table 4.12-1 would occur over approximately 20 years. During construction of these projects, there is an increased potential for turbidity, resuspension of

contaminated sediments, and storm water runoff. In recent years, construction-generated runoff and turbidity have been subjected to increasingly stringent and effective controls. Because of those controls and the monitoring that would be employed during construction of each project, in no individual case for which environmental review has been completed is the impact considered significant. Cumulatively, construction of the projects could have a minor adverse impact on water quality in San Pedro Bay. The impact is not expected to be significant, however, because of the effectiveness of construction controls [e.g., compliance with the requirements of the RWQCB's WDR permit, the ACOE's section 404 permit, and the CSWRCB's NPDES General Permit for Storm Water Discharges Associated with Construction Activity (see section 4.3.3.2)] and the temporal and spatial separation of the individual projects.

Operational impacts on water quality attributable to cumulative development in the San Pedro Bay area could occur as a result of storm water runoff. Runoff is subject to stringent controls and BMPs as required by the general industrial NPDES permit program and the applicable municipal storm water permits administered by the Cities of Los Angeles and Long Beach. Implementation of the BMPs would reduce the cumulative impacts associated with the projects identified in table 4.12-1 to less than significant levels.

Dredging activities would remove contaminated sediments for appropriate disposal. This could minimize the total amount of contaminated sediments in contact with the marine environment. Dredging permits for all of the projects would include measures to prevent significant resuspension of contaminants into the water column and ensure that sediments are handled and disposed of properly (e.g., monitoring and reporting programs to ensure that significant levels of contaminants would not be released to the harbor waters or adversely affect beneficial uses of the harbor). Because all of the projects would be subject to strict operational controls (e.g., specifications for the storage of fuel and other hazardous liquids; requirements for inspection of equipment for leaks and deterioration; and notification, response, and cleanup procedures in the event of a spill), they are not likely to contribute to substantial sediment contamination in the future.

4.12.4 Biological Resources

Construction and operation of the Long Beach LNG Import Project would not result in the permanent loss of marine habitat; however, other projects identified in table 4.12-1 involve the creation of up to 508 acres of new land that would cause a permanent loss of marine habitat. These habitat alterations are increments caused by continued expansion of the ports and, collectively, are considered a significant impact. However, because the proposed project would not involve loss of marine habitat, it would not contribute to that impact.

The increased volumes of international cargo that present and reasonably foreseeable marine terminal projects are intended to accommodate would increase the number and size of ships that call at the ports of Long Beach and Los Angeles. In either case, the volumes of ballast water those ships would carry could increase the possibility that exotic marine species would be introduced into San Pedro Bay. This issue has been addressed at the federal and state levels, resulting in the institution of a program of mandatory ballast water exchange and reporting. The program covers all ships calling at California ports from overseas. Despite these measures, the exotic species issue remains potentially considerable as a result of the cumulative impacts of continuing port development and growth in international trade. The ships associated with the Long Beach LNG Import Project, however, are not expected to contribute to this cumulative impact. The ships would arrive at the terminal facility fully loaded with LNG from locations throughout the Pacific region. To maintain a constant draft during the unloading operation, the LNG ship would bring on ballast water during transfer of its LNG cargo and retain this ballast water until after the LNG ship departs the harbor. The absence of ballast water discharges within the harbor would decrease the potential for importing an exotic species during operation of the Long Beach LNG Import Project.

The 17 projects involving in-water activity have the potential to affect federally designated EFH in the harbor through construction-related turbidity and disturbance and, in the long term, the loss of up to 508 acres of open water. Even when all projects are considered cumulatively, the construction impacts would not be significant because of the control measures that would be employed (e.g., measures to reduce dredging impacts, implementing storm water pollution and spill prevention procedures, using special construction techniques to minimize in-water disturbance) and the small scale of disturbance relative to the extent of the habitat.

Seven species listed as federally threatened or endangered were identified as potentially occurring in the San Pedro Bay area. Of these seven species, there is a low potential for five to occur in the project area (the western snowy plover and the green, Ridley, loggerhead, and leatherback sea turtles). The other two species, the California brown pelican and the California least tern, are water-dependent birds that are common in San Pedro Bay and could be affected by the cumulative impacts associated with increasing development of the harbor complex. The California brown pelican, however, does not rely on the bay for breeding or nesting. In addition, roosting or feeding pelicans are generally acclimated to operations in the ports of Long Beach and Los Angeles, including construction and dredging activities. As a result, increasing development does not appear to represent a cumulatively significant impact on this species.

A large colony of California least terns nests on Pier 400 in the POLA and has traditionally foraged in the shallow water habitat west of the Navy Mole in Los Angeles and Long Beach harbors. The potential cumulative impact on the food supply from construction activities and loss of habitat associated with land fills is an issue that the ports and the applicable resource agencies have addressed through the consultation process under section 7 of the ESA. The Long Beach LNG Import Project would not result in the permanent loss or degradation of existing habitats and, therefore, would not contribute to cumulative impacts on this species.

American peregrine falcons are state-listed endangered species that are primarily found near large bodies of water where they feed on water birds. American peregrine falcons forage regularly in Los Angeles and Long Beach Harbors, and several pairs of peregrine falcons are known to nest within and near the ports of Los Angeles and Long Beach. Potential cumulative impacts on the American peregrine falcon could occur as a result of loss or degradation of foraging habitat and disruptive noise from construction and operation of multiple projects in the area. However, peregrine falcons in the project area have become acclimated to POLB operations, including construction and dredging activities. In addition, the Long Beach LNG Import Project would not result in the permanent loss or degradation of existing foraging habitat or significantly increase existing noise levels during construction and operation. Therefore, the proposed project would not contribute to cumulative impacts on this species.

4.12.5 Land Use

All of the projects identified in table 4.12-1 would be consistent with the land use polices and designations of the Cities of Long Beach and Los Angeles and their respective ports. In the harbor area, the projects would be industrial or commercial and port-related, which would conform to the approved PMPs. The LNG terminal would be an industrial use that generally conforms to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans and would be consistent with existing surrounding uses. However, an amendment to the PMP would be necessary to accommodate the LNG facility because LNG is not an expressly identified “hazardous cargo” as permitted within Terminal Island Planning District 4 of the POLB. The projects in the City of Long Beach would be consistent with existing commercial and residential uses and conform to the city’s zoning and land use plans. As a result, the combination of identified projects would not significantly contribute to cumulative impacts on land use.

4.12.6 Recreation

Several of the existing or proposed projects would enhance recreational and leisure facilities and opportunities in the region (e.g., the Cabrillo Marine Aquarium Expansion, Cabrillo Way Marina - Phase II, Fishing Reef, San Pedro Waterfront Promenade, and hotel developments). While none of the existing or proposed industrial or commercial projects would displace any recreational facilities, continued port development may have a minor cumulative impact on recreational opportunities. The Long Beach LNG Import Project is not expected to contribute to any cumulative impacts on recreational activities because it would not adversely affect waters currently used for recreation.

4.12.7 Visual Resources

All of the projects identified in table 4.12-1 would be constructed in highly developed areas associated with the ports and Cities of Long Beach and Los Angeles. Construction and operation of new buildings or structures associated with these projects, including those at the LNG terminal, would have a permanent effect on visual resources. The cumulative impacts would not be significant, however, because the facilities would be seen in the context of the existing facilities in the area and would not adversely affect the viewshed from sensitive locations or change the character of the landscape in terms of either physical characteristics or land uses. The existing facilities at the ports of Long Beach and Los Angeles would screen, backdrop, and otherwise minimize the overall visual impact of these projects to less than significant levels.

4.12.8 Socioeconomics

The present and reasonably foreseeable future projects could cumulatively impact socioeconomic conditions in the project area, including population, employment, and housing; public service systems; utilities and service systems; and environmental justice.

Population, Employment, and Housing – The Long Beach LNG Import Project would not result in potentially significant impacts on population, employment, or housing; therefore, significant cumulative impacts would not occur as a result of this project in combination with the other projects identified in table 4.12-1.

Public Service Systems – The existing and proposed projects identified in table 4.12-1 may increase the demand for police and fire protection in the region. The increased demand would be consistent with the overall pattern of growth that the Cities of Long Beach and Los Angeles incorporate into their planning processes. Construction of the Long Beach LNG Import Project would not add to the cumulative demand for public services because the non-local workforce would be small relative to the current population. However, the proposed project would introduce a new product (i.e., LNG) to the POLB that also would be new to the local fire and emergency response services; therefore, operation of the project could add to cumulative impacts on the local public service systems in the event of an emergency at the LNG terminal. As discussed in section 4.6.5, the NASFM, the OPS, and the OEP are developing an LNG safety module that will be added to the firefighter safety program to train the local fire services. In addition, SES is working with local emergency providers to develop procedures to handle potential fire emergencies and is working with the LBFD to provide hazard control and firefighting training that is specific to LNG and LNG vessels. SES has also committed to funding all necessary security/emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs. These measures should adequately equip the LBFD to handle any type of emergency at the proposed LNG terminal. As a result, the proposed project would not

significantly contribute to cumulative impacts on public service systems. A discussion of cumulative impacts on emergency response times is presented in section 4.12.13.

Utilities and Service Systems – The proposed project would not result in potentially significant impacts on utility and service systems; therefore, significant cumulative impacts would not occur as a result of the proposed project in combination with the other projects identified in table 4.12-1.

Environmental Justice – Although the City of Long Beach could be characterized as poorer than average and has an over 50 percent minority population, there is no evidence that the project would result in cumulative impacts on any racial, ethnic, or socioeconomic group because the facilities would be located primarily within an existing industrial area associated with the POLB. In addition, all of the projects identified in table 4.12-1 would be consistent with the land use polices and designations of the Cities of Long Beach and Los Angeles and their respective ports as well as with the past development of the ports. A Health Risk Assessment was conducted to evaluate the potential for impacts on human health associated with air toxics (see section 4.9.7). The assessment concluded that the impact of the Long Beach LNG Import Project on human health risks would be less than significant; however, toxic air pollutants resulting from the project would likely contribute to cumulative air quality impacts in the SCAB (see section 4.12.11). As discussed in section 4.12.11, it is likely that the incremental increase in the cancer risk level for toxic air pollutants as a result of the proposed project would contribute to an existing cumulatively significant health impact in the SCAB. These health impacts could disproportionately affect the environmental justice communities located near the project area.

4.12.9 Transportation

Land Transportation – The future baseline traffic conditions discussed in section 4.7.2 were developed by considering the cumulative traffic effects of regional growth and traffic generated by other proposed developments in the POLB area. Traffic associated with construction and operation of the project was then added to the future baseline conditions to develop the cumulative impact scenarios for the proposed project. The traffic analysis is, therefore, representative of a cumulative traffic impact analysis of the proposed project and other reasonably foreseeable growth in traffic. During construction, cumulative traffic occurring in the evening at the Henry Ford Avenue/Anaheim Street intersection is likely to have a significant impact. The proposed Heim Bridge Replacement and State Route 47 Truck Expressway Projects would reduce this impact. However, if these projects do not go forward, the LADOT may require improvements at the Henry Ford Avenue/Anaheim Street [e.g., re-striping portions of the roads and/or imposing parking restrictions (see section 4.7.2.3)]. With implementation of these mitigation measures, no significant cumulative traffic impact is expected in the area as a result of construction or operation of the proposed project.

Marine Transportation – Cumulative projects could cause an increase in the amount of vessel traffic in San Pedro Bay and its approaches. As discussed in section 4.7.3.1, the POLB currently experiences about 3,085 ship calls, which results in about 6,170 inward and outward ship movements per year. By 2020, this total is expected to increase to between 10,400 and 15,200 inward and outward ship movements. Any increase would represent an increased risk of collision and groundings. To accommodate existing and future vessel traffic and to increase safety, the Los Angeles-Long Beach Marine Exchange and the Coast Guard established a VTS that manages vessel traffic in southern California waters. Because the VTS ensures the capacity of the two ports to handle future vessel traffic safely, the effect of cumulative project development on marine transportation is considered less than significant. In addition, the vessel traffic associated with the Long Beach LNG Import Project (i.e., 120 ship calls per year or 240 inward and outward ship movements) would represent only about 4 percent of current ship traffic and 2 percent of the total projected levels in 2020. As a result, the proposed project would not significantly contribute to cumulative impacts on marine transportation.

4.12.10 Cultural Resources

The Long Beach LNG Import Project would be constructed in areas that have undergone extensive previous disturbance. Accordingly, the proposed project would not contribute to cumulative impacts on cultural resources because no historic properties or unique archaeological resources would be affected. Each of the other existing or proposed projects would include mitigation measures designed to avoid or minimize impacts on cultural resources if present. As a result, no significant cumulative impacts on cultural resources are anticipated.

4.12.11 Air Quality

All of the projects identified in table 4.12-1 are located in the SCAB, which experiences chronic exceedances of state and federal air quality standards as described in section 4.9. All of the existing or proposed projects would have air emissions associated with construction and most would have air emissions during operation of the facilities. With the exception of the Pike at Rainbow Harbor (formerly the Queensway Bay Master Plan), all of the projects that have undergone environmental review would have emissions that represent significant impacts even after the incorporation of mitigation measures recommended by the SCAQMD. Air emissions associated with the Long Beach LNG Import Project are also expected to remain significant after implementation of SES' proposed control measures and the Agency Staffs' recommended mitigation measures. During construction of the proposed project, the SCAQMD significance thresholds would be exceeded for all criteria pollutants except SO_x on a peak daily and quarterly basis. During operation, the project's net emissions after SCAQMD-required emission offsets and implementation of SES' proposed control measures would exceed the daily SCAQMD significance thresholds for NO_x, ROC, PM_{10}, and SO_x. As a result, the existing and proposed projects are assumed to have both individually and cumulatively significant impacts on air quality.

Most of the impacts on air quality associated with the various projects would be attributable to emissions from mobile sources (e.g., construction equipment, terminal operating vehicles, marine vessels, trains, trucks, and on-road vehicles). Ongoing programs administered by the EPA, the CARB, and the SCAQMD would lessen those emissions by encouraging, and in some cases mandating, measures such as alternative fuels, reformulated diesel fuels, cleaner engines, and ride-sharing. In addition, the proposed project would make an alternative cleaner burning fuel (i.e., LNG) more available for distribution locally to fuel LNG-powered vehicles. As a result, there is a potential for air quality benefits associated with the proposed project because LNG-powered vehicles have lower emissions than diesel-powered vehicles. Nevertheless, the cumulative projects represent additions of potentially significant and unavoidable emissions in the SCAB.

As discussed in section 4.9.7, a Health Risk Assessment of toxic air contaminant emissions on humans was conducted for the Long Beach LNG Import Project in accordance with SCAQMD Rule 1401. The Health Risk Assessment concluded that the proposed project would not individually exceed cancer risk level significance thresholds established by the SCAQMD for toxic air pollutant health impacts; however, the total carcinogenic risk in the SCAB and the Port areas currently exceeds thresholds of significance based on data gathered in the MATES II Study. Therefore, even though project-specific toxic air pollutant health impacts would not be significant, it is likely that the incremental increase in the cancer risk level for toxic air pollutants as a result of the proposed project would contribute to an existing cumulatively significant health impact in the south-central Los Angeles area, the harbor area, and near freeways.

4.12.12 Noise

Construction and operation of the projects identified in table 4.12-1 would contribute noise and vibration to the environment and may raise the overall noise level as a result of increasing the intensity of site activities within the ports of Long Beach and Los Angeles and the City of Long Beach. If more than one project is constructed in the same place at the same time, cumulative impacts on noise could occur. As previously discussed, the demolition of buildings and the removal of pavement associated with the Long Beach Naval Complex Disposal and Reuse Project would be the only other project that would occur at the same place as the proposed project and those activities would be completed before SES' initiation of activities associated with the Long Beach LNG Import Project. During operation, the facilities associated with the proposed project would not produce vibrations and would be located over 1 mile from the nearest NSAs. In addition, the activities associated with all of the projects would be required to comply with applicable noise ordinances. Therefore, the cumulative impacts on noise and vibration would be considered less than significant.

4.12.13 Reliability and Safety

Impacts on reliability and public safety would be mitigated through the implementation of applicable federal, state, and local rules and regulations for each individual project. The specific rules and regulations that apply to each individual project would ensure that the applicable design standards are implemented to protect the public and to prevent accidents and failures. The LNG terminal facilities would be sited, designed, constructed, operated, and maintained in compliance with the federal safety standards summarized in table 2.7.1-1. The pipelines and aboveground facilities associated with the Long Beach LNG Import Project would be designed, constructed, operated, and maintained in accordance with DOT Minimum Federal Safety Standards in Title 49 CFR Part 192.

Several of the present or reasonably foreseeable future projects, including the proposed project, would involve cargo terminals that could be expected to ship hazardous materials. Accidents involving such materials represent a potential impact on public safety. Continued growth in international commerce is likely to result in increased quantities of hazardous materials being shipped to and from the region.

It is difficult to evaluate the cumulative risk that such growth represents or has represented. In addition, it is difficult to measure the cumulative risk for an intentional attack on the Port or the LNG facility. As discussed in section 4.11.10, the POLB Quest Study reported that the historical probability of a successful terrorist event would be less than seven chances in a million. The addition of the LNG facility and its associated LNG ships would not significantly change the risk of an intentional attack on the POLB. It is reasonable to assume that the rate of ship accidents (including those involving the release of hazardous materials) is likely to rise with more vessel traffic, which could cumulatively increase the risk of an accident having an impact on public safety. As previously discussed, the Los Angeles-Long Beach Marine Exchange and the Coast Guard established a VTS that manages vessel traffic and increases safety in southern California waters. The Coast Guard would also enforce a security zone around LNG ships. These and other operational controls by the Coast Guard, VTS, and Jacobsen Pilots and the characteristics of the POLB would minimize the risk of accidents involving LNG ships. Furthermore, the implementation of federal, state, and local rules and regulations concerning security and the results of the WSA with its associated operations and Emergency Response Plan would minimize the risk to the POLB and the LNG operation.

Emergency response time is a key aspect of public health and safety. Projects that increase traffic congestion or interfere with access are the most likely source of adverse impacts on response times. None of the projects identified in table 4.12-1 where the environmental analysis has been completed is expected to cause an increase in response times for emergency services. Cumulative impact on one intersection,

combined with the traffic associated with the proposed project, would likely result in significant impacts during construction. However, no significant cumulative impacts on emergency services are expected because sufficient emergency services and facilities exist in the area to accommodate cumulative projects, and because of mitigation measures that would reduce the cumulative traffic impact at this intersection (see sections 4.7.2.3 and 4.12.9). No significant cumulative impacts on emergency services are expected during operation of the proposed project. Section 4.11.9 includes the Agency Staffs' recommendation that SES prepare an Emergency Response Plan and coordinate procedures with local emergency planning groups, the ports of Long Beach and Los Angeles, fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies to be used in the event of an incident. As discussed in sections 4.6.5 and 4.11.7.4, SES has committed to funding all necessary security/emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs. With the implementation of the coordination procedures in the Emergency Response Plan and the funding of additional emergency management equipment and personnel, no cumulative impacts would be expected on emergency response services during operation of the proposed project.

4.13 GROWTH-INDUCING IMPACTS

The CEQA requires the consideration and discussion in an EIR of the growth-inducing impacts of the proposed project. Analysis of growth-inducing impacts includes characteristics of the proposed action that may encourage and facilitate activities that would, either individually or cumulatively, affect the environment. These activities include increases in population growth that could affect the economy, housing, and community services. For example, population increases could create demands for construction of additional housing and/or impose new burdens on existing community service facilities. Growth may be considered beneficial, adverse, or of no significance environmentally depending on its effects on the environmental resources present.

Most of the natural gas that would be supplied by the LNG terminal would be transported into the SoCal Gas system and would be used to meet existing and future natural gas demand in the LA Basin. The demand for energy is a result of, rather than a precursor to, development in the region. As discussed in section 1.1, currently, imports from out of state represent approximately 87 percent of supply and are anticipated to rise to 88 percent by 2013, meaning that additional external supplies will be needed to keep up with demand. Given the short- and mid-term demand for natural gas and the need to reduce potential supply interruptions, the CEC has identified the need for California to develop new natural gas infrastructure to access a diversity of fuel supply sources and to remove constraints on the delivery of natural gas. The LNG that would be made available for vehicle fuel would be used to meet existing and projected future demand and provide a new source of fuel to facilitate conversion of diesel or gasoline-fueled vehicles to LNG, which could reduce air emissions in the area.

Given the large local labor pool in Los Angeles and Orange Counties, no substantive influx of workers would occur during construction and operation of the Long Beach LNG Import Project. As a result, the project would not cause a significant increase in population or demand for housing. The project would have a beneficial impact on the local economy and employment because the majority of the construction and operation workforce is expected to be hired from the local labor pool. However, given the size of the regional economy, these benefits are not expected to result in significant growth-inducing impacts. Because the non-local workforce would be small relative to the current population, construction of the project facilities would not impact the local community facilities and services such as police, fire, and medical services. The LBFD's experience, extensive and comprehensive training in petroleum and shipboard firefighting; the training specific to LNG that would be provided by the NASFM, the OPS, the OEP, and SES; and the funding of additional emergency management equipment and personnel should adequately equip the LBPD and other local emergency providers to handle any type of emergency during operation of the proposed LNG terminal.

5.0 APPLICATION SUMMARY REPORT

This narrative, including the EIS/EIR, constitutes an Application Summary Report and Proposed Staff Recommendations prepared in accordance with the certified PMP as amended and the CCA. Based on data contained herein, the proposed project is in conformance with the stated policies of the PMP. This document was circulated for public review and becomes effective upon certification by the BHC.

5.1 CONFORMANCE WITH THE PORT MASTER PLAN

As discussed in section 1.4.3, the natural gas pipeline, the portion of the C_2 pipeline located within the POLB, and the electric distribution facilities associated with the Long Beach LNG Import Project conform to the permitted utility uses within both the Terminal Island Planning District 4 and the Northwest Harbor Planning District 3. Therefore, these facilities are consistent with the PMP. The LNG terminal generally conforms to the overall goals of the current PMP and is consistent with the long-range planning goal for Terminal Island Planning District 4 to redevelop excess Navy property for development of Port facilities and the objective of pursuing development of primary Port and ancillary facilities on available lands within the district. An amendment to the PMP would be necessary, however, to accommodate the LNG facility because LNG is not an expressly identified "hazardous cargo" as permitted within Terminal Island Planning District 4.

5.2 CONFORMANCE WITH THE CALIFORNIA COASTAL ACT

To certify a PMP amendment, the CCC must find the amendment consistent with the policies of Chapter 3 and Chapter 8 of the CCA.

Consistency with Chapter 3 of the CCA

As described in section 1.4.2, Chapter 3 of the CCA lists the six coastal resources planning and management polices that are used to evaluate a proposed project's consistency with the CCA. These six coastal resources planning and management polices and their relationship to the proposed project are discussed below.

Maximize Access to California's Coast (Sections 30210 to 30214) – The proposed LNG terminal would be located in a previously developed, industrial area associated with the POLB. The closest onshore recreational facilities are located over 1 mile from the LNG terminal site. Construction and operation of the Long Beach LNG Import Project would not interfere with or change public access to coastal areas.

Protect Water-Oriented Recreational Activities (Sections 30220 to 30224) – Recreational boating and associated offshore recreational activities such as fishing are not allowed within the West Basin, which immediately surrounds the LNG terminal site. In general, fishing in the Los Angeles and Long Beach Harbors is discouraged because of heavy metal contamination of certain fish species. Minor delays to recreational boats could occur on days when an LNG ship arrives at the LNG terminal. SES estimates that LNG ships would arrive at the terminal up to 120 days per year. The Coast Guard, with the assistance of the POLB, would enforce the Title 33 CFR Part 165.1151 moving security zone of 1,000 yards ahead and 500 yards on each side and astern of the LNG ships. Other vessels, including recreational boats, would be prohibited within the security zone during the arrival of LNG ships. These effects would be temporary and minimized by the fact that the LNG ships would use established commercial shipping lanes that currently accommodate about 6,170 inward and outward vessel movements per year and the Coast Guard and the HSC currently require ships entering and leaving the POLB to maintain a minimum separation distance of 500 yards.

Maintain, Enhance, and Restore California's Marine Environment (Sections 30230 to 30237) – Potentially significant impacts on water quality associated with construction and operation of the LNG terminal would be reduced to less than significant levels through adherence to measures included in all applicable permits, implementation of the POLB's Dredge and Disposal Plan, and disposal of all sediments associated with dredging activities at approved sites. SES would also obtain a General NPDES Permit and WDR permit for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties from the RWQCB and adhere to its terms and conditions. To minimize impacts associated with storm water runoff associated with the proposed LNG terminal, SES has prepared a draft site-specific SWPPP for the Long Beach LNG Import Project in accordance with the CSWRCB's NPDES General Permit for Storm Water Discharges Associated with Construction Activity. BMPs consisting of permanent features and operational practices designed or implemented to minimize the discharge of pollutants in storm water or non-storm water flows from the LNG terminal site would be adhered to by SES in accordance with its SWPPP once construction is completed and the facility is operational. As part of its SWPPP, SES has prepared a Spill Procedure to address preventive and mitigative measures that would be used to minimize the potential impact of a hazardous spill during construction and operation of the project facilities.

Activities associated with construction and operation of the LNG terminal including dredging, reinforcement of the shoreline structures, construction of the LNG ship berth and unloading facility, as well as noise and the accidental release of hazardous materials associated with these activities could impact marine organisms that occur in the project area. Overall, none of these impacts would substantially affect local resident or migratory marine organisms and, as such, are not considered significant. Adherence to the measures included in the ACOE's section 404 permit and the RWQCB's WDR permit would minimize turbidity-related impacts associated with dredging on marine organisms. In addition, implementation of SES' Spill Procedure would reduce impacts on marine organisms associated with a hazardous spill or leak to less than significant levels.

Protect Sensitive Habitats and Agricultural Uses (Sections 30240 to 30244) – There are no agricultural areas in the vicinity of the proposed LNG terminal site. The LNG terminal would be located in an existing industrialized area associated with the POLB. The proposed project area is designated EFH for the Coastal Pelagics and Pacific Groundfish Management Plans. Fourteen of the 86 species managed under these two plans are known to occur in the Los Angeles and Long Beach Harbors and could be affected by the proposed project. Although disturbance of an estimated 11.9 acres of sea floor and the temporary resuspension of sediments into the water column during dredging activities could potentially adversely affect EFH, adherence to the measures included in the ACOE's section 404 permit and the RWQCB's WDR permit and implementation of the BMPs in the POLB's Dredge and Disposal Plan, SES' SWPPP, and SES' Spill Procedure would serve to avoid or minimize impacts on EFH to less than significant levels.

Minimize Environmental and Aesthetic Impacts of New Development (Sections 30250 to 30255) – The proposed LNG terminal would be located in a previously developed, industrial area associated with the POLB. The existing infrastructure and public services of the POLB and surrounding areas would generally be able to accommodate the proposed facilities. However, because LNG would be a new product to the POLB, it would also be new to the local fire and emergency response services. SES is working with local emergency providers to develop procedures to handle potential fire emergencies and is working with the LBFD to provide hazard control and firefighting training that is specific to LNG and LNG vessels. The procedures would be included in an Emergency Response Plan for the facility. In addition, SES has committed to funding all necessary security/emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs. These measures should adequately equip the LBFD to handle any type of emergency at the proposed LNG terminal.

Construction and operation of the LNG terminal facilities would have a permanent impact on visual resources. The LNG storage tanks, in particular, would be tall in relation to the surrounding structures. Although there are a substantial number of potential mobile and stationary viewers and visibility is high in some locations (e.g., Queensway Bridge), the LNG facilities would be seen in the context of the existing industrial facilities at the POLB and would not adversely affect the viewshed from sensitive locations or change the character of the landscape in terms of either physical characteristics or land uses. In addition, the LNG facilities would not block or alter an important/valued view or have an adverse effect on a scenic vista. The overall visual impact associated with the LNG terminal facility was rated moderate to low and the existing POLB facilities would screen, backdrop, and otherwise minimize the overall visual impact of the LNG storage tanks to less than significant levels.

Locate Coastal-Dependent Industrial Facilities within Existing Sites Whenever Possible (Sections 30260 to 30265.5) – The LNG terminal associated with the Long Beach LNG Import Project is a coastal dependent industrial facility. Currently, the only feasible method of importing large volumes of LNG from overseas is by ship. The terminal would be located within an existing industrial area associated with the POLB. Specifically, the LNG terminal would be located on an existing portion of Pier T within Terminal Island Planning District 4 of the POLB.

Consistency with Chapter 8 of the CCA

Chapter 8 of the CCA recognizes the California ports, including the POLB, as primary economic and coastal resources and as essential elements of the national maritime industry [section 30701(a)]. Relevant sections of Chapter 8 of the CCA are listed below with a discussion of their relationship to the proposed project.

Section 30705

(a) – Dredging is allowed for berthing areas and facilities required for the safety and accommodation of vessels. Preparation of the ship berth for the LNG terminal facility would require the dredging of approximately 175,000 cubic yards of sediments to a depth of about -55 feet MLLW to accommodate safe under keel clearance and tidal fluctuation. This depth would safely accommodate the largest LNG ships expected to use the terminal.

(c) – Time dredging to minimize disruption to fish and birds, marine habitats, and water circulation. The dredging associated with the Long Beach LNG Import Project would be conducted within the West Basin where the tidal velocities are low and water circulation is currently somewhat restricted. The proposed dredging activities would not cause significant disruptions to water circulation. In addition, because the project would not involve the creation of new land, no permanent disruptions to water circulation would occur. Birds found in the area are acclimated to noise and/or temporary degradation of foraging habitats associated with dredging activities within the Port and would temporarily use similar habitats in adjacent areas. Due to the temporary nature of the disruption, the overall impact on birds would be less than significant. Adherence to the measures included in the ACOE's section 404 permit and the RWQCB's WDR permit and implementation of the BMPs in the POLB's Dredge and Disposal Plan would serve to avoid or minimize impacts on fish, including EFH, and marine habitats associated with dredging to less than significant levels.

The Navy and the POLB have conducted physical and chemical analysis of the sediments in the West Basin. In general, these studies found that the West Basin sediments consist of sand, fine silts, and clays. Metals, pesticides, PCBs, VOC, and semi-VOC were documented in sediments throughout the West Basin, but at generally higher concentrations under piers and near sea walls than in open water. The POLB currently plans to dispose of the dredged sediments at a confined disposal site previously approved

for contaminated materials within Long Beach Harbor (e.g., ITS Slip fill, East Basin Slip 1 fill, or upland site). The POLB could propose to dispose of uncontaminated dredged materials at an unconfined aquatic location (i.e., Western Anchorage Temporary Sediment Storage Site). In order to determine disposal site suitability, the POLB would prepare and implement a Sampling and Analysis Plan in accordance with the three-tiered testing protocols in the EPA/ACOE Inland Testing Manual. Based on the results of the tiered testing protocols, the ACOE would review and approve or deny the use of an unconfined aquatic location, or alternately approve the POLB's request to take the materials to a confined or upland site. Adherence to measures included in all applicable permit requirements, implementation of the POLB's Dredge and Disposal Plan, and disposal of all sediments at approved sites would reduce impacts on water quality associated with in-water work to less than significant levels.

Section 30707

(a) – Minimize the risk of collision from movement of other vessels. The Coast Guard, with the assistance of the POLB, would enforce the Title 33 CFR Part 165.1151 moving security zone of 1,000 yards ahead and 500 yards on each side and astern of the LNG ships. Enforcement of the moving safety zone would minimize the risk of collision from movement of other vessels. In addition, SES would participate with the Coast Guard in the development of procedures to reduce impacts on marine transportation, including implementation of an LNG Vessel Operation and Emergency Contingency Plan that would provide the basis for operation of LNG ships within the POLB. As a result, ship traffic associated with the Long Beach LNG Import Terminal would not cause significant vessel traffic congestion within the harbor and would not exceed the capacity for maritime commerce to operate efficiently and safely within the POLB.

Section 30708

(a) – Minimize substantial adverse environmental impacts. Potentially significant impacts associated with seismic hazards would be minimized by designing the project facilities to meet the POLB's seismic design criteria and exceed the seismic design criteria of NFPA 59A and other applicable codes. Potentially significant impacts on water and marine resources would be minimized through the implementation of SES' SWPPP (including Spill Procedure) and HDD Plan and the POLB's Dredge and Disposal Plan and adherence to measures included in the ACOE's section 404 permit and the RWQCB's WDR permit. All sediments would be disposed of at approved sites.

Emissions (criteria air pollutants) from construction and operation of the proposed project would result in significant unavoidable adverse air quality impacts because mitigation measures would be unable to reduce air emissions to less than the SCAQMD significance thresholds and the predicted impacts from operational emissions would potentially worsen an existing violation of the ambient air quality standards for PM_{10} and $PM_{2.5}$. Construction impacts would, however, be temporary and intermittent and cease at the end of the construction phase.

The project is not expected to result in a substantial increase in the potential for incidents that would cause serious injury or death to members of the public. Furthermore, the implementation of federal, state, and local rules and regulations concerning security and the results of the WSA with its associated operations and Emergency Response Plan would minimize the risk to the POLB and the LNG operations. In addition, SES has committed to funding all necessary security/emergency management equipment and personnel costs that would be imposed on state and local agencies as a result of the project and would prepare a comprehensive plan that identifies the mechanisms for funding these costs.

(b) – Minimize potential traffic conflicts between vessels. The Coast Guard, with the assistance of the POLB, would enforce the Title 33 CFR Part 165.1151 moving security zone of 1,000 yards ahead and

500 yards on each side and astern of the LNG ships. The Coast Guard and the HSC already require ships moving within the precautionary area (i.e., the area extending 8 nm south of the Queens Gate entrance to the southern marine traffic separation scheme and 10 nm to the southwest to the western marine traffic separation scheme) and inside the breakwaters of the POLB to maintain a minimum separation distance of 500 yards. The additional 500 yards enforced ahead of an LNG ship should not cause any significant impacts on other commercial vessels within the POLB. In addition, as discussed above, SES would participate with the Coast Guard in the development of procedures to reduce impacts on marine transportation, including implementation of an LNG Vessel Operation and Emergency Contingency Plan that would provide the basis for operation of LNG ships within the POLB. As a result, ship traffic associated with the Long Beach LNG Import Terminal would not cause significant vessel traffic congestion within the harbor and would not exceed the capacity for maritime commerce to operate efficiently and safely within the POLB.

(c) – Give highest priority to the use of existing land space within harbors for Port purposes. No new land space would be created as a result of the proposed project. The facilities associated with the Long Beach LNG Import Project would take advantage of existing land space within the POLB for Port purposes (i.e., a shipping industry with related support and access facilities).

Section 30715

(a) – Appealable developments. The proposed project is appealable to the CCC.

5.3 CONFORMANCE WITH THE RISK MANAGEMENT PLAN

The RMP is a certified amendment to the PMP. The RMP provides a framework for siting hazardous facilities by identifying and defining hazards, vulnerable resources, and criteria for determining consistency with RMP policies. The approach for assessing the consequences of hazards specified in the RMP differs from that followed by the FERC. The RMP requires that the vulnerability of populations and facilities within the Port be assessed if they are in an area defined as hazardous; the FERC does not consider Port populations and facilities to be vulnerable.

The proposed LNG terminal is a hazardous facility as defined by the RMP. The hazards described in the RMP that are relevant to this project are radiant heat from a fire at the LNG terminal or on a vessel transporting LNG, and blast overpressure from the delayed ignition of a vapor cloud at the LNG terminal.

Four worst-case, radiant heat scenarios involving the release of LNG were deemed credible by Quest (i.e., having a frequency of greater than 1 in 1 million years) and analyzed for their hazard effects (see Appendix F). Three scenarios were characterized as accidental releases and one as an intentional release: rupture of process equipment (accidental); LNG ship collision (accidental); earthquake-induced failure (accidental); and terrorist-induced release (intentional). A number of specific events and outcomes were studied for each scenario. In addition, one vapor cloud scenario was deemed credible in connection with a rupture of process equipment.

The RMP requires that only the worst-case *probable* events be analyzed (Chapter II, C). Probabilities calculated for each event were used to determine which credible events are probable. Based on probability definitions developed by the LACFD and summarized on figure 4.11.10-1, events with a frequency equal to or less than 1 in 10,000 years are considered improbable, or "(n)ot expected or likely to occur at all." Two radiant heat events (earthquake-induced failure and a terrorist-induced event) and the vapor cloud event have calculated probabilities less frequent than this threshold and were not assessed for consistency with the RMP.

It follows that events that occur more frequently than 1 in 10,000 years are considered probable. Two radiant heat events have calculated probabilities in the range of 1 in 100 years to 1 in 10,000 years and were assessed for consistency with the RMP:

- An accidental release at the LNG terminal stemming from a rupture of process equipment that results in a release of liquid product. Flow from the rupture lasts about 60 seconds until the product is exhausted. A total of 64,000 pounds of product is released. The escaping LNG ignites immediately and produces a torch fire.

- An accidental release from an LNG vessel due to the vessel colliding bow-first with the breakwater west of Queens Gate or due to the vessel colliding with another ship outside the breakwater. A release of product occurs initially from the cargo tank nearest the bow and, eventually, from the remaining cargo tanks. Within 20 minutes all five tanks have released their cargo. The released LNG pools on the water and ignites.

The sections below provide the criteria by which the consequences of these LNG releases can be assessed.

Hazard Footprints

The following criteria were used to delimit the areas (referred to in this section as hazard footprints) wherein impacts on vulnerable resources are identified:

- Not more than 1,600 Btu/ft^2-hr for exposed personnel.
- Not more than 10,000 Btu/ft^2-hr for structures.

The hazard footprint criterion for exposed personnel is consistent with the RMP (Chapter II, C.1.a), and is also contained in federal regulations (Title 49 CFR Part 193, which references NFPA 59A) as the basis for evaluating the risk associated with the outdoor assembly of people.

The hazard footprint criterion for structures is a value taken from NFPA 59A, and is used by the FERC as the maximum thermal heat flux value that cannot be exceeded outside the site property line. Note that this criterion is different from that contained in the RMP. The RMP, which was certified in 1981, allows for the use of updated standards per the following (Chapter II, C.2):

> *The risk management policies developed in this study are based on technologies and procedures in effect at this time. It must be realized that if the use of the new technology, including equipment, materials, procedures, regulations, and enforcement can render risk sufficiently improbable, then the existing criteria may become inapplicable and subject to revision.*

Hazard footprints for the 1,600 Btu/ft^2-hr and 10,000 Btu/ft^2-hr values for the largest rupture of process equipment release event are shown on figures 4.11.10-3 and 4.11.10-6. Hazard footprints for the 1,600 Btu/ft^2-hr and 10,000 Btu/ft^2-hr values for the largest ship collision release events are shown on figures 4.11.10-2 and 4.11.10-5.

Vulnerable Resources

The RMP defines vulnerable resources as follows (Chapter II, B):

> *…residential, recreational, and visitor populations, and the Port working populations, critical regional facilities and high value facilities.*

The RMP characterizes population vulnerable resources in terms of density. For Port working populations, high density is specifically referenced in policies for siting hazardous facilities (see RMP Siting Policies below). However, the RMP does not explicitly define high density. High density is assumed to be the highest density category contained in the legends for the RMP's population density maps, or more than 20 people per acre.

The RMP further characterizes critical and high value facilities as follows (Chapter II, B.2 and B.3):

> *[Critical facilities are] facilities in the Port that are important to the local or regional economy, national defense, or some major aspect of commerce.*
>
> *[High value facilities are] facilities within and near the Port which have very high value. These include both facility improvements and cargo in place….*

A survey of Port tenants was taken in May and June 2005 for purposes of analyzing Port working populations. The total numbers of employees, including ILWU labor, and the number of employees in a primary office building were collected from each tenant. Worker population densities were calculated for the primary building sites and for exposed workers (derived by subtracting workers in buildings from total workers). For purposes of deriving meaningful population densities for risk assessment purposes, calculations were performed only for tenants with 50 or more employees. This is consistent with NFPA 59A, which identifies the following as exclusionary areas within 1,600 Btu/ft^2-hr footprints:

> *…outdoor assembly by groups of 50 or more persons….*

RMP Siting Policies

The RMP provides the following as primary guidance in the siting of hazardous facilities (Chapter II, preamble):

> *The overall policy to be followed by the Port …will have as its objective the elimination of overlaps of hazard footprints and areas of residential, recreational, and visitor populations, and with* ***high-density working populations*** *[emphasis added].*
>
> *This Plan contains policies to guide the future development of the Port in an effort to* ***eliminate*** *the danger of such accidents to residential, recreational, or visitor area populations, and to* ***minimize*** *the degree of hazard to the port working populations and property [emphasis added].*

A hazardous facility cannot be consistent with the RMP if its hazard footprint affects residential, recreational, visitor-serving, or high density working populations (i.e., more than 20 people per acre). Conversely, a hazardous facility can be consistent with the RMP if its hazard footprint affects working populations of 20 people or less per acre, critical facilities, or high value facilities as long as impacts are minimized.

Project Impact/RMP Consistency

The project's hazard footprints were combined with the Port's spatial information on vulnerable resources to produce the following consistency findings.

Rupture of Process Equipment Event

- No residential populations are within the 1,600 Btu/ft^2-hr hazard footprint.

- No visitor-serving or recreation populations are within the 1,600 Btu/ft^2-hr hazard footprint.

- Essentially no exposed Port workers are beyond the LNG terminal site within the 1,600 Btu/ft^2-hr hazard footprint. Only a small crane maintenance building on Pier T falls within the hazard footprint, but workers inside this building would be shielded from the radiant heat. Pier T's main office building is located approximately 1,000 feet beyond the hazard footprint boundary.

- There are no critical or high-value facilities within the 10,000 Btu/ft^2-hr hazard footprint. The nearest such facility is the Gerald Desmond Bridge, which is about 2,500 feet beyond the hazard footprint boundary.

The project is consistent with the RMP relative to the release of LNG due to a rupture of process equipment at the LNG terminal site.

Vessel Collision with the Breakwater or with Another Ship Outside the Breakwater Events

- No residential populations are within the 1,600 Btu/ft^2-hr hazard footprint.

- No visitor-serving or recreation populations are within the 1,600 Btu/ft^2-hr hazard footprint.

- There are no exposed Port workers within the 1,600 Btu/ft^2-hr hazard footprint. The footprint exists entirely over the water and does not overlap terminal land. The nearest terminal with exposed Port workers is over 3,000 feet beyond the hazard footprint boundary.

- There are no critical or high-value facilities within the 10,000 Btu/ft^2-hr hazard footprint. The nearest such facility is the SeaLaunch complex, including its two high-value vessels used to launch missiles, which is nearly 1.5 miles beyond the hazard footprint boundary.

The project is consistent with the RMP relative to the release of LNG due to a collision of an LNG vessel with the breakwater or with another ship outside the breakwater.

6.0 RECOMMENDATIONS

6.1 SUMMARY OF THE FERC AND POLB STAFFS' ENVIRONMENTAL ANALYSIS

The recommendations presented in this section are those of the environmental staffs of the FERC and the POLB (Agency Staffs). These recommendations were developed with input from the ACOE and the Coast Guard as cooperating agencies in the preparation of this EIS/EIR. However, the ACOE and the responsible agencies participating in the CEQA review process will present their own recommendations as part of their permit decisions. The recommendations of the Coast Guard will be presented in its LOR.

The Agency Staffs will recommend that the project be determined by their respective Commissions to be an environmentally acceptable action if it is constructed and operated in accordance with applicable laws and regulations, SES' proposed mitigation (i.e., control measures), and the Agency Staffs' additional mitigation recommendations. This recommendation is based on a review of the information provided by SES and further developed from data requests; field investigations; scoping; literature research; alternatives analysis; and contacts with federal, state, and local agencies, and individual members of the public. Although many factors were considered in developing this recommendation, the principal reasons are:

- the LNG terminal would be located in a previously developed portion of the POLB and 100 percent of the routes of the pipelines and electric distribution facilities would cross heavily disturbed, industrialized areas associated with the POLB and surrounding areas;

- the LNG terminal generally conforms to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans and would be consistent with existing surrounding uses. The POLB would obtain an amendment to its PMP because LNG is not an expressly identified "hazardous cargo" as permitted within Terminal Island Planning District 4. The certified PMP amendment would demonstrate consistency with the CCA;

- the pipeline and electric distribution facilities would be consistent with existing surrounding uses and conform to the overall goals of the current PMP, local zoning ordinances, and relevant regional plans;

- the project would be consistent with the RMP;

- the project facilities would be designed to meet the POLB's seismic design criteria and exceed the seismic design criteria of NFPA 59A and other applicable codes;

- SES would implement its SWPPP and HDD Plan to protect natural resources during construction and operation of the project;

- the appropriate consultations with the FWS, NOAA Fisheries, and the SHPO have determined that the project would not adversely affect special status species, would not have a significant impact on EFH, and would have no impact on cultural resources;

- the project would not have a significant impact on land transportation;

- SES would complete a full air quality analysis and identify any mitigation requirements necessary to allow the FERC to determine that the project conforms with the applicable SIP and AQMP;

- final design plans addressing the FERC's cryogenic design and technical review would be submitted for approval before construction;

- none of the events considered possible according to the LACFD criteria have the potential to produce radiant impacts that could affect the public outside of the industrial area defined by the POLB boundary line;

- SES would develop a WSA in consultation with the Coast Guard and state and local officials that would determine the appropriate safety and security measures to mitigate the risks while an LNG ship is operating in the VTS area;

- SES' development and implementation of an LNG Vessel Operation and Emergency Contingency Plan in consultation with the Coast Guard would ensure that ship traffic associated with the project would not cause significant vessel traffic congestion within the harbor and would not exceed the capacity for maritime commerce to operate efficiently and safely within the POLB;

- an LOR addressing the suitability of the POLB for LNG transport would be issued by the Coast Guard;

- consultations with the Coast Guard and other appropriate agencies to prepare the Facility Security Plan would be completed before commencement of service;

- consultations with local emergency planning groups, the ports of Long Beach and Los Angeles, fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies to develop an Emergency Response Plan would be completed before initial site preparation;

- SES would prepare a plan for funding all project-specific security/emergency management costs, including any necessary equipment and personnel base that would be imposed on state and local agencies as a result of the project, and would fund those costs; and

- an environmental inspection and mitigation monitoring program would ensure compliance with all mitigation measures that become conditions of authorization.

6.2 ALTERNATIVES CONSIDERED

The No Action or No Project Alternative was considered. While the No Action or No Project Alternative would eliminate the environmental impacts identified in this EIS/EIR, none of the objectives of the proposed project would be met. Specifically, SES would not be able to provide a new and stable supply of natural gas and LNG vehicle fuel to southern California. It is purely speculative to predict the actions that could be taken by other suppliers or users of natural gas and LNG in the region as well as the resulting effects of those actions. Because the demand for energy in southern California is predicted to increase, customers would likely have fewer and potentially more expensive options for obtaining natural gas and LNG supplies in the near future. This might lead to alternative proposals to develop natural gas

delivery or storage infrastructure, increased conservation or reduced use of natural gas, and/or the use of other sources of energy.

It is possible that the infrastructure currently supplying natural gas and LNG to the proposed market area could be developed in other ways unforeseen at this point. This might include constructing or expanding regional pipelines as well as LNG import and storage systems. Any construction or expansion work would result in specific environmental impacts that could be less than, similar to, or greater than those associated with the Long Beach LNG Import Project. Increased costs could potentially result in customers conserving or reducing use of natural gas. Although it is possible that additional conservation may have some effect on the demand for natural gas, conservation efforts are not expected to significantly reduce the long-term requirements for natural gas or effectively exert downward pressures on gas prices.

Denying SES' applications could force potential natural gas customers to seek regulatory approval to use other forms of energy. California regulators are promoting renewable energy programs to help reduce the demand for fossil fuels. While renewable energy programs can contribute as an energy source for electricity, they cannot at this time reliably replace the need for natural gas or provide sufficient energy to keep pace with demand.

Alternatives involving the use of other existing or proposed LNG or natural gas facilities to meet the stated objectives of the proposed project were evaluated. None of the pipeline system alternatives could provide a stable source of LNG for vehicle fuel or the storage of up to 320,000 cubic meters of LNG to address fluctuating energy supply and demand (two of the three stated objectives of the Long Beach LNG Import Project). Several of the proposed LNG import systems (either offshore California or in Mexico) could provide a new source of natural gas to southern California markets; however, none of these system alternatives could meet the proposed project's stated objective of providing a stable source of LNG for vehicle fuel. Furthermore, each of the system alternatives could result in its own set of significant environmental impacts that could be greater than those associated with the proposed project.

Alternative sites for an LNG import terminal were evaluated. The examination of alternative sites for an LNG import terminal involved a comprehensive, step-wise process that considered environmental, engineering, economic, safety, and regulatory factors. The alternative sites evaluated for an LNG terminal were not found to avoid or substantially lessen any significant environmental effects of the proposed project and/or could not meet all or most of the project objectives.

An evaluation of alternative routes for the natural gas and C_2 pipelines was also conducted. The alternatives were not found to avoid or substantially lessen impacts associated with the corresponding segment of the proposed routes and/or were infeasible due to the number of existing utilities already in place along the alignments and the lack of adequate space to install the facilities.

Reduced dredge/fill alternatives and alternative ship berth configurations, dredge disposal alternatives, and alternative dredging methods were evaluated to avoid or minimize impacts on water quality or biological resources associated with the in-water work needed for construction of the LNG ship berth and unloading facility and strengthening the shoreline structures. None of these alternatives were found to be feasible or would avoid or substantially lessen any significant environmental effects of the proposed project.

Vaporizer alternatives were also evaluated. The shell and tube vaporizer, which is the proposed vaporizer for the Long Beach LNG Import Project, was found to be efficient, readily able to be integrated with the NGL extraction system, and to utilize proven vaporizer technology. Shell and tube vaporizers are also the most compact LNG vaporizers available, an important consideration given the size of the LNG terminal site. New vaporization processes that primarily utilize air exchangers as a heat source were

also evaluated because they would have lower fuel gas requirements than conventional combustion vaporizers. Reduced fuel use would lead to a corresponding reduction in air emissions and operating costs. The space requirements of these new vaporization processes, however, appear to make this approach technically infeasible at the proposed site.

6.3 ENVIRONMENTALLY PREFERABLE/SUPERIOR ALTERNATIVE

The Agency Staffs will recommend to their respective Commissions that SES' proposed project is the environmentally preferable/superior alternative that can meet the project objectives.

6.4 UNAVOIDABLE SIGNIFICANT IMPACTS/STATEMENT OF OVERRIDING CONSIDERATIONS

Emissions (criteria air pollutants) from construction and operation of the proposed project would result in significant unavoidable adverse air quality impacts because control and mitigation measures would be unable to reduce air emissions to less than the SCAQMD significance thresholds and the predicted impacts from operational emissions would potentially worsen an existing violation of the ambient air quality standards for PM_{10} and $PM_{2.5}$. Construction impacts would, however, be temporary and intermittent and cease at the end of the construction phase.

Although the proposed project would not exceed cancer risk level significance thresholds established by the SCAQMD for toxic air pollutant health impacts, the SCAB and Port areas in particular are assumed, on the basis of the SCAQMD's MATES II Study, to suffer significant impacts related to toxic air pollutants and associated cancer risk levels. Therefore, toxic air pollutants resulting from the project would likely contribute to an existing cumulatively significant air quality impact in the SCAB.

Approval of the project would be subject to a Statement of Overriding Considerations under the CEQA due to these significant unavoidable impacts that would remain after mitigation is applied.

6.5 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The proposed project involves tradeoffs between long-term productivity and short-term uses of the environment. Construction activities would result in a number of temporary impacts that would cease upon completion of the construction phase. Such impacts include the temporary exposure of the fill materials on the affected portion of Terminal Island and the native soils along the pipeline routes to the effects of wind, rain, and runoff, which could cause erosion and sedimentation in the area; minor increases in turbidity as a result of dredging, excavation, or disposal of dredge materials; water quality impacts from storm water run-off and from potential spills, leaks, or accidental releases of hazardous substances; biological resources impacts from the destruction of benthic infauna resulting from dredging; and air quality impacts from increased emissions of criteria pollutants. The impacts on soils, water, and biological resources would be mitigable. The impacts on air quality would not be mitigable to a less than significant level.

The long-term benefits of the project include an increase in tax revenues and an increase in supplies of natural gas for domestic consumption.

6.6 IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

Section 15126 of the CEQA Guidelines requires that EIRs address any significant irreversible environmental changes that would be involved in the proposed project should it be implemented. The

project would involve two types of resources: general industrial resources, including capital, labor, fuels, and construction materials; and project-specific resources, such as biological resources, water resources, and land uses.

The proposed project would require the irreversible and irretrievable commitment of fossil fuels, rock, concrete and gravel, capital, labor, and construction materials. Fossil fuels and energy would be consumed during construction and operation activities. Use of these energy resources would be irretrievable and irreversible. Materials such as the rock that would be required for reinforcement of the shoreline structures would also be irretrievably committed.

The primary project-specific resources irretrievably lost would include soils (resulting from water and wind erosion in disturbed areas), land use (the terminal and aboveground facilities and permanent rights-of-way for the pipelines would preclude the sites from future development), and visual resources (construction and operation of the LNG terminal facilities, the aboveground facilities associated with the pipelines, and the electric distribution facilities would permanently affect the viewshed).

Because the proposed project would provide a new and stable supply of natural gas and LNG vehicle fuel to southern California, the irreversible and irretrievable resource commitments are considered to be acceptable.

6.7 FERC AND POLB STAFFS' RECOMMENDED MITIGATION

If the FERC and the POLB approve the Long Beach LNG Import Project, the Agency Staffs recommend that the following measures be included as specific conditions of the Order and/or the Harbor Development Permit to further mitigate the environmental impact associated with the construction and operation of the proposed project.

FERC Staff's Recommended Measures

1. Sound Energy Solutions (SES) shall follow the construction procedures and mitigation measures described in its applications, supplemental filings (including responses to staff data requests), and as identified in the environmental impact statement/environmental impact report (EIS/EIR), unless modified by the Federal Energy Regulatory Commission (Commission or FERC) Order. SES must:

    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (Secretary);
    b. justify each modification relative to site-specific conditions;
    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
    d. receive approval in writing from the Director of the Office of Energy Projects (OEP) **before using that modification**.

2. For pipeline facilities, the Director of OEP has delegated authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the project. This authority shall allow:

    a. the modification of conditions of the FERC Order; and
    b. the design and implementation of any additional measures deemed necessary (including stop-work authority) to assure continued compliance with the intent of the environmental

conditions as well as the avoidance or mitigation of adverse environmental impact resulting from project construction and operation.

3. For liquefied natural gas (LNG) facilities, the Director of OEP has delegated authority to take all steps necessary to ensure the protection of life, health, property, and the environment during construction and operation of the project. This authority shall include:

   a. stop-work authority and authority to cease operation; and
   b. the design and implementation of any additional measures deemed necessary to assure continued compliance with the intent of the conditions of the FERC Order.

4. **Prior to any construction,** SES shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, environmental inspectors (EIs), and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before becoming involved with construction and restoration activities.**

5. The authorized facility locations shall be as shown in the EIS/EIR, as supplemented by filed alignment sheets, and shall include the staff's recommended facility locations, if any. **As soon as they are available, and before the start of construction,** SES shall file with the Secretary revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the FERC Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

6. SES shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction** in or near that area.

   This requirement does not apply to extra workspace allowed by the Upland Erosion Control, Revegetation, and Maintenance Plan or minor field realignments per landowner needs and requirements that do not affect other landowners or sensitive environmental areas such as wetlands.

   Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

   a. implementation of cultural resources mitigation measures;
   b. implementation of endangered, threatened, or special concern species mitigation measures;
   c. recommendations by state regulatory authorities; and
   d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

7. **At least 60 days before the anticipated start of construction,** SES shall file an initial Implementation Plan with the Secretary for the review and written approval of the Director of OEP describing how SES will implement the mitigation measures required by the FERC Order. SES must file revisions to the plan as schedules change. The plan shall identify:

   a. how SES will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;
   b. the number of EIs assigned and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;
   c. company personnel, including EIs and contractors, who will receive copies of the appropriate materials;
   d. what training and instructions SES will give to all personnel involved with construction and restoration (initial and refresher training as the project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);
   e. the company personnel (if known) and specific portion of SES's organization having responsibility for compliance;
   f. the procedures (including use of contract penalties) SES will follow if noncompliance occurs; and
   g. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

      i. the completion of all required surveys and reports;
      ii. the mitigation training of onsite personnel;
      iii. the start of construction; and
      iv. the start and completion of restoration.

8. SES shall file updated status reports with the Secretary on a **biweekly** basis **until** all construction and restoration activities are complete. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

   a. the current construction status of each spread, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;
   b. a listing of all problems encountered and each instance of noncompliance observed by the EI(s) during the reporting period (both for the conditions imposed by the FERC and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);
   c. corrective actions implemented in response to all instances of noncompliance, and their cost;
   d. the effectiveness of all corrective actions implemented;
   e. a description of any landowner/resident complaints that may relate to compliance with the requirements of the FERC Order, and the measures taken to satisfy their concerns; and
   f. copies of any correspondence received by SES from other federal, state, or local permitting agencies concerning instances of noncompliance, and SES's response.

9. SES must receive written authorization from the Director of OEP **before commencing service** from the LNG terminal and the other components of the project. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with

FERC approval and applicable standards, can be expected to operate safely as designed, and the rehabilitation and restoration of the pipeline right-of-way and other areas affected by the project are proceeding satisfactorily.

10. **Within 30 days of placing the certificated facilities in service,** SES shall file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or
    b. identifying which of the Order conditions SES has complied with or will comply with. This statement shall also identify any areas along the right-of-way where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

11. SES shall complete a full air quality analysis and identify any mitigation requirements necessary for a finding of conformity with the applicable State Implementation Plan and the Air Quality Management Plan. SES shall file documentation supporting conformity with the Secretary **before the end of the draft EIS/EIR comment period** for review and analysis in the final EIS/EIR.

12. SES shall provide **in its comments on the draft EIS/EIR, or in a separate document submitted at the same time**, evidence of its ability to exercise legal control over the activities that occur within the portions of the thermal radiation exclusion zones that fall outside the site property line that can be built upon.

The following measures shall apply to the LNG terminal design and construction details. Information pertaining to these specific recommendations shall be filed with the Secretary for the review and written approval of the Director of OEP either: prior to initial site preparation; prior to construction of final design; prior to commissioning; or prior to commencement of service as specified in each recommendation below. This information shall be submitted a minimum of 30 days before approval to proceed is required.

13. A complete plan and list of the hazard detection equipment shall be filed **prior to initial site preparation**. The information shall include a list with the instrument tag number, type and location, alarm locations, and shutdown functions of the proposed hazard detection equipment. Plan drawings shall clearly show the location of all detection equipment.

14. **Prior to initial site preparation**, SES shall file a technical review of its facility design that:

    a. identifies all combustion/ventilation air intake equipment and the distance(s) to any possible hydrocarbon release (LNG, flammable refrigerants, flammable liquids, and flammable gases); and
    b. demonstrates that these areas would be adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion equipment whose continued operation could add to or sustain an emergency.

15. A complete plan and list of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment shall be filed **prior to initial site preparation**. The information shall include a list with the equipment tag number, type, size, equipment covered, and automatic and manual remote signals initiating discharge of the units. Plan drawings shall clearly show the planned location of all fixed and wheeled extinguishers.

16. The **final design** of the hazard detection equipment shall identify manufacturer and model.

17. The **final design** of the hazard detection equipment shall include redundancy and fault detection and fault alarm monitoring in all potentially hazardous areas and enclosures.

18. The **final design** of the hazard detection equipment shall provide flammable gas and ultraviolet/infrared hazard detectors with local instrument status indication as an additional safety feature.

19. The **final design** of the fixed and wheeled dry-chemical, fire extinguishing, and high expansion foam hazard control equipment shall identify manufacturer and model.

20. The **final design** shall include equipment and instrumentation for the measurement of translational and rotational movement of the inner vessel for use during and after cool down.

21. The **final design** shall include a minimum of three onsite seismic instruments that would have the capability of actuating an automatic plant-wide emergency shutdown in the event of seismic activity approaching the site Contingency Level Earthquake. SES shall specify the set point to be used.

22. In the **final design** all structures, besides the LNG storage tanks, shall be designed to withstand the effects of an Operating Basis Earthquake, as required by Title 49 Code of Federal Regulations Part 193 and National Fire Protection Association (NFPA) 59A (2001), and, further, the condition of these structures shall not adversely affect the stability and integrity of the tanks in the Safe Shutdown Earthquake event.

23. The **final design** shall include details of the LNG tank tilt settlement and differential settlement limits between each LNG tank and piping and procedures to be implemented in the event that limits are exceeded.

24. The **final design** shall include drawings and specifications of the piping support structure of the LNG storage tanks.

25. The **final design** shall include provisions to ensure that hot water circulation is operable at all times when LNG is present in the secondary LNG booster pump discharge piping or when the temperature in the LNG inlet channel to any vaporizer is below 35 degrees Fahrenheit.

26. The **final design** shall include detection instrumentation and shutdown procedures for vaporizer tube leak, shell side overpressure, or bursting disc failure.

27. The **final design** shall include provisions to drain the fractionation systems to safe locations.

28. The **final design** shall ensure that air gaps are installed downstream of all seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that: would continuously monitor for the presence of a flammable fluid; would alarm the hazardous condition; and would shut down the appropriate systems.

29. The **final design** shall include a fire protection evaluation carried out in accordance with the requirements of NFPA 59A, Chapter 9.1.2.

30. The **final design** shall include details of the shutdown logic, including cause and effect lists for alarm and shut down.

31. The **final design** shall include emergency shutdown of equipment and systems activated by hazard detection devices for flammable gas, fire, cryogenic spills, and earthquake, when applicable.

32. The **final design** shall include procedures for offsite contractors' responsibilities, restrictions, limitations, and supervision of the contractors by SES staff.

33. Security personnel requirements prior to and during LNG vessel unloading shall be filed **prior to commissioning**.

34. An operation and maintenance manual and safety procedure manual shall be filed **prior to commissioning**.

35. Copies of the U.S. Coast Guard (Coast Guard)-approved Facility Security Plan and LNG Vessel Operation and Emergency Contingency Plan shall be filed **prior to commissioning**.

36. The contingency plan for failure of the outer LNG tank containment shall be filed **prior to commissioning**.

37. The final detailed drawings of the transfer line impoundment systems, including cross sections, shall be filed **prior to commissioning**.

38. A copy of the criteria for horizontal and rotational movement of the inner vessel for use during and after cool down shall be filed **prior to commissioning**.

39. The FERC staff and Coast Guard shall be notified of any proposed revisions to the security plan and physical security of the facility **prior to commencement of service**.

40. Progress on the construction of the LNG terminal shall be reported in **monthly** reports filed with the Secretary. Details shall include a summary of activities, problems encountered, and remedial actions taken. Problems of significant magnitude shall be reported to the FERC **within 24 hours**.

The following measures shall apply throughout the life of the facility:

41. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least a **biennial** basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, SES shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, shall be submitted.

42. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions, abnormal operating experiences, activities (including ship arrivals, quantity and composition of imported LNG, vaporization quantities, boil-off/flash gas, etc.), and plant modifications including future plans and progress thereof. Abnormalities shall include, but not be limited to: unloading/shipping problems, potential hazardous conditions from

offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, vapor or liquid releases, fires involving natural gas and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boiloff rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days** after each period ending **June 30 and December 31**. In addition to the above items, a section entitled "Significant plant modifications proposed for the next 12 months (dates)" also shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance projects at the LNG facility.

43. In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified.

44. Significant non-scheduled events, including safety-related incidents (i.e., LNG or natural gas releases, fires, explosions, mechanical failures, unusual over pressurization, and major injuries) and security-related incidents (i.e., attempts to enter site, suspicious activities) shall be reported to the FERC staff and the Coast Guard **within 24 hours**. In the event an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. This notification practice shall be incorporated into the LNG facility's emergency plan. Examples of reportable LNG-related incidents include:

a. fire;
b. explosion;
c. estimated property damage of $50,000 or more;
d. death or personal injury resulting in patient hospitalization;
e. free flow of LNG for 5 minutes or more that results in pooling;
f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes gas or LNG;
g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes gas or LNG;
h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes gas or LNG to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure limiting or control devices;
i. a leak in an LNG facility that contains or processes gas or LNG that constitutes an emergency;
j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;
k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shut down of operation of a pipeline or an LNG facility that contains or processes gas or LNG;

l. safety-related incidents to LNG vessels occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident.

45. **Prior to the issuance of the final EIS**, SES shall submit a Preliminary and Follow-on Waterway Suitability Assessment (WSA) to the Captain of the Port Coast Guard Sector Los Angeles-Long Beach for review and validation and provide a copy to the FERC staff.

46. SES shall **annually** review its WSA for the project, update the assessment to reflect changing conditions, provide the updated assessment to the Captain of the Port Coast Guard Sector Los Angeles-Long Beach for review and validation, and provide a copy to the FERC staff.

FERC and POLB Staffs' Recommended Measures

47. SES shall revise its Horizontal Directional Drill Plan (HDD Plan) to describe the procedures that would be followed if an existing submerged pipeline is encountered during the horizontal directional drill operations. SES shall file the revised HDD Plan with the FERC and the POLB for the review and written approval of the Director of OEP and the POLB Director of Planning **before construction**.

48. SES shall require that the construction workforce work 6 a.m. to 2:30 p.m. instead of 7 a.m. to 3:30 p.m.

49. SES shall:

a. require all contractors to use ultra-low sulfur or California Air Resources Board-approved alternative diesel fuel in all diesel-powered equipment used onsite during construction; and

b. use alternative-fuel buses to transport workers to and from the temporary laydown and worker parking area.

50. SES shall conduct a noise survey to verify that the noise from the LNG terminal when operating at full capacity does not exceed a day-night sound level (L_{dn}) of 55 decibels of the A-weighted scale (dBA) at any nearby noise-sensitive areas (NSAs) or 70 dBA at the property boundary, and file the results of the noise survey with the FERC and the POLB **no later than 60 days** after placing the LNG terminal in service. If the noise attributable to the operation of the LNG terminal exceeds an L_{dn} of 55 dBA at any nearby NSA or 70 dBA at the property boundary, SES shall file a report on what changes are needed and shall install additional noise controls to meet these levels within 1 year. SES shall confirm compliance with the L_{dn} of 55 dBA at the nearby NSAs and 70 dBA at the property boundary requirements by filing a second noise survey with the FERC and the POLB **no later than 60 days** after it installs the additional noise controls.

51. **Concurrent with the submission of the Follow-on WSA to the FERC staff**, SES shall file its comprehensive plan identifying the mechanisms for funding all project-specific security/emergency management costs that would be imposed on state and local agencies with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning.

52. SES shall provide a separate 24-hours-per-day security staff and coordinate with the Coast Guard to define the responsibilities of SES' security staff in supplementing other security personnel and in protecting the LNG ships and terminal.

53. SES shall develop emergency evacuation routes for the areas along the route of the LNG vessel transit in conjunction with the local emergency officials and file the routes with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning **prior to initial site preparation**.

54. SES shall develop an Emergency Response Plan (including evacuation) and coordinate procedures with local emergency planning groups, the ports of Long Beach and Los Angeles, fire departments, state and local law enforcement, the Coast Guard, and other appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;
    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;
    c. procedures for notifying residents, employees, and recreational users within areas of potential hazard;
    d. locations of permanent sirens and other warning devices; and
    e. an "emergency coordinator" on each LNG vessel to activate sirens and other warning devices.

    The Emergency Response Plan shall be filed with the FERC and the POLB for the review and written approval of the Director of OEP in consultation with the POLB Director of Planning **prior to initial site preparation.** SES shall notify the FERC and POLB staffs of all planning meetings in advance and shall report progress on the development of its Emergency Response Plan at 3-month intervals.

Draft Environmental Impact Statement/ Environmental Impact Report

Volume II - Appendices

Long Beach LNG Import Project

Federal Energy Regulatory Commission
FERC/EIS - 0168D
Docket No. CP04-58-000, et al.

Port of Long Beach
POLB Application No. HDP 03-079
SCH No. 2003091130

Cooperating Agencies:
U.S. Army Corps of Engineers
U.S. Coast Guard

October 2005

FEDERAL ENERGY REGULATORY COMMISSION
Routing Code: PJ-11.2
Washington, DC 20426

Official Business
Penalty for Private Use

FERC/EIS - 0168D

Volume II

Long Beach LNG Import Project

Draft Environmental Impact Statement/ Environmental Impact Report

THE PORT OF LONG BEACH

SCH No. 2003091130

October 2005

Draft Environmental Impact Statement/ Environmental Impact Report

Volume II - Appendices

Long Beach LNG Import Project

Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

Port of Long Beach
Long Beach, CA 90802

Cooperating Agencies:
U.S. Army Corps of Engineers
U.S. Coast Guard

US Army Corps of Engineers

October 2005

TABLE OF CONTENTS

Long Beach LNG Import Project
Draft Environmental Impact Statement/
Environmental Impact Report

VOLUME II – LIST OF APPENDICES

APPENDIX A	DRAFT EIS/EIR DISTRIBUTION LIST FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX B	STORM WATER POLLUTION PREVENTION PLAN FOR THE LONG BEACH LNG IMPORT PROJECT (DRAFT)
APPENDIX C	HORIZONTAL DIRECTIONAL DRILL PLAN FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX D	TRAFFIC INTERSECTION WORKSHEETS FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX E	DRAFT GENERAL CONFORMITY DETERMINATION FOR THE LONG BEACH LNG IMPORT PROJECT
APPENDIX F	HAZARDS ANALYSIS OF A PROPOSED LNG IMPORT TERMINAL IN THE PORT OF LONG BEACH, CALIFORNIA
APPENDIX G	REFERENCES AND CONTACTS
APPENDIX H	LIST OF PREPARERS

APPENDIX A

DRAFT EIS/EIR DISTRIBUTION LIST
FOR THE LONG BEACH LNG IMPORT PROJECT

APPENDIX A

DRAFT EIS/EIR DISTRIBUTION LIST

Federal Agencies

Advisory Council on Historic Preservation, CO
Advisory Council on Historic Preservation, DC
    Director, Cultural Resources
Army Corps of Engineers, CA
    Aaron Allen, Ph.D.
    Josh Burnam
    David J. Castanon, Chief, Regulatory Branch
Army Corps of Engineers, DC
    James Hand
Centers for Disease Control and Prevention, GA
    Chemical Demilitarization Program
        Linda Anderson, CDB
    National Center for Environment and Health
        Kenneth W. Holt, MSEH
Council on Environmental Quality, DC
Department of Agriculture, CA
    Natural Resources Conservation Service
        Lancaster Service Center
Department of Agriculture, DC
    Forest Service
        Director, Environmental Coordination Staff
    Natural Resources Conservation Service
        National Environmental Coordinator
    Office of Finance and Management
Department of Commerce, CA
    National Oceanic and Atmospheric Administration, National Marine Fisheries Service
        Bob Hoffman
Department of Commerce, DC
    National Oceanic and Atmospheric Administration, National Marine Fisheries Service
        Director, Ecology and Conservation
Department of Defense, CA
    Navy Base Realignment and Closure Program Office
        Kimberly Kesler
Department of Defense, DC
    Air Force
        Environment and Safety
Department of Energy, DC
    Office of Environmental Compliance
    Office of Fossil Energy
        Sally Kornfield
        Cliff Tomachevski
    Office of Intergovernmental Affairs
        Steve Lerner

Federal Agencies (cont'd)

Department of Homeland Security, CA
- Coast Guard
  - Lt. Peter Gooding
  - LCDR Eva Kummerfeld, Chief, Port Operations
  - Ryan Manning
- Los Angeles District Office

Department of Homeland Security, DC
- Coast Guard
  - Commandant

Department of Homeland Security, GA
- Coast Guard
  - CDR Timothy M. Close
  - LCDR DeWayne R. Penberthy

Department of Homeland Security, LA
- Coast Guard
  - LT Frank Cesario
  - LCDR Mark J. McCadden

Department of Homeland Security, MA
- Coast Guard
  - LT Antonellis
  - Capt. Brian Salerno, Captain of the Port

Department of Homeland Security, MD
- Coast Guard
  - CDR Gordon Loebel

Department of Homeland Security, RI
- Coast Guard
  - Capt. Mary E. Landry, Commanding Officer

Department of Homeland Security, TX
- Coast Guard
  - Captain G.W. Anderson
  - LCDR Michael Hunt
  - CDR Paul F. Thomas, PE

Department of Homeland Security, VA
- Coast Guard
  - LCDR Joe Snowdon

Department of Housing and Urban Development, DC
- Director of Environment

Department of Justice, DC
- Land and Natural Resources Division

Department of Labor, DC
- Office of Regulatory Economics

Department of State, DC
- Office of Environment and Health

Department of the Interior, CA
- Melanie Daniel
- Fish and Wildlife Service
  - Jack Fancher

Department of the Interior, DC
- National Park Service

Federal Agencies (cont'd)

Office of Environmental Policy and Compliance
Director
Department of Transportation, CO
Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety
Kimbra Davis, Community Assistance and Technical Services
Department of Transportation, DC
Office of Environment and Policy
Director
Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety
Tom Fortner
William H. Gute, Director, Eastern Region
Mike Israni
Stanley T. Kastanas
Department of Transportation, MO
Pipeline and Hazardous Materials Safety Administration, Office of Pipeline Safety
Karen Butler, Community Assistance and Technical Services
Harold Winnie, Community Assistance and Technical Services
Environmental Protection Agency, DC
Office of Federal Activities
Director
Environmental Protection Agency, Region 9, CA
Dave Farrel, Environmental Review Coordinator
Steven John
Brian Ross
Office of Federal Activities
Leonidas Payne
David P. Schmidt
Federal Energy Regulatory Commission, DC
Michael Boyle
Interstate Commerce Commission, DC
Energy and Environment
Chief
Library of Congress, DC
Exchange and Gift Division, Federal Documents Section
Senate, DC
Committee on Energy and Natural Gas

Federal Senators and Representatives

Representative Juanita Millender-McDonald
Representative Dana Rohrabacher

Senator Barbara Boxer
Senator Dianne Feinstein

State Senators and Assembly Members

Senator Alan Lowenthal

Assembly Member Betty Karnette

Native American Tribes

Cindi Alvitre, Ti'At Society, Reseda, CA
David Belardes, Chairperson, Juaneno Band of Mission Indians Acjachemen, San Juan Capistrano, CA
Robert F. Dorame, Chairperson, Gabrielino Tongva Indians of California Tribal Council, Culver City, CA
Samuel H. Dunlap, Temecula, CA
Anita Dunlap, Juaneno Band of Mission Indians, Anaheim, CA
Susan Frank, Gabrielino Band of Mission Indians of California, Beaumont, CA
Gabrielino/Tongva Council/Gabrielino Tongva Nation, Santa Monica, CA
John Jeffredo, Island Gabrielino Group, San Marcos, CA
Sonia Johnston, Chairperson, Juaneno Band of Mission Indians, Santa Ana, CA
LA City/County Native American Indian Comm, Los Angeles, CA
Anthony Morales, Chairperson, Gabrielino/Tongva Tribal Council, San Gabriel, CA
Carol A. Pulido, Frazier Park, CA
Damien Shilo, Chairman, Juaneno Band of Mission Indians Acjachemen Nation, San Juan Capistrano, CA
Craig Torres, Gabrielino Tongva, Santa Ana, CA
John Valenzuela, Ish Panesh United Band of Indians, Hesperia, CA
Jim Velasques, Coastal Gabrieleno Diegueno, Riverside, CA
Rob Wood, Environmental Specialist III, Native American Heritage Commission, Sacramento, CA

State Agencies

Governor Arnold Schwarzenegger
Air Resources Board
- Gary Honcoop, Manager, Strategic Analysis & Liaison Section
- Gary Yee, Manager, Industrial Section
- Antelope Valley Air Quality Management District
  - Bret Banks, Operations Manager
- Mojave Desert Air Quality Management District
  - Paul J. Luellig, Jr., Chairman
- South Coast Air Quality Management District
  - Carol Coy
  - Kathy Hsiao
  - Chung Coy
  - Pang Mueller
  - Mohsen Nazemi
  - Paul Park
  - Steve Smith
  - Abe Udobot
  - Barry Wallerstein, Executive Director
  - Connie Yee

State Agencies (cont'd)

Coastal Commission
- Alison J. Dettmer, Manager, Energy and Ocean Resources Unit
- Peter Douglas
- Al Padilla

Department of Boating and Waterways
- Debra Deverter, Chief Administrator

Department of Conservation
- Debbie Sareeram, Deputy Director
- Division of Oil, Gas, and Geothermal Resources
  - Paul L. Frost, Associate Oil and Gas Engineer
  - Robert Samuelian

Department of Fish and Game
- Environmental Services
- Marilyn Fluharty
- Eric Larson, Manager, Marine Reg.

Department of General Services
- Environmental Services Section
  - Robert Sleppy, Section Chief

Department of Health Services
- Diana Bonta, Director

Department of Toxic Substances Control
- Halssam Salburn
- John Scondura
- Joe Serna, Jr., Sacramento Headquarters
- Southern California Cleanup Operations Branch
  - Johnson P. Abraham, Project Manager
  - Greg Holmes, Unit Chief

Department of Transportation
- District 7
  - Stephen Buswell
  - Wilford Melton

Department of Water Resources
- Michael Spear, Interim Director
- Phil Wendt, Chief

Energy Commission
- B.B. Blevins, Executive Director
- Kevin Kennedy
- Mignon Marks, Siting Policy Specialist
- David Maul, Manager, Natural Gas and Special Projects Office
- Terrence O'Brien, Deputy Director

Environmental Protection Agency
- Winston Hickox, Agency Secretary
- State Water Resources Control Board
  - Susan Cloke, Chair, Los Angeles Region (4)

Office of Homeland Security
- David Raimer, Executive Fellow

State Agencies (cont'd)

Public Utilities Commission
- William Ahern, Executive Director
- Andrew Barnsdale
- David R. Effross, Energy Division
- Deana Friedson
- Stephen Larson, Executive Director
- Douglas M. Long
- Los Angeles Office
- Pam Nataloni
- Michael Peevey, President, Headquarters Office

Regional Water Quality Control Board
- Michael Lyons

San Francisco Bay Conservation and Development Commission

Southern California Association of Governments
- Jeffrey M. Smith, Senior Planner

State Clearinghouse

State Lands Commission
- Madha Ahuja
- Terry Ely
- Dwight W. Sanders
- Marine Facilities Division
  - Maurya B. Falkner
  - John Freckman
- Mineral Resources Management Division
  - Gregory Scott

State Office of Historic Preservation
- Dr. Knox Mellon

State Park and Recreation Commission
- Caryl Hard, Chair

County Agencies

Los Angeles County
- Supervisor Michael Antonovich, Board of Supervisors
- Supervisor Yvonne Brathwaite Burke, Chair of the Board, Board of Supervisors
- Joseph Chesler, Department of Beaches and Harbors
- Brian Everett, Department of Public Works
- County Flood Control District
- P. Michael Freeman, Fire Chief, Fire Department
- Thomas Garthwaite, MD, Director and Chief Medical Officer, Department of Health Services
- Carlos Jackson, Executive Director, Community Development Commission
- Dr. Ara Kasparian, Bureau of Engineers
- Supervisor Don Knabe, Board of Supervisors
- David Leininger, Chief, Forestry Division, Fire Department
- Mapping and Property Management, Department of Public Works
- Frank Meneses, Regional Planning
- Supervisor Gloria Molina, Board of Supervisors

County Agencies (cont'd)

Kendra Morries, Metropolitan Transit Authority
Los Angeles County Department of Public Works, Mapping & Property Management
Stan Wisniewski, Director, Department of Beaches and Harbors
Supervisor Zen Yaroslavsky, Board of Supervisors

Yolo County
Terry V. Bassett, Executive Director, Yolo County Transportation District

Town Agencies

Lawrence E. Dale, Mayor, Barstow, CA

City of Carson, Carson, CA

Humboldt Bay Harbor Recreation and Conservation District, Eureka, CA

Rick Longobart, Fleet Superintendent, Public Works Department, Inglewood, CA

Lee Anthony, Fire Department, Long Beach, CA
Dan Baker, City Council, Long Beach, CA
Jeff Benedict, Health Department, Long Beach, CA
Gary Burroughs, Office of the City Auditor, Long Beach, CA
Tim Busby, Fire Inspector, Fire Department, Fire Prevention Bureau, Long Beach, CA
Dennis Carroll, City Council, Long Beach, CA
Frank Colonna, City Council, Long Beach, CA
Dennis Eschen, Parks, Recreation, and Marine, Long Beach, CA
Charles Gale, Office of the City Attorney, Long Beach, CA
Battalion Chief Mike Garcia, Commander, Fire Department District 1, Long Beach, CA
Deputy Chief Scott Giles, Fire Marshal, Fire Department, Long Beach, CA
Chief Terry Harbour, Fire Department, Long Beach, CA
Larry Hierera, City Clerk, Long Beach, CA
Phil T. Hester, Parks, Recreation, and Marine, Long Beach, CA
Dominic Holzhaus, Principal Deputy City Attorney, Long Beach, CA
Jackie Kell, City Council, Long Beach, CA
Val Lerch, City Council, Long Beach, CA
City of Long Beach, Department of Planning & Building, Long Beach, CA
Bonnie Lowenthal, City Council, Long Beach, CA
Fady Mattar, Acting Director of Planning and Building, Department of Planning and Building, Long Beach, CA
Gerald Miller, City Manager, Office of the City Manager, Long Beach, CA
Beverly O'Neill, Mayor, Long Beach, CA
Deputy Chief Alan Patalano, Fire Department, Operations Bureau Commander, Long Beach, CA
Tonia Reyes Uranga, City Council, Long Beach, CA
Laura Richardson, City Council, Long Beach, CA
Mark Sandoval, Marine Bureau, Long Beach, CA
Robert Shannon, City Attorney, Long Beach, CA
Christine Shippey, Deputy City Attorney/Acting Director of Public Works, Long Beach, CA

Town Agencies (cont'd)

Dennis Sullivan, Department of Oil Properties, Long Beach, CA
Mark Taylor, Chief of Staff, Office of Dan Baker, Long Beach, CA
Rob Webb, City Council, Long Beach, CA
Captain Eugene Willingham, Fire Department, Fire Prevention Bureau, Long Beach, CA
Deputy Chief Brad Wilson, Commander, Fire Department, Support Services Bureau, Long Beach, CA

James K. Hahn, Mayor, Los Angeles, CA
Janice Hahn, District 15, City Council, Los Angeles, CA

Sam Armentrout, City Councilmember, Madera, CA

Tim Purvis, Director of Transportation, Poway Unified School District, Poway, CA

Gary George, Councilmember, Redlands, CA

Don Johnson, Fleet Manager, Public Services Department, San Bernardino, CA

Dr. Ralph Appy, Port of Los Angeles, Environmental Management, San Pedro, CA
City of Los Angeles, Harbor District, San Pedro, CA
Port of Los Angeles, City of Los Angeles, San Pedro, CA

Lewis R. Nelson, Director, Public Works, Tulare, CA

Mike Klinkner, Public Works Superintendent, Union City, CA

Libraries

Carson Regional Library, Carson, CA
Alamitos Neighborhood Library, Long Beach, CA
Bay Shore Neighborhood Library, Long Beach, CA
Bret Harte Neighborhood Library, Long Beach, CA
Brewitt Neighborhood Library, Long Beach, CA
Burnett Neighborhood Library, Long Beach, CA
County of Long Beach Main Library, Long Beach, CA
Dana Neighborhood Library, Long Beach, CA
El Dorado Neighborhood Library, Long Beach, CA
Los Altos Neighborhood Library, Long Beach, CA
North Neighborhood Library, Long Beach, CA
Ruth Bach Neighborhood Library, Long Beach, CA
San Pedro Regional Library, San Pedro, CA
Los Angeles City Library, Wilmington Branch, Wilmington, CA

Media

Charlotte Aiken, Long Beach Press-Telegram, Long Beach, CA
George Economides, Long Beach Business Journal, Long Beach, CA
Kurt Helin, Gazette Newspapers, Long Beach, CA

Media (cont'd)

Nancy Rivera Brooks, LA Times, Los Angeles, CA
Martin Romjue, Daily Breeze, Torrance, CA

Editor, Pipeline Digest, Houston, TX

Intervenors

Bruna Jeider, Power Resources Manager, Burbank Water and Power, Burbank, CA
William B. Wong, Senior Deputy District Counsel, South Coast Air Quality Management District, Diamond Bar, CA
Steven G. Lins, Senior Assistant City Attorney, Office of the City Attorney, City of Glendale, Glendale, CA
Don May, California Earth Corps, Lakewood, CA
Laurie C. Angel, Long Beach, CA
Marc Coleman, Attorney, I.L.W.U. Local 63, Long Beach, CA
John Donaldson, Long Beach Citizens for Utility Reform, Long Beach, CA
Tetsuko Egawa, SES, Long Beach, CA
Roger Erickson, Long Beach Citizens for Utility Reform, Long Beach, CA
Christopher J. Garner, Energy Department, Long Beach, CA
Thomas E Giles, C.O.O., Sound Energy Solutions, Long Beach, CA
Linda L Ivers, Citizens Advocating Responsible Development, Long Beach, CA
Diana Mann, Californians for Renewable Energy, Long Beach, CA
Carol McCafferty, Citizens Advocating Responsible Development, Long Beach, CA
Bry Laurie Myown, Long Beach Citizens for Utility Reform, Long Beach, CA
Carol A. Shaw, Deputy City Attorney, Office of the City Attorney, Long Beach, CA
Joseph M. Weinstein, Long Beach Citizens for Utility Reform, Long Beach, CA
Adam C Abrahms, Attorney at Law, Proskauer Rose LLP, Los Angeles, CA
Kenneth A Ehrlich, Jeffer Mangels Butler & Marmaro LLP, Los Angeles, CA
John R. Ellis, Attorney, Sempra Energy, Los Angeles, CA
David L. Huard, Parner, Manatt, Phelps and Phillips, LLP, Los Angeles, CA
Gordon Labedz, Sierra Club, Los Angeles, CA
Bruce Monroe, Conservation Chair, Long Beach Sierra Club, Los Angeles, CA
Norman A. Pedersen, Hanna and Morton LLP, Los Angeles, CA
Robert L. Pettinato, Natural Gas Group, Los Angeles Department of Water and Power, Los Angeles, CA
June Suwara, Manager of Gas Case Management, Sempra Energy, Los Angeles, CA
Mark Theodore, Proskauer Rose LLP, Los Angeles, CA
Douglas K. Kerner, Attorney at Law, Ellison, Schneider & Harris LLP, Sacramento, CA
Erin R Koch-Goodman, Staff Counsel, California Electricity Oversight Board, Sacramento, CA
Erik N Saltmarsh, Chief Counsel, California Electricity Oversight Board, Sacramento, CA
Monica Schwebs, Staff Counsel, California Energy Commission, Sacramento, CA
Jamee Jordan Patterson, Supervising Deputy Attorney General, Office of the Attorney General, San Diego, CA
Bill Powers, Border Power Plant Working Group, San Diego, CA
Jonathan A. Bromson, Public Utilities Commission of the State of California, San Francisco, CA
Christine S. Hwang, Esq., Leonard Carder, LLP, Attorneys for ILWU, San Francisco, CA
Shiran Kochavi, Pacific Gas and Electric Co Law Dept, San Francisco, CA
Kenneth E. Lewis, Public Utilities Commission of the State of California, San Francisco, CA
Frank R. Lindh, Pacific Gas and Electric Co Law Dept, San Francisco, CA

Intervenors (cont'd)

Harvey Morris, Principal Counsel, Public Utilities Commission, San Francisco, CA
Wendy Maria Phelps, Public Utilities Commission of the State of California, San Francisco, CA
Stephen Mussell, 1300 Pennsylvania Ave, NW, Suite 550, Mailbox 142, San Ramon, CA
Michael E Boyd, President, Californians for Renewable Energy, Inc., Soquel, CA
Cory J Briggs, Briggs Law Corp, Upland, CA
Roger Pelote, The Williams Company, Inc., Valley Village, CA

Lee A. Alexander, Esq., Dickstein, Shapiro Morin Oshinsky LLP, Washington, DC
Kurt W. Bilas, Senior Counsel, Reliant Energy Power Generation, Inc., Washington, DC
Jeffrey McIntyre Gray, Associate, Manatt, Phelps and Phillips, LLP, Washington, DC
Stefan M. Krantz, Dickstein, Shapiro Morin Oshinsky LLP, Washington, DC
Jane R. Lewis, Senior Managing Counsel and Director, American Gas Association, Washington, DC
Charles Middlekauff, Pacific Gas and Electric Co, Washington, DC
William A. Mogul, Dorsey & Whitney LLP, Washington, DC
Jeff Petrash, Senior Managing Counsel and Director, American Gas Association, Washington, DC
Julia R Richardson, Esquire, Van Ness Feldman PC, Washington, DC
John R Staffier, Stuntz, Davis & Staffier, P.C., Washington, DC
David Sweet, Executive Director, International LNG Alliance, Washington, DC

Adam H. Sheinkin, King & Spalding LLP, New York, NY
Lisa M. Tonery, King & Spalding LLP, New York, NY

Alex A. Goldberg, The Williams Company, Inc., Tulsa, OK
David G. Richins, Williams Power Company, Inc, Tulsa, OK
David Williams, Williams Power Company, Inc, Tulsa, OK

Carl M. Fink, Esq., Assistant General Counsel, North Baja Pipeline, LLC, Portland, OR
John A. Roscher, Director, Rates and Regulatory Affairs, North Baja Pipeline, LLC, Portland, OR

Steven Billot, Vice President, BHPB Billiton LNG International Inc., Houston, TX
Jon M. Bowden, Counsel, BHPB Billiton LNG International Inc., Houston, TX
James G. Busch, BP Energy Co, Houston, TX
Craig Chancellor, National Director, Gas Regulatory, Calpine Corporation, Houston, TX
Bruce A. Connell, Director of Regulatory Affairs, ConocoPhillips Company, Houston, TX
Jay D Dibble, Manager - National Regulatory, Calpine Corporation, Houston, TX
William S Garrett, Jr., President, Crystal Energy LLC, Houston, TX
William Henry, Vice President, LNG, Freeport LNG Development, L.P., Houston, TX
Gary Hinners, Director, Gas Regulatory Issues, Reliant Energy, Houston, TX
Larry Jenkins, Occidental Energy Marketing, Inc, Houston, TX
Stephanie D. Jones, ConocoPhillips Company, Houston, TX
Frederick T. Kolb, BP America Inc., Houston, TX
Andrea Kunkel, Occidental Energy Marketing, Inc, Houston, TX
Jason F. Leif, Jones Day, Houston, TX
Keith M Meyer, President, Cheniere LNG, Inc, Houston, TX
Michael L. Riggs, Senior Counsel, ConocoPhillips Company, Houston, TX
Stuart G. Leson, Manager, LNG and Gas Marketing, Unocal Midstream and Trade, Sugar Land, TX
Carol J. Westmoreland, Assistant Counsel, Union Oil Company of California, Sugar Land, TX
David S. Andersen, Attorney for, Questar Southern Trails Pipeline Co, Salt Lake City, UT

Intervenors (cont'd)

Toni A. Sharp, Sr. Reg. Analyst, Kern River Gas Transmission Company, Salt Lake City, UT
Richard N. Stapler, Jr., Senior Attorney, Kern River Gas Transmission Company, Salt Lake City, UT
Billie L. Tolman, Manager, Tariffs and Certificates, Kern River Gas Transmission Co, Salt Lake City, UT
Leonard G. Wright, Director, Federal Regulatory Affairs, Questar Pipeline Co, Salt Lake City, UT

Katherine B. Edwards, Edwards & Associates, Alexandria, VA
John Paul Floom, Edwards & Associates, Alexandria, VA

Organizations and Individuals

Paul Smith, Executive Vice President, Sales and Marketing, New Flyer, Winnipeg, MB, Canada

Maryam Ayati, Shell Gas & Power International, B.V., The Hague, The Netherlands

* David Van Kirk, Prescott, AZ
Steve Gregory, Director of Maintenance, ATC-Tempe, Tempe, AZ

Greg Magda, University Marelich Mechanical, Anaheim, CA
Rich Mcdevitt, Cortech Engineering, Anaheim, CA
Tom Vogt, President, Taormina Industries, Anaheim, CA
John D. Weaver, President, Weaver, Inc., Anaheim, CA
* Evonne M Fowler, Banning, CA
Deborah Reyes Castro, Belmont Shore, CA
BP West Coast Products LLC, Buena Park, CA
* Brian L & Lydia Martz, Canyon Country, CA
* Ellis R & Lois M Driver, Carson, CA
City of Long Beach, ACTA, Carson, CA
* Arturo Velazquez, Carson, CA
Watson Land Company, Carson, CA
Kirk Hunter, Director, Southwest Transportation Agency, Caruthers, CA
Yuzo Tobisaka, Claremont, CA
Patrick Smith, Transportation Manager, Harris Farms Inc., Coalinga, CA
Frank Allen, Southern California Edison, Compton, CA
* Winston Dabbs, Compton, CA
Leopoldo Moreno, Compton, CA
Juan J. Nuno, Compton, CA
Jim Santangelo, Teamsters Joint Council 42, Covina, CA
Geoff Straw, General Manager, Unitrans, Davis, CA
JoAnn Armenta, Clean Cities Coordinator, The Partnership, Diamond Bar, CA
Michael L. Eaves, President, California Natural Gas Vehicle Coalition, Diamond Bar, CA
* Wayne & Mary Tyler, Duarte, CA
Auden Aaberg, NRG Services Corp, El Segundo, CA
J S Deka, Chevron USA Inc, El Segundo, CA
Grant Wright, Sempra Energy Global Enterprises, Escondido, CA
* Michael & Rita Rodrigue, Fallbrook, CA
Mel Keegan, Spec Services, Inc., Fountain Valley, CA
George K. Ramsay, Spec Services, Inc., Fountain Valley, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

James Samuel, Maintenance Manager, Fresno Area Express, Fresno, CA
Lou Baglietto, Butterfield Communications, Inc, Gardena, CA
* Grace S W Kim, Haarbor City, CA
* Jean Dermott, Habor City, CA
* Mahinda & Gwendoline Ram, Habor City, CA
* Kuda B & Ratnavali Aluwihare, Harbor City, CA
* Patrick & Iris Alvarado, Harbor City, CA
* Gerardo Alvarez, Harbor City, CA
* Juan J & Maria Alvillar, Harbor City, CA
* Donald T Anderson, Harbor City, CA
* Jerry H & Janet Anderson, Harbor City, CA
* Susan Anderson, Harbor City, CA
* Robert A & Candace L Archer, Harbor City, CA
* Raul S & Debra Arroyos, Harbor City, CA
* James Ayers, Harbor City, CA
* Heather L Backstrom, Harbor City, CA
* Cary Barnes, Harbor City, CA
* Ronald & Sandra Barnes, Harbor City, CA
* Rodney & Diana Barrett, Harbor City, CA
* Michelle J & Ian Bedell, Harbor City, CA
* Richard & Alicia Benbough, Harbor City, CA
* Irilynne A Benson, Harbor City, CA
* Florencio G & Carmen Biagan, Harbor City, CA
* Linda F Bilbrew, Harbor City, CA
* LAlma E Blant, Harbor City, CA
* Debra L Bolin, Harbor City, CA
* Jacqueline Boone, Harbor City, CA
* Christopher Boykins, Harbor City, CA
* Greg Bradley, Harbor City, CA
* Brian D Brantley and Brantley Gloria L Figueroa, Harbor City, CA
* Geoffrey E & Lynda Brown, Harbor City, CA
* Earl S Bryant, Harbor City, CA
* Pamela Bryson, Harbor City, CA
* Kathryn E Burlingame, Harbor City, CA
* Donald & Mell Buttram, Harbor City, CA
* Moon Chong Byung, Harbor City, CA
* Maynard A Cabacungan and Charlotte H Cruz, Harbor City, CA
* Hugh M Callaghan, Harbor City, CA
* Ronald M Campbell, Harbor City, CA
* Edward & Maureen Carlson, Harbor City, CA
* Robert D & Cristina Carrillo, Harbor City, CA
* King E Carter, Harbor City, CA
* Jared B & Carolee Casper, Harbor City, CA
* Anastacio G Castaneda, Harbor City, CA
* Alexander & Irma Castillo, Harbor City, CA
* Celso V Catipon, Harbor City, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Yong H Choe, Harbor City, CA
* Stephen W Choi and Ji E L, Harbor City, CA
* Miyara Chokin, Harbor City, CA
* Augustine J Chung and Ji Sun, Harbor City, CA
* Gregg L Clark, Harbor City, CA
* Sarah Coaronado, Harbor City, CA
* Christopher A Colburn and Jennifer A Baker, Harbor City, CA
* Estela Compos, Harbor City, CA
* George W & Darline Cook, Harbor City, CA
* John R & Linda Cookson, Harbor City, CA
  Bonnie L Corona, Harbor City, CA
* Joseph V & Marie Cortez, Harbor City, CA
* Jeffrey R Cowan, Harbor City, CA
* John H & Joanne Crawford, Harbor City, CA
* Ismael & Yazmin Cruz, Harbor City, CA
* Robert Daligney, Harbor City, CA
* Lawrence E Daniels, Harbor City, CA
* Richard & Laura Danna, Harbor City, CA
* Jacqueline Davidson, Harbor City, CA
* Gregory A & Leona Davis, Harbor City, CA
* Fabiola G De Alba, Harbor City, CA
* Timothy Decker, Harbor City, CA
* Virginia Delgado, Harbor City, CA
* John W & Josephine Devins, Harbor City, CA
* Steve Doh, Harbor City, CA
* John W and Jeffrey A Donald, Harbor City, CA
* Harold A & Barbara Dove, Harbor City, CA
* Jennifer L Duhn, Harbor City, CA
* Valorie D Edwards, Harbor City, CA
* Nancy L Ellis, Harbor City, CA
* Felipe Escalera and Beatriz Paramo, Harbor City, CA
* Aurora U Escuedero, Harbor City, CA
* Victor & Donna Espinosa, Harbor City, CA
* Encarna Espiritu, Harbor City, CA
* Michael & B Feyder, Harbor City, CA
* Samuel Fine, Harbor City, CA
* Martin Fisher, Harbor City, CA
* Donald J Francisco, Harbor City, CA
* Donald J Francisco and Laura F Richelson, Harbor City, CA
* Josephine J Freese, Harbor City, CA
* Christopher & Cynthia Garcia, Harbor City, CA
* Elodia Garcia, Harbor City, CA
* Darrin L Garza, Harbor City, CA
* Mokless G Ghaly, Harbor City, CA
* John E & Sandra Gibbs, Harbor City, CA
* John H and Rose P Glass, Harbor City, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Scott T Glei, Harbor City, CA
* Rene R Gonzalez, Harbor City, CA
* Lawrence E & Kathleen Grey, Harbor City, CA
* Volney D Griffin, Harbor City, CA
* Frank A & Llona Grippando, Harbor City, CA
* Pamela J Grundman, Harbor City, CA
* Everardo & Martha Gutierrez, Harbor City, CA
* Larry T Halem and Jennifer G Shaw, Harbor City, CA
* Denise G Hall, Harbor City, CA
* Francine E Hanby, Harbor City, CA
* Thomas Harpur, Harbor City, CA
* Barbara L & James Harris, Harbor City, CA
* Sheila Hatcher and Patrick J Healy, Harbor City, CA
* Pauline H Hayashibara, Harbor City, CA
* Wilbert Hendrix & Linda M Warren, Harbor City, CA
* Florence J Henton and Glenn K Buchan, Harbor City, CA
* Glen W & Suzanne Hermann, Harbor City, CA
* Elizabeth Hermanns, Harbor City, CA
* Roswitha C Hernandez, Harbor City, CA
* Brandea L Hill and Karen D Papadakis, Harbor City, CA
* Hirahara Earl 2003 Trust, Harbor City, CA
* Bret A & Jorie Holman, Harbor City, CA
* Donald B Holmes, Harbor City, CA
* Hooton Vivian Trust, Harbor City, CA
* Riko Hosoya, Harbor City, CA
* Kwang H Hwang, Harbor City, CA
* Thomas Jacqueline Trust, Harbor City, CA
* Barbara L Jensen, Harbor City, CA
* Cary J Jordahl, Harbor City, CA
* Aera Jun, Harbor City, CA
* Kirb Kaleem and Candis Sargent, Harbor City, CA
* Michael & Colleen Karow, Harbor City, CA
* Reels Keith and Donna Trust, Harbor City, CA
* Bobby L Kennedy, Harbor City, CA
* Fany & Nina Khiev, Harbor City, CA
* Min J Kim, Harbor City, CA
* Won K & Suk Kim, Harbor City, CA
* Barbara Kincaid, Harbor City, CA
* Chandra R Kincaid, Harbor City, CA
* Frances Kirby, Harbor City, CA
* Steven K Koda, Harbor City, CA
* Mark S & Kelly Kohagura, Harbor City, CA
* Ines Kordich, Harbor City, CA
* Joseph S Krupa, Harbor City, CA
* Hee Han Kun, Harbor City, CA
* L A City, Harbor City, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Laguna Vista Small Animal Equine Veterinary Hospital Inc, Harbor City, CA
* Amrit U Lal, Harbor City, CA
* Estrelita Lane, Harbor City, CA
* Clifton Lee, Harbor City, CA
* Gina J Lee, Harbor City, CA
* Kwang Il & Young Lee, Harbor City, CA
* Rosa K Lee, Harbor City, CA
* Louis Y Lee and Thomas P Schmidt, Harbor City, CA
* Hal Leisure, Harbor City, CA
* Danny L & Rosana Lieu, Harbor City, CA
* Hyung W & Kyoung Lim, Harbor City, CA
* Silvia L Lipe, Harbor City, CA
* Stephanie Little, Harbor City, CA
* John A & Carolyn Long, Harbor City, CA
* Lopez Family Trust, Harbor City, CA
* Maria D Lopez, Harbor City, CA
* Timothy W & Bobbi Lucas, Harbor City, CA
* Thelma Luhrsen, Harbor City, CA
* Pacita Macababbad, Harbor City, CA
* Bill S & Maria Magallanez, Harbor City, CA
* Mai Maltam and Amy Maitam, Harbor City, CA
* Laurie & Robert Manley, Harbor City, CA
* Antonio J & Barbara Martinez, Harbor City, CA
* Ray E Martinez, Harbor City, CA
* Dean Mccabe, Harbor City, CA
* John J & Allison Mcfadden, Harbor City, CA
* Carol McGee, Harbor City, CA
* Ricahard E & Kimberly Mclennan, Harbor City, CA
* David A & Trudy Mcmurray, Harbor City, CA
* Brankica Mihailo, Harbor City, CA
* Ericka Miller, Harbor City, CA
* Gary Miller, Harbor City, CA
* Robin & Robert Mitchell, Harbor City, CA
* Verlen A & Shelia Mitchell, Harbor City, CA
* Hidero Miyamori, Harbor City, CA
* Mario A Montes, Harbor City, CA
* Yeuh M Mooney, Harbor City, CA
* Graylan A & Lashun Moore, Harbor City, CA
* Cristobal Morales, Harbor City, CA
* Melvin L & Ingeborg Morgan, Harbor City, CA
* Raymond R & Shujen Moser, Harbor City, CA
* Ralph Nagle, Harbor City, CA
* Miles I Nan and Ivy H Kuan, Harbor City, CA
* Russell S Nekomoto, Harbor City, CA
* Tra Nguyen, Harbor City, CA
* Mercedes M Nickell and Paz M Nall, Harbor City, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Gerardo & Pablo Noh, Harbor City, CA
* Danilo & Nida Oliveros, Harbor City, CA
* Carlos & Jeannie Orozco, Harbor City, CA
* Craig Osterberg, Harbor City, CA
* Nick J Ovalasiti, Harbor City, CA
* Khalilah Palmer, Harbor City, CA
* Grace A Palting, Harbor City, CA
* Harold E & Susie Pangle, Harbor City, CA
* Wei L Pao and Andy Pao, Harbor City, CA
* James & Thelma Paraon, Harbor City, CA
* Song H Park, Harbor City, CA
* I A Patalano, Harbor City, CA
* Kathryn A Pawly, Harbor City, CA
* Lyle H & Kathleen Pedersen, Harbor City, CA
* Eduardo Pena, Harbor City, CA
* Franklin A Pena, Harbor City, CA
* James T Perdue, Harbor City, CA
* Perez Family Trust Dooley-Perez Family Trust, Harbor City, CA
* Norman A & Geneva Perry, Harbor City, CA
* Jon B Peterson, Harbor City, CA
* Walter Po, Harbor City, CA
* Jeremy & Dick Powell, Harbor City, CA
* Michael R & Love Pruitt, Harbor City, CA
* Ryan P & Carolyn Puni, Harbor City, CA
* John M Quinto, Harbor City, CA
* Calvin R & Dorothy Ratliff, Harbor City, CA
* Dorothy T Remington, Harbor City, CA
* Raymond Roberts, Harbor City, CA
* Jose A Romero, Harbor City, CA
* Dale Ruman, Harbor City, CA
* Glenn D & Denise Russell, Harbor City, CA
* Richard K & Cheryl Ryan, Harbor City, CA
* David A & Jennifer Rybus, Harbor City, CA
* Na Jae and Na Susan S, Harbor City, CA
* Ahmad J Sabra & Daniel Graham, Harbor City, CA
* Robert & Thelma Sanborn, Harbor City, CA
* Rolando O Sanchez, Harbor City, CA
* Hyo Kim Sang and Sunny Park, Harbor City, CA
* Dennis N & Janice E Sato, Harbor City, CA
* Robert H & Maria Schulz, Harbor City, CA
* Lamecha D Scott, Harbor City, CA
* Jason S Seieroe, Harbor City, CA
* Jose Seminario, Harbor City, CA
* Youngsoo Seo, Harbor City, CA
* Hammed & Sorriya Shams, Harbor City, CA
* Wayne M Shimokochi and Shimokochi S E Crandall, Harbor City, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Kyung Y Shin, Harbor City, CA
* Patricia I Simonetti, Harbor City, CA
* Kulwant Singh, Harbor City, CA
* Richard C Skaff, Harbor City, CA
* Claudette F Skelton, Harbor City, CA
* John F & Margaret Smit, Harbor City, CA
* James R & Marie Smith, Harbor City, CA
* Kim E Smith-Cochran, Harbor City, CA
* Steven & Celine Solberg, Harbor City, CA
* Brian E Stafford, Harbor City, CA
* Ian Stevenson, Harbor City, CA
* Freeda E Stone, Harbor City, CA
* George Stringos and Tracey Schettino, Harbor City, CA
* Gadjeindran Subramaniam & Vimala D Velayutham, Harbor City, CA
* Kakuen Tang and Laurie L Eng, Harbor City, CA
* Alan H Tanji, Harbor City, CA
* Turner Debra Taylor, Harbor City, CA
* Benella M Thomas, Harbor City, CA
* Marilyn L Toliver, Harbor City, CA
* Ruby S Tomiyoshi, Harbor City, CA
* Taj O Toole, Harbor City, CA
* Alex A Tostado, Harbor City, CA
* Atsuhiro & Keiko Tsuji, Harbor City, CA
* Kyung S & June Um, Harbor City, CA
* Christie Uyematsu, Harbor City, CA
* David J & Sharen Uyematsu, Harbor City, CA
* Hamid and Nahid Vaghefi, Harbor City, CA
* Janet Van Auken, Harbor City, CA
* Peter Van Der Linden and Nelly Hartz, Harbor City, CA
* Joseph L & Terry Van Ryckeghem, Harbor City, CA
* Carmen & Juan Vasquez, Harbor City, CA
* Victor L & Mirta Verme, Harbor City, CA
* Renee Villarreal, Harbor City, CA
* Gina M Viloria, Harbor City, CA
* Gilberto Vilorio, Harbor City, CA
* Michael J & Margaret Walsh, Harbor City, CA
* Eugene Warshawsky, Harbor City, CA
* Kathleen Watkins, Harbor City, CA
* Woods G Welch, Harbor City, CA
* Kristy Wi, Harbor City, CA
* Carol A & Diane Wiley, Harbor City, CA
* Christina Williams, Harbor City, CA
* David W & Karolyn Williamson, Harbor City, CA
* Ronald L & Susan Willippo, Harbor City, CA
* John Woolington and Pamela Weiss, Harbor City, CA
* Yunchun & Yi Yang, Harbor City, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Ja Yi Ye, Harbor City, CA
* Boksoon A Yi, Harbor City, CA
* Young H Yoon, Harbor City, CA
* Rosemary A Zaragoza, Harbor City, CA
* Stephen D Ziegler, Harbor City, CA
* Douglas P Erhard and Bustillos Ermelinda, Hermosa Beach, CA
* Anaheim Belleporte LLC , Hermosa Beach, CA
* Norman M Boyar, Huntington Beach, CA
  Akihiro Fujimaru, Huntington Beach, CA
  Green Trust, Huntington Beach, CA
  Gary Pope, Huntington Beach, CA
  Scott Kuhn, Communities for a Better Environment, Huntington Park, CA
  Michael Dougherty, Petro-Diamond Incorporated, Irvine, CA
  Steve Ferrara, TRC, Irvine, CA
* Greystone Homes Inc, Irvine, CA
  Betsy Lindsay, Ultrasystems Environmental, Irvine, CA
  Kenneth Lord, Michael Brandman Associates, Irvine, CA
  James Menees, Petro Diamond, Irvine, CA
  Eric Walther PhD, TRC, Irvine, CA
  Mike Paik, Southern California Edison, Irwindale, CA
  Alan N. Stewart, La Mesa, CA
* Hugh M Callaghan, Laguna Beach, CA
  Anthony Caldwell, Lakewood, CA
  Francis Suhier, Lakewood, CA
  Rudy Vietmeier, Lakewood, CA
  Dgh 1500 Lomita Industrial Llc, Lawndale, CA
* Eino A & Gloria Jussila, Lomita, CA
* Helen L Kelly, Lomita, CA
  Acting Manager, Long Beach Marina, Long Beach, CA
  Hari & Sharda Agarwal, C/O Law Offices of Doug Otto, Long Beach, CA
  Capt. Masayuki Akiyama, International Transportation Service Inc, Long Beach, CA
  Henry Anderson, Southern California Edison, Long Beach, CA
  Paul & Lucy Baker, Long Beach, CA
  Don Beaumont, L G Everist Inc, Long Beach, CA
  Don Bogart, Long Beach, CA
  Larry Boland, Long Beach, CA
  Greg Bombard, Catalina Channel Express, Long Beach, CA
  Leslie Bonilla, CMA, Office Manager, Memorial Maritime Clinic, Inc., Long Beach, CA
  Joe Brown, New NRG Inc., Long Beach, CA
  Hank Bruzza, Lengner and Sons Express, Long Beach, CA
  Building Manager, Arco Center Building, Long Beach, CA
  Roger & Gloria Burke, Long Beach, CA
  Ca State Univ & College Hdqtrs, Long Beach, CA
  Ann Cantrell, Long Beach, CA
  Don Carter, US Sea Launch, Long Beach, CA
  Cathy Chambers, Long Beach, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

Ken & Lisa Chappell, Long Beach, CA
Frank Clarke, Long Beach, CA
Cathy Clarkin, Ecology and Environment, Long Beach, CA
ConocoPhillips Company / Tosco Corporation, Long Beach, CA
Conservation Chairman, Sierra Club of Long Beach, Long Beach, CA
Robert Daugherty, Long Beach, CA
J de la Vega, International Maritime Inc., Long Beach, CA
Thomas Deats, The Coast Long Beach Hotel, Long Beach, CA
Alex Delgado, Fremont Forest Group Corp, Long Beach, CA
Ann Denison, Long Beach, CA
Mr. and Mrs. James l. Denison, Long Beach, CA
Elaine DeRouche, Long Beach, CA
John di Bernardo, Ssa, Long Beach, CA
Joe Dileva, Total Terminals International LLC, Long Beach, CA
Steve Dillon, Cemex, Long Beach, CA
Ken Dobson, Morton Salt, Long Beach, CA
Barry Evans, Harbor Diesel & Equipment, Long Beach, CA
John Fawcett, Long Beach, CA
Sal Ferrigno, Pacific Container Terminal, Long Beach, CA
Paul Gagnon, Matson Terminals, Long Beach, CA
John Gallucci, Quick Stop Commercial Oil & Lube, Long Beach, CA
Jon Goch, Long Beach, CA
Pat Gorman, Port Petroleum Inc, Long Beach, CA
Dave Greenwald, Toyota Motor Sales USA, Long Beach, CA
Dave Hall, Long Beach, CA
Sam S. Hanson, Spun Products Inc., Long Beach, CA
Timothy Hawkins, District Manager, BP Pipelines (North America) Inc., Long Beach, CA
J Hennon, Polar Tankers Inc, Long Beach, CA
Dr. Gary Herbertson, Institute for Global Solutions, Long Beach, CA
Jim Holland, Long Beach, CA
Roger Holman, Long Beach, CA
Conrad Housley, Long Beach, CA
Victor Hovsepian, City Paper & Metal, Long Beach, CA
Kim Huertas, Horizon Lines, Long Beach, CA
Sho Ishitobi, Intl Transportation Service, Long Beach, CA
Tom Jacobsen, Jacobsen Pilot Services Inc, Long Beach, CA
Edward Kaveney, Intl Seafarers Center of LB, Long Beach, CA
George B Kelly, Marinus Inc, Long Beach, CA
Pat Kennedy, Petro Diamond, Long Beach, CA
Wayne Kiser, Superior Electrical Adv, Long Beach, CA
Frank Komin, Thums Long Beach Company, Long Beach, CA
Robert Lamond, Long Beach, CA
Clint Larison, Connolly Pacific Co, Long Beach, CA
Garcia Laurencio, Long Beach, CA
Scott Lebbin, Koch Carbon Inc, Long Beach, CA
Tony Liberatore, Crescent Terminals Inc, Long Beach, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

Mike Lingerfelt, California United Terminals, Long Beach, CA
Joseph Lombardi, Applied Industrial Materials, Long Beach, CA
Dr Samuel Maehara, Srm Corporation, Long Beach, CA
Manager, The Reef Restaurant, Long Beach, CA
Diana Mann, Long Beach, CA
Marty Marcum, Mitsubishi Cement Corp, Long Beach, CA
Rick Mathews, Chemoil Marine Terminal, Long Beach, CA
Tyrone Mc Laine, Shell Oil Products, Long Beach, CA
Jim Mc Laughlin, BP Arco, Long Beach, CA
Alyce McCall, Long Beach Energy, Long Beach, CA
Arthur J Merrick, Long Beach Container Terminal, Long Beach, CA
Rugerio Moises, Long Beach, CA
Dorothy Moore, Long Beach, CA
John Moore, Island Express Helicopters Inc, Long Beach, CA
Mark Mosunic, Chiquita Banana N.A., Long Beach, CA
Kevin Nicolello, Hanjin Shipping Company Ltd, Long Beach, CA
Raymond Nottingham, Clean Coastal Waters, Long Beach, CA
Jim Nuckels, Pacific Coast Recycling, Long Beach, CA
Phyllis O'Connor, Long Beach, CA
Phil Osterlind, Long Beach, CA
Jim Penny, Crowley Marine Services, Long Beach, CA
Mark Perez, Memorial Maritime Clinic, Long Beach, CA
Ray Pok, Long Beach, CA
Joseph Prevratil, Queen Mary Rms Foundation, Long Beach, CA
Robert Quintero, So Ca Edison Co (Long Beach Dist), Long Beach, CA
Nancy Risch, Long Beach, CA
Norm Ryan, Long Beach, CA
Frank San Nicholas, International Maritime Inc, Long Beach, CA
Michael Sarna, Long Beach, CA
Thomas Scranton, Foss Environmental, Long Beach, CA
David Selga, Foss Maritime Company, Long Beach, CA
Bob Shajary, Gp Gypsum Inc, Long Beach, CA
Gary Shelton, Long Beach, CA
Mark Shemaria, Tidelands Oil Production Co, Long Beach, CA
Shoreline Harbor Marina, Long Beach, CA
Dorothy Shubin, Long Beach, CA
Jack Shubin, Long Beach, CA
Pieter Shuttorp, Ssat Long Beach Terminal, Long Beach, CA
Steve Simons, Loren Scale Company Inc, Long Beach, CA
* James A & Kathy R Sirago, Long Beach, CA
Michael Spies, J H Baxter Co, Long Beach, CA
Chris Stahl, Long Beach Iron Works Inc, Long Beach, CA
Marianne G. Stiles, Long Beach, CA
Rob Streed, BP Pipelines North America, Long Beach, CA
Dale Strieter, Patriot Environmental Services, Long Beach, CA
Barbara Sullivan, Sullivan International, Long Beach, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Surfrider Foundation, Long Beach Chapter, Long Beach, CA
Anastacia Talieres, Long Beach, CA
Bruce Taverner, Oxbow Carbon & Minerals, Long Beach, CA
Regina Taylor, Sierra Club of Long Beach, Long Beach, CA
Martyn Temple, Weyerhaeuser Company, Long Beach, CA
Sean Torkelson, Long Beach, CA
Shawn Torkelson, Clean Coastal Waters Inc, Long Beach, CA
Kay Tortorice, Long Beach, CA
Charles Tripp, Serrf Solid Waste, Long Beach, CA
John Tsouvalas, Pacific Energy Partners LP, Long Beach, CA
Tamara Van Nuck, Long Beach, CA
Lisa Van Malsen, Safer Systems, Long Beach, CA
Ravi Varma, Long Beach, CA
Shirley Vaughan, Long Beach, CA
Carlos Vela, Forest Terminals Corp, Long Beach, CA
Ed Viner, Cooper/ T Smith Stevedoring, Long Beach, CA
Randy Watson, Sulex Inc, Long Beach, CA
Chris Webb, Moffatt and Nichol, Long Beach, CA
Del Whan, Long Beach, CA
Rich Whitley, Long Beach, CA
Mike Williams, Maritime Administration, Long Beach, CA
David Wilson, Long Beach, CA
Alan Winter, Long Beach Energy, Engr. & Constr. Bureau Mgr., Long Beach, CA
Ej Wright, Long Beach, CA
Phillip Wright, Zim American Israeli Shipping Co, Long Beach, CA
Steve Yeargin, Long Beach, CA
Richard Young, Pacific Energy Resources Inc, Long Beach, CA
Rin-Rin Yu, Adler Public Affairs, Long Beach, CA
Andy Andreoli, Baker Commodities Inc, Los Angeles, CA
State of California, Department of Transportation, Los Angeles, CA
Tim Carmichael, Coalition For Clean Air, Los Angeles, CA
George Chien, Los Angeles, CA
Miguel Contreras, LA Union, Los Angeles County Federation of Labor, AFL,CIO, Los Angeles, CA
Friends of the LA River, Los Angeles, CA
Anita X. H. García, Los Angeles, CA
Reb Guthrie, President, Fuel Solutions, Inc., Los Angeles, CA
Russell J Hammer, President and CEO, Los Angeles Area Chamber of Commerce, Los Angeles, CA
* Harbor Gardens LLC, Los Angeles, CA
Larry Henderson, Int'l Brotherhood of Electrical Workers, Los Angeles, CA
Bob Kemper, Los Angeles, CA
Darlene Kuba, Los Angeles, CA
Mike McCarron, Southwest Regional Council of Carpenters, Los Angeles, CA
* Elaine L Permg, Los Angeles, CA
* Elaine L Perng, Los Angeles, CA
Richard Slawson, LA/Orange Building & Construction Trades Council, Los Angeles, CA
* Arthur & Erwin Sokol, Los Angeles, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Yoko Truffart, Los Angeles, CA
* United Workers Union Local 770 Food & Commercial, Los Angeles, CA
* Jesse J & Laura Nelson, Manhattan Beach, CA
  Santa Monica Baykeeper, Marina del Rey, CA
  Bill Coryell, Vice President, Sales and Marketing, North American Bus Industries, Ontario, CA
  Michael Jasberg, Mitsubishi Cement Corporation, Ontario, CA
  Michael Gasparro, DMJM & Harris, Orange, CA
  Kinder Morgan Energy Partners, L.P./GATX Tank Storage, Orange, CA
  Scott, Fischler, Clean Cities Coordinator, Clean Cities Coachella Valley Region, Palm Springs, CA
  Rick Wade, General Manager, Palm Springs Disposal Services, Palm Springs, CA
* Jodie S Holick, Palos Verdes, CA
  Sally Higman, Higman Doehle, Inc., Palos Verdes Estates, CA
* Michael Mulligan & Joseph Schwartz, Palos Verdes Estates, CA
* Daniel P & Carol Sullivan, Palos Verdes Estates, CA
  Victor Benton, Paramount, CA
  Matt Gallagher, KBR, Pasadena, CA
* Kaiser Foundation Hospitals, Pasadena, CA
  Alan Sako, SAIC, Pasadena, CA
  Tosco Corp, Paso Robles, CA
* Esequiel Zepeda, Pico Rivera, CA
  Chris Ferrara, Clean Cities Coordinator, East Bay Clean Cities, Pleasant Hill, CA
* Gina R Steed, Ranch Palos Verdes, CA
* Rodney A & Nancy Briggs, Rancho Palos Verdes, CA
* Michael R Fantone, Rancho Palos Verdes, CA
* Joseph H & Edith Gerson, Rancho Palos Verdes, CA
* Kunkle D I Fourth Ltd Ptnshp, Rancho Palos Verdes, CA
* Joseph J & J Mannara, Rancho Palos Verdes, CA
* Paul and Haida Nakkashian, Rancho Palos Verdes, CA
* Richard & Yvetta Williams, Rancho Palos Verdes, CA
  Attn: Brian Kenyon, Plumbers & Steamfitters Union, Local 662, Redding, CA
* 1223 Anaheim Street LLC, Redondo Beach, CA
* Joan M Collier, Redondo Beach, CA
* E Mark Klempa, Redondo Beach, CA
* Debra R Michael, Redondo Beach, CA
* Palos Verdes Rancho Mobile Home Park, Redondo Beach, CA
  Rose Scheuckes, Study Group, Amnilore Dominguis Co, Redondo Beach, CA
  Mary Wallace, Redondo Beach, CA
* Gary & Cindi Wells, Redondo Beach, CA
  Barbara Spoonhour, Program Manager, Western Riverside County Clean Cities Coalition, Riverside, CA
* Ohannes H & Sonia Hamayan, Rolling Hills, CA
* Farzad Nourai, Rolling Hills, CA
* Sean A and Leslie A Bennett, Rolling Hills Estate, CA
* Wiessner Robert P & M B Trust, Rolling Hills Estate, CA
  Garry Garrigue, So Ca Edison Co, Rosemead, CA
  Karen Greenberg, Southern California Edison, Rosemead, CA
  Jeff Asay, Union Pacific Railroad, Roseville, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

Durand L. Rall, CEO/General Manager, Omnitrans, San Bernardino, CA
Walt Smith, Burlington Northern Santa Fe, San Bernardino, CA
Chris Evans, Surfrider Foundation, San Clementa, CA
Don Beaumont, Nielsen Beaumont Marine, San Diego, CA
Isabel Freeland, Coast Citrus, San Diego, CA
Gregory M. Newhouse, Chairman, San Diego Regional Clean Fuels Coalition, San Diego, CA
Rick Ruvolo, Clean Cities Coordinator, San Francisco Clean Cities Coalition, San Francisco, CA
Norwalk LP Industries, San Jose, CA
Steve Allen, Marine Terminals Corp LB Shop, San Pedro, CA
* Lou Baglietto, Butterfield Communications, San Pedro, CA
Greg Bombard, Catalina Channel Express, San Pedro, CA
Gwen Butterfield, Butterfield Communications, Inc, San Pedro, CA
Frank Capo, Marine Terminals Corporation, San Pedro, CA
* Phillip J Costillo, San Pedro, CA
Jim Cross, San Pedro, CA
* Marc D Elliott and Joann Carrabbio, San Pedro, CA
Barb Garrett, San Pedro, CA
Vern Hall, San Pedro, CA
Richard Havenick, San Pedro, CA
Roslyn Holtz, San Pedro, CA
* Jimmie D & Joanne Hudson, San Pedro, CA
* Laurie A Jacobs, San Pedro, CA
Dennis Lord, Scg, San Pedro, CA
Dr. John Miller, San Pedro, CA
* Susan L Nunnery, San Pedro, CA
Noel Park, San Pedro & Peninsula Ho Coalition, San Pedro, CA
Mike Scala, Chevron Shipping Company, San Pedro, CA
* Boris & Helen Tabakovic, San Pedro, CA
Jayme Wilson, Spirit Cruises, San Pedro, CA
Gary A. Young, San Pedro, CA
Gretchen Honan, Ch2M Hill, Santa Ana, CA
Jim Nickerson , TetraTechECInc., Santa Ana, CA
Paul Tranquill, ERM, Santa Ana, CA
Gerry Tintle, Tosco Refining Company, Santa Fe Springs, CA
Gail R Feuer, NRDC, Santa Monica, CA
Mark Gold, Heal the Bay, Santa Monica, CA
Louis Warschaw, Warland Investments Co, Santa Monica, CA
Al Basham, Clean Energy, Seal Beach, CA
Dwight Hanson, Western Regional Sales Manager, Cummins Westport Inc., Seal Beach, CA
* Dae Y & Uk J Kim, Seal Beach, CA
* Newcomb B & Alma Weisenberger, Signal Hill, CA
Memie Miradjaja, World Oil Corp, South Gate, CA
* Ibrahim S Guirges and Magda Azer, St Seal Beach, CA
Marlene Holley, Great Lakes Dredge & Dock Co, Terminal Island, CA
George Wall, Al Larson Boat Shop, Terminal Island, CA
* Richard W & Richardjr Cole, Torrance, CA
* Arsenio B & Priscilla Coloma, Torrance, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Linden H & Jeannette Comstock, Torrance, CA
* Thomas M Coughlin, Torrance, CA
* Herbert & Maria Funk, Torrance, CA
* Christine E Gafford, Torrance, CA
  Jerry Kopecek, Acta Risk Management Services, Torrance, CA
* John B Pennington, Torrance, CA
  Cecil Ransom, Toyota Motor Sales USA, Torrance, CA
* Debra Robertson, Torrance, CA
* Chia Hsiaing Sung, Torrance, CA
  Bruce Buckner, Project Manager, Allsup Corporation, Upland, CA
  Jerry Leavitt, Regional Manager, ET Energy, Valencia, CA
  Greg Chittick, Ventura, CA
  Kathi Hann, Ventura, CA
  Jim Harrison, Vice President, E.J. Harrison and Sons, Ventura, CA
  Michael Ducharm, VP of Transportation, Sysco Food Services, Walnut, CA
* Billy A Billings, Westminster, CA
  Ronald J Cardona, Westminster, CA
  R. Lynn Forsberg, Fremont Forest Group Corp, Whittier, CA
  Ruth I. Frazen, Engineering Technician, Planning and Property Management Section, County Sanitation District of Los Angeles County, Whittier, CA
  Darrell Hatch, County Sanitation District of Los Angeles County, Whittier, CA
  Ed Southerland, Southern California Edison, Whittier, CA
* Juan P & Maria Castaneda, Wilmington, CA
* Luis F & A Flores, Wilmington, CA
  Andrew Fox, Pacific Harbor Line, Wilmington, CA
  Al Garnier, Metropolitan Stevedoring, Wilmington, CA
* Gilbert O & Ruth Geerdts, Wilmington, CA
  Global Oil Production LLC, Wilmington, CA
  Arthur Hanson, Wilmington, CA
* Ron Hoffard, Harbor Co-Gen, Wilmington, CA
  Alicia Izarraraz, BP Wilmington Calciner, Wilmington, CA
  Jong S & Kyoung Kim, Wilmington, CA
  Mike Kulakowski, Shell Oil Products, Wilmington, CA
* LA City Community College Dist, Wilmington, CA
  James A & Susan Legaspi, Wilmington, CA
  Leonidas & Martha Lopez, Wilmington, CA
  Jesse Marquez, Jr., Wilmington, CA
* Josefa Martinez, Wilmington, CA
  Tyrone Mclaine, Equilon Enterprises For Shell Oil, Wilmington, CA
  Ted Meadows, Valero Wilmington Refinery, Wilmington, CA
  Marcus Mo, Mo Family Trust, Wilmington, CA
* Alejandro Rodriguez, Wilmington, CA
* Ignacio Sanchez, Wilmington, CA
  Todd Schmid, BP West Coast Products, Wilmington, CA
* David & Alicia Sparks, Wilmington, CA
* Ignacio & Maria Torres, Wilmington, CA

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

* Erlan & Rene Trenholm, Wilmington, CA
Roman & Gracie Udabe, Wilmington, CA
* Ricardo Vallejo, Wilmington, CA
* James E & Diane Walton, Wilmington, CA
Seymour & Betty Waterman, Wilmington, CA
Gary Young, Carpenters/Pile Drivers Union, Wilmington, CA
* Thomas Y Huang, Woodland Hills, CA
* Edward M & Evelyn D Hatch, Yucca Valley, CA

Wayne Driggers, Westway Trading Group, Jacksonville, FL
* Bernard F Schier, Miami, FL

Brad Floyd, TRC, Duluth, GA

Gatx Tank Storage Terminals Corp, Chicago, IL
* Jeffrey A & Mary Hall, Oak Brook, IL

Randy Dennis, VP Sales/Customer Support, Kalmar Industries Corp, Ottawa, KS
* Deanne Bahr, Sac & Fox Nation Of Missouri, Reserve, KS

Eddie Soileau, Eunice, LA
J.D. Lormand, Exec. Director, Rocky Mountain P/L Constr Assoc, Lafayette, LA

* David A. Moore, Anita L Rizzi, Gaithersburg, MD

Ruth Mulvena, Catherine Marshick, Whitmore, MI

Amy Davis, Natural Resource Group, Inc., Minneapolis, MN
Jennifer Lee, Natural Resource Group, Inc., Minneapolis, MN
Todd Mattson, Natural Resource Group, Inc., Minneapolis, MN
Zeke Rice, Natural Resource Group, Inc., Minneapolis, MN
Guy A. Burgess, LNG Alternative Fuel Systems, Chart Industries, Inc., New Prague, MN

Tracy Wilson-Kleekamp, Thisland Pac, Columbia, MO

Sou Pac Trans Co, Omaha, NE
Union Pacific Railroad, Omaha, NE

Eldon & Juanita Perkins, Las Vegas, NV

John B. Cornwell, Qwest Consultants, Inc., Norman, OK
* Marianne Long, Iowa Tribe of Oklahoma, Perkins, OK

Dr. Donald McIsaac, Executive Director, Pacific Fishery Management Council, Portland, OR

Ken Kelley, CEO, Applied LNG Technologies, Amarillo, TX

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

Organizations and Individuals (cont'd)

J Patrick Tielborg, Pipe Line Contractors Assoc, Dallas, TX
Chaitali Dane, KBR, Houston, TX
Equilon Enterprises LLC, Houston, TX
Ron Huebner, Fleet Maintenance, H.E. Butt Grocery Company, Houston, TX
Terry Mitchell, Houston, TX
Benson Pair, KBR, Houston, TX
Gerardo Rivera, ConocoPhillips, Houston, TX
Shell Oil Company/Equilon Enterprises LLC, Houston, TX
Liz Williamson, ConocoPhillips Du2022, Houston, TX
David J. Pearce, VP/General Manager, GreenField Compression, Inc., Richardson, TX

Janet de Tapia, Director of Market Services, Trillium USA, Salt Lake City, UT

* Sue A Silagy, Brush Prairie, WA

Tom Chrisfield, VP, Sales, NorthStar, Inc., Evanston, WY

* These parties were sent the Notice of Availability/Notice of Completion of the draft EIS/EIR rather than the draft EIS/EIR because they are not Port of Long Beach tenants or affected landowners and did not provide comments or ask to be on the mailing list to receive the draft EIS/EIR.

APPENDIX B

STORM WATER POLLUTION PREVENTION PLAN
FOR THE LONG BEACH LNG IMPORT PROJECT (DRAFT)

SOUND ENERGY SOLUTIONS

DRAFT

STORM WATER POLLUTION PREVENTION PLAN
for
CONSTRUCTION ACTIVITIES

Sound Energy Solutions, Long Beach LNG Import Project

(Name of Project)

Pier T, Port of Long Beach

(Street Address of Construction Site)

Long Beach, California 90802

WDID No. _____

Prepared by:

Name of Firm:	***Tetra Tech EC, Inc.***
Street Address	***1940 E. Deere Ave, Suite 200***
City, State, and Zip:	***Santa Ana, CA 92705***
Telephone No.:	***949-756-7500***

May 14, 2005

(Date Prepared)

CERTIFICATION OF STORM WATER POLLUTION PREVENTION PLAN

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

This SWPPP shall be evaluated and re-certified annually until the construction project is completed and the Notice of Termination is submitted to the Los Angeles Regional Water Quality Control Board.

_____

(Signature of Authorized Representative)

_____

(Typed Name and Title of Authorized Representative)

_____

(Date of Signature)

ANNUAL RE-CERTIFICATION OF STORM WATER POLLUTION PREVENTION PLAN

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

Based upon the maintenance and repair of construction-related Best Management Practices and the site inspections described in Section 4.0 of this Storm Water Pollution Prevention Plan, I certify, under penalty of law that all construction activities are in compliance with the requirements of the General Permit for Storm Water Discharges Associated with Construction Activity.

I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Owner or Owner's Representative

Name (Print)	Signature	Date

TABLE OF CONTENTS

SECTION PAGE

I. INTRODUCTION 1
- A. Notice of Intent 2
- B. Plan Availability 2
- C. Plan Changes 3
- D. Retention of Records 3
- E. Compliance Certification 3
  - 1. SWPPP Certification 3
  - 2. Signatory Requirements for Compliance Certification 3
- F. Contractor/Subcontractor List 3
- G. Notice of Termination 4

II. SITE DESCRIPTION 6
- A. Existing Site Conditions 7
- B. Proposed Construction Activities 8
- C. Storm Water Run-on from Offsite Areas 8
- D. Construction Schedule 9
- E. Potential Construction Site Pollutants 10

III. BEST MANAGEMENT PRACTICES 11
- A. Erosion Control and Site Stabilization 11
  - 1. Erosion and Sediment Control 11
  - 2. BMPs to Minimize Off-Site Tracking 14
  - 3. Site Stabilization Practices 14
- B. Other Control Measures 15
  - 1. Waste Management and Disposal 15
  - 2. Compliance with State/Local Sanitary Waste Regulations 16
  - 3. Spill Prevention and Control 16
  - 4. Vehicle and Equipment Cleaning, Fueling, and Maintenance 19
  - 5. Material Delivery and Storage 19
  - 6. Concrete Materials Management 20
  - 7. Painting Materials Management 21
  - 8. Paving Operations Management 21
  - 9. Landscaping Activities Management 22
  - 10. Non-Storm Water Discharges 22
- C. Post-Construction Storm Water Management Measures 22

IV. MAINTENANCE, REPAIR, AND INSPECTION 24
- A. Maintenance 24

B. Inspections 25

V. TRAINING 26

VI. RESPONSIBILITIES OF OPERATORS 27

A. Site Manager 27
B. Project Field Engineer 27
C. Construction Environmental Inspector 27
D. Subcontractors Administrator 28

VII. MONITORING AND REPORTING PROGRAM 29

A. Site Inspections 29
B. Compliance Certification 29
C. Noncompliance Reporting 29
D. Requirements for Sampling and Analysis 29

List of Tables

1 Summary of SWPPP Revisions
2 Contractor / Subcontractor List
3 Construction Activity Milestones
4 Typical Construction Site Pollutants
5 SWPPP Reportable Quantity Releases

Appendices

A General Permit for Storm Water Discharges Associated with Construction Activities Disturbing One or More Acres
B Site Map(s)
C Post-Construction BMPs
D Construction Site Inspection Report Form
E Training Reporting Form
F SWPPP Non-Compliance Report Form
G Sampling and Analysis Plan
H Sediment Control Plan
I Spill Prevention and Response Procedure

I. Introduction

This Storm Water Pollution Prevention Plan (SWPPP) has been prepared to comply with California's General Permit for Storm Water Discharges Associated with Construction Activity (Construction General Permit). The Construction General Permit (General Permit No. CAS000002) was adopted by the State Water Resources Control Board (SWRCB) on August 19, 1999 as Order No. 99-08-DWQ. Subsequently, on December 2, 2002, order No. 99-08-DWQ was modified to change the threshold acreage of soil disturbance requiring permit coverage from five (5) acres to one (1) acre. A copy of the Construction General Permit is provided in Appendix A.

This SWPPP has four major objectives:

- Identify pollutant sources, including sources of sediment, that may affect the quality of storm water discharges from the construction site
- Identify non-storm water discharges
- Identify, construct, implement and maintain Best Management Practices (BMPs) to reduce or eliminate pollutants in storm water discharges and authorized non-storm water discharges, from the construction site during construction
- Identify, implement and assign maintenance responsibilities for post-construction BMPs, which are those measures to be installed during construction that are intended to reduce or eliminate pollutants after construction is completed
- Identify baseline mitigation measures for minimizing erosion and sedimentation as defined by the Federal Energy Regulatory Commission (FERC) using BMPs that are applicable to the proposed project.

This Storm Water Pollution Prevention Plan (SWPPP) was prepared for Sound Energy Solutions (SES), which will construct and operate a liquefied natural gas (LNG) import terminal on a 25-acre site on the eastern portion of Pier T in the Port of Long Beach (POLB). Pier T is located within a former United States naval complex that included the Long Beach Naval Station, Navy Mole, and Naval Shipyard. The project, referred to as the Long Beach LNG Import Project, will involve the construction and operation of LNG terminal facilities consisting of a ship berth and unloading facility, two LNG storage tanks, vaporization and vapor handling systems, a natural gas liquids (NGL) recovery system, and an LNG trailer truck loading facility. Associated facilities include an approximately 2.3-mile-long, 36-inch-diameter natural gas sendout pipeline that will deliver natural gas to Southern California Gas Company's (SoCal Gas) existing Line 765 at its Salt Works Station; a 4.6-mile-long, 10-inch-diameter ethane (C_2) pipeline that will deliver C_2 to ConocoPhillips' Los Angeles Refinery Carson Plant (LARC); and approximately 0.8 mile of electric distribution lines and a new substation to connect the LNG terminal to two of Southern California Edison's existing substation taps. The natural gas sendout pipeline will be constructed, owned, and operated by SES. The C_2 pipeline will be constructed, owned, and operated by ConocoPhillips. Another SWPPP will be prepared for operation of the project.

A. Notice of Intent

To obtain coverage under the Construction General Permit, the site owner or operator must submit a Notice of Intent (NOI) to the SWRCB. The NOI is a two-page form that provides the SWRCB with information about the construction project, such as:

- property owner
- developer or general contractor
- construction site address and other characteristics
- applicable local ordinances, if any
- receiving water for discharges
- vicinity map

The Planning Division of the Port of Long Beach (POLB) prepares and submits the NOI for construction projects within its Harbor District. The NOI must be certified as accurate and complete then submitted to the SWRCB with a fee of $700.00.

Operators of the site are those parties that have operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications (e.g. land developer). Additionally, parties are also considered operators if they have day to day operational control over activities at a project which are necessary to ensure compliance with the SWPPP or other permit conditions (e.g. general contractor, erosion control contractor).

The site operator for this construction project has not yet been determined. When known, the site operator name and contact information will be inserted here.

General Contractor: _____
(Firm Name)

Representative: _____
(Person's Name and/or Position)

Representative's Telephone No.: _____

B. Plan Availability

The SWPPP must be retained at the construction site from the date of project initiation to the date of termination of coverage under the Construction General Permit. The SWPPP should be available at all times to site employees, the general public, and to representatives of the Los Angeles Regional Water Quality Control Board, SWRCB, Region IX of the United States Environmental Protection Agency, or local municipality or storm water management agency.

C. Plan Changes

The SWPPP must be amended whenever there is a change in project design, construction, or operations that may have a significant effect on the potential for discharge of pollutants or if the SWPPP proves to be ineffective in eliminating or minimizing pollutants in storm water discharges. In addition, the plan must be amended to identify any new contractor and/or subcontractor that will implement a measure of the SWPPP. SWPPP amendments or revisions are recorded in Table 1.

D. Retention of Records

The Site Operator must retain copies of the SWPPP, all required inspection reports, compliance certifications, non-compliance reports, training records and records of data used to complete the NOI for at least 3 years from the date that the site is finally stabilized. The Site Operator must retain a copy of the SWPPP and inspection reports at the construction site from the date of project initiation to the date coverage under the Construction General Permit is terminated.

E. Compliance Certification

1. SWPPP Certification

This SWPPP must be certified and annually evaluated and re-certified until the construction project is complete and a Notice of Termination has been submitted to the Los Angeles Regional Water Quality Control Board. The SWPPP Certification and the SWPPP Annual Re-Certification follow the title page and precede the Table of Contents for this SWPPP.

2. Signatory Requirements for Compliance Certification

All reports, certifications or other information required by the Construction General Permit must be signed by the following:

- For a corporation: by a responsible corporate officer, which means: (a) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or (b) the manager of the construction activity if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;
- For a partnership of sole proprietorship: by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public agency: by either a principal executive officer, ranking elected official, or duly authorized representative.

F. Contractor/Subcontractor List

Contractors and subcontractors who will work on the site are listed in Table 2. This list of contractors and subcontractors shall be kept current throughout the construction project. Each contractor and subcontractor shall have access to copies of applicable sections of the SWPPP or equivalent document prior to commencement of construction.

G. Notice of Termination

To terminate coverage under the Construction General Permit, a Notice of Termination (NOT) must be submitted. The NOT is a two-page form that is submitted to the Los Angeles Regional Water Quality Control Board when the construction project is complete and the following conditions have been met:

(1) All elements of the SWPPP have been completed;

(2) Construction materials and waste have been properly disposed;

(3) The site is in compliance with all local storm water management requirements;

(4) A post-construction storm water operation and management plan is in place.

The Planning Division of the Port of Long Beach prepares and submits the NOT for construction projects within its Harbor District.

Table 1. Summary of SWPPP Amendments or Revisions

Section and Page	Summary of Revision	Name/Title and Date

Table 2. Contractor/Subcontractor List

Contractor/Subcontractor	Contact Name	Phone Number

II. Site Description

This SWPPP was prepared for construction activities on the eastern portion of Pier T, which was part of a former United States naval complex that was transferred to the POLB. SES will construct and operate an LNG import terminal on a 25-acre site on the eastern portion of Pier T. The project will include an offloading dock, two LNG storage tanks, an LNG vehicle fuel tank, vaporization facilities, an NGL recovery unit, and an LNG trailer truck loading facility.

The terminal site is located within the city limits of Long Beach, Los Angeles County, California. Access for ships to the marine facilities associated with the LNG terminal will be through Queens Gate and Long Beach Channel. The onshore facilities associated with the LNG terminal will be accessed from Interstate 710, Ocean Boulevard, and Pier T Avenue. A 36-inch-diameter natural gas sendout pipeline will extend approximately 2.3 miles north from the LNG terminal, crossing the Cerritos Channel with a horizontal directional drill (HDD), and terminating at SoCal Gas' existing Line 765 at its Salt Works Station. A 4.6-mile-long, 10-inch-diameter C_2 pipeline will be constructed approximately parallel to the natural gas sendout pipeline as far as the interconnection point with SoCal Gas' existing Line 765 and will continue on a primarily due north route, through city streets, to ConocoPhilips' LARC facility.

A vicinity map for the construction project site is provided in Appendix B. Appendix B will include, prior to construction, other site maps and/or construction drawings that depict the following information:

Shown	Information Element on Drawing or Map
Yes	Construction site perimeter, roadways, lots
Yes	General topography before and after the project
N/A	Drainage patterns and slopes anticipated after major grading activities are completed
Yes	Existing and planned paved areas and buildings
N/A	Areas of vegetative cover which will remain undisturbed during the construction project
N/A	Areas of soil disturbance including cut or fill areas which will be stabilized during the rainy season by BMPs
N/A	An outline of areas of planned soil disturbance including cut and fill areas which will not be stabilized and will therefore require alternative erosion control measures
Yes	Locations where the construction site's storm water discharges to a municipal storm water drainage system or receiving water
Yes	On-site surface water bodies (including wetlands)
N/A	Off-site areas that drain onto or through the site (storm water run-on). Show storm water inlets or receiving waters on the construction site
Yes	Temporary on-site drainage BMPs to control erosion and to prevent damage to downstream properties
Yes	Existing site features that may contribute pollutants to storm water
Yes	Locations of primary site entrance and exit points

Shown	Information Element on Drawing or Map
Yes	Areas designated for the a) storage of soil or wastes, b) vehicle storage and service areas, c) construction material loading, unloading, access and storage areas and d) equipment fueling, storage, and maintenance areas
Yes	Drainage patterns into each on-site storm water inlet point or into receiving waters
Yes	Locations of major structural and nonstructural controls identified in the SWPPP including: – BMPs that will protect on-site storm water inlets or receiving water discharge points – Run-on (runoff from off-site areas which enters the construction site) control BMPs – Locations where stabilization practices are planned

A. Existing Site Conditions

☐

The LNG terminal will be located on a 25-acre site that was part of a former United States naval complex on Pier T in the POLB. The 25-acre site is located along designated Berth 126 and is currently paved with concrete and/or asphalt and includes two abandoned buildings. The POLB will demolish the buildings on the site and remove the pavement prior to SES' initiation of activities associated with the proposed project as part of previously planned activities associated with the closing of the Long Beach Naval Shipyard. There is no vegetation on the site. The entire 25 acres will be used for the proposed LNG terminal facility. Surface elevations at the site are without relief and are about 20 feet above mean lower low water. The entire route of the natural gas and C_2 pipelines is within heavily disturbed, industrialized areas.

The project area is underlain by fill materials. Most of the early fill was placed by hydraulic methods. Fills placed after a period of subsidence in the 1940s and 1950s consisted predominantly of land-based materials placed by mechanical methods. These artificial fills are variable, ranging from loose sands to soft, compressible silts and clays with varying degrees of in-situ strength. Fill soils were encountered in all borings, ranging in thickness from 45 to 60 feet below ground surface (bgs). Below a depth of about 25 feet, the fill materials beneath the entire LNG terminal site consist of predominantly loose to medium dense sands and silty sands, with layers of medium stiff to stiff fine-grained materials.

The shallow aquifer in the project area, found at depths ranging from 20 to 40 bgs, is saline (salt water intrusion). The Gaspur aquifer is at about 60 to 150 feet bgs in this area, is mostly fresh in this location, and has some areas of benzene contamination (Houston, 2003). The route of the natural gas and C_2 pipelines is flat, and largely located in roads and/or through industrial/commercial areas.

B. Proposed Construction Activities

The LNG terminal facilities will include:

- an 1,100-foot-long LNG ship berth and unloading facility with unloading arms, mooring and breasting dolphins, and a fendering system that will be capable of unloading one ship at a time;
- two LNG storage tanks, each with a gross volume of 160,000 cubic meters (1,006,000 barrels) surrounded by a security barrier wall;
- 20 electric-powered booster pumps;
- four shell and tube vaporizers using a primary, closed-loop water system;
- three boil-off gas compressors, a condensing system, an NGL recovery system, and an export C_2 heater;
- an LNG trailer truck loading facility with a small LNG storage tank;
- a natural gas meter station and odorization system;
- utilities, buildings, and service facilities; and
- associated hazard detection, control, and prevention systems; site security facilities; cryogenic piping; and insulation, electrical, and instrumentation systems.

A 36-inch-diameter natural gas sendout pipeline will extend approximately 2.3 miles north from the LNG terminal, crossing the Cerritos Channel with a HDD, and terminating at SoCal Gas' existing Line 765 at its Salt Works Station. A 4.6-mile-long, 10-inch-diameter C_2 pipeline will be constructed approximately parallel to the natural gas sendout pipeline as far as the interconnection point with SoCal Gas' existing Line 765 and will continue on a primarily due north route, through city streets, to ConocoPhilips' LARC facility.

Project site grading will occur on approximately 100 percent of the site. This grading includes both cut and fill, and the total graded material is estimated to be 50,000 cubic yards. Graded materials will be hauled away.

C. Storm Water Run-on from Offsite Areas

There is no anticipated offsite run-on to this construction site because the site and its surroundings are part of a completely flat, artificial fill island built in the harbor.

Runoff-Coefficient

The site is currently 100 percent impervious surface with an estimated runoff coefficient of 0.85. After construction is completed, the site is estimated to be approximately 100 percent impervious surface area with a runoff coefficient of 0.85.

D. Construction Schedule

A construction activity schedule, describing all major activities such as mass grading, paving, lot or parcel improvements at the site and the proposed time frame to conduct those activities, is provided in Table 3. The schedule will be updated on a regular basis to show changes in start or completion dates. SES assumes that the POLB will complete all demolition, pavement removal, and upland site preparation by the first half of 2007. It further assumes that the offloading platform will be started in the first half of 2007 and completed in the first half of 2008. The milestones listed in Table 3 are for SES' activities only.

Table 3. Construction Activity Milestones

Milestone	Start Date	End Date
Date Notice of Intent (NOI), vicinity map and filing fee submitted to SWRCB	July 2006	July 2006
Prepare SWPPP. A construction site is covered by the General Permit upon filing a complete NOI and implementation of a defensible SWPPP.	May 2005	May 2005
Wet season dates	11-01-06 11-01-07 11-01-08 11-01-09	04-15-06 04-15-07 04-15-08 04-15-09
Dry season dates	04-16-07 04-16-08 04-16-09	10-31-07 10-31-08 10-31-09
Initial ground-breaking (must occur after completion of SWPPP and submittal of NOI)	July 2006	August 2006
Grading/excavation/trenching activities	July 2006	May 2007
Paving activities	N/A	
Implement erosion control measures	July 2006	July 2010
Implement sediment control measures	July 2006	July 2010
Construction of structures and paved surfaces	July 2007	June 2010
Site clean-up	May 2010	July 2010
Anticipated construction completion date	July 2010	July 2010
Anticipated filing of Notice of Termination (NOT) to Los Angeles Regional Board.	August 2010	August 2010

E. Potential Construction Site Pollutants

As with most construction sites, pollutants have a potential to be present in storm water discharges during construction if no BMPs are implemented. Table 4 lists common construction products and construction site activities and the associated potential pollutants.

Table 4. Typical Construction Site Pollutants

Insert "X" if Present	Products/Activities With Potential To Cause Storm Water Pollution	Associated Potential Pollutants
X	Grading activities	Sediment
X	Disturbance of contaminated soil	Sediment List identified soil contaminant
X*	Adhesives, glues, resins, epoxy synthetics, caulks, sealers, putty, sealing agents and coal tars (Naphtha, Pitch)	Phenolics, formaldehydes, asbestos, benzene, phenols and naphthalene
	Polishes (metal, ceramic, tile), etching agents, cleaners, ammonia, lye, caustic sodas, bleaching agents and chromate salts	Metals Acidity/alkalinity Chromium
X*	Solder (lead, tin), flux (zinc chloride), pipe fitting, galvanized metal in nails and fences, and electric wiring	Lead, copper, zinc and tin
X	Paint thinners, acetone, methyl ethyl ketone, stripper paints, lacquers, varnish, enamels, turpentine, gum spirit, solvents, dyes, stripping pigments and sanding	VOCs, metals, phenolics and mineral spirits
X*	Sawdust, particle board dust and treated woods	BOD, formaldehyde, copper and creosote
X	Cement and brick dust, colored chalks, concrete curing compounds, glazing compounds and surfaces cleaners	Sediments, acidity, metals and asbestos
X	Tile cutting, flashing, drywall and adhesives	Copper, aluminum, sediments and minerals
	Venting systems and the use of insulation, brick, cement and drywall and from saw cutting during remodeling and demolition	Asbestos, aluminum and zinc
X	Yard operation and maintenance procedures such as vehicle and machinery maintenance, grading, earth moving, fire hazard control (herbicides), pest control, vehicle washing and the use of gasoline, oils, additives, marking pens and sprays and portable toilets	Oils and grease, coolants, benzene and derivatives, vinyl chloride, metals, sediments, BOD, disinfectants, pathogens, sodium arsenite, dinitro compounds, rodenticides, insecticides, herbicides and concrete
	Insulation, coolant reservoirs and adhesives	Asbestos and freon
	Planting and plant maintenance, excavation, tiling, masonry, the exposing of mineral deposits, the revegetation of graded areas, and the use of soil additives and well as the production of solid waste such as trees, shrubs, green waste and mulch	Pesticides, herbicides, nutrients, sediment, BOD, acidity/alkalinity, metals, aluminum sulfate, sulfur and fertilizers
X	Wash waters	Concrete, sediment, oil and grease, detergents
	Saw Cut Slurries	Concrete, asphalt, sediment
X	Hydrostatic test water, pipe flushing	Sediment
	Demolition	Trash and debris

X* = During construction of administrative/control building only.

III. Best Management Practices

This section contains a series of BMPs to eliminate or reduce pollutants in storm water runoff from the project site during construction. The Construction General Permit prohibits the discharge of storm water that causes or threatens to cause pollution, contamination or nuisance. It also allows the developer/ owner to choose the most economical, effective, and possibly innovative BMPs to reduce or eliminate pollutants in runoff. These Construction General Permit requirements must be met, not only during the wet season, but also on a year-round basis. The SWPPP must be implemented in a proactive manner during all seasons until the construction project is complete. Appendix H also identifies baseline mitigation measures as defined by the FERC for minimizing erosion and sedimentation using BMPs that are applicable to this project

A. Erosion Control and Site Stabilization

1. Erosion and Sediment Control

The requirements for erosion and sediment controls for construction activities in the Construction General Permit have the following goals and criteria:

- Construction phase erosion and sediment controls should be designed with the objective to retain sediment on site;
- Control measures must be properly selected and installed in accordance with sound engineering practices and manufacturer's specifications;
- Off-site accumulations of sediment must be regularly removed to minimize impacts;
- Sediment should be removed from sediment traps when the design capacity has been reduced by 50%;
- Litter shall be prevented from entering a receiving water; and
- Off-site material storage areas must be addressed in the SWPPP.

As a rule, native vegetation in undisturbed areas represents the "baseline" for erosion control. Thus, retaining native vegetation in undisturbed areas provides the first and best line of defense against erosion and sedimentation, and at the least cost to the contractor.

The erosion and sediment control measures denoted with an "X" will be implemented and maintained at the project construction site.

Choose one or more of the following by typing an "X" in the first column.

	Before commencing grading or clearing, steep slopes and areas adjacent to water bodies will be stabilized. Stabilization will be accomplished with vegetative cover including grass, trees, vines, shrubs, etc. or with nonvegetative controls such as geotextiles, riprap or gabions (wire mesh boxes filled with rock), and mulches such as straw or bark in conjunction with vegetation.

X	To prevent transport of sediment into existing storm drain inlets and onto adjacent properties and roadways, before grading or clearing, the site perimeter will be stabilized (preferably through preservation of buffer strips of vegetation); storm drain inlets will be protected; and sediment basins (if applicable) will be constructed.
	Before commencing grading or clearing of the site, clearing limits, easements, setbacks, and vegetation to be preserved will be delineated by marking in the field.
X	Site disturbance and vegetation clearing will be minimized.
X	During the rainy season, disturbed areas of the construction site that will not be re-disturbed for 21 days or more will be stabilized within 7 days of the last disturbance.
	Vegetated buffer areas adjacent to water bodies and on steep slopes will be preserved.
	Runoff velocities, both on slopes and at discharge points, will be retarded to prevent erosion.
X	The wetting down of exposed soil for dust control during construction shall be done in such a manner that no runoff is generated.
X	Temporary silt fences along site perimeters will be constructed and maintained at the toe of exposed and erodible slopes downslope of exposed soil areas or around temporary soil stockpiles to allow sediment to settle from runoff before water leaves the site.
	Baled hay or straw dams will be constructed and maintained at the toe of exposed and erodible slopes downslope of exposed soil areas or around temporary soil stockpiles to allow sediment to settle from runoff before water leaves the site.
	Diversion ditches to prevent run-on from off-site areas will be constructed and maintained.
	Check dams or other energy dissipation structures in unlined drainage channels will be built to slow runoff velocity and encourage settlement of sediment.
	Temporary earth berms and ditches will be constructed and maintained to divert storm flow from an erodible surface to a public roadway.
	Level spreaders, outlets for dikes and flow channels consisting of an excavated depression constructed at zero grade across a slope, will be used to convert concentrated runoff into diffuse flow to be released onto areas stabilized by existing vegetation.
X	Reasonably available control measures will be implemented, installed and maintained to control fugitive dust release from the construction site.
X	As new storm drain inlets/catch basins are constructed to collect on-site storm flows to the surrounding drainage system and/or project storm sewer system, loose sediment shall be prevented from entering the storm drain inlet by employing an appropriate storm drain inlet protection technique such as filter fabrics, block and gravel filters, gravel and wire mesh filters, or sand bag barriers. These storm drain inlet protection techniques shall remain in place until the site paving and stoning/graveling is completed.
	A sedimentation basin will be utilized to remove sediment from dewatering waters prior to discharge.

	Storm water sediment basin(s) will be constructed early in the site grading process to collect sediment from all areas during construction. The sediment basin will follow one of the four design options summarized below: 1. A sediment basin designed pursuant to local ordinance provided that the design efficiency is as protective or more protective of water quality than Option No. 3 2. A sediment basin designed with a minimum capacity of 3,600 cubic feet of storage per acre of disturbed land in a watershed equivalent to or more efficient than Option No. 3 3. A sediment basin designed using the following equation: **$(V) = 1.2(SD)Q/Vs_{ED}$ where:** **V** = settling zone volume, **Q** = flowrate based on peak discharge from a specified design storm, and **Vs_{ED}** = settling velocity of the design soil particle. 4. A basin designed using an equivalent surface area design equation, equivalent to or more efficient than Option No. 3
	Dewatering of the basin must occur within 7 days following the storm event. The outflow from the basin must be designed to prevent erosion and/or scouring of the basin embankment and channel.
	Soil stabilizers, binders, blankets (i.e., rolled erosion control products), mulches, matrices, temporary vegetation, and temporary seeding will be used on disturbed soil areas as a temporary surface cover until soils can be prepared for revegetation and permanent vegetation is established.
	Permanent seeding, sodding, or planting will be performed on areas of disturbed soil that are complete or nearly complete to prevent erosion and remove pollutants in storm water and non-storm water runoff.
	Earthen dikes and drainage swales will be installed to convey surface runoff down sloping land, to intercept and divert runoff to avoid sheet flow over sloped surfaces and to direct runoff towards a stabilized watercourse, drainage pipe or channel.
	Brush, sandbag, and straw bale barriers, fiber rolls and/or silt fences will be installed as temporary sediment barriers in areas where sheet flow runoff occurs. They are ineffective if the runoff is concentrated into rill or gully flow. These devices will be installed to reduce the velocity of sediment-laden runoff to allow sediments to settle out.
	All cut and fill slopes will be roughened perpendicular to the direction of runoff by trackwalking, sheepsfoot rolling, imprinting, or other appropriate technique.
	Pipe slope and/or subsurface drains will be installed to protect slopes against erosion by collecting surface runoff from the roadbed, the tops of cuts or from benches in cut or fill slopes and conveying it down the slope to a stabilized drainage ditch or area.
	Rock outlet protection (i.e. rip rap) will be placed at pipe outlets to prevent scour and reduce the velocity and/or energy of exiting storm water flows.
X	The area will be swept thoroughly, manually of mechanically, to remove as much street sediment as possible.

Locations for specific erosion and sediment control measures for the project are included on the site map(s) and will be provided by the Contractor prior to construction and added to Appendix B of this SWPPP.

2. BMPs to Minimize Off-Site Tracking

The BMPs denoted with an "X" will be implemented to control off-site tracking of sediment:

	Before grading or clearing the site, designated and stabilized site access points for vehicle entry/egress will be provided and maintained or otherwise vehicle trackout of sediments will be prevented.
	A wheel wash facility will be constructed away from drainage ways and graded to drain to a sediment catchment pit. Also, the wheel washing facility will be either bermed or surrounded by sandbags to prevent washwater from exiting the wash area.
X	The construction site's entrances and exits shall be swept as needed to keep the adjacent streets clean of sediment.

3. Site Stabilization Practices

Retaining native vegetation in undisturbed areas provides the first and best line of defense against erosion and sedimentation cost. Where this retention of native vegetation is not possible, the Construction General Permit requires that stabilization be employed as soon as possible in critical areas.

Site stabilization measures for the project will be provided if necessary prior to construction by the general Contractor, and drawings will be appended to Appendix B of this SWPPP. The site stabilization measures that will be implemented are denoted with an "X".

Choose one or more of the following by typing an "X" in the first column.

	Native vegetation will be retained in undisturbed areas to the extent possible.
X	Grading of the site will be phased to minimize the total area of exposed soil and the duration of exposure.
	During construction, exposed areas will be stabilized with temporary ground cover (e.g., temporary seeding, mulch, chemical and fabric stabilizers), to protect the soil from erosion until permanent vegetation or other site stabilization features are installed.
X	After the project is completed, selected areas of the site (e.g., roadways and parking areas) will be paved with bituminous asphalt, concrete, or approved equivalent. The remainder of the site (not covered with structures and facilities) will be stabilized with either of the two following methods: 1. A uniform vegetative cover with 70 percent coverage, or 2. Equivalent stabilization measures such as geotextile blankets (i.e. with vegetative seeds), channel liners, soil cement, fiber matrices, or other erosion resistant soil coverings

B. Other Control Measures

This construction project will also employ BMPs that will address potential construction site pollutants other than sediment from erosion.

1. Waste Management and Disposal

Construction sites can generate any of the following non-hazardous and hazardous wastes:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures and building construction
- Packaging materials including wood, paper and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags and plastic wrappers and cigarettes
- Paints, solvents, petroleum products such as oils, fuels and grease, herbicides and pesticides, acids and concrete curing compounds

The BMPs that are denoted with an "X" shall be implemented to keep a clean site and reduce the potential for non-hazardous and potentially hazardous waste from coming in contact with storm water or non-storm water discharges:

Choose one or more of the following by typing an "X" in the first column.

X	After existing facilities are demolished, any materials not re-used on-site will be either loaded directly onto waste hauler trucks for off-site removal the same day, or will be collected and stored in dumpsters (roll-offs) until off-site removal is accomplished.
	If any asbestos is discovered in the demolished materials, asbestos removal and disposal will be performed by a licensed contractor or licensed subcontractor trained in asbestos removal. All removal and disposal will be done in accordance with state and federal regulations. Any asbestos wastes stored on-site prior to removal will be stored within dumpsters (roll-offs) covered with tarps or other appropriate method to prevent contact with rain and minimize exposure to wind.
X	The site will be kept clean of litter and waste.
X	Waste materials will be segregated and recycled (e.g., paints, solvents, used oil, batteries, anti-freeze). Wastes will not be mixed since this can cause chemical reactions, will make recycling impossible and complicate disposal.
X	Toxic wastes and chemicals will not be disposed of in dumpsters designated for construction debris.
X	Covered waste bins will be designated for the disposal of all empty product (e.g., paints, solvents, glues, petroleum products, concrete, exterior finishes, pesticides, fertilizers, etc.) containers.
X	All of a hazardous material will be used before disposing of the container.

X	The original product label will not be removed as it contains important safety and disposal information.
	Secondary containment will be provided for hazardous waste containers.
X	Site trash will be collected daily, especially during windy or rainy conditions, to maintain a clean construction site. Additional containers and more frequent pickup will be provided during the demolition phase of construction.
X	Trash hauling contractors will be informed that only watertight dumpsters will be accepted for on-site use. Dumpsters will be inspected for leaks and any dumpster that is not watertight will be repaired.
X	Storage of hazardous materials on site will be minimized. Any hazardous materials generated during construction will be containerized and kept closed during work activities, except for filing. Waste containers will be placed in a designated hazardous waste storage area that is covered and has an impermeable bottom surface surrounded by secondary containment to minimize the mixing of wastes with storm water and to prevent the direct release of liquid waste to storm water. The temporary storage and removal of hazardous wastes from the site will be in accordance with all applicable state and federal laws.
X	When practical, non-hazardous site wastes (small enough to fit into dumpsters) will be stored within covered dumpsters and/or containers that prevent exposure to rain and prevent loss of wastes when it is windy.
X	Dumpsters will not be hosed out on the construction site. Any required dumpster cleaning will be done off-site by the trash hauling contractor.
X	Any solid waste that may accumulate at erosion and sediment control devices will be removed immediately.
X	All local and state solid waste disposal and nuisance requirements will be followed.
X	All federal, state, and local requirements for hazardous waste, contaminated soil and sanitary/septic waste management will be followed.
X	Employees and subcontractors will be trained in proper waste management.

2. Compliance with State/Local Sanitary Waste Regulations

The following measures will be implemented to ensure compliance with state or local waste disposal, sanitary sewer or septic system regulations:

- Portable sanitary facilities will be transported to and from the site by a licensed contractor, placed in a convenient location and maintained in good working order by a licensed service.
- Untreated wastewater will never be discharged to surface waters or on-site storm drains and will never be buried.

3. Spill Prevention and Control

The measures that are denoted by an "X" will be undertaken at the site to prevent or reduce the discharge of pollutants to storm water from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees: further information is found in Appendix I, the Spill Prevention and Response Procedure.

Choose one or more of the following by typing an "X" in the first column.

X	Construction vehicles will be inspected daily, before use, for leaks and repaired as necessary.
X	During on-site vehicle and equipment fueling, "topping-off" of fuel tanks will be discouraged, secondary containment such as a drain pan or drop cloth will always be used when fueling to catch spills/leaks.
X	If a spill were to occur at the site, it will never be cleaned-up by hosing off the area. Dry material spills will never be hosed down or buried. The type of minor spill that could occur will be controlled as follows: 1. The site construction manager or his designated representative will be notified immediately. 2. The spilled material will be identified and the approximate quantity will be estimated. 3. The spread of the spill will be contained using absorbent material or barriers. 4. If the spill has occurred on a paved/impermeable surface, it will be cleaned up using dry methods (absorbent materials, cat litter, and/or rags). Encircling it with absorbent materials will contain the spill. If the spilled material is hazardous, then the used cleanup materials are also hazardous and will be sent to either a certified laundry (rags) or disposed of as hazardous waste. 5. If the spill has occurred on an unpaved or permeable surface, constructing an earthen dike will immediately contain the spill. The contaminated soil will be excavated and properly disposed of. 6. If the spill has occurred during a rain event, the area will be covered as quickly as possible. The spill will be cleaned up as soon as possible after cessation of rain.
X	Spill cleanup materials will be stored near potential spill areas (e.g., painting, vehicle maintenance areas).
X	The Construction Environmental Coordinator shall coordinate any required spill reporting. Table 5, SWPPP Reportable Quantity Releases, should be completed for any spill that meets the reportable quantity threshold.

Table 5. SWPPP Reportable Quantity Releases

This table will be completed for any Reportable Quantity spill (as established under 40 CFR Part 110[1], 40 CFR Part 117[2], or 40 CFR 302[3]) that occurs on site.

Date of Spill	Material Spilled	Approximate Quantity	Agencies Notified	Date Notified

1 40 CFR Part 110 addresses the discharge of oil in such quantities as may be harmful pursuant to Section 311(b)(4) of the Clean Water Act.

2 40 CFR Part 117 addresses the determination of such quantities of hazardous substances that may be harmful pursuant to Section 311(b)(3) of the Clean Water Act.

3 40 CFR Part 302 addresses the designation, reportable quantities, and notification requirements for the release of substances designated under Section 311(b)(2)(A) of the Clean Water Act.

4. Vehicle and Equipment Cleaning, Fueling, and Maintenance

As with most construction sites, vehicle and equipment cleaning, fueling, and maintenance have the potential to contribute to storm water pollution. This potential can be reduced by using off-site facilities whenever feasible, performing work in designated areas only, running a "dry site" and training employees and subcontractors. See also Appendix I, Spill Prevention and Response Procedure.

The measures that are denoted with an "X" will be undertaken at the site to prevent or reduce the discharge of pollutants to storm water from vehicle and equipment cleaning, fueling and maintenance:

Choose one or more of the following by typing an "X" in the first column.

	Vehicle and equipment fueling, cleaning and maintenance will be conducted off-site.
	Vehicles and equipment will be fueled on-site by a mobile vehicle fueling truck, and only minor amounts of fuel will be stored in a covered storage area (e.g. construction warehouse, trailer, shed).
X	Construction vehicle maintenance will be performed off site, when feasible. Only minor amounts of lubricants and other vehicle and equipment fluids will be stored in a covered storage area (e.g. construction warehouse, trailer, shed).
X	Areas will be designated for on-site fueling and maintenance away from storm drain inlets and surface water bodies.
X	Spills and leaks during fueling and maintenance operations will be prevented or contained and cleaned up immediately.
X	Vehicles, equipment, and tanks will be checked for leaks and spills regularly.
X	Drip pans or adsorbent materials will be placed under leak-prone machinery when idle.
X	Steam cleaning will not be permitted on-site since steam cleaning can generate significant pollutant concentrations.
X	All vehicle, equipment, and machinery washing will be done off-site at commercial wash facilities or at a facility that is properly permitted and discharges wash water to a recycle/reuse system or to the sanitary sewer.
	Vehicles and equipment may be washed on-site. A designated, bermed wash area will be used to prevent wash water from contacting storm water or discharging into creeks, rivers, and other water bodies. The wash area may be sloped for wash water collection and subsequent infiltration into the ground. As little water as possible will be used to avoid having to install erosion and sediment controls for the wash area.
	Vehicle, equipment, or machinery wash water will not be discharged to the storm drain system, surface water bodies or soils.
X	Employees and subcontractors will be trained on proper vehicle maintenance and the need to conduct vehicle maintenance and cleaning off-site, when feasible.
X	All federal, state and local requirements for fuel storage tanks will be followed.

5. Material Delivery and Storage

The discharge of pollutants to storm water from material deliveries and material storage areas will be prevented or reduced by the implementation of the material management BMPs denoted with an "X":

Choose one or more of the following by typing an "X" in the first column.

X	Designate areas of the construction site for material delivery and storage. Material storage areas will be placed near construction site entrances, away from drain inlets, culverts and surface water bodies.
X	Designated storage areas will be kept clean and well organized.
X	An accurate, up-to-date inventory of materials delivered and stored on-site will be kept.
X	Storage of hazardous materials on-site will be minimized and handled as infrequently as possible.
X	The following types of materials will be stored in a covered storage area: fertilizers, herbicides, pesticides, detergents, fuels, oil, grease, glues, paints, plaster, solvents, curing compounds materials, and other similar materials that could be considered potential pollutants in storm water discharge.
X	Any chemicals, drums or bagged materials not stored in a covered location, will be stored on pallets, and when possible in secondary containment.
	Secondary containment will be provided for liquids.
	Secondary containment areas will be covered to prevent accumulation of rainwater.
X	Chemicals will be kept in their original containers, and will be well labeled.
X	Regular inspections of storage areas will be conducted to monitor inventory and check for leaking containers.
X	State and local requirements for storage of hazardous materials will be followed.
X	Employees and subcontractors will be trained on proper storage practices

6. Concrete Materials Management

Prior to construction, the general Contractor will amend this section if the concrete suppliers are not close enough to manage all truck washout procedures at their own facility. The BMPs that are denoted with an "X" shall be implemented to control potential pollutants from concrete wastes:

	No raw cement materials will be stored on site.
	Concrete trucks and transfer chutes will be washed-out on-site utilizing a sediment catchment pit to collect all washwater and concrete waste. The pit will be regularly maintained to prevent concrete waste build-up. The catchment pit will be sized so that no washwater will be discharged off-site. The washout area will be at least 50 feet from storm drains, open ditches or water bodies.
	Any concrete sawcutting wastewater will be contained on site.
X	No concrete washout water or concrete sawcutting wastewater will be discharged off-site.
	Sandbags will be used to prevent off-site discharge of saw-cut slurry and sediment will be cleaned up when dry.
X	On a regular basis during concrete work, solid concrete that has accumulated on-site will be broken up, removed and hauled away. Washing of fresh concrete will be avoided to the extent possible.

X	Excess concrete will not be dumped on-site, except in designated areas.
X	Sweepings from exposed aggregate concrete will not be washed into the street or storm drain. The sweepings will be collected and returned to the aggregate stockpile or disposed in the trash.
X	Employees and subcontractors will be trained in proper concrete waste management.

7. Painting Materials Management

The BMPs that are denoted with an "X" will be implemented to reduce potential pollutants from any painting activities that may occur during construction:

X	Paint brushes, paint containers, or any other chemical-holding containers will not be rinsed or cleaned onto dirt, stone or paved areas of the site, or into streets, gutters, storm drains, or drainage channels (natural or man-made). Brushes will be "painted out" as much as possible. Water-based paints will be rinsed into waste buckets to be disposed to the sanitary sewer (off-site). Thinners and solvents will be filtered and re-used to the extent feasible. Excess oil-based paints and sludge will be disposed in accordance with applicable waste regulations.
X	All paints, thinners and solvents will be stored in a covered storage area.
X	Outdoor painting will not be conducted during rain events.
X	Waste from scraping or sandblasting will be collected for proper disposal.
X	Painting operations will be properly enclosed or covered to avoid drift.
X	Southern California Air Quality Management District (SCAQMD) and OSHA standards for wind drift while painting will be followed. SCAQMD regulations may, in many areas, specify painting procedures that, if properly carried out, are usually sufficient to protect storm water quality.
X	Paint will be mixed indoors or in a containment area.

8. Paving Operations Management

The BMPs that are denoted with an "X" will be implemented to reduce potential pollutants from any paving activities that may occur during construction:

X	Paving materials (e.g. asphalt, sand, gravel, coating and sealing products) will be prohibited from entering storm drain systems or surface water bodies.
X	Excess materials (e.g. asphalt, concrete) will be collected, properly stored, and then disposed upon completion of paving operations.
X	The spillage of cleaning materials will be avoided when cleaning paving equipment on-site.
X	Secondary containment will be used to catch drips, leaks or spills.
X	Paving materials and machinery will be stored away from storm drains and water bodies.
X	Paving will not take place within 72 hours of a predicted storm event.

X	Paving during rainfall will be prohibited.
X	Drainage courses will be protected, particularly in areas with a grade, by employing BMPs to divert runoff or trap/filter sediment.
X	Catch basins and manholes will be covered when applying seal coat, tack coat, slurry seal, fog seal, etc.
	Saw-cut slurry will be shoveled, vacuumed and removed from site. Storm drains will be covered or barricaded during saw cutting to contain slurry.

9. Landscaping Activities Management

The BMPs that are denoted with an "X" will be implemented to reduce potential pollutants from any landscaping activities that may occur during construction. No landscaping activity is planned at this time.

	Only trained personnel, certified in accordance with federal and state regulations, will perform pesticide application.
	Recommended usage instructions will be followed for application of pesticides, herbicides and fertilizers.
	Herbicides and pesticides will not be over applied. Only the amount needed will be prepared.
	Application of pesticides, fertilizers and herbicides will be avoided when precipitation is forecasted and will be prohibited during precipitation events.
	Fertilizers will be applied in multiple smaller applications, as opposed to one large application.
	Vegetative debris will be disposed as green waste or solid waste.

10. Non-Storm Water Discharges

The elimination or reduction of non-storm water discharges to the storm drain system or receiving waters is a major goal of the Construction General Permit. Non-storm water discharges to the storm drain system and receiving waters should be eliminated or reduced to the greatest extent possible. Non-storm water discharges can be either direct discharges (e.g. pumped contaminated groundwater) or can result from dumping, washing, spills or leakage from storage tanks or transfer areas. To the greatest extent possible, the Site Operator will operate a dry construction site. Non-storm water flows will not be discharged in an uncontrolled fashion onto the construction site or into storm drains.

C. Post-Construction Storm Water Management Measures

Once construction has been completed, activities at the site have an ongoing potential to cause storm water pollution. Post-construction storm water management measures to reduce pollutants in storm water discharges will be implemented after all construction phases have been completed at the site. Post-construction BMPs consist of permanent features and operational practices designed or implemented to minimize the discharge of pollutants in storm water or non-storm water flows from the site once construction is completed and the facility is operational. Proper operation and maintenance is important for permanent structural BMPs so that they continue to function as designed. This is especially important

for treatment controls (e.g., on-site retention or detention basins, vegetated swales, catch basin filters or inserts), since their routine maintenance involves activities such as sediment removal, vegetation management, and replacement of filters or inserts.

Post-construction BMPs, both permanent structural and operational practices, are considered and selected during the planning phase of projects within the Port. The post-construction BMPs applicable to this project are described in Appendix C, which has been developed by the Port's Planning Division. Appendix C also describes the operation and maintenance procedures necessary to ensure proper function of permanent structural BMPs and the entity or entities responsible for their operation and maintenance.

IV. Maintenance, Repair, and Inspection

A. Maintenance

The SWPPP must include a written plan to address maintenance, inspection and repair procedures for all construction related BMPs so that all grade surfaces, walls, berms, drainage structures, vegetation, erosion and sediment control measures, and other controls are maintained in good and effective condition and are promptly repaired or restored. A qualified person must be assigned the responsibility to conduct these inspections and all completed inspection/maintenance forms must be kept with the SWPPP.

The goals of the inspection program are:

- To identify areas contributing to storm water discharge;
- To evaluate whether measures to reduce pollutants identified in the SWPPP are adequate and properly installed and functioning in accordance with the terms of the Construction General Permit, and
- To evaluate whether additional control practices or corrective maintenance activities are needed.

Implementation of the maintenance activities denoted with an "X" will help ensure BMPs are functioning properly:

X	Retention basin(s) shall be cleaned of accumulated sediment when sediment reaches 10 percent of the basin capacity. Removed sediment shall be properly transferred to a temporary soil storage area.
X	Silt fences shall be inspected and sediment removed before the accumulation is one-third the height of the fabric. Tears, overtopped areas, or broken fabric attachment to posts shall be replaced or repaired immediately.
	Hay/straw bale dikes shall be replaced when strings break. Each bale shall have two stakes. Firm contact shall be maintained between adjacent bales.
X	Storm drain inlet protections shall be inspected weekly and after each rain event to ensure no clogging has occurred. Replace clogged filter fabric or stone filters immediately. Remove accumulated sediment behind the filer when depth exceeds half the height of the filter.
	Diversion ditches and swales shall be maintained at the required depth. Settled sediment will be removed.
X	Stabilized construction entrances/exits shall be inspected for the transport of sediment onto public rights-of-way before and after each rainfall. Stone/gravel material shall be replaced when surface voids are visible. Construction entrances shall be swept as needed to keep them clear of accumulated sediment.
	Dikes or berms will be inspected for washouts and repaired as required. Dikes or berms susceptible to erosion will be armored with stone.

	Riprap will be inspected for evidence of movement or washout. Riprap experiencing movement or washout will be removed and carefully replaced individually in response to observed runoff flow patterns. Larger stones will be incorporated into the structure for anchoring and support where needed.
	Temporary stone filter dikes will be inspected and replaced when sediment impedes the effective functioning of the device.
	For temporary and permanent seeding used to stabilize exposed areas, the seeding will be inspected weekly during its period of establishment for bare spots and areas of insufficient germination or growth. Remedial action will be taken to establish surface cover in these areas once identified.
	If seeding is not used to stabilize exposed areas, a stabilizing layer of gravel will be placed.
X	Maintenance of waste management BMPs includes daily collection of site trash, inspection of the construction site waste area before and after rain events, and arranging for regular waste collection.
	The concrete truck washout drainage collection pit will be regularly maintained to ensure adequate capacity to contain washwater and prevent overflow.
	Maintenance of truck wheel washing shall include inspection of accumulated sediment in the drainage pit (to be cleaned when accumulated sediment reaches 10 percent of capacity) before and after rain events and berm repair as needed.
X	The covered material storage area shall be kept clean and organized.

B. Inspections

At a minimum maintenance inspections will be conducted:

- Prior to every forecasted event;
- Once each 24-hour period during extended storm events;
- After every storm event that produces observable runoff.

Pre-storm inspections are to ensure that all BMPs are in place and post-storm inspections are to determine whether the BMPs have functioned properly. If the required site inspections identify controls that are not operating effectively, maintenance shall be performed before the next anticipated storm event or as necessary to maintain the continued effectiveness of the controls. Written documentation of the inspection shall be maintained for three years. A sample BMP inspection report form is contained in Appendix D.

V. Training

The SWPPP must include procedures to ensure that all personnel implement the SWPPP and that trained personnel perform the inspections. When properly trained, site personnel are more capable of managing materials properly, preventing spills, and implementing BMPs efficiently and correctly. Personnel at all levels shall be trained in the components and goals of the Construction General Permit. Specifically, employees of the Contractor and any subcontractors working on the construction site shall be informed of the goals of the storm water pollution prevention plan at a training meeting prior to commencing construction activities. The training meeting shall cover basic storm water information as well as the specific requirements of the Construction General Permit. Specifically, the meeting will focus on implementation, inspection, and maintenance of storm water BMPs. Employees responsible for implementing, inspecting, maintaining, or repairing storm water BMPs will receive copies of relevant portions of the SWPPP. The Construction Environmental Coordinator shall train all new employees and subcontractors before they will be permitted to work on the site. For projects that start during the dry season, refresher sessions on storm water pollution control will be conducted prior to the wet season. Additional training will be provided as necessary based on site inspections and evidence of storm water quality problems. A sample form "Record of SWPPP Training Sessions" is contained in Appendix E.

VI. Responsibilities of Operators

The following sections describe the responsibilities of Site Operator with regard to effective SWPPP implementation.

A. Site Manager

The Site Manager has the overall responsibility for SWPPP implementation, ensuring that materials and manpower are made available for the successful maintenance of all erosion and sediment control and other BMPs specified in the SWPPP.

B. Project Field Engineer

The Project Field Engineer shall be responsible for:

- maintaining an up-to-date copy of this SWPPP onsite at all times, from commencement of construction to final site stabilization;
- making a copy of the SWPPP available for inspection by outside authorized regulatory authorities upon request;
- documenting any revisions to the SWPPP in Table 1 of the SWPPP;
- documenting in Table 2 of the SWPPP any changes in contractors/subcontractors and ensuring the new contractors/subcontractors are made aware of their responsibilities in this SWPPP;
- ensuring that field engineering activities are planned and conducted in accordance with the SWPPP;
- directing ongoing regular BMP maintenance activities (e.g. silt fence repair, hay bale replacement, sediment removal in retention basin, timely waste disposal, etc);
- implementing and overseeing necessary corrective actions to the erosion/sediment control devices and other BMPs identified by the Construction Environmental Coordinator during regular site inspections; and
- maintaining all site records pertaining to inspection and maintenance of erosion and sediment controls and other BMPs as well as records detailing the dates on which major construction activities began and were completed.

C. Construction Environmental Inspector

The Construction Environmental Inspector is responsible for all environmental compliance activities at the construction site including storm water pollution prevention. Specific duties are as follows:

- Conducting Environmental Awareness Training for site personnel (including subcontractor personnel). This involves increasing awareness of the need to comply with the SWPPP which includes: minimizing sediment in storm water discharges off-site as well as keeping a clean site and minimizing the potential for construction materials and wastes from entering storm water discharges.
- Conducting regular documented inspections of erosion and sediment control devices and other BMPs contained in this SWPPP (as discussed in Section 4.0). The findings of these inspections

are discussed with the Project Field Engineer who in turn makes available the necessary resources to repair/replace any defective control devices identified in the inspection.

- Conducting regular site environmental inspections and noting the conditions of those areas onsite that have the potential to result in pollution of storm water. Results of these inspections are discussed with the Project Field Engineer and any corrective actions necessary performed under the Project Field Engineer's oversight. Required documentation of the inspections and any corrective actions will be kept on site.
- Acting as the site spill coordinator to document spills, direct clean-up activities, minimize impact to storm water, and ensure that the proper reporting, if necessary, is completed.
- Additional duties of the Environmental Inspector are described in the Sediment Control Plan (Appendix H).

D. Subcontractors Administrator

The Subcontracts Administrator is responsible for ensuring that all subcontractors involved with construction activities, which may potentially affect storm water quality at the site, are made aware of, and their contracts reflect that they must comply with the applicable provisions of this SWPPP.

VII. Monitoring and Reporting Program

A. Site Inspections

Site inspections as described in Section 4.2 are a component of the monitoring and reporting required under the Construction General Permit.

B. Compliance Certification

Certification that the construction activities are in compliance with the Construction General Permit, as described in Section 1.5, is a component of the monitoring and reporting required under the Construction General Permit.

C. Noncompliance Reporting

The Construction General Permit requires that any instances of noncompliance with the requirements of the Construction General Permit shall be reported to the Los Angeles Regional Board within 30 days. Further, the Planning Division of the Port of Long Beach requires that any instances of noncompliance with the requirements of the Construction General Permit must be reported to them within 48 hours of detection of the noncompliance. The notification of noncompliance shall describe the noncompliance event, including an initial assessment of any water quality impact, the actions necessary to achieve compliance, and a time schedule for achieving compliance. A form that may be used for non-compliance reporting is included in Appendix F.

D. Requirements for Sampling and Analysis

The SWRCB Resolution No. 2001-046 requires that specific sampling and analytical procedures be implemented to determine whether BMPs implemented on a construction site are:

- Preventing further impairment by sediment in storm waters discharged directly into waters listed as impaired (Clean Water Act Section 303(d) List) for sediment, silt, or turbidity; and
- Preventing other pollutants that are known or should be known by dischargers to occur on construction sites and that can not be visually observed or detected in storm water discharges, from causing or contributing to exceedences of water quality objectives.

The Harbor District under the jurisdiction of the Port of Long Beach does not currently discharge storm water directly to water bodies listed on the 303(d) List as impaired for sediment/siltation or turbidity. Therefore, a sampling and analysis plan for sediment or turbidity is not required.

Sampling and analysis for pollutants that cannot be visually detected is required under the following conditions:

- Visual inspections, which are currently required before, during and after storm events, indicate that there has been a breach, malfunction, leakage or spill from a BMP that could result in the discharge of pollutants in storm water and the pollutants would not be visually detectable; or

- Storm water that comes into contact with soil amendments, other exposed materials, or site contamination will be discharged from the construction site.

Comprehensive and diligent implementation, inspection, maintenance, and repair of BMPs are critical and should prevent the need for sampling and analysis. However, a contingency Sampling and Analysis Plan must be developed. A Sampling and Analysis Plan template is included in Appendix G.

Appendix A

General Permit for Storm Water Discharges Associated with Construction Activities Disturbing One or More Acres

[Note: To be obtained and added before construction.]

Appendix B

Site Map(s)

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Appendix B
Vicinity Map

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Appendix B
Site Map

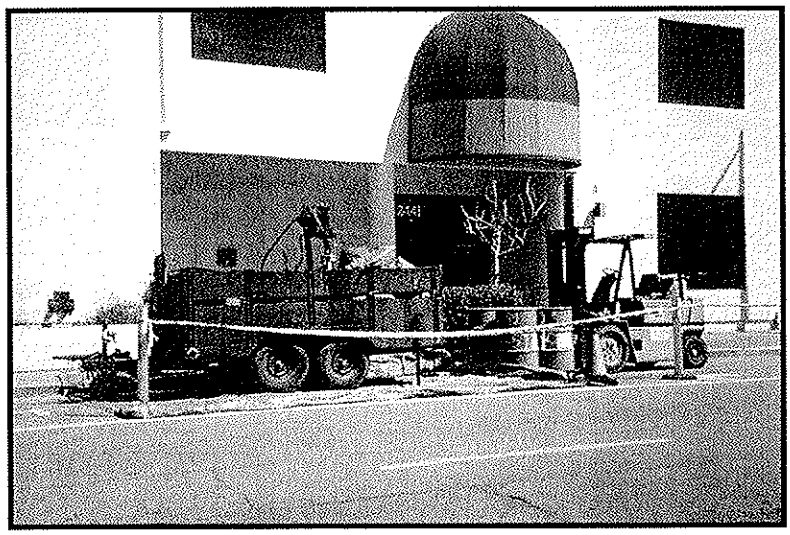
Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov

Appendix C

Post-Construction BMPs

[Note: Examples attached. Final BMPs to be developed before operation.]

Spill Prevention, Control & Cleanup SC-11



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

CASQA
California Stormwater Quality Association

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

- Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

Training

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan (Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off" of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Vehicle and Equipment Cleaning SC-21

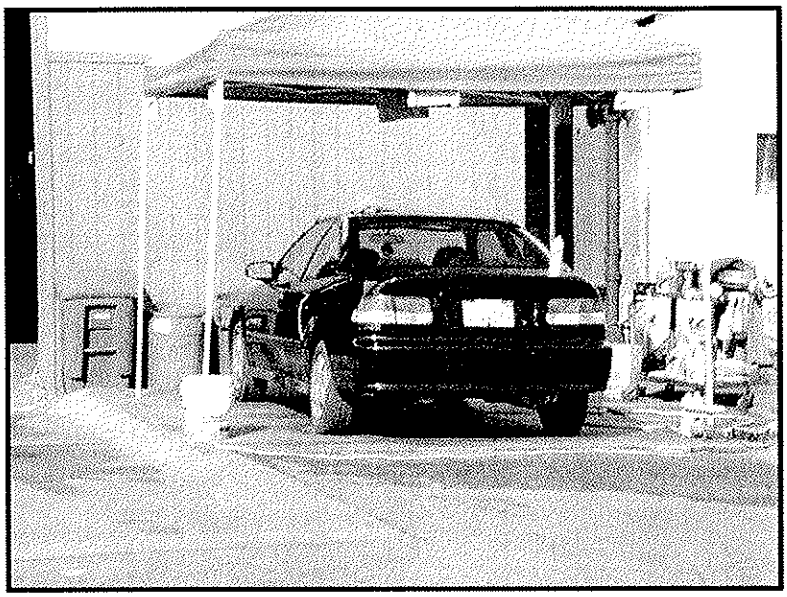


Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Wash water from vehicle and equipment cleaning activities performed outdoors or in areas where wash water flows onto the ground can contribute toxic hydrocarbons and other organic compounds, oils and greases, nutrients, phosphates, heavy metals, and suspended solids to stormwater runoff. Use of the procedures outlined below can prevent or reduce the discharge of pollutants to stormwater during vehicle and equipment cleaning.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives

Pollution Prevention

- If possible, use properly maintained off-site commercial washing and steam cleaning businesses whenever possible. These businesses are better equipped to handle and properly dispose of the wash waters.

- Good housekeeping practices can minimize the risk of contamination from wash water discharges.

CASQA
California Stormwater Quality Association

Suggested Protocols

General

- Use biodegradable, phosphate-free detergents for washing vehicles as appropriate.
- Mark the area clearly as a wash area.
- Post signs stating that only washing is allowed in wash area.
- Provide trash container in wash area.
- Map on-site storm drain locations to avoid discharges to the storm drain system.
- Emphasize the connection between the storm drain system and runoff, help reinforce that car washing activities affect local water quality through storm drain stenciling programs.

Vehicle and Equipment Cleaning

- Have all vehicle washing done in areas designed to collect and hold the wash and rinse water or effluent generated. Recycle, collect or treat wash water effluent prior to discharge to the sanitary sewer system.
- If washing/cleaning must occur on-site, consider washing vehicle equipment inside the building or on an impervious surface to control the targeted constituents by directing them to the sanitary sewer.
- If washing must occur on-site and outdoor:
  - Use designated paved wash areas. Designated wash areas must be well marked with signs indicating where and how washing must be done. This area must be covered or bermed to collect the wash water and graded to direct the wash water to a treatment or disposal facility.
  - Do not conduct oil changes and other engine maintenance in the designated washing area. Perform these activities in a place designated for oil change and maintenance activities.
  - Cover the wash area when not in use to prevent contact with rain water.
- Install sumps or drain lines to collect wash water for treatment.
- Use hoses with nozzles that automatically turn off when left unattended.
- Do not permit steam cleaning wash water to enter the storm drain.
- Pressure and steam clean off-site to avoid generating runoff with high pollutant concentrations. If done on-site, no pressure cleaning and steam cleaning should be done in areas designated as wellhead protection areas for public water supply.

Disposal

- Consider filtering and recycling wash water.
- Discharge equipment wash water to the sanitary sewer, a holding tank, or a process treatment system, regardless of the washing method used.
- Collect all wash water from vehicle cleaning operations and (1) discharge to a sanitary sewer, holding tank, or process treatment system or (2) run through an enclosed recycling system.
- Collect and treat wash water at the facility and either recycle or discharge to the sanitary sewer system or collect and dispose of as an industrial waste.
- Discharge wash water to sanitary sewer after contacting local sewer authority to find out if pretreatment is required.

Training

- Train employees on proper cleaning and wash water disposal procedures and conduct "refresher" courses on a regular basis.
- Train staff on proper maintenance measures for the wash area.
- Train employees and contractors on proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

Spill Response and Prevention

- Keep the Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.

Other Considerations (Limitations and Regulations)

- Some municipalities may require pretreatment and monitoring of wash water discharges to the sanitary sewer.
- Steam cleaning can generate significant pollutant concentrations requiring that careful consideration be given to the environmental impacts and compliance issues related to steam cleaning.
- Most car washing best management practices are inexpensive, and rely more on good housekeeping practices (where vehicles are washed, planning for the collection of wash water) than on expensive technology. However, the construction of a specialized area for vehicle washing can be expensive. Also, for facilities that cannot recycle their wash water, the cost of pre-treating wash water through either structural practices or planning for

collection and hauling of contaminated water to sewage treatment plants can be cost-prohibitive.

Requirements

Costs

- Capital costs vary as follows depending on measures implemented:
  - Low cost ($2000-5,000) for berm construction
  - Medium cost ($10,000-30,000) for plumbing modifications (including re-routing discharge to sanitary sewer and installing simple sump)
  - High cost ($60,000-200,000) for on-site treatment and recycling
- O&M costs increase with increasing capital investment.

Maintenance

- Perform berm repair and patching.
- Sweep washing areas frequently to remove solid debris.
- Inspect and maintain sumps, oil/water separators, and on-site treatment/recycling units.

Supplemental Information

Design Considerations

Designated Cleaning Areas

- Washing operations outside should be conducted in a designated wash area having the following characteristics:
  - Paved with Portland cement concrete
  - Covered and bermed to prevent contact with stormwater and contain wash water
  - Sloped for wash water collections
  - Discharges wash water to the sanitary or recycle treatment process waste sewer, or to a dead-end sump
  - Equipped with an oil/water separator if necessary

Examples

The City of Palo Alto has an effective program for commercial vehicle service facilities. Many of the program's elements, including specific BMP guidance and lists of equipment suppliers, are applicable to industrial vehicle service facilities.

The U.S. Postal Service in West Sacramento has a new vehicle wash system that collects, filters, and recycles wash water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

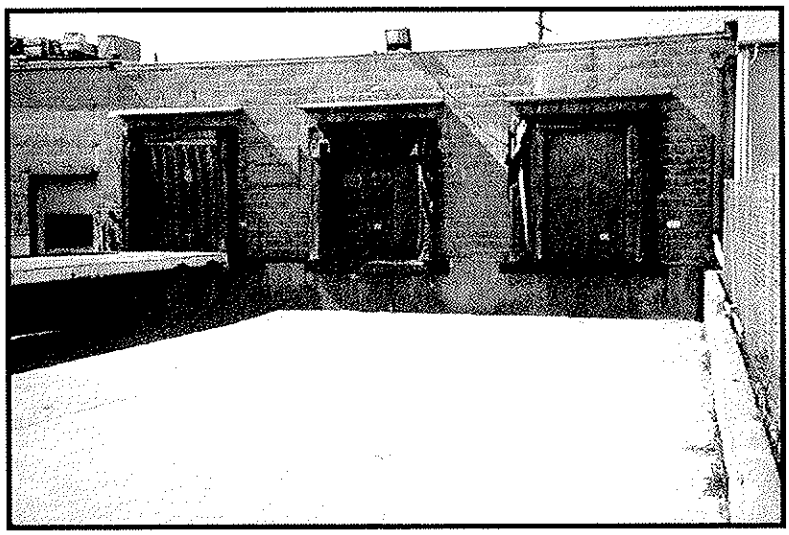
Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

Outdoor Loading/Unloading SC-30



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

CASQA
California Stormwater Quality Association

Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Waste Handling & Disposal SC-34

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

CASQA California Stormwater Quality Association

Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Vehicle and Equipment Repair SC-22

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Vehicle or equipment maintenance and repair are potentially significant sources of stormwater pollution, due to use of harmful materials and wastes during maintenance and repair processes. Engine repair and service (e.g., parts cleaning), replacement of fluids (e.g., oil change), and out door equipment storage and parking (leaking vehicles) can impact water quality if stormwater runoff from areas with these activities becomes polluted by a variety of contaminants. Implementation of the following activities will prevent or reduce the discharge of pollutants to stormwater from vehicle and equipment maintenance and repair activities.

Approach

- Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.

CASQA California Stormwater Quality Association

- Minimize use of solvents. Clean parts without using solvents whenever possible, or use water-based solvents for cleaning.
- Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.

Suggested Protocols

General

- Move maintenance and repair activities indoors whenever feasible.
- Store idle equipment under cover
- Use a vehicle maintenance area designed to prevent stormwater pollution - minimize contact of stormwater with outside operations through berming and appropriate drainage routing.
- Avoid hosing down your work areas. If work areas are washed, collect and direct wash water to sanitary sewer. Use dry sweeping if possible.
- Paint signs on storm drain inlets to indicate that they are not to receive liquid or solid wastes.
- Post signs at sinks to remind employees not to pour wastes down drains.
- Clean yard storm drain inlets(s) regularly and especially after large storms.
- Do not pour materials down storm drains.
- Cover the work area to limit exposure to rain.
- Place curbs around the immediate boundaries of process equipment.
- Build a shed or temporary roof over areas where parked cars await repair or salvage, especially wrecked vehicles. Build a roof over vehicles kept for parts.

Material and Waste Handling

- Designate a special area to drain and replace motor oil, coolant, and other fluids, where there are no connections to the storm drain or the sanitary sewer, and drips and spills can be easily cleaned up.
- Drain all fluids immediately from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g., larger pans are needed to contain antifreeze, which may gush from some vehicles).
- Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- Do not put used or leftover cleaning solutions, solvents, and automotive fluids and in the sanitary sewer.
- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.

- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
- Place oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal since municipalities prohibit or discourage disposal of these items in solid waste facilities. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters. Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater.
- Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling or household hazardous waste facilities.

Maintenance and Repair Activities

- Provide a designated area for vehicle maintenance.
- Keep equipment clean; don't allow excessive build-up of oil and grease.
- Use a tarp, ground cloth, or drip pans beneath the vehicle or equipment to capture all spills and drips if temporary work is being conducted outside. Collected drips and spills must be disposed, reused, or recycled properly.
- Perform all vehicle fluid removal or changing inside or under cover if possible to prevent the run-on of stormwater and the runoff of spills:
  - Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, or remove other parts. Use a drip pan under any vehicle that might leak while working on it to keep splatters or drips off the shop floor.
  - Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
  - Keep drip pans or containers under vehicles or equipment that may drip during repairs.
  - Do not change motor oil or perform equipment maintenance in non-appropriate areas.
- Drain oil and other fluids first if the vehicle or equipment is to be stored outdoors.
- Monitor parked vehicles closely for leaks. Pans should be placed under any leaks to collect the fluids for proper disposal or recycling.
- Use one of the following for lubricating vehicle-trailer coupling:
  - Adhesive lubricant
  - Plastic plates
  - Fifth wheels with plastic inserts
  - On-Board lubricating system

Parts Cleaning

- Mechanics should clean vehicle parts without using liquid cleaners wherever possible to reduce waste.
- Steam cleaning and pressure washing may be used instead of solvent parts cleaning. The wastewater generated from steam cleaning must be discharged to an on-site oil water separator that is connected to a sanitary sewer or blind sump. Non-caustic detergents should be used instead of caustic cleaning agents, detergent-based or water-based cleaning systems in place of organic solvent degreasers, and non-chlorinated solvent in place of chlorinated organic solvents for parts cleaning. Refer to SC21 for more information on steam cleaning.

Inspection

- Inspect vehicles and equipment for leaks regularly and repair immediately.
- Make sure incoming vehicles are checked for leaking oil and fluids. Do not allow leaking vehicles or equipment on-site.

Training

- Train employees and contractors in the proper handling and disposal of engine fluids and waste materials.
- Ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures (You can use reusable cloth rags to clean up small drips and spills instead of disposables; these can be washed by a permitted industrial laundry. Do not clean them at home or at a coin-operated laundry business). Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place an adequate stockpile of spill cleanup materials where it will be readily accessible.
- Clean leaks, drips, and other spills with as little water as possible. Use rags for small spills, a damp mop for general cleanup, and dry absorbent material for larger spills. Use the following three-step method for cleaning floors:
  - Clean spills with rags or other absorbent materials
  - Sweep floor using dry absorbent material
  - Mop the floor. Mop water may be discharged to the sanitary sewer via a toilet or sink.
- Remove the adsorbent materials promptly and dispose of properly when using adsorbent materials on small spills.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all work from being conducted indoors.
- It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours.
- Drain pans (usually 1 ft. x 1 ft.) are generally too small to contain antifreeze, so drip pans (3 ft. x 3 ft.) may have to be purchased or fabricated.
- Dry floor cleaning methods may not be sufficient for some spills. Use three-step method instead.
- Identification of engine leaks may require some use of solvents.
- Installation of structural treatment practices for pretreatment of wastewater discharges can be expensive.
- Prices for recycled materials and fluids may be higher than those of non-recycled materials.
- Some facilities may be limited by a lack of providers of recycled materials, and by the absence of businesses to provide services such as hazardous waste removal, structural treatment practice maintenance, or solvent equipment and solvent recycling.

Requirements

Costs

- Costs should be low, but will vary depending on the size of the facility.

Maintenance

- For facilities responsible for pre-treating their wastewater prior to discharging, the proper functioning of structural treatment practices is an important maintenance consideration. Routine cleanout of oil and grease is required for the devices to maintain their effectiveness, usually at least once a month. During periods of heavy rainfall, cleanout is required more often to ensure pollutants are not washed through the trap. Sediment removal is also required on a regular basis to keep the device working efficiently.
- It is important to sweep the maintenance area weekly, if it is paved, to collect loose particles, and wipe up spills with rags and other absorbent material immediately. Do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Waste Reduction

Parts are often cleaned using solvents such as trichloroethylene, 1,1,1-trichloroethane or methylene chloride. Many of these cleaners are harmful and must be disposed of as a hazardous waste. Cleaning without using liquid cleaners (e.g., wire brush) whenever possible reduces waste. Prevent spills and drips of solvents and cleansers to the shop floor. Do all liquid cleaning at a centralized station so the solvents and residues stay in one area. Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents.

- Clean parts without using liquid cleaners whenever possible to reduce waste.
- Prevent spills and drips of solvents and cleansers to the shop floor.
- Do all liquid cleaning at a centralized station so the solvents and residues stay in one area.
- Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

Recycling

Separating wastes allows for easier recycling and may reduce treatment costs. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents (e.g., 1,1,1-trichloroethane) separate from non-chlorinated solvents (e.g., kerosene and mineral spirits).

Many products made of recycled (i.e., refined or purified) materials are available. Engine oil, transmission fluid, antifreeze, and hydraulic fluid are available in recycled form. Buying recycled products supports the market for recycled materials.

- Recycling is always preferable to disposal of unwanted materials.
- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.
- Label and track the recycling of waste material (e.g., used oil, spent solvents, batteries).
- Purchase recycled products to support the market for recycled materials.

Vehicle-Trailer Lubrication

Fifth-wheel bearings on trucks require routine lubrication. Typically chassis grease is applied to the fifth-wheel bearing at rates that result in grease dripping off of the bearing into the environment. To address this concern the following options are available:

- Use adhesive lubricant. Follow manufacturer's label regarding the use of adhesive lubricant for truck fifth-wheels. Typically this means applying no more than 6 oz. of grease. No visible extrusion of lubricant from the fifth-wheel bearing when truck and trailer are connected should be present.
- Use plastic plates oil on fifth-wheels with plastic inserts.
- Use on-board truck or on-board trailer lubrication system. If these systems apply lube thinner than National Grease Lubrication Institute #2, equipment for collection of used lubricant is needed to prevent excess lubricant from dripping off the truck.

Safer Alternatives

If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

- Use non-caustic detergents instead of caustic cleaning for parts cleaning.
- Use detergent-based or water-based cleaning systems in place of organic solvent degreasers. Wash water may require treatment before it can be discharged to the sewer.
- Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
- Choose cleaning agents that can be recycled.

Examples

- Pick N Pull Auto Dismantlers in Rancho Cordova drains all fluids from automobiles before they enter the yard.
- Ecology Auto Wrecking in Rialto is surrounded by a steel plate/concrete fence and has a completely paved lot that is graded to a central low point. Collected stormwater is channeled through an underground drainage system of clarifiers and then stored in a 60,000 gallon UST before being processed through a filter system. In addition, the work area is covered, ventilated and has an additional sump. Vehicle fluids are drained in this area and segregated for recycling.
- All Auto Parts, Fontana, has a complete water recycling system in a 10,000 square foot concrete slab surrounded by a curb that contains all the runoff and sends it to the recycling system. All receiving, dismantling, and shipping occur on the slab.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/E

Appendix D

Construction Site Inspection Report Form

Construction SWPPP BMP Inspection Checklist	
Project Location:	Weather
Date of Inspection:	Storm Start Time:
Inspector	Duration of Storm:
Name (print):	Time Since Last Storm:
Title:	Approximate Rainfall (in):
Signature:	Type of Inspection: ☐ Pre-storm ☐ Storm event ☐ Post-storm ☐ Routine (dry season inspection)
Telephone No:	

YES	NO	1. Inspect the following BMPs 2. Check YES/ No 3. Describe Corrective Actions
		Does the Plan reflect current site conditions?
		Has there been rain at the site since the last inspection?
		Are the BMPs called for on the SWPPP installed in the proper location according to the specifications for the SWPPP and are they functioning properly?
		Are all operational storm drain inlets protected from sediment inflow?
		Do any structural practices require repair or clean-out to maintain adequate function? If yes, indicate which ones:
		Is there evidence of equipment leakage/ spillage of equipment/vehicle maintenance fluids?
		Are construction on-site traffic routes, parking, and storage of equipment and supplies restricted to areas specifically designated for those uses?
		Are all material handling and storage areas reasonably clean and free of spills, leaks, or other deleterious materials?
		Are all materials and equipment properly covered?
		Are locations of temporary soil stockpiles or construction materials in approved areas?
		If present, are all exposed slopes protected from erosion through the implementation of acceptable soil stabilization practices?
		Do any seeded or landscaped areas require maintenance, irrigation, fertilization, seeding or mulching?
		If present, are sediment traps/basins installed and functioning properly?
		Is there any evidence that sediment is leaving the site? Are all external discharge points (i.e. outfalls) reasonable free of any noticeable pollutant discharges, significant erosion or sediment transport? Are sediment controls in place at discharge points from the site?
		Are slopes free of significant erosion?
		Is there any evidence of sediment, debris, or mud on public roads at intersections with site access roads?
		Is there any evidence of incorrect waste disposal (paints, concrete, solid wastes)?
		Is the overall housekeeping sufficiently maintained?

Construction SWPPP BMP Inspection Checklist (Continued)		
YES	NO	1. Inspect the following BMPs 2. Check YES/ No 3. Describe Corrective Actions
		Are vehicle/ equipment maintenance and cleaning areas clean and free of oil, grease or potential pollutants?
		Are all materials and equipment properly covered?
		Is the construction area access point stabilized? Has potential for mud/ dirt tracking from the site been minimized?
		Is sediment, debris, or mud being cleaned from public roads at intersections with site access roads?
		Are liquid transfer areas (equipment fueling) clean and protected from rain?
		Are there any visible non-storm water discharges? Is there evidence that non-storm water discharges occurred in the past? If so, describe the non-storm water discharge:

If extreme weather conditions do not permit visual inspection of on-site BMPs, observe the following:

Surface Water Outfall or Discharge Points:

Downstream Locations:

Describe Required Corrective Actions:

Describe necessary revisions to the SWPPP:

Appendix E

Training Reporting Form

Record of SWPPP Training Session	
Training Date:	
Instructor:	
Topics Covered:	☐ **Inspections** ☐ **BMP Maintenance/Repair** ☐ **SWPPP BMPs** ☐ **Non-Storm Water Discharges** ☐ **Other (e.g., workshops offered by agencies, SWRCB/RWQCB, or professional organizations)**

Name	Company	Telephone Number	SWPPP Responsibilities[(a)]	Received Complete SWPPP or Excerpt (Yes/No)

(a) SWPPP responsibilities may include one or more of the following: BMP Installation, Inspection, Maintenance; Training; SWPPP Revisions, Non-Storm Water Discharges, Storm Water Sampling

Appendix F

SWPPP Non-Compliance Report Form

SWPPP NON-COMPLIANCE REPORT

Dischargers who cannot certify compliance with the permit and/or who have had other instances of non-compliance, excluding exceedances of water quality standards, shall notify the RWQCB within 30 days.

Inspector Name:	
Inspector Phone Number:	
Non-Compliance Identification Date:	

Description of Non-Compliance:
Initial assessment of any impact caused by the non-compliance:
Actions required to achieve compliance:
Time schedule of remediation activities:
When compliance will be achieved:

Appendix G

Sampling and Analysis Plan

SAMPLING AND ANALYSIS PLAN

Long Beach LNG Import Project

Pier T, Port of Long Beach

Long Beach, California 90802

WDID No. _____

Date Prepared May 2005

Prepared by:

Name of Firm:	***Tetra Tech EC, Inc.***
Street Address	***1940 E. Deere Ave, Suite 200***
City, State, and Zip:	***Santa Ana, CA 92705***
Telephone No.:	***949-756-7500***

TABLE OF CONTENTS

SECTION PAGE

1.0 INTRODUCTION 1-1
1.1 Sampling and Analysis Plan Description 1-1
1.2 Roles and Responsibilities for Storm Water Monitoring 1-1

2.0 MONITORING SITE LOCATIONS 2-1

3.0 LABORATORY ANALYSIS 3-1
3.1 Water Quality Analysis 3-1
3.2 Analytical Constituents 3-1

4.0 DATA QUALITY OBJECTIVES 4-1
4.1 Project Goals and Objectives 4-1
4.1.1 Monitoring Due to a Breach, Malfunction, Leakage, or Spill 4-1
4.1.2 Monitoring Areas of Historic Contamination or Soil Amendments 4-3
4.2 Analytical Reporting Limits 4-7
4.3 Analytical Precision, Accuracy, and Completeness 4-7

5.0 FIELD EQUIPMENT MAINTENANCE 5-1
5.1 Water Quality Sampling Equipment 5-1
5.2 Cleaning of Sample Collection Bottles 5-3

6.0 MONITORING PREPARATION AND LOGISTICS 6-1
6.1 Storm Sampling Criteria 6-1
6.2 Weather Tracking 6-1
6.3 Sample Bottle Ordering 6-1
6.4 Sample Bottle Labeling 6-1
6.5 Field Equipment Preparation 6-2

7.0 SAMPLE COLLECTION, PRESERVATION, AND DELIVERY 7-1
7.1 Sample Collection Methods 7-1
7.2 Field Measurement Methods 7-1
7.3 Sample Containers and Handling 7-1
7.4 QA/QC Sample Collection Methods 7-2
7.5 Forms and Procedures for Documenting Sample Collection and Field Measurements 7-2
7.6 Laboratory Communication Procedures 7-4
7.7 Sample Shipping/Delivery and Chain of Custody 7-4

7.8 Sample Preservation and Filtration 7-4

8.0 QUALITY ASSURANCE/QUALITY CONTROL 8-1

8.1 Field and lab Procedures for QA/QC 8-1

8.1.1 QA/QC for Water Sample Collection 8-1

8.1.2 Laboratory QA/QC 8-1

9.0 LABORATORY SAMPLE PREPARATION AND ANALYTICAL METHODS 9-1

10.0 DATA MANAGEMENT AND REPORTING PROCEDURES 10-1

10.1 Analytical Data Validation 10-1

10.2 Electronic Data Transfer 10-1

10.3 Reports 10-1

TABLES

Table 3-1. List of Non-Visible Laboratory Analytical Constituents 3-2

Table 4-1. Testing Requirements for Pollutants Not Visually Detectable: Pollutants Due To Breach, Malfunction, Leakage, or Spill 4-5

Table 4-2. Testing Requirements for Pollutants Not Visually Detectable: Pollutants Due To Historic Contamination or Soil Amendments 4-6

Table 4-3. Specifications For Non-Visible Laboratory Constituent Analyses 4-8

Table 4-4. Precision and Accuracy Control Limits for Non-Visible Analytical Constituents 4-9

Table 8-1. Laboratory QA/QC Analyses 8-2

Table 8-2. QA/QC Sample Frequency 8-2

Appendix

G-1 Non-Visible Pollutant Monitoring Report

1.0 INTRODUCTION

1.1 SAMPLING AND ANALYSIS PLAN DESCRIPTION

This Sampling and Analysis Plan provides the technical detail and protocols for conducting storm water quality monitoring. Storm water quality monitoring will be required whenever the failure of a BMP (for example, a breach, malfunction, leakage or spill) has occurred. Storm water samples will be collected and analyzed for constituents that are not visible in storm water runoff. This Sampling and Analysis Plan will be amended if necessary as permit requirements or site conditions require. The techniques and methodologies for collection of storm water and analyses of water quality constituents are the standard of use by the U.S. Environmental Protection Agency (EPA).

1.2 ROLES AND RESPONSIBILITIES FOR STORM WATER MONITORING

The Storm Water Pollution Prevention Plan (SWPPP) Compliance Inspector will have overall responsibility for storm water monitoring. Overall, this person shall:

- Maintain overall responsibility for the monitoring effort;
- Serve as primary contact with the analytical laboratory regarding sampling issues;
- Conduct or oversee sample collection;
- Coordinate sample delivery to the analytical laboratory;
- Ensure that proper documentation is recorded; and
- Ensure that Quality Assurance/Quality Control (QA/QC) procedures are followed.

On a day-to-day basis, Compliance Inspector duties will also include:

- Prepare storm water monitoring equipment;
- Collect storm water in laboratory-provided sample bottles;
- Complete all applicable documentation (site logs, checklists, chain-of-custody forms); and

Deliver samples to water quality laboratory.

-

2.0 MONITORING SITE LOCATIONS

Monitoring locations include any pipe, culvert, gutter, channel, stream, or other conveyance that transports storm water runoff from the site. In some locations, these conveyances will be permanent structures. In other cases, the storm water conveyances may change in type of location due to changes in the construction activity. Specific monitoring locations are likely to vary from event to event (except for the area of the site where pre-existing lead contamination is known to exist). The selection of monitoring equipment used to collect grab samples may vary depending on the site.

3.0 LABORATORY ANALYSIS

This section of the Sampling and Analysis Plan describes the laboratory analysis of the water quality samples collected. It provides a general description of the protocols and the analytical constituents for water quality testing.

3.1 WATER QUALITY ANALYSIS

Grab samples of storm water will be collected and monitored for biological, physical, and chemical water quality constituents. Section 7 of the Sampling and Analysis Plan describes the sample collection, preservation, and delivery procedures.

3.2 ANALYTICAL CONSTITUENTS

The types of non-visible pollutant analyses that may be required are presented in Table 3-1. The table also lists the laboratory analytical method to be used, target reporting limit (concentration), minimum sample volume, container and preservative types, and holding time for each analysis.

Table 3-1. List of Non-Visible Laboratory Analytical Constituents

Constituent/Parameter Name	Constituent Abbreviation	Bottle Type	Volume Required(1) (mL)	Preservation
Conventional				
Specific Conductance	EC	Poly-Propylene	50	N/A
pH(3)	pH		50	N/A
Hydrocarbons				
Total Recoverable Petroleum Hydrocarbons	TRPH	Glass	1000	4 degrees Celsius
Oil and Grease (HEM/SGT)	O&G		1000	H_2SO_4 to pH<2
Nutrients				
Nitrate-Nitrogen	NO_3-N	Poly-Propylene	100	4 degrees Celsius
Ammonia-Nitrogen	NH_3-N		100	None
Total Phosphorus	Total P		100	HNO_3 or H_2SO_4 to pH<2
Detergents	MBAS		500	4 degrees Celsius
Bacteriological				
Coliform (Fecal)	FC	Poly-Propylene	50	$Na_2S_2O_3$
Coliform (Total)	TC		50	$Na_2S_2O_3$
Metals				
Total Recoverable	TR	Poly-Propylene	250	HNO_3 or H_2SO_4 to pH<2
Dissolved (4)	Diss		250	HNO_3 or H_2SO_4 to pH <2(2)
Organics				
Volatile Organics	VOCs	Glass	2 x 40 vials	4 degrees Celsius
Semi-Volatile Organics	SVOCs		1000	4 degrees Celsius
Pesticides	Pest		1000	4 degrees Celsius

Notes:

(1) For analytical methods, reporting limits, and other specifications, see Table 4-1.

(2) Dissolved metals preserved after filtration.

(3) Report pH to nearest 0.1 std. pH unit. Also report temperature at time of measurement.

(4) Filter dissolved samples prior to analysis.

4.0 DATA QUALITY OBJECTIVES

4.1 PROJECT GOALS AND OBJECTIVES

The storm water monitoring conducted for the construction site will evaluate the amount and concentration of non-visually detectable constituents that may be transported from the site during storm events because of a breach, malfunction, leakage, spill, application of soil amendments, or due to pre-existing contamination at the site. Specific objectives of the storm water monitoring are to:

- Comply with the storm water monitoring requirements under the California Storm Water General Permit for Construction Activities[1]; and
- Evaluate the presence of non-visually detectable pollutants in storm water runoff due to a breach, malfunction, leakage, spill, application of soil amendments, or historic contamination in order to repair, replace, maintain, or select and implement more effective BMPs.

4.1.1 Monitoring Due to a Breach, Malfunction, Leakage, or Spill

Non-visible pollutant monitoring in areas not historically contaminated and without soil amendments will proceed according to the following steps:

Step 1. Is there a non-visible pollutant present that may be discharged from the site in storm water runoff? If yes, then proceed to Step 2.

Step 2. Is the non-visible pollutant stored in a watertight condition (i.e., in a watertight container, in a building, or under a watertight roof)? If no, then proceed to Step 3.

Step 3. Does routine weekly, pre-rain, during-rain, or post-rain visual monitoring reveal that there has been or there is currently occurring a spill or leak, or a breach or malfunction of a BMP that could result in the discharge of a non-visible pollutant in storm water from the site? If yes, then proceed to Step 4.

Step 4. After containing the spill, leak, breach, or malfunction, do you still suspect that there is currently, has been, or could be, a discharge (i.e., transport off the site) in storm water of a non-visible pollutant? If yes, then proceed to Step 5.

Step 5. Conduct non-visible pollutant monitoring according to the following steps:

A. **Identify parameters.** For all samples, analyze the sample for indicator parameter(s) relevant to the particular pollutant for which the non-visible pollutant monitoring is being conducted. More detail regarding the specific parameters to be analyzed may be found in Table 4-1.

[1] State Water Resources Control Board Resolution No. 2001-046.

B. **Identify type of testing.** Determine whether field or laboratory testing will be employed, based on Table 6-1.

i. Field testing. The following personnel have been assigned by the owner and properly trained to oversee the collection and analysis of field samples:

Name	***Phone***
Name	***Phone***

All field testing will be conducted following the manufacturer's instructions on the testing device for the analysis of both the contaminated and uncontaminated samples in addition to the steps described below.

ii. **Laboratory testing.** Field testing for certain parameters or for certain non-visible pollutants may not be feasible using field testing methods. In these instances, laboratory testing will be employed. The selected analytical laboratory should be contacted to obtain proper containers, including any required preservatives. The field testing personnel named above shall be responsible for collecting samples for analysis in the laboratory. Once collected and transported, laboratory samples will be analyzed in accordance with 40 CFR Part 136.

C. **Comply with timing requirements.** Collect all samples within the first two hours of discharge from rain events that occur during daylight hours (7 days per week, including weekends and holidays) and which generate runoff.

D. **Identify location(s) and collect sample(s).** Determine the proper sampling location(s).

i. Collect all samples at a point before the storm water runoff from the site mixes with storm water flowing in the receiving water or public storm drain.

ii. Collect samples at the relevant location(s) based on the following:

a) Identify the discharge point(s) and the potential testing locations on the relevant catchment, sub-watershed, or sub-basin map prepared for the project.

b) If the site has multiple discharge locations, samples should be collected of runoff from the area where the spill, leak, or BMP malfunction or breach occurred, if possible. Alternatively, samples may be taken from a catch basin inlet accepting flow from the area where the spill, leak, or BMP malfunction or breach occurred.

c) All discharge locations sampled must be safely accessible.

E. **Collect uncontaminated sample.** Collect and analyze an uncontaminated sample. Select a location on the site either upstream or otherwise away from the area sampled that does not drain the area where the spill, leak, or BMP malfunction or breach occurred. If feasible, the location for collection of the uncontaminated sample should be in the same phase of development as the sample potentially containing a non-visible pollutant. For example, if the sampling event takes place in an area where mass grading is occurring, the

uncontaminated sample should, likewise, be collected in an area were mass grading is occurring, as opposed to an area where buildout is nearly complete.

F. **Prepare documentation.** Prepare a Non-Visible Pollutant Monitoring Report (provided in Appendix G-1) for each sampling event and append the form to the SWPPP. Keep all analytical data, including chain-of-custody forms, with the SWPPP until such time as a Notice of Termination is submitted and approved.

G. **Evaluate the data.** If analysis of the samples indicate that non-visible pollutants are being discharged from the site, determine if you need to make any reports to the Los Angeles Regional Water Quality Control Board under Section 7.3 of the SWPPP. In addition to any reporting obligation, take the following steps as soon as possible:

Step 1. Repair or replace any BMP that has failed.

Step 2. Maintain any BMP that is not functioning properly due to lack of maintenance.

Step 3. Evaluate whether additional or alternative BMPs should be implemented.

H. **Use trained personnel.** Personnel trained in the collection of field or laboratory samples shall collect the contaminated and uncontaminated samples for all non-visible pollutant monitoring. Appropriate personnel shall be available to collect samples on regular working days, as well as on weekends and holidays, should the need arise. Training of personnel to collect the samples will include training regarding sample collection methods, operation of field analysis devices or laboratory collection and transport protocols, and appropriate indicator parameters to be analyzed for the non-visible pollutants sampled.

4.1.2 Monitoring Areas of Historic Contamination or Soil Amendments

For non-visible pollutant monitoring in the areas of historic contamination or application of soil amendments, monitoring shall proceed as follows:

Step 1. **Identify area(s) to be monitored.** Determine the area(s) to be monitored. Areas to be monitored will be those areas for which remediation of the historic contaminants is not yet complete (or for which detection of non-visible pollutants is still occurring), and those areas where soil amendments have been applied.

Step 2. **Identify analytical parameters.** Analyze the sample for the indicator parameter(s) relevant to the particular pollutant for which the non-visible pollutant monitoring is being conducted. More detail regarding the specific parameters to be analyzed may be found in Table 6-2.

Step 3. **Identify type of testing.** An analytical laboratory will analyze all samples from the historically contaminated area. The selected laboratory should be contacted to obtain proper containers, including any required preservatives. The field testing personnel named above shall be responsible for collecting samples for analysis in the laboratory. Once collected and transported, laboratory samples will be analyzed by the laboratory selected in accordance with 40 CFR Part 136.

Analysis for any soil amendments applied at the site may be both field and laboratory testing, in accordance with Table 4-2. The field testing personnel named above will be responsible for performing the field tests and collecting samples for analysis in the laboratory. All laboratory samples will be analyzed by certified water quality laboratory.

Step 4. **Comply with required timing.** For the areas of historic site contamination, collect all samples within the first two hours of discharge from rain events that occur during daylight hours and which generate runoff. Every rain event shall be monitored in the historically contaminated areas, so long as those rain events occur during daylight hours and so long as they generate runoff, until the area of historic contamination has been mitigated.

For areas of applied soil amendments, if the data from the first monitoring event show a problem, then it is advisable that field monitoring be continued to verify that pollutants are no longer being discharged in the storm water runoff from the site. Additionally, the discharge must be reported to the Los Angeles Regional Water Quality Control Board in accordance with the requirements of the General Permit.

Step 5. **Identify sampling location(s) and collect sample(s):**

A. Collect all samples at a point before the storm water runoff from the site mixes with storm water flowing in the receiving water or public storm drain.

B. Collect samples at the relevant location based on the following:

i. In locations downstream of applied soil amendments.

ii. All discharge locations sampled must be safely accessible.

Step 6. **Take uncontaminated sample(s).** Collect and analyze uncontaminated sample(s) as follows:

A. Collect all samples at a point above (upstream) of where the storm water runoff contacts the non-visible pollutants.

B. Collect samples at the relevant location based on the following:

i. In locations upstream of applied soil amendments.

ii. All discharge locations sampled must be safely accessible.

Step 7. **Prepare documentation.** Prepare a Non-Visible Pollutant Monitoring Report (provided in Appendix G-1) for each sampling event and append the form to the SWPPP. Keep all analytical data with the SWPPP until such time as a Notice of Termination is submitted and approved.

Step 8. **Define frequency of sampling.** If two consecutive sampling events for a particular pollutant in a particular area reveal a level of pollutant discharge as zero or below the detection limit for the analysis method used, then that pollutant in that particular area need not be monitored in future storms.

Table 4-1. Testing Requirements for Pollutants Not Visually Detectable: Pollutants Due To Breach, Malfunction, Leakage, or Spill

Pollutant Source	Field Test[1]	Laboratory Test[1]
Demolition		
Sediment	(visible)	
Paint Strippers	N/A	Volatile Organics
Solvents	N/A	Volatile Organics
Adhesives	N/A	Semi-Volatile Organics
Vehicle Fuels	N/A	Oil and Grease or TPH
Metals	N/A	Total/Dissolved Metals
Bacteria	N/A	Total/Fecal Coliform
Litter	(visible)	
Utility Installation		
Sediment	(visible)	
Fuels/Lubricants	N/A	Oil and Grease/TPH
Chlorinated Water	Colorimetric	
Concrete	pH	Lab pH
Pesticides/Herbicides	N/A	Pesticide Scan/Semi-Volatile Organics
Fertilizers	N/A	$NO_3/NH_3/P$
Bacteria	N/A	Total/Fecal Coliform
Vertical Construction		
Sediment	(visible)	
Paint Strippers	N/A	Volatile Organics
Solvents, Thinners	N/A	Volatile Organics
Detergents	Colorimetric	MBAs
Adhesives, Sealants, Resins	N/A	Semi-Volatile Organics
Fuels, Lubricants, Hydraulic Fluid	N/A	Oil and Grease or TPH
Concrete	pH	Lab pH
Litter	(visible)	
Bacteria	N/A	Total/Fecal Coliform
Organics	N/A	Semi-Volatile Organics
Paint	(visible)	
Wood (sawdust)	(visible)	
Acid Wash	pH	Lab pH
Asphalt (liquid)	N/A	TPH
Habitat Conservation		
Sediment	(visible)	
Nutrients (Fertilizers)	N/A	$NO_3/NH_3/P$
Bacteria	N/A	Total/Fecal Coliform

[1] Based on consultation with SWPPP Preparer or monitoring specialist.

Table 4-2. Testing Requirements for Pollutants Not Visually Detectable: Pollutants Due To Historic Contamination or Soil Amendments

Historic Contamination[1]			
Area(s)	Pollutant(s)	Field Test(s)	Laboratory Test(s)
Soil Amendments [2, 3]			
To be identified by Project Engineer	Based on product MSDS and consultation with SWPPP Preparer or Monitoring Specialist	TBD. May include pH, electrical conductivity (EC)	TBD.

[1] Based on Section 2.1 of the SWPPP.

[2] Soil amendments include any material that is added to the soil to change its chemical properties, engineering properties, or erosion resistance that could become mobilized by storm water and would not be visible in the runoff. Soil amendments include lime, cementitious binders (e.g., gypsum), chlorides, emulsions, polymers, soil stabilizers, and tackifiers applied as a stand-alone treatment (i.e., without mulch). Plant fibers (such as straw or hay), wood and recycled paper fibers (such as mulches and matrices), bark or wood chips, green waste or composted organic materials, and biodegradable or synthetic blanket fibers would not be included as soil amendments in this context because they would be visible in storm water runoff.

[3] Sampling and analysis is required for construction projects that utilize soil amendments that are in contact with storm water runoff, unless independent test data are available that demonstrate acceptable concentration levels.

4.2 ANALYTICAL REPORTING LIMITS

Reporting limits are the lowest concentration of a constituent that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operating procedures. Section 3 lists the chemical constituents that will be analyzed in order to meet the water quality monitoring requirements of the permit. Tables 4-1, 4-2, 4-3, and 4-4 list the testing requirements for pollutants not visually detectable due to breach, malfunction, leakage or spill; testing requirements for pollutants not visually detectable due to historic contamination and soil amendments; specifications for non-visible laboratory constituent analyses; and precision and accuracy control limits for non-visible analytical constituents respectively. Reporting limits were based on the limits that are achievable by most contract analytical laboratories.

4.3 ANALYTICAL PRECISION, ACCURACY, AND COMPLETENESS

Precision

Analytical precision is the measure of the degrees of agreement among replicate analyses of a sample (i.e., the closeness of two or more measured values to one another). This Sampling and Analysis Plan recommends the collection of duplicate samples that can be compared and a relative percent difference (RPD) calculated to determine the precision of water quality analysis. The RPDs listed in Table 4-4 represent the acceptable differences in duplicate samples to confirm precision of the laboratory water quality analyses.

Accuracy

Accuracy of a water quality constituent is determined from the deviation of a measured value from the true value. This Sampling and Analysis Plan recommends the use of both laboratory control spikes measured in blanks, and matrix spikes measured in samples collected at storm water outfalls. The upper and lower recovering limits of the spikes are included in Table 4-4 and reflect the accuracy with which the true water quality is being measured.

Completeness

Completeness refers to the total percentage of samples that are both analyzed and validated with respect to all the samples collected. The completeness goal for this project is 85 percent. This means that at least 85 percent of the water quality results must be acceptable without qualification to adequately meet project goals. The control limits for analytical precision and accuracy for each analytical constituent are listed in Table 4-4.

Table 4-3. Specifications For Non-Visible Laboratory Constituent Analyses

Constituent Name	Method Type	EPA Method Number	Holding Time	Units	Target Reporting Limit
Conventional					
EC	N/A	120.1	ASAP	umhos/cm	1
PH	Electrometric	150.1	ASAP	pH unit	+/- 0.1
Hydrocarbons					
TRPH	Gas chromatography	8015b	14 days	µg/L	50
O&G (HEM/SGT)	Gravimetric	1664	28 days	mg/L	5
Nutrients					
NO_3-N	Ion chromatography	300.0	48 hours	mg/L	0.1
NH_3-N	Titrimetric	350.2	28 days	mg/L	0.1
Total P	Colorimetric	365.2	28 days	mg/L	0.03
Bacteriological					
FC	Multiple-tube fermentation	9211E	6 hours	MPN/100 ml	1
TC	Multiple-tube fermentation	9221B	6 hours	MPN/100 ml	1
Metals					
TR	GFAA; ICP-MS	200.8	Filter for dissolved fraction and preserve within 48 hours; analyze within 6 months.	µg/L	0.2-5*
Diss	GFAA; ICP-MS	200.8		µg/L	0.2-5*
Organics					
VOCs	GC-MS	8020	14 days	µg/L	0.5-50
SVOCs	GC-MS	8270	Extract in 7 days, analyze within 40 days.	µg/L	0.05-0.25
Pest	Gas chromatography	8141, 8081		µg/L	0.05-1
Detergents					
MBAS	Colorimetric	425.1	48 hours	mg/L	0.1

* Target Reporting Limit varies by metal.

Table 4-4. Precision and Accuracy Control Limits for Non-Visible Analytical Constituents

Constituent/Parameter Name	EPA Method Number	Maximum Allowable RPD (%)	MS/MSD Recovery Lower Limit (%)	MS/MSD Recovery Upper Limit (%)
Conventional				
EC	120.1	N/A	N/A	N/A
pH	150.1	20	N/A	N/A
Hydrocarbons				
TRPH	8015b	21	45	129
O&G (HEM/SGT)	1664	18	79	114
Nutrients				
NO_3-N	300.0	20	80	120
NH_3-N	350.3	20	80	120
Total P	365.2	20	80	120
Bacteriological				
FC	SM 9221E	N/A	N/A	N/A
TC	SM 9221B	N/A	N/A	N/A
Metals				
TR	200.8	20	75	125
Diss	200.8	20	75	125
Organics				
VOCs	8020	20-30	See method: constituent specific	
SVOCs	8270	30-50	See method: constituent specific	
Pesticides	8141/8081	20	See method: constituent specific	
Detergents				
MBAS	425.1	N/A	N/A	N/A

N/A: Not available.

5.0 FIELD EQUIPMENT MAINTENANCE

This section describes the equipment that will be used for collecting storm water samples and information on the proper cleaning of sampling bottles.

5.1 WATER QUALITY SAMPLING EQUIPMENT

All storm water samples will be collected as manual grab samples. Sample collection equipment may vary, depending on the specific monitoring location and configuration. Examples of typical equipment include:

- Polypropylene scoops, jars, or flat trowels;
- Polypropylene buckets;
- Polypropylene containers attached to an extendable aluminum pole;
- Polypropylene funnels;
- Latex gloves (always wear during sample collection);
- Cooler filled with ice (to keep water samples cold);
- Distilled water (for rinsing sampling equipment); and
- Towels and paper towels.

A comprehensive list of sampling equipment is provided as a checklist on the next page.

SAMPLING EQUIPMENT CHECKLIST

Field/Specialty Box

____ Water-proof Pens (2)
____ Sampling and Analysis Plan (1)
____ Sample Funnels
____ Latex Gloves (24 pairs)
____ Paper Towels (1 roll)
____ Paper Cups (2 cups)
____ Ziploc Bags (1 box)
____ Solvex (green) Gloves (2 pairs)
____ Duct Tape (1 roll)
____ First Aid Kit (1)
____ Flashlight w/ extra batteries (2)
____ Sample Scoops (3)
_____ Clipboard w/Data Sheets
_____ Cutting Knife (1)
_____ Fire Extinguisher (1)
_____ Field Test Kit (pH and conductivity meters); colorimetric test kits (for detergents and/or chlorine)

Safety/Traffic Equipment

_____ Cellular Telephone (1)
_____ Hard Hat for each Team Member
_____ Traffic Safety Vests
_____ Rain Gear with reflective tape
_____ Safety Boots (with steel toes)

Other

_____ Ice for coolers (purchase en route)
_____ Bubble wrap for sample bottles
_____ Coolers
_____ Sunglasses (2)
_____ Sunscreen
_____ Soap
_____ Reflective Tape

Signature_____ **Date**_____ **Time:** _____

5.2 CLEANING OF SAMPLE COLLECTION BOTTLES

All sample collection bottles and lids will be cleaned prior to sample collection by the laboratory, consistent with the equipment cleaning procedures described in this section. This cleaning protocol will be provided to the selected analytical laboratory prior to receipt of sampling bottles in preparation for a sampling event. The analytical laboratory cleaning procedures are:

Water Sample Collection Bottles (Laboratory Protocols)

1. Rinse bottle with warm tap water three times as soon as possible after emptying sample.
2. Soak in a 2% detergent (e.g., Contrad®) solution for 48 hours; scrub with clean plastic brush.
3. Rinse three times with tap water.
4. Rinse five times with Milli-Q® or equivalent (water passed through two filters after deionized system), rotating the bottle to ensure water contact with the entire inside surface.
5. Rinse three times with hexane, rotating the bottle to ensure contact with the entire inside surface (use 30ml per rinse).
6. Rinse six times with Milli-Q water.
7. Rinse three times with 2N nitric acid (1 liter per bottle, per rinse) rotating the bottle to ensure contact with the entire inside surface.
8. Rinse six times with Milli-Q water.
9. Cap bottle with Teflon™-lined lid, cleaned as specified below.

Sample Bottle Lids

1. Make up a 2% solution of disinfectant soap (Micro®) in warm tap water.
2. Rinse tubing three times with the 2% Micro solution, wash lids and strainers with Micro solution and a plastic brush.
3. Rinse three times with tap water.
4. Rinse three times with Milli-Q water.
5. Rinse three times with a 2N nitric acid solution.
6. Soak 24 hours in a 2N nitric acid solution.
7. Rinse three times with Milli-Q water.
8. Seal the tubing on both ends with clean latex material.
9. Individually double-bag tubing in properly labeled new polyethylene bags. Double-bag lids and strainers individually in Ziploc™ bags.

Cleaning Solutions

The following cleaning solutions are effective and appropriate for use in cleaning storm water sampling bottles and equipment.

- 2% Contrad = 200 ml concentrated Contrad (detergent) per full 10L bottle of Milli-Q water.
- 2% HNO3 Acid = 80 ml concentrated HNO3 acid (16N) per gallon of Milli-Q water.
- 2% Micro = 80ml concentrated Micro (disinfectant) per gallon of Milli-Q water.

6.0 MONITORING PREPARATION AND LOGISTICS

Pre-storm sampling event procedures include tracking weather forecasts, evaluating storm sampling criteria, and preparing sampling equipment before each storm event.

6.1 STORM SAMPLING CRITERIA

The following storm sampling criteria have been established to determine which storms will be sampled for water quality constituents:

- The storm event produces measurable runoff

AND

- There may be pollutants in the runoff that are not visually detectable due to:
  - Runoff contacting and discharging from an area of historic contamination; OR
  - Runoff contacting and discharging from surfaces to which soil amendments have been applied; OR
  - Inspections indicate a breach, spill, leakage, or malfunction has occurred.

In each instance, runoff is to be sampled both upstream and downstream of the activity triggering the requirement to sample.

6.2 WEATHER TRACKING

The SWPPP Compliance Inspector will track weather forecasts on a daily basis. The daily tracking includes review of publicly available data (e.g., the National Weather Service, The Weather Channel, Internet weather sites). When data from these various sources indicate that a storm event is imminent, storm water sampling staff will be on "stand-by alert" in the event that storm water sampling is required. The storm water sampling staff will be prepared to mobilize to collect samples, if required, **during the first two hours of runoff**.

6.3 SAMPLE BOTTLE ORDERING

Storm water sample collection bottles will be purchased from the selected analytical laboratory. The laboratory will provide the correct type and size of bottles required for the particular analysis being conducted. In addition, the laboratory will add preservative to the sample bottles, if required. A sufficient amount of bottles must be ordered to collect both environmental and quality control composite samples and to ensure that a shortage of bottles does not occur. The analytical laboratory will provide blank water for the collection of required field blank samples.

6.4 SAMPLE BOTTLE LABELING

Storm water collection bottles will be pre-labeled prior to each sampling event. All labels will include the site name, collection date and time, site outfall location, names of the sampling team, event sample

number and bottle number (if more than one). Only the collection date and time, sample location and number, and sampling personnel names will need to be filled out at the time of collection. All other information can be filled out in a dry environment prior to field mobilization. All information will be written with a permanent quick-drying ink marker that is water- and fade-resistant on a water-resistant label prior to transport to the laboratory.

6.5 FIELD EQUIPMENT PREPARATION

If the updated forecast shows that the potential storm event will satisfy the selection criteria within the next 12 hours, field sampling personnel will set up the grab sampling equipment, bottles, and coolers. The procedures for field equipment preparation are as follows:

- Determine where samples may need to be collected;
- Obtain proper sample bottles;
- Set up prepared coolers containing ice and labeled water sample bottles;
- Set up grab sampling gear and field support equipment (flashlights, tarp, table, as needed); and
- Place all equipment supplies in a convenient location to be mobilized from.

Detailed field procedures for sample collection are outlined in Section 7 of the Sampling and Analysis Plan.

7.0 SAMPLE COLLECTION, PRESERVATION, AND DELIVERY

This section describes the procedures involved in the collection, preservation, and delivery of water quality samples to the analytical laboratory. Information describing sample representativeness and the analytical prioritization of the individual water quality analyses are also included.

7.1 SAMPLE COLLECTION METHODS

If possible, field teams will consist of two persons. Because of the unpredictability of storm events, and the requirement to sample within the first two hours of runoff, it is desirable for field crews to be available to arrive at the monitoring sites before any significant storm water runoff has been observed.

Grab Storm Water Sample Collection

Field personnel will arrive at the monitoring sites before the event to ensure that samples are collected within the first two hours of runoff. Provided there is adequate runoff available, the grab samples will be collected upstream and downstream of the area requiring monitoring.

Detailed Grab Sample Collection Procedures for Each Monitoring Site

A. Inspect general conditions of the site. Note the conditions of the site at the time of sampling.

B. Once flowing water is observed in the drain pipe (or other storm water conveyance), manually collect a water sample with the polypropylene collection device.

C. Once sufficient water has been collected in the device, carefully pour the water into each of the laboratory sample bottles using the polypropylene funnels. Note: For collection of the oil and grease sample, a glass or metal funnel should be used.

D. After all water samples have been collected, rinse off the polypropylene collection device and funnels with distilled water and towel dry to prepare for the next sampling event.

7.2 FIELD MEASUREMENT METHODS

Certain grab samples will require field measurement of certain parameters. To accomplish this, pour a portion of storm water a clean plastic cup for field measurements. Electrical conductivity and pH can be measured using hand-held devices. The devices will be calibrated prior to mobilization at the monitoring site. At some locations, colorimetric field test kits (e.g., HACH field kits) may be used to test for the presence of chlorine or detergents. Follow manufacturers' instructions on proper use of the test kits. The measurements will be recorded in field notes and on the chain-of-custody forms. The sample portion will then be discarded following recording of the field measurements.

7.3 SAMPLE CONTAINERS AND HANDLING

Sampling procedures involving handling items that have direct contact with the samples (i.e., sampling container, container lid, etc.) will be performed in accordance with proper sample handling techniques designed to minimize contamination of the sample. In summary, sampling personnel are required to wear clean powder-free nitrile gloves. One member of the field team will not come into contact with any other

items and will change gloves between sample collections or when the gloves have come in contact with any potential source of contamination. The other field team member will be responsible for cleaning of sampling equipment and all other activities that do not involve handling items that have direct contact with the sample.

7.4 QA/QC SAMPLE COLLECTION METHODS

In order to maintain sample integrity, the following QA/QC procedure will be followed during collection of a storm water grab sample:

> Wearing clean powder-free nitrile gloves, one member of the field team will collect the storm water samples with the polypropylene scoop and the collection funnels. The second team member will organize the appropriate sample bottles and will label the collected samples. Once the entire sample volume has been collected, the first team member will pour a portion of the sample as required into a cup and take the field measurements while the second member records the data.

7.5 FORMS AND PROCEDURES FOR DOCUMENTING SAMPLE COLLECTION AND FIELD MEASUREMENTS

The following forms are to be completed during each storm event monitored at each site:

- Chain-of-custody form (An example of a chain-of-custody form appears on the next page.)
- Monitoring checklist (found in Section 5.1)
- Non-Visible Pollutant Monitoring Report (see Appendix G-1).

CHAIN OF CUSTODY RECORD

PAGE ____ OF ____

DATE ____/____/____

PROJECT NAME: _____ PROJECT NO: _____

Sample ID	Time Collected	Sample Type	Container	Preservation Temp	Preservation Chemical	Analysis Required (Method)

Total Number of Samples Shipped: _____ Comments: _____

Sampler's Signature: _____

Relinquished By	Received By	Date
Signature: _____	Signature: _____	___/___/___
Printed Name: _____	Printed Name: _____	Time
Company: _____	Company: _____	_____
Reason: _____	Reason: _____	
Relinquished By	Received By	Date
Signature: _____	Signature: _____	___/___/___
Printed Name: _____	Printed Name: _____	Time
Company: _____	Company: _____	_____
Reason: _____	Reason: _____	

7.6 LABORATORY COMMUNICATION PROCEDURES

The SWPPP Compliance Inspector will contact the analytical laboratory 24 hours before the anticipated beginning of the storm event. The laboratory will be instructed to prepare sample bottles for use at the monitoring sites and to prepare for receipt of samples during and following the storm event.

7.7 SAMPLE SHIPPING/DELIVERY AND CHAIN OF CUSTODY

After grab samples are collected, storm water sampling staff are responsible for delivery of grab samples to the analytical laboratory as soon as possible to meet sample holding time requirements. If samples are to be analyzed for bacteria, they must be delivered to the laboratory within six hours of sample collection. Samples for all other analyses should be delivered within 24 hours of collection. The laboratory should be notified of estimated time of delivery and be alerted when weekend delivery is required. The following list outlines the packaging and shipping procedures for pick-up:

- Assemble and package all sample bottles in an orderly and secure manner for delivery to the laboratory.
- Verify information on the chain-of-custody form completed by the field crew on a cooler-by-cooler basis.
- If multiple coolers contain bottles from the same station, indicate this on all related forms.
- Use military time (i.e., 2 p.m. = 1400 hours) for all entries in the Chain-of-Custody form.
- If necessary, re-pack coolers with ice to keep samples cool and to prevent breakage.
- Place the completed chain-of-custody form in a Ziploc™ bag and place the form in the cooler with the bottles.
- Pack any sampler bottles to be cleaned for delivery to lab.

7.8 SAMPLE PRESERVATION AND FILTRATION

During collection of grab samples, the field teams will seal sample bottles in Ziploc bags, place them in a cooler, and pack the cooler with ice in order to preserve the samples below 4 degrees Celsius. Once samples are at the laboratory, they will be refrigerated until analysis.

Sample filtration and/or preservative may be required for some analyses, including dissolved metals. Because of contamination concerns, this will be performed in the laboratory in accordance with procedures specified by the appropriate analytical method.

8.0 QUALITY ASSURANCE/QUALITY CONTROL

8.1 FIELD AND LAB PROCEDURES FOR QA/QC

The measurement of chemical constituents at the trace level is often difficult due to inherent properties of environmental samples, field sampling techniques, and analysis techniques. In order to assess and maximize data quality, a strict QA/QC program will be implemented as an integral part of the sampling plan. The QA/QC program is designed to enable an evaluation and validation of the analytical data for accuracy, and precision and contamination. This section describes the QA/QC program for field sample collection and for laboratory analysis.

8.1.1 QA/QC for Water Sample Collection

Several additional samples will be collected in the field and analyzed to help identify potential sources of error introduced into the storm water sampling process. These samples will include equipment blanks, field sample duplicates, and laboratory sample duplicates. The specific procedures for collecting each of these samples are provided below.

Equipment Blanks – Equipment blanks will be obtained to verify that the sample equipment is not a source of contamination. Sample blanks will be collected from the grab sample collection equipment during at least one storm event. Deionized water, supplied by the laboratory, will be passed through clean equipment and collected following normal sample collection procedures.

Laboratory Duplicates (Splits) – Sampling staff will collect occasional samples based on sufficient volume of storm water collected for the laboratory to perform laboratory duplicates to assess the precision of the analytical laboratory methods. The laboratory will perform laboratory duplicates for approximately 10% of the total number of samples collected. Laboratory duplicate procedures are explained in more detail in Section 8.1.2.

Field Duplicates (Splits) – Duplicate grab samples will be collected and analyzed for 10% of the total number of grab samples collected.

8.1.2 Laboratory QA/QC

The analytical laboratory will also run method-specific QA/QC protocols, such as Matrix Spike/Matrix-Spike Duplicates and Method Blanks. The laboratory QA/QC analyses are listed in Table 8-1. The QA/QC sample frequency for both field and laboratory QA/QC samples is listed in Table 8-2.

Table 8-1. Laboratory QA/QC Analyses

Type of Analysis	Description
Standards	Calibration standards with known concentrations will be prepared and used in the laboratory to obtain instrument calibration curves in accordance with the provisions of the various method specifications.
Method Blanks	Analyte-free water will be processed through all sample preparation procedures at the analytical laboratory and analyzed as a method blank. This will provide an indication as to whether contamination is occurring as a result of laboratory procedures. Method blanks will be prepared and analyzed by the laboratory for each QC batch analyzed.
Laboratory Duplicates (Splits)	The laboratory will analyze duplicate samples corresponding to 25% of the total number of samples collected. A sufficient amount of water volume will be collected in the field under normal sample collection procedures. However, the sample container will be labeled "laboratory duplicate" indicating to the laboratory that a split should be taken on that particular sample.
Matrix Spikes	Internal spikes (matrix spikes) will be prepared in the laboratory by adding a known amount of target and or surrogate analyte(s) into a field sample prior to laboratory preparation. To meet project goals, the matrix spike will be at one to five times the analyte concentration, in the original sample to prior analysis for the analyte. If the matrix spike is outside of the desired one to five range, a second spike will be required. Each of the spiked samples will also be analyzed in duplicate for an assessment of the analytical method precision. Matrix Spikes will be prepared and analyzed by the laboratory at a 10% frequency.

Table 8-2. QA/QC Sample Frequency

QA/QC Sample Type	Sampling Frequency
Equipment Blanks	Will be collected from polypropylene grab sampling equipment prior to the sampling season.
Field Duplicates	Will be collected for 10% of the total number of samples collected.
Laboratory Duplicates	Will be collected for 10% of the total number of samples collected.
Matrix Spike/ Matrix Spike Duplicates	Will be collected for 10% of the total number of samples collected.
Method Blanks	Will be run with each QC batch analyzed by the laboratory.

9.0 LABORATORY SAMPLE PREPARATION AND ANALYTICAL METHODS

Before analysis, the laboratory will be involved in the following activities:

- Reviewing the QA/QC criteria;
- Determining maximum reporting limits, turnaround times and report formats;
- Coordinating with construction site storm water sampling staff prior to the sampling event; and
- Providing sampling staff with clean sample bottles and blank water.

10.0 DATA MANAGEMENT AND REPORTING PROCEDURES

10.1 ANALYTICAL DATA VALIDATION

Results of precision and accuracy and contamination checks will be reviewed after each storm event. In the event that data quality objectives are not met, data will be qualified and documented as necessary.

Data collected from the laboratory will be validated through the following procedures:

- Review hard copy data package;
- Compare chain-of-custody forms to logbooks and laboratory data reports to ensure successful data transfer;
- Ensure that laboratory reports are complete;
- Ensure that there are no typographical errors or incongruities in the data;
- Compare QA/QC results with data quality objective criteria;
- Tabulate and analyze the success rate of each QA/QC parameter; and
- Document and report out-of-range values.

10.2 ELECTRONIC DATA TRANSFER

Data from the laboratory will be delivered in hard copy and electronic format. Both data packages will include:

- A narrative of any problems, corrections, anomalies, and conclusions; and
- Results/summary of QA/QC elements, including:
  - sample extract and analysis dates
  - method blanks, laboratory control spikes, and matrix spikes
  - analytical accuracy
  - analytical precision
  - reporting limits.

10.3 REPORTS

Monitoring reporting requirements are described in Section 7.3 of the SWPPP.

Appendix G-1

Non-Visible Pollutant Monitoring Report

NON-VISIBLE POLLUTANT MONITORING REPORT

Owner/Operator: _____ WDID No.: _____

Date of Sampling Event: _____ Time Runoff Started: _____

I. Reason for Sampling

Check one:

☐ Historic contamination

☐ Breach, malfunction, leakage, or spill

☐ Application of soil amendments

Describe: _____

_____

II. Non-Visible Pollutant Sample(s) Collection Information

Location sample(s) taken: _____

Time sample(s) taken: _____

Number of samples: _____

Non-visible pollutant(s) for which sample(s) was collected: _____

III. Uncontaminated Sample Collection Information

Location sample(s) taken: _____

Time sample(s) taken: _____

Number of samples: _____

IV. Field Analysis

☐ Not Performed

Device(s) used: _____

Parameter	Uncontaminated Sample		Non-visible Pollutant Sample	
	1	2*	1	2*

* If duplicate is taken

V. Laboratory Analysis

☐ Not Performed

Analytical Laboratory: _____

Parameters: _____

Attach laboratory results and chain-of-custody forms to this form.

Sample(s) collected by: _____ **Date:** _____
(Signature)

Printed Name and Title: _____

NON-VISIBLE POLLUTANT MONITORING REPORT

VI. Follow-Up Actions Taken (check appropriate boxes based on evaluation of test results)

☐ Repaired or Replaced BMP that has failed.

Describe: _____

_____

☐ Maintained BMP that is not functioning properly due to lack of maintenance.

Describe: _____

_____

☐ Implemented Additional or Alternating BMPs.

Describe: _____

_____

☐ Notified Regional Board of discharge.

Date: _____

Signature: _____ **Date:** _____

Printed Name and Title: _____

APPENDIX H

SEDIMENT CONTROL PLAN

SEDIMENT CONTROL PLAN

The intent of this Sediment Control Plan is to identify baseline mitigation measures for minimizing erosion and sedimentation using best management practices (BMPs) that are applicable to Sound Energy Solutions' (SES) Long Beach LNG Import Project. The project will be located on a 25-acre site on Pier T at designated Berth 126 within the Port of Long Beach (POLB) in Los Angeles County, California and will involve construction of a liquefied natural gas (LNG) import terminal capable of unloading LNG ships ranging in capacity up to 208,000 cubic meters. The project will provide an average sendout capacity of 700 million standard cubic feet per day with a peak capacity of 1 billion standard cubic feet per day. The LNG terminal facilities will include:

- an 1,100-foot-long LNG ship berth and unloading facility with unloading arms, mooring and breasting dolphins, and a fendering system that will be capable of unloading one ship at a time;
- two LNG storage tanks, each with a gross volume of 160,000 cubic meters (1,006,000 barrels) surrounded by a security barrier wall;
- 20 electric-powered booster pumps;
- four shell and tube vaporizers using a primary, closed-loop water system;
- three boil-off gas compressors, a condensing system, a natural gas liquids recovery system, and an export ethane (C_2) heater;
- an LNG trailer truck loading facility with a small LNG storage tank;
- a natural gas meter station and odorization system;
- utilities, buildings, and service facilities; and
- associated hazard detection, control, and prevention systems; site security facilities; cryogenic piping; and insulation, electrical, and instrumentation systems.

A 36-inch-diameter natural gas sendout pipeline will extend approximately 2.3 miles north from the LNG terminal, crossing the Cerritos Channel with a horizontal directional drill (HDD), and terminating at Southern California Gas Company's (SoCal Gas) existing Line 765 at its Salt Works Station. A 4.6-mile-long, 10-inch-diameter C_2 pipeline will be constructed approximately parallel to the natural gas sendout pipeline as far as the interconnection point with SoCal Gas' existing Line 765 and will continue on a primarily due north route, through city streets, to ConocoPhilips' Los Angeles Refinery – Carson facility. The project will also include 0.8 mile of electric distribution lines to provide 66 kilovolt service to a new substation (the Sound Substation) that will be located within the LNG terminal boundaries at the northern end of the site. Approximately 4,160 circuit feet of overhead 954 spaced aerial cable on 10 tubular steel poles will be installed. The first 830-foot-long extension will connect along the APL Substation tap along Pier T Avenue, going westerly to the new Sound

Substation, and requires the installation of one new pole switch. The remaining 3,300-foot-long extension will connect along the Dock Substation tap along Seaside/Ocean Boulevard, going southerly to the new Sound Substation, and requires the installation of one new pole switch.

Construction of the LNG terminal facilities will occur entirely within a previously disturbed and currently maintained portion of the existing Pier T on land leased from the POLB. The site is located on fill land and was historically used as a naval shipyard. It is currently a paved/asphalted area with abandoned buildings that will be demolished and removed by the POLB prior to the start of any construction activities for the LNG terminal. There are no wetlands or vegetation on site; Long Beach Middle Harbor abuts the south and west sides of the site.

The entire route of the natural gas and C_2 pipelines is within heavily disturbed, industrialized areas. No wetlands or residential areas will be crossed. One waterbody (the Cerritos Channel) and several railroad lines, driveways, and roads will be crossed by both pipelines. The C_2 pipeline will also cross the Dominguez Channel.

This Sediment Control Plan incorporates those sections of the Federal Energy Regulatory Commission's (FERC or Commission) January 2003 *Upland Erosion Control, Revegetation, and Maintenance Plan* (Plan) and *Wetland And Waterbody Construction and Mitigation Procedures* (Procedures) that are relevant to the environmental conditions in the project area.

Mitigation measures embedded in the FERC Plan and Procedures are included here for purposes of confirming environmental protection for all aspects of the project, including the pipelines and the rehabilitation of the wharf and marine facilities.

Provisions of the Plan and Procedures that SES considers unnecessary due to local conditions are identified in Table H-1 along with justification for why those provisions are not applicable.

Table H-1
Justification for Not Incorporating Provisions of the Plan and Procedures

Section	Topic	Justification
Procedures		
II.A. 2	Schedule for trenching or blasting within each waterbody greater than 10 feet wide or within any designated coldwater fishery	No applicable resources.
II B 1	File plans for any extra work areas that would be closer than 50 feet from the water's edge	Extra work areas for the Cerritos and Dominquez Channel crossings will be located over 50 feet from the

Table H-1
Justification for Not Incorporating Provisions of the Plan and Procedures

Section	Topic	Justification
		waterbody.
II B 3	Use of construction right-of-way greater than 75 feet in wetlands	No wetlands crossed.
IV. A. 1. f.	No concrete coating within 100 feet of a wetland or waterbody	No plans for concrete coating activities .
V.A.2, 4	Potable surface water intakes, trenching or blasting in waterbodies	No applicable resources or activities.
V.B.1	Time window for instream work	No freshwater instream work; POLB will comply with U.S. Army Corps of Engineers permit time windows for dredging in Long Beach Harbor.
V.B.2	Extra Work Areas	Extra work areas for the Cerritos and Dominquez Channel crossings will be located over 50 feet from the waterbody.
V.B.3 c,d,e,f	Pipeline paralleling waterbody, multiple channel waterbodies, flow rates in channel, buffers and setbacks	Extra work areas for the Cerritos and Dominquez Channel crossings will be located over 50 feet from the waterbody; no applicable resources or activities.
V.B.5	Equipment bridges	No applicable activity.
V.B.6 a, b, c	Dry-ditch crossing methods including dam-and-pump, flume	No applicable activity.
V.B.7	Crossings of minor waterbodies	No applicable resources.
V.B.8	Crossings of intermediate waterbodies	No applicable resources.
V.B.9	Crossings of major waterbodies	Plans for the crossings will be submitted to appropriate federal and state regulatory agencies
V.B.10.a	Sediment barrier at waterbody crossings	Extra work areas for the Cerritos and Dominquez Channel crossings will be located over 50 feet from the waterbody.
V.B.10.c	Trench plugs	No applicable activities; horizontal directional drill and existing pipe bridge crossings.
V.C.	Restoration	No applicable resources or activities.
V.D.	Vegetation control and protection	No vegetation present on Pier T or at crossing locations requiring protection. No noxious weed

Table H-1
Justification for Not Incorporating Provisions of the Plan and Procedures

Section	Topic	Justification
		populations present.
VI.	Wetland crossing procedures	No wetlands crossed.
VII. A 1,3,. – B.2, C.	Hydrostatic testing procedures for wetlands and waterbodies	No applicable resources; hydrostatic test water will be purchased from public water supply.
Plan		
II.B.3	Environmental Inspector (EI) responsible for flagging clearing limits	No applicable activities; no clearing needed.
II.B.4	EI responsible for flagging sensitive resources	No applicable activities; Cerritos Channel crossing does not approach the waterbody closer than 200 feet; Dominquez Channel will be crossed using an existing pipe bridge.
II. B. 8., 9., and 11.	EI responsibilities relative to access roads, wetlands, compaction, rutting, or soils imported for agricultural and residential use.	No applicable facilities or resources.
III. A. 2.	Expanded cultural resources and endangered species surveys	No anticipated need to work outside of approved areas.
III. B. – C.	Drain tile and irrigation systems and grazing deferment.	No applicable resource.
III. F.	Agency coordination for permanent erosion control, revegetation, noxious weeds, and soil pests.	No applicable resource concerns; no noxious weed populations present in work areas or on Pier T.
IV. A. 2.	Right-of-way shall not exceed 75 feet	No applicable facility.
IV. B.- D.	Topsoil segregation, drain tile and Irrigation	No applicable resource concerns.
IV.E.2	Crushed stone access pads in residential or agricultural areas	No applicable facility.
IV. F. 1.a-d	Temporary slope breakers	No slopes
IV. F. 3	Mulching slopes	No slopes.
V. A. 1– 5, 7.	Cleanup of construction right-of-way	No applicable facility, no slopes, and no contours to restore.
V. B. – D.	Trench and slope breakers, soil compaction, revegetation	No applicable resource concerns.
VI.	Off-road vehicle control	No forested lands
VII. A 1–2, 4– 6, B	Monitoring, maintenance, and reporting	No applicable facilities

I. PRECONSTRUCTION FILING (FERC Procedures II.)

A. SES plans to obtain hydrostatic test water from public water supply sources and to discharge the water through existing stormwater drains in the POLB. Before construction, SES will file with the Secretary of the Commission the final plans identifying the hydrostatic test water sources and discharge location. (FERC Procedures II.A.1. and VII.B.3.)

B. Construction at the site will require construction within 50 feet of the harbor waters. SES will file site-specific construction plans with the Secretary of the FERC showing the location of sediment controls prior to construction. (FERC Procedures II.B.1.)

II. ENVIRONMENTAL INSPECTOR (FERC PROCEDURES III. AND PLAN II.A.)

A. SES will designate at least one Environmental Inspector during construction of the facilities and the pipeline owner(s) will designate an Environmental Inspector as called for in federal or state permits who shall have peer status with all other activity inspectors. (FERC Plan II.A.2.FERC Procedures II.A.1)

B. The Environmental Inspector will have the authority to stop activities that violate the environmental conditions of the Order, state and federal environmental permit conditions, or POLB requirements; and to order appropriate corrective action. (FERC Plan II.A.3.)

C. The Environmental Inspector's responsibilities will at a minimum include: (FERC Plan II.B.)

1. Ensuring compliance with the requirements of SES' Sediment Control Plan, Stormwater Pollution Prevention Plan (SWPPP), the environmental conditions of the FERC authorization, the mitigation measures proposed by SES (as approved and/or modified by the Order), other environmental permits and approvals, and requirements of the POLB. (FERC Plan II.B.1.)

2. Identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance. (FERC Plan II.B.2.)

3. Identifying erosion/sediment control and soil stabilization needs in all areas. (FERC Plan II.B.5)

4. Ensuring that the location of dewatering structures will not direct water into known cultural resources sites or locations of sensitive species. (FERC Plan II.B.6)

5. Verifying that dewatering activities do not result in the deposition of sand, silt, and/or sediment near the point of discharge into the harbor. If such deposition is occurring,

the dewatering activity shall be stopped and the design of the discharge shall be changed to prevent reoccurrence. (FERC Plan II.B.7)

6. Ensuring restoration of contours. (FERC Plan II.B.10)

7. Determining the need for and ensuring that erosion controls are properly installed, as necessary to prevent sediment flow into the harbor, sensitive areas, and onto roads. (FERC Plan II.B.12)

8. Inspecting and ensuring the maintenance of temporary erosion control measures at least: (FERC Plan II.B.13.)

   a. on a daily basis in areas of active construction or equipment operation;

   b. on a weekly basis in areas with no construction or equipment operation;

   and

   c. within 24 hours of each 0.5 inch of rainfall.

9. Ensuring the repair of all ineffective temporary erosion control measures within 24 hours of identification. (FERC Plan II.B.14)

10. Keeping records of compliance with the environmental conditions of the FERC Order, and the mitigation measures proposed by the project sponsor in the application submitted to the FERC, and other Federal or state environmental permits during active construction and restoration. (FERC Plan II.B.15)

11. Identifying areas that should be given special attention to ensure stabilization and restoration after the construction phase. (FERC Plan II.B.16)

III. PRECONSTRUCTION PLANNING (FERC Procedures II, IV. and V. and Plan III.)

A. SES will identify all construction work areas that will be needed for safe construction and will ensure that appropriate cultural resources and biological surveys have been conducted. (FERC Plan III.A.1.)

B. SES has provided a plan for the HDD of the Cerritos Channel and will provide this plan to the pipeline owner(s) for compliance purposes. (FERC Procedure V.B.6.d)

C. SES plans show that the HDD crossings are as perpendicular to Cerritos Channel as possible given presence of other utilities and crossing engineering. (FERC Procedure V.B.3.b).

D. SES plans show nearest work areas to Cerritos Channel are at least 50 feet from the waterbody and that there will be no equipment, ground disturbance, or spoil storage within 50 feet of the waterbody. (FERC Procedure V.B.3.a,b, V.B.4.a)

E. The pipeline owner(s) will submit plans for the HDD crossing of the Cerritos Channel to applicable regulatory agencies and will obtain and comply with the terms and conditions of all necessary permits, including the U.S. Army Corps of Engineers section 10 permit and Regional Water Quality Control Board section 401 permits if necessary. (FERC Procedures II.B.2, 4, IV.A.1.d, V.A.1, 3, 4, and V.B.3.a)

F. SES will plan for safe and accessible conditions at all roadway crossings and access points during construction and restoration. (FERC Plan III.D.)

G. SES will determine methods and locations for the disposal of construction debris (e.g., timber, slash, mats, garbage, drilling fluids, excess rock, etc). Off-site disposal in other than commercially operated disposal locations is subject to compliance with all applicable survey, landowner permission, and mitigation requirements. (FERC Plan III.E.)

H. SES will have a copy of the SWPPP prepared for compliance with the U.S. Environmental Protection Agency's National Stormwater Program General Permit requirements. The SWPPP shall contain Spill Prevention and Response Procedures that meet the requirements of state and federal agencies. (FERC Plan III.G. and Procedures IV.A.)

I. SES and its contractors will structure their operations in a manner that reduces the risk of spills or the accidental exposure of fuels or hazardous materials to the harbor. SES and its contractors will, at a minimum, ensure that: (FERC Procedures IV.A.1.a. through IV.A.1.e.)

   1. all employees handling fuels and other hazardous materials are properly trained;

   2. all equipment is in good operating order and inspected on a regular basis;

   3. fuel trucks transporting fuel to on-site equipment travel only on approved access roads;

   4. all equipment is parked overnight and/or fueled at least 100 feet from the Cerritos and Dominquez Channel crossings. On Pier T, where construction requires equipment parked overnight or fueled closer than 100 feet from the

Long Beach Harbor, SES contractors will use appropriate measures to prevent spills and provide for prompt cleanup in the event of a spill; and

5. hazardous materials, including chemicals, fuels, and lubricating oils, are not stored within 100 feet of the harbor or the Cerritos and Dominquez Channels, unless the location is designated for such use by an appropriate governmental authority. This applies to storage of these materials and does not apply to normal operation or use of equipment in these areas.

J. The project sponsor and its contractors must structure their operations in a manner that provides for the prompt and effective cleanup of spills of fuel and other hazardous materials. At a minimum, the project sponsor and its contractors must: (FERC Procedures IV.A.2.a. through d.)

1. ensure that each construction crew (including cleanup crews) has on hand sufficient supplies of absorbent and barrier materials to allow the rapid containment and recovery of spilled materials and knows the procedure for reporting spills;

2. ensure that each construction crew has on hand sufficient tools and material to stop leaks;

3. know the contact names and telephone numbers for all local, state, and federal agencies (including, if necessary, the U. S. Coast Guard and the National Response Center) that must be notified of a spill; and

4. follow the requirements of those agencies in cleaning up the spill, in excavating and disposing of soils or other materials contaminated by a spill, and in collecting and disposing of waste generated during spill cleanup.

K. SES will coordinate with the appropriate local, state, and federal agencies as outlined in this Sediment Control Plan and in the FERC Order. (FERC Procedures VI.B.)

IV. CONSTRUCTION PROCEDURES (FERC Procedure IV, V, Plan IV.)

A. SES will limit all project-related ground disturbance to the approximate project site, laydown area, and other areas approved in the FERC Order. SES will request FERC approval for any project-related ground disturbing activities outside these approved areas. All construction or restoration activities outside of the approved areas will be subject to all applicable survey and mitigation requirements. (FERC Plan IV.A.1.)

B. SES will maintain safe and accessible conditions at all access points during construction. (FERC Plan IV.E.1.)

C. SES will install temporary erosion controls immediately after initial disturbance of the soil. Temporary erosion controls will be properly maintained throughout construction (on a daily basis) and reinstalled as necessary until replaced by permanent erosion controls or restoration is complete. (FERC Plan IV.F.)

D. SES will install and maintain temporary sediment barriers as needed to prevent sediment from leaving the site or entering the harbor where the harbor is adjacent to the project site. Sediment barriers are intended to stop the flow of sediments and to prevent the deposition of sediments into sensitive resources. They may be constructed of materials such as silt fence, staked hay or straw bales, compacted earth, sand bags, or other appropriate materials. (FERC Procedures VI.A.2, D, and Plan IV.F.2.a. through IV.F.2.c.)

E. SES (for testing tanks) and the pipeline owner(s) (for testing pipelines) will obtain hydrostatic testing permits from the Regional Water Quality Control Board, Los Angeles Region and will abide by their terms and conditions and by any terms and conditions set by the POLB for the use of its storm drain system. Water will be purchased from the public water supply and discharged to the existing POLB storm drain system for both tank and pipeline facilities. (FERC Procedures VII A.2.d).

F. The pipeline owner(s) will construct trench breakers as required for the slope of the trench. (FERC Plan V.B.1)

V. CLEANUP (FERC Plan V.A.)

A. SES will remove construction debris from all construction work areas unless the POLB approves otherwise. (FERC Plan V.A.6.)

B. SES will monitor and correct problems with drainage resulting from construction. (FERC Plan VII.A.3.)

APPENDIX I

SPILL PREVENTION AND RESPONSE PROCEDURE

SPILL PREVENTION AND RESPONSE PROCEDURE
LONG BEACH LNG IMPORT PROJECT

1 PURPOSE

The purpose of this Spill Prevention and Response Procedure (SPRP) is to provide preventive and mitigative measures to be employed by Sound Energy Solutions, Inc. (SES) to avoid or minimize the environmental impact of spills or releases of fuels, lubricants, or other hazardous materials within 100 feet of any waterbody associated with the construction of the proposed LNG terminal.

2 PLANNING AND PREVENTION

SES will require its contractors to implement proper planning and preventive measures to minimize the likelihood of spills, and to quickly and successfully cleanup a spill if one should occur. As part of the planning that will be undertaken prior to construction, detailed preparations will be made to ensure that storage arrangements for any hazardous materials, chemicals, fuels, lubricating oils or other such materials required for performing the construction tasks, are safe and secured in containers manufactured for the suited purpose.

3 ROLES AND RESPONSIBILITIES

SES's construction contractor (Contractor) shall designate an independent contractor that is an expert in environmental clean-up (Emergency Response Contractor). This independent contractor shall be responsible for remediating spills that are considered beyond the capabilities of the Contractor.

The Contractor shall be responsible and accountable for any and all of its subcontractors' activities relative to environmental regulations and requirements. All subcontractors shall comply with the SPRP.

The Contractor shall provide SES with copies of Material Safety Data Sheets (MSDS) for any hazardous chemicals supplied by the Contractor. SES shall provide the Contractor with copies of MSDS for any hazardous chemicals supplied by SES.

The Contractor shall be considered the waste generator for all spills caused by Contractor activity.

The Contractor shall identify and prepare a written inventory of approved waste transporters and disposal sites for both hazardous and non-hazardous wastes near the site of construction activities. This information shall be provided to SES' chief inspector.

4 TRAINING

All personnel responsible for handling any fuel, lubricants, chemicals, or hazardous materials shall receive training on the requirements of this SPRP.

Handling of all fuel, lubricants, chemicals, or hazardous materials shall be conducted by personnel who have been trained for the specific task.

The training specified above shall be completed prior to commencing any activities or carrying out any task associated with such materials.

The Project Manager or his designee shall be responsible for ensuring the requirements of this section are completed.

5 SPILL PREVENTION AND MITIGATION MEASURES

5.1 GENERAL

The Contractor will be responsible for developing and maintaining an equipment list to be kept on site for spill countermeasures. This list will be submitted to SES and to the Federal Energy Regulatory Commission and the Port of Long Beach for approval prior to commencing construction. In addition, the Contractor will be responsible for developing a list of Best Management Practices, including equipment inspection measures, that will be employed and for submitting that list prior to construction for approval by SES and by appropriate federal, state, and local agencies.

5.2 CONTAINER STORAGE AND SECONDARY CONTAINMENT STRUCTURES

All containers of 55 gallons or greater for fuel or hazardous materials shall be stored in designated areas equipped with secondary containment structures within the construction workspaces. All storage will occur at a distance greater than 100 feet from any surface water. These structures shall provide a minimum containment volume of 110 percent of the volume of the largest storage vessel and provide at least 1-foot of freeboard. If 55-gallon drums of fuel or hazardous materials require temporary storage in the immediate work area, they shall be stored in polyethylene drum spill skids.

Earthen secondary containment areas shall be made impervious to spills by lining the area with ≥40-mil gauge plastic sheeting.

All fuel and hazardous chemical containers shall be properly labeled and identified.

5.3 LEAK AND STRUCTURAL INTEGRITY INSPECTIONS

During construction activities, daily visual inspection will be made on vehicles, stationary equipment, secondary containment areas (tank and drum storage areas), and spill response areas to look for indications of leaks. At the LNG terminal site, all equipment will be inspected by a site environmental officer upon arrival at the site and before being put to work.

A. FUELS AND HAZARDOUS MATERIAL HANDLING

- Fueling for mobile equipment will take place in designated areas only. At the time of construction, the Contractor will supply SES with a drawing of designated fueling areas, which must be greater than 100 feet from any surface water. Suitable drip trays shall be placed underneath the equipment fuel tank nozzle or sump prior to the work commencing. Absorbent material/pads will be available at the immediate location while refueling or servicing is taking place and any drips will be cleaned up on completion of each operation.

- If possible, stationary equipment will be located a minimum distance of 100 feet from any waterbody or site boundary and placed within a drip tray or on a concrete slab having raised edges. During the actual refueling and servicing of stationary equipment, a supply of sand and absorbent pads will be available adjacent to the equipment location. Stationary equipment location and fueling/servicing arrangements will be agreed upon by the Contractor and the SES Environmental Inspector.

- Fuel tanks located on barges will be located over drip trays or within a containment area suitable to collect any leaks or spills and prevent fluids flowing from the barge. Absorbent pads will be held in the immediate location of the equipment during re-fueling or servicing. In addition, the barge will be equipped with floating booms to be deployed immediately in the event of a spill when transferring fuel from an adjacent barge or land based delivery tanker to replenish fuels stored on board.

6 TYPICAL HAZARDOUS MATERIALS

Typical hazardous materials to be stored on site will include fuels, oils, and greases for the construction equipment together with other materials, such as for finish painting and other necessary protective coatings. The quantity of hazardous materials that will be permitted on site at any one time will be limited to that required as short-term supply

only (i.e. "ready to use"). The individual types of materials will be segregated and stored in accordance with manufacturers' recommendations and all state or federal laws as applicable.

The exact quantities of materials needed on a daily basis will be calculated and recorded as part of the preconstruction planning activity.

7 SPILL HANDLING PROCEDURE

7.1 INITIAL SPILL MANAGEMENT

- Immediately upon learning of any fuel, oil, or hazardous material spill, the person discovering the situation shall initiate actions to contain the spill and shall initiate actions to eliminate the source of the spill.
- The SES Facility Manager or Contractor shall be notified immediately.
- An Emergency Response Contractor shall be used in event the spill containment and cleanup is beyond the capabilities of the Contractor.
- The Environmental Inspector shall assist the Contractor's Spill Coordinator in determining spill notification requirements to the appropriate federal, state, and local agencies.
- The type of material and quantity released shall be identified and appropriate personal protective equipment shall be worn as recommended by the product (see specific MSDS).
- Spill containment may include construction of earthen dikes around the spill area, deployment of absorbent materials, or use of commercially available spill kits.
- Contaminated soil and spilled material shall be stored in appropriate and properly labeled containers.
- If a spill enters a surface water, containment booms shall be deployed and product shall be removed with a vacuum truck, if necessary.
- For large spills on land, pooled material shall be pumped into tank trucks.

7.2 LAND BASED

Drip trays and containment areas will be kept clean of any fuel or oil residues at all times. However, in the event of a spill or fuel/oil leak occurring on land-based equipment outside of the drip tray or containment, the source of the discharge will be identified and immediate steps taken to prevent any further discharge. Spilled fuel will be prevented from spreading before being collected and placed in suitable containers for disposal. Soils contaminated by the spill, together with absorbent materials used to cleanup the spill, will also be gathered for disposal at an approved location.

7.3 OVER WATER

Spills occurring within drip trays or containment areas around equipment mounted on barges will be dealt with in the same manner as for land-based events. However, in the event of spills occurring over water, the source of discharge will be identified and measures taken to prevent further discharge. The floating boom held on board the barge will be immediately deployed to surround the affected area and the residue collected with the use of a suction pump or buckets and absorbent materials depending upon the volume involved. Contaminated fluids will be placed into a suitable container or tank for disposal at an authorized location.

7.4 MATERIAL DISPOSAL

Spilled materials, contaminated soils and water, absorbents, and miscellaneous spill-related debris require proper handling. It is the Contractor's responsibility to properly dispose of these and any other materials associated with spill containment and cleanup.

The Contractor shall supply SES with copies of all documentation concerning the disposal of contaminated soil, water, and other materials.

APPENDIX C

HORIZONTAL DIRECTIONAL DRILL PLAN
FOR THE LONG BEACH LNG IMPORT PROJECT

SOUND ENERGY SOLUTIONS
LONG BEACH LNG IMPORT PROJECT
HORIZONTAL DIRECTIONAL DRILL PLAN
TABLE OF CONTENTS

1 INTRODUCTION C-1

2 HORIZONTAL DIRECTIONAL DRILLING PROCESS C-1

3 MONITORING PROCEDURES C-2

4 CONTAINMENT AND CONTROL C-3

5 NOTIFICATION PROCEDURES C-4

6 STORAGE OF LUBRICANTS AND FLUIDS TO BE USED C-4

7 HAZARDOUS MATERIALS CONTINGENCY PLAN C-5

8 ABANDONMENT PLAN C-6

HORIZONTAL DIRECTIONAL DRILL PLAN
Long Beach LNG Import Project

1 INTRODUCTION

An associated part of the Long Beach LNG Import Project will involve the construction of an approximately 2.3-mile-long, 36-inch-diameter natural gas sendout pipeline to transport the vaporized natural gas from the LNG terminal to an interconnection with Southern California Gas Company's (SoCal Gas) Line 765 at its Salt Works Station north of Anaheim Street. In addition, a 4.6-mile-long, 10-inch-diameter ethane pipeline will be constructed approximately parallel to the natural gas sendout pipeline as far as the interconnection point with SoCal Gas' existing Line 765 and will continue on a primarily due north route, through city streets, to ConocoPhilips' Los Angeles Refinery Carson Plant. Installation of the pipelines will involve horizontal directional drills (HDD) under the Cerritos Channel within the Port of Long Beach (POLB).

This HDD Plan identifies specific procedures and steps involved with an HDD, as well as a contingency plan to contain the inadvertent release of drilling fluid. The Cerritos Channel is an artificial channel that provides access from the outer Long Beach Harbor to Channels 2 and 3 and the Main Channel in the Los Angeles Harbor.

The HDDs of the Cerritos Channel will be approximately 2,700 feet in length and will be a maximum of approximately 50 feet below the channel bottom (90 feet below ground surface). The drill rig will be set up at the Long Beach Generating Station, about 1,000 feet from the southern edge of the Cerritos Channel. The drills will exit on the north side of the channel about 300 feet from the water's edge. All drilling operations will be confined to a 200-foot by 200-foot temporary extra workspace at the HDD entry site, a 100-foot by 150-foot temporary extra workspace at the HDD exit location, and right-of-way along the path of the HDD that will include the staging for the pipe strings for the pull backs. The pipe strings will be laid out on the north side of Cerritos Channel along Carrack Street.

2 HORIZONTAL DIRECTIONAL DRILLING PROCESS

Installation of a pipeline by HDD is generally accomplished in the following three stages:

1. The first stage consists of directionally drilling a small diameter pilot hole along a predetermined path. During drilling of the pilot hole, directional control is achieved by using a non-rotating drill string with an asymmetrical leading edge. The asymmetry of the leading edge creates a steering bias, which allows the operator to control the direction of the drill bit. The actual path of the pilot hole is determined during drilling by a very accurate monitoring and control system, which tracks the progress and exact location of the drilling head at all times.

2. The second stage begins once the pilot hole is complete, when the pilot hole is enlarged (reamed) to a diameter that will accommodate the pipeline. Typically, numerous "reaming" passes are necessary with each pass enlarging the diameter of the pilot hole incrementally. The reamers are typically attached to the drill string at the exit point and are rotated and drawn to the drilling rig, thus enlarging the pilot hole with each pass. To minimize heaving during pullback, a pullback rate that maximizes the removal of soil cuttings and minimizes compaction of the ground around the borehole is used. The pullback rate is also set to minimize overcutting of the borehole during the back reaming operation to ensure excessive voids are not created resulting in post installation settlement.

3. The third stage of pipe installation is accomplished by attaching a prefabricated pipeline pull section behind a reaming assembly at the exit point and pulling the entire pipeline string assembly back through the drilled hole to the drilling rig. After the pipe is in place, tie-in welds on each side of the crossing are completed.

In the recent past, a 36-inch-diameter pipeline from Carrack Street to Terminal Island was successfully installed using the HDD method. Therefore, it is reasonable to assume that these pipelines, using similar techniques and technology, can also be successfully installed using the HDD method.

3 MONITORING PROCEDURES

Contractor personnel will be on-site during HDD activities and will continuously monitor all operations during drilling activities. The drilling operator will maintain records on drilling fluid pumping rates, pressures, viscosity and density, etc. throughout the course of drilling activities. Drilling is typically done during daytime hours. If nighttime drilling activities are necessary, appropriate lighting will be provided to assure continued drilling fluid release monitoring.

Contractor personnel will:

- visually inspect the drill path, including monitoring the channel for evidence of drilling fluid release;
- continuously check drilling fluid pressures and return flows; and
- inspect the site during and after break-down and equipment move-off.

4 CONTAINMENT AND CONTROL

The best way to avoid problems is by monitoring drilling operations continuously with experienced personnel trained in all aspects of the HDD process. HDD procedures include a very accurate monitoring and control system to track the progress and exact location of the drilling head at all times. Horizontal and vertical adjustments are made throughout the procedure to ensure that the drilling profile matches the planned profile. Drilling fluid is used during the advancement of the drill string to erode the formation and aid in stabilizing the pilot hole. The specific weight of the drilling fluid is adjusted throughout the procedure to ensure hydrological stability. Jetting pressures will be limited to avoid a drilling fluid release during drilling. However, should a release of drilling fluid occur in the project area, operations will stop immediately and the following measures will be implemented:

<u>Measures to Contain a Release of Drilling Fluid in a Waterway:</u>

- If a release of drilling fluid occurs within a major waterway, appropriate federal and state agencies will be contacted immediately and informed about any threat to public health and safety. Drilling fluid pressure will be reduced and operations will be suspended to assess the extent of the release and to implement other possible corrective actions.
- If public health and safety is threatened, drilling fluid circulation pumps will be turned off. This measure will be taken as a last resort because of the potential for drill hole collapse resulting from loss of down-hole pressure.

Measures to Contain a Release of Drilling Fluid on Land:

- If a land release is detected, the drilling crew will take immediate corrective action to contain the release and to prevent migration off-site.
- Pits and/or berms will be constructed around the bore hole entry point to contain drilling fluids and returns.
- Containment equipment including earth moving equipment, portable pumps, hand tools, sand bags, hay bales, silt fencing, lumber, and vacuum trucks will be stored and readily available at the drilling site.
- If the amount of drilling fluid from an on-land release does not allow practical collection, the drilling fluid will be diluted with fresh water and allowed to dry. Steps will be taken (such as berm, silt fence and/or hay bale installation) to prevent silt-laden water from escaping the affected area.
- If hand tools cannot contain a small on-land release, small collection sumps (less than 5 cubic yards) may be constructed to pump the release material into the drilling fluid processing system.
- Any drilling fluid seepage will be removed using sump pumps or a vacuum truck and then transported to an approved disposal site.

5 NOTIFICATION PROCEDURES

Agency contact names and telephone numbers will be provided before construction of the HDDs. At a minimum, the following agencies will be notified immediately in the event an inadvertent release of drilling fluid is discovered:

1. POLB
2. City of Long Beach
3. U.S. Army Corps of Engineers (ACOE)
4. California Department of Fish and Game (CDFG)

6 STORAGE OF LUBRICANTS AND FLUIDS TO BE USED

At this time, the drilling fluid is assumed to be bentonite slurry with no additives. If use of additives becomes necessary, specifications for such additives will be provided to the POLB and the Cities of Long Beach and Los Angeles as well as to the ACOE prior to use. There are no plans to include any toxic or hazardous materials in the drilling mud. All drilling fluid brought onto the project site will be kept in closed containers in compliance with the U.S. Department of Transportation packing specifications except when transferred to mixing boxes during HDD activities.

7 HAZARDOUS MATERIALS CONTINGENCY PLAN

The only known hazardous materials that will be on site during the construction phase will be fuels and lubricants in the construction equipment. No fuels or lubricants will be stored on the construction location. The exposure to a fuel or lubricant spill will be limited to the actual tank capacity of the equipment. In the event of a fuel or lubricant spill on site, the following procedures will be implemented:

1. Primary Action at the Spill Location
    a. Notify the Project Supervisor.
    b. Minimize the spill by building earth dikes to contain it.

2. Secondary Action
    a. For a small quantity spill, absorbent pads, which will be carried in each supervisor's vehicle, will be applied. Additional pads will be stored in the construction storage container on site. All absorbent pads will be disposed of in plastic bags and placed into a container marked for proper disposal.
    b. For a larger quantity spill, a hazardous waste removal contractor will be mobilized to the site with a vacuum truck.
    c. If any hazardous material reaches any waterway or ditch containing water, absorbent booms, which are stored at the construction container on site, will be deployed.

3. Final Cleanup
    a. All contaminated soil or other contaminated materials will be removed and placed into plastic bags or other approved containers and disposed of off site by the hazardous waste contractor.
    b. Backfilling and grading will be performed to restore the spill area.

4. Notifications
    a. Ensure a copy of this notification information is in the possession of the contractor site supervisor.
    b. Immediately notify the on site contractor supervisor and owner representative.
    c. Make all notifications to county and state agencies as appropriate including:
        i. POLB
        ii. City of Long Beach Fire Department
        iii. Los Angeles County Office of Emergency Services
        iv. California Office of Emergency Services

8 ABANDONMENT PLAN

If for any reason, it becomes necessary to suspend HDD operations and/or abandon the partially completed drill holes, the following procedures will be implemented.

During Pilot Hole Drilling. If drilling is suspended during pilot hole drilling, the drill string will be withdrawn and the hole will be pumped with cement or industry approved fill material to displace the drilling fluid.

During Reaming. If drilling is suspended during the reaming of the hole

1. If possible, the reamer will be pushed back to the exit end, then:
    a. Reamer will be replaced with a cementing head.
    b. Drill string will be withdrawn and the hole will be pumped with cement or industry approved fill material to displace the drilling fluid.

2. If the reamer can not be pushed back to the exit end, then:
    a. Drill string will be withdrawn and the hole will be pumped with cement or industry approved fill material to displace the drilling fluid.
    b. Drilling rig will rig down at the entry end and rig up at the exit end.
    c. Drilling rig will run in the pilot hole with cement head on pilot hole drill string until previously cemented reamed hole is bumped.
    d. Drill string will be withdrawn and hole pumped with cement or industry-approved fill material to displace the drilling fluid.

HDD Realignment. If it is found necessary to abandon the original location, the proposed alignment will be modified to accommodate a new drill. The proposed new exit and entry areas will be surveyed for sensitive biological and cultural resources, and agencies with regulatory control will be contacted to amend approvals as needed.

APPENDIX D

TRAFFIC INTERSECTION WORKSHEETS
FOR THE LONG BEACH LNG IMPORT PROJECT

Pier T LNG Facility
Existing
AM Peak

Scenario Report

Scenario:	Existing AM
Command:	Existing AM
Volume:	Existing AM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	Default Trip Generation
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Existing
AM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 11 Navy Wy & Seaside	B	xxxxx	0.659	B	xxxxx	0.659	+ 0.000 V/C
# 15 Alameda St & Anaheim St	A	xxxxx	0.558	A	xxxxx	0.558	+ 0.000 V/C
# 16 Pier S Ave & New Dock St	A	xxxxx	0.261	A	xxxxx	0.261	+ 0.000 V/C
# 17 Pier S Ave & Ocean Bl	D	xxxxx	0.847	D	xxxxx	0.847	+ 0.000 V/C
# 18 Henry Ford Av & Anaheim St	A	xxxxx	0.592	A	xxxxx	0.592	+ 0.000 V/C
# 19 Henry Ford & TI Ramps	A	xxxxx	0.234	A	xxxxx	0.234	+ 0.000 V/C
# 20 SR-47 SB Ramp & New Dock St	B	11.5	0.000	B	11.5	0.000	+ 0.000 D/V
# 21 SR-47 & Ocean Bl	F	xxxxx	1.114	F	xxxxx	1.114	+ 0.000 V/C
#187 SR-47 NB Ramp & Pier S Main En	A	8.2	0.098	A	8.2	0.098	+ 0.000 V/C
#197 Henry Ford Av & Deni St	A	xxxxx	0.261	A	xxxxx	0.261	+ 0.000 V/C
#559 Pier S Ave & MT Exit	B	10.8	0.000	B	10.8	0.000	+ 0.000 D/V
#560 Alameda St & PCH e/o Alameda S	B	xxxxx	0.614	B	xxxxx	0.614	+ 0.000 V/C
#561 Alameda St & PCH n/o PCH	A	xxxxx	0.421	A	xxxxx	0.421	+ 0.000 V/C

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #11 Navy Wy & Seaside

Cycle (sec): 100 Critical Vol./Cap. (X): 0.659
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 59 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Ignore			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2 0	0 0	1	0 0	0 0	0	0 0	3 0	1	2 0	3 0	0
Volume Module:												
Base Vol:	202	0	693	0	0	0	0	1619	83	266	2482	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	202	0	693	0	0	0	0	1619	83	266	2482	0
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	202	0	0	0	0	0	0	1619	83	266	2482	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	202	0	0	0	0	0	0	1619	83	266	2482	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	222	0	0	0	0	0	0	1619	83	293	2482	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	2.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00	1.00	2.00	3.00	0.00
Final Sat.:	2850	0	1425	0	0	0	0	4275	1425	2850	4275	0
Capacity Analysis Module:												
Vol/Sat:	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.06	0.10	0.58	0.00
Crit Vol:	111				0		0				827	
Crit Moves:	****						****				****	

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #15 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.558
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 42 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Protected		
Rights:	Ovl			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 1	1	1 0	2 0	1	1 0	2 0	1	2 0	1 1	0
Volume Module:												
Base Vol:	9	127	387	6	250	142	87	730	8	385	731	19
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	9	127	387	6	250	142	87	730	8	385	731	19
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	9	127	387	6	250	142	87	730	8	385	731	19
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	9	127	387	6	250	142	87	730	8	385	731	19
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	9	127	426	6	250	142	87	730	8	424	731	19
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	2.00	1.00	2.00	1.00	1.00	2.00	1.00	2.00	1.95	0.05
Final Sat.:	1425	1425	2850	1425	2850	1425	1425	2850	1425	2850	2778	72
Capacity Analysis Module:												
Vol/Sat:	0.01	0.09	0.15	0.00	0.09	0.10	0.06	0.26	0.01	0.15	0.26	0.26
Crit Vol:			213	6				365		212		
Crit Moves:			****	****				****		****		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #16 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.261
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 31 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	259	67	30	8	18	31	6	100	346	59	103	32
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	259	67	30	8	18	31	6	100	346	59	103	32
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	259	67	30	8	18	31	6	100	0	59	103	32
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	259	67	30	8	18	31	6	100	0	59	103	32
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	259	67	30	8	18	31	6	100	0	59	103	32
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.37	0.63	1.00	2.00	1.00	1.00	2.29	0.71
Final Sat.:	1600	1600	1600	1600	588	1012	1600	3200	1600	1600	3662	1138
Capacity Analysis Module:												
Vol/Sat:	0.16	0.04	0.02	0.01	0.03	0.03	0.00	0.03	0.00	0.04	0.03	0.03
Crit Moves:	****				****			****		****		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #17 Pier S Ave & Ocean Bl

Cycle (sec): 100 Critical Vol./Cap. (X): 0.847
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 121 Level Of Service: D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	1! 0	0	1 0	3 0	0	0 0	3 0	1
Volume Module:												
Base Vol:	0	0	0	253	0	190	212	2325	0	0	2763	351
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	253	0	190	212	2325	0	0	2763	351
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	253	0	190	212	2325	0	0	2763	351
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	253	0	190	212	2325	0	0	2763	351
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	253	0	190	212	2325	0	0	2763	351
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.14	0.00	0.86	1.00	3.00	0.00	0.00	3.00	1.00
Final Sat.:	0	0	0	1828	0	1372	1600	4800	0	0	4800	1600
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.14	0.13	0.48	0.00	0.00	0.58	0.22
Crit Moves:				****			****				****	

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #18 Henry Ford Av & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.592
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 46 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	93	270	70	126	323	36	32	1042	265	62	1064	126
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	93	270	70	126	323	36	32	1042	265	62	1064	126
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	93	270	70	126	323	36	32	1042	0	62	1064	126
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	93	270	70	126	323	36	32	1042	0	62	1064	126
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	102	270	70	126	323	36	32	1042	0	62	1064	126
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.70	0.30	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	3846	429	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.07	0.09	0.05	0.09	0.08	0.08	0.02	0.37	0.00	0.04	0.37	0.09
Crit Vol:		135		126				521		62		
Crit Moves:		****		****				****		****		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #19 Henry Ford & TI Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.234
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 24 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	22	205	101	183	291	36	85	9	5	40	5	40
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	22	205	101	183	291	36	85	9	5	40	5	40
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	22	205	0	183	291	36	85	9	5	40	5	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	22	205	0	183	291	36	85	9	5	40	5	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	22	205	0	201	291	36	85	9	5	40	5	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.78	0.22	1.00	0.64	0.36	0.89	0.11	1.00
Final Sat.:	1425	2850	1425	2850	2536	314	1425	916	509	1267	158	1425
Capacity Analysis Module:												
Vol/Sat:	0.02	0.07	0.00	0.07	0.11	0.11	0.06	0.01	0.01	0.03	0.03	0.00
Crit Vol:		103		101			85				45	
Crit Moves:		****		****			****				****	

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #20 SR-47 SB Ramp & New Dock St

Average Delay (sec/veh): 7.2 Worst Case Level Of Service: B[11.5]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	0	2	0 0
Volume Module:																
Base Vol:	24	0	10		0	9	342		0	151	8		0	0	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	24	0	10		0	9	342		0	151	8		0	0	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	24	0	10		0	9	342		0	151	8		0	0	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	24	0	10		0	9	342		0	151	8		0	0	0	
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	xxxxx	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	xxxxx	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	156	xxxx	76	xxxx	159	0	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	802	xxxx	977	xxxx	737	900	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	492	xxxx	977	xxxx	737	900	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.05	xxxx	0.01	xxxx	0.01	0.38	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.2	xxxx	0.0	xxxxx	xxxx	0.7	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	12.7	xxxx	8.7	xxxxx	xxxx	9.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	B	*	A	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	890	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	0.8	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	10.1	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	*	*	*				
ApproachDel:	11.5				10.0		xxxxxx			xxxxxx						
ApproachLOS:	B				B		*			*						

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #21 SR-47 & Ocean Bl

Cycle (sec): 100 Critical Vol./Cap. (X): 1.114
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: F

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Protected				Protected			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 1	0 1		1	0 1	1 1		2	0 2	1 0		1	0 3	0 1	
Volume Module:																
Base Vol:	16	10	53		425	24	645		305	2565	40		10	2453	322	
Growth Adj:	1.12	1.12	1.12		1.12	1.12	1.12		1.12	1.12	1.12		1.12	1.12	1.12	
Initial Bse:	18	11	59		476	27	722		342	2873	45		11	2747	361	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	18	11	59		476	27	722		342	2873	45		11	2747	361	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	18	11	59		476	27	722		342	2873	45		11	2747	361	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	18	11	59		476	27	722		342	2873	45		11	2747	361	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	1.00	1.00		1.00	1.00	2.00		2.00	2.95	0.05		1.00	3.00	1.00	
Final Sat.:	1600	1600	1600		1600	1600	3200		3200	4726	74		1600	4800	1600	
Capacity Analysis Module:																
Vol/Sat:	0.01	0.01	0.04		0.30	0.02	0.23		0.11	0.61	0.61		0.01	0.57	0.23	
Crit Moves:			****		****				****					****		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Base Volume Alternative)

Intersection #187 SR-47 NB Ramp & Pier S Main Entrance

Cycle (sec): 100 Critical Vol./Cap. (X): 0.098
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 8.2
Optimal Cycle: 0 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 1	0	0	0	0 0	0	0	1	1 0	1	0	0	0 1	1	0
Volume Module:																
Base Vol:	0	0	0		0	0	0		141	0	0		0	0	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		0	0	0		141	0	0		0	0	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	0	0		0	0	0		141	0	0		0	0	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		0	0	0		141	0	0		0	0	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	0	0		0	0	0		141	0	0		0	0	0	
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	1.00	0.00		0.00	0.00	0.00		2.00	1.00	0.00		0.00	2.00	0.00	
Final Sat.:	0	0	0		0	0	0		1440	0	0		0	0	0	
Capacity Analysis Module:																
Vol/Sat:	xxxx	xxxx	xxxx		xxxx	xxxx	xxxx		0.10	xxxx	xxxx		xxxx	xxxx	xxxx	
Crit Moves:									****							
Delay/Veh:	0.0	0.0	0.0		0.0	0.0	0.0		8.2	0.0	0.0		0.0	0.0	0.0	
Delay Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
AdjDel/Veh:	0.0	0.0	0.0		0.0	0.0	0.0		8.2	0.0	0.0		0.0	0.0	0.0	
LOS by Move:	*	*	*		*	*	*		A	*	*		*	*	*	
ApproachDel:	xxxxxx				xxxxxx				8.2				xxxxxx			
Delay Adj:	xxxxx				xxxxx				1.00				xxxxx			
ApprAdjDel:	xxxxxx				xxxxxx				8.2				xxxxxx			
LOS by Appr:	*				*				A				*			

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #197 Henry Ford Av & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.261
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 19 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Permitted				Permitted			
Rights:	Include				Include				Include				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 2	1	0	0	1 1	1	0	1	0 0	1	0	0	0 1!	0	0
Volume Module:																
Base Vol:	0	335	30		17	406	15		190	6	34		27	9	27	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	335	30		17	406	15		190	6	34		27	9	27	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	335	30		17	406	15		190	6	34		27	9	27	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	335	30		17	406	15		190	6	34		27	9	27	
PCE Adj:	1.00	1.00	1.00		2.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	335	30		34	406	15		190	6	34		27	9	27	
Saturation Flow Module:																
Sat/Lane:	1500	1500	1500		1500	1500	1500		1500	1500	1500		1500	1500	1500	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.75	0.25		0.25	2.65	0.10		1.00	0.15	0.85		0.43	0.14	0.43	
Final Sat.:	1500	4130	370		379	3973	148		1500	225	1275		643	214	643	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.08	0.08		0.04	0.10	0.10		0.13	0.03	0.03		0.04	0.04	0.04	
Crit Vol:			122		17				190					63		
Crit Moves:			****		****				****					****		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #559 Pier S Ave & MT Exit

Average Delay (sec/veh): 0.4 Worst Case Level Of Service: B[10.8]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	1	0 1	1	0	0	1	1	0 1	1	0 0	0	1	0	0 1!	0	0
Volume Module:																
Base Vol:	0	361	6		7	259	32		0	0	0		8	0	9	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	361	6		7	259	32		0	0	0		8	0	9	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	361	6		7	259	32		0	0	0		8	0	9	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	0	361	6		7	259	32		0	0	0		8	0	9	
Critical Gap Module:																
Critical Gp:	xxxxx	xxxx	xxxxx		4.1	xxxx	xxxxx		xxxxx	xxxx	xxxxx		6.8	xxxx	6.9	
FollowUpTim:	xxxxx	xxxx	xxxxx		2.2	xxxx	xxxxx		xxxxx	xxxx	xxxxx		3.5	xxxx	3.3	
Capacity Module:																
Cnflict Vol:	xxxx	xxxx	xxxxx		367	xxxx	xxxxx		xxxx	xxxx	xxxxx		508	xxxx	184	
Potent Cap.:	xxxx	xxxx	xxxxx		1203	xxxx	xxxxx		xxxx	xxxx	xxxxx		500	xxxx	834	
Move Cap.:	xxxx	xxxx	xxxxx		1203	xxxx	xxxxx		xxxx	xxxx	xxxxx		497	xxxx	834	
Volume/Cap:	xxxx	xxxx	xxxx		0.01	xxxx	xxxx		xxxx	xxxx	xxxx		0.02	xxxx	0.01	
Level Of Service Module:																
Queue:	xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Stopped Del:	xxxxx	xxxx	xxxxx		8.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
LOS by Move:	*	*	*		A	*	*		*	*	*		*	*	*	
Movement:	LT -	LTR -	RT		LT -	LTR -	RT		LT -	LTR -	RT		LT -	LTR -	RT	
Shared Cap.:	xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	633	xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	0.1	xxxxx	
Shrd StpDel:	xxxxx	xxxx	xxxxx		8.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	10.8	xxxxx	
Shared LOS:	*	*	*		A	*	*		*	*	*		*	B	*	
ApproachDel:	xxxxxx				xxxxxx				xxxxxx					10.8		
ApproachLOS:	*				*				*					B		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #560 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.614
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 48 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Include				Ovl				Include				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 0	0	0	1	0 0	0	1	1	0 2	0	0	0	0 2	0	1
Volume Module:																
Base Vol:	0	0	0		264	0	187		230	858	0		0	761	134	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		264	0	187		230	858	0		0	761	134	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	0	0		264	0	187		230	858	0		0	761	134	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		264	0	187		230	858	0		0	761	134	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	0	0		264	0	187		230	858	0		0	761	134	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		1.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	1.00	
Final Sat.:	0	0	0		1425	0	1425		1425	2850	0		0	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.19	0.00	0.13		0.16	0.30	0.00		0.00	0.27	0.09	
Crit Vol:		0			264				230					380		
Crit Moves:					****				****					****		

Pier T LNG Facility
Existing
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #561 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.421
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 32 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 3	0 1		1	0 3	0 0		0	0 0	0 0		1	0 0	0 1	
Volume Module:																
Base Vol:	0	380	151		284	676	0		0	0	0		165	0	224	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	380	151		284	676	0		0	0	0		165	0	224	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	380	151		284	676	0		0	0	0		165	0	224	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	380	151		284	676	0		0	0	0		165	0	224	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	380	151		284	676	0		0	0	0		165	0	224	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	3.00	1.00		1.00	3.00	0.00		0.00	0.00	0.00		1.00	0.00	1.00	
Final Sat.:	0	4275	1425		1425	4275	0		0	0	0		1425	0	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.09	0.11		0.20	0.16	0.00		0.00	0.00	0.00		0.12	0.00	0.16	
Crit Vol:			151		284					0			165			
Crit Moves:			****		****								****			

Pier T LNG Facility
Existing
PM Peak

Scenario Report

Scenario:	Existing PM
Command:	Existing PM
Volume:	Existing PM
Geometry:	Existing
Impact Fee:	Default Impact Fee
Trip Generation:	Default Trip Generation
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Existing
PM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/C	Future LOS	Future Del/ Veh	Future V/C	Change in V/C
# 11 Navy Wy & Seaside	B	xxxxx	0.601	B	xxxxx	0.601	+ 0.000 V/C
# 15 Alameda St & Anaheim St	C	xxxxx	0.785	C	xxxxx	0.785	+ 0.000 V/C
# 16 Pier S Ave & New Dock St	A	xxxxx	0.219	A	xxxxx	0.219	+ 0.000 V/C
# 17 Pier S Ave & Ocean Bl	E	xxxxx	0.914	E	xxxxx	0.914	+ 0.000 V/C
# 18 Henry Ford Av & Anaheim St	C	xxxxx	0.767	C	xxxxx	0.767	+ 0.000 V/C
# 19 Henry Ford & TI Ramps	A	xxxxx	0.366	A	xxxxx	0.366	+ 0.000 V/C
# 20 SR-47 SB Ramp & New Dock St	B	10.7	0.000	B	10.7	0.000	+ 0.000 D/V
# 21 SR-47 & Ocean Bl	F	xxxxx	1.284	F	xxxxx	1.284	+ 0.000 V/C
#187 SR-47 NB Ramp & Pier S Main En	B	11.5	0.438	B	11.5	0.438	+ 0.000 V/C
#197 Henry Ford Av & Deni St	A	xxxxx	0.487	A	xxxxx	0.487	+ 0.000 V/C
#559 Pier S Ave & MT Exit	B	10.2	0.000	B	10.2	0.000	+ 0.000 D/V
#560 Alameda St & PCH e/o Alameda S	C	xxxxx	0.704	C	xxxxx	0.704	+ 0.000 V/C
#561 Alameda St & PCH n/o PCH	A	xxxxx	0.555	A	xxxxx	0.555	+ 0.000 V/C

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #11 Navy Wy & Seaside

Cycle (sec): 100 Critical Vol./Cap. (X): 0.601
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 50 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Ignore				Include				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2	0	0	0 1	0	0	0	0 0	0	0	3	0 1	2	0	3	0 0
Volume Module:																
Base Vol:	257	0	1049		0	0	0		0	1885	63		80	2147	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	257	0	1049		0	0	0		0	1885	63		80	2147	0	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	257	0	0		0	0	0		0	1885	63		80	2147	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	257	0	0		0	0	0		0	1885	63		80	2147	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.10	1.00	1.00	
Final Vol.:	283	0	0		0	0	0		0	1885	63		88	2147	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	2.00	0.00	1.00		0.00	0.00	0.00		0.00	3.00	1.00		2.00	3.00	0.00	
Final Sat.:	2850	0	1425		0	0	0		0	4275	1425		2850	4275	0	
Capacity Analysis Module:																
Vol/Sat:	0.10	0.00	0.00		0.00	0.00	0.00		0.00	0.44	0.04		0.03	0.50	0.00	
Crit Vol:	141						0			0				716		
Crit Moves:	****								****					****		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #15 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.785
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 86 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Permitted				Protected			
Rights:	Ovl				Include				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	1	1 1	1	0	2	0 1	1	0	2	0 1	2	0	1	1 0
Volume Module:																
Base Vol:	51	304	652		20	175	31		115	912	13		516	1301	25	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	51	304	652		20	175	31		115	912	13		516	1301	25	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	51	304	652		20	175	31		115	912	13		516	1301	25	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	51	304	652		20	175	31		115	912	13		516	1301	25	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.10		1.00	1.00	1.00		1.00	1.00	1.00		1.10	1.00	1.00	
Final Vol.:	51	304	717		20	175	31		115	912	13		568	1301	25	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	1.00	2.00		1.00	2.00	1.00		1.00	2.00	1.00		2.00	1.96	0.04	
Final Sat.:	1425	1425	2850		1425	2850	1425		1425	2850	1425		2850	2796	54	
Capacity Analysis Module:																
Vol/Sat:	0.04	0.21	0.25		0.01	0.06	0.02		0.08	0.32	0.01		0.20	0.47	0.47	
Crit Vol:			359		20					456			284			
Crit Moves:			****		****					****			****			

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #16 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.219
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 29 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	152	30	47	11	37	14	15	260	346	17	59	40
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	152	30	47	11	37	14	15	260	346	17	59	40
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	152	30	47	11	37	14	15	260	0	17	59	40
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	152	30	47	11	37	14	15	260	0	17	59	40
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	152	30	47	11	37	14	15	260	0	17	59	40
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.73	0.27	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1161	439	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.10	0.02	0.03	0.01	0.03	0.03	0.01	0.08	0.00	0.01	0.02	0.03
Crit Moves:	****				****			****		****		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #17 Pier S Ave & Ocean Bl

Cycle (sec): 100 Critical Vol./Cap. (X): 0.914
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	1! 0	0	1 0	3 0	0	0 0	3 0	1
Volume Module:												
Base Vol:	0	0	0	382	0	230	145	3469	0	0	2742	222
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	382	0	230	145	3469	0	0	2742	222
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	382	0	230	145	3469	0	0	2742	222
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	382	0	230	145	3469	0	0	2742	222
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	382	0	230	145	3469	0	0	2742	222
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.25	0.00	0.75	1.00	3.00	0.00	0.00	3.00	1.00
Final Sat.:	0	0	0	1997	0	1203	1600	4800	0	0	4800	1600
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.19	0.00	0.19	0.09	0.72	0.00	0.00	0.57	0.14
Crit Moves:				****				****				

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #18 Henry Ford Av & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.767
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 80 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	452	460	176	112	101	42	78	1105	94	70	1169	100
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	452	460	176	112	101	42	78	1105	94	70	1169	100
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	452	460	176	112	101	42	78	1105	0	70	1169	100
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	452	460	176	112	101	42	78	1105	0	70	1169	100
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	497	460	176	112	101	42	78	1105	0	70	1169	100
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.56	1.44	1.00	1.00	2.12	0.88	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	2221	2054	1425	1425	3019	1256	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.22	0.22	0.12	0.08	0.03	0.03	0.05	0.39	0.00	0.05	0.41	0.07
Crit Vol:	319			112			78			585		
Crit Moves:	****			****			****			****		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #19 Henry Ford & TI Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.366
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 29 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	84	637	81	51	165	35	59	1	0	115	1	289
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	84	637	81	51	165	35	59	1	0	115	1	289
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	84	637	0	51	165	35	59	1	0	115	1	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	84	637	0	51	165	35	59	1	0	115	1	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	84	637	0	56	165	35	59	1	0	115	1	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.65	0.35	1.00	1.00	0.00	0.99	0.01	1.00
Final Sat.:	1425	2850	1425	2850	2351	499	1425	1425	0	1413	12	1425
Capacity Analysis Module:												
Vol/Sat:	0.06	0.22	0.00	0.02	0.07	0.07	0.04	0.00	0.00	0.08	0.08	0.00
Crit Vol:	319			28			59			116		
Crit Moves:	****			****			****			****		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #20 SR-47 SB Ramp & New Dock St

Average Delay (sec/veh): 2.4 Worst Case Level Of Service: B[10.7]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	0	2	0 0
Volume Module:																
Base Vol:	1	0	16		0	9	171		0	617	0		0	0	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	1	0	16		0	9	171		0	617	0		0	0	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	1	0	16		0	9	171		0	617	0		0	0	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	1	0	16		0	9	171		0	617	0		0	0	0	
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	xxxxx	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	xxxxx	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	622	xxxx	309	xxxx	617	0	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	375	xxxx	693	xxxx	408	900	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	299	xxxx	693	xxxx	408	900	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.00	xxxx	0.02	xxxx	0.02	0.19	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.1	xxxxx	xxxx	0.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	17.1	xxxx	10.3	xxxxx	xxxx	9.4	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	C	*	B	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	807	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	0.4	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	10.0	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	*	*	*				
ApproachDel:	10.7				9.8		xxxxxx			xxxxxx						
ApproachLOS:	B				A		*			*						

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #21 SR-47 & Ocean Bl

Cycle (sec): 100 Critical Vol./Cap. (X): 1.284
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: F

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Protected				Protected			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 1	0	1	1	0 1	1	1	2	0 2	1	0	1	0 3	0	1
Volume Module:																
Base Vol:	10	30	77		261	2	600		892	2925	15		13	2724	423	
Growth Adj:	1.12	1.12	1.12		1.12	1.12	1.12		1.12	1.12	1.12		1.12	1.12	1.12	
Initial Bse:	11	34	86		292	2	672		999	3276	17		15	3051	474	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	11	34	86		292	2	672		999	3276	17		15	3051	474	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	11	34	86		292	2	672		999	3276	17		15	3051	474	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	11	34	86		292	2	672		999	3276	17		15	3051	474	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	1.00	1.00		1.00	1.00	2.00		2.00	2.98	0.02		1.00	3.00	1.00	
Final Sat.:	1600	1600	1600		1600	1600	3200		3200	4776	24		1600	4800	1600	
Capacity Analysis Module:																
Vol/Sat:	0.01	0.02	0.05		0.18	0.00	0.21		0.31	0.69	0.69		0.01	0.64	0.30	
Crit Moves:			****		****				****					****		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Base Volume Alternative)

Intersection #187 SR-47 NB Ramp & Pier S Main Entrance

Cycle (sec): 100 Critical Vol./Cap. (X): 0.438
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 11.5
Optimal Cycle: 0 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Stop Sign			Stop Sign			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	0	0 0	0 0	0	1 1	0 1	0	0 0	1 1	0
Volume Module:												
Base Vol:	0	0	0	0	0	0	630	0	0	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	0	0	0	630	0	0	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	0	0	0	630	0	0	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	0	0	0	630	0	0	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	0	0	0	630	0	0	0	0	0
Saturation Flow Module:												
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	2.00	0.00
Final Sat.:	0	0	0	0	0	0	1440	0	0	0	0	0
Capacity Analysis Module:												
Vol/Sat:	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	0.44	xxxx	xxxx	xxxx	xxxx	xxxx
Crit Moves:							****					
Delay/Veh:	0.0	0.0	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	0.0	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0
LOS by Move:	*	*	*	*	*	*	B	*	*	*	*	*
ApproachDel:	xxxxxx			xxxxxx			11.5			xxxxxx		
Delay Adj:	xxxxx			xxxxx			1.00			xxxxx		
ApprAdjDel:	xxxxxx			xxxxxx			11.5			xxxxxx		
LOS by Appr:	*			*			B			*		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #197 Henry Ford Av & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.487
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 28 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 1	0	0 1	1 1	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	0	838	40	29	279	13	345	8	15	16	10	38
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	838	40	29	279	13	345	8	15	16	10	38
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	838	40	29	279	13	345	8	15	16	10	38
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	838	40	29	279	13	345	8	15	16	10	38
PCE Adj:	1.00	1.00	1.00	4.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	838	40	116	279	13	345	8	15	16	10	38
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.86	0.14	1.00	1.90	0.10	1.00	0.35	0.65	0.25	0.16	0.59
Final Sat.:	1500	4295	205	1500	2857	143	1500	522	978	375	234	891
Capacity Analysis Module:												
Vol/Sat:	0.00	0.20	0.20	0.02	0.10	0.09	0.23	0.02	0.02	0.04	0.04	0.04
Crit Vol:		293			29		345				64	
Crit Moves:		****			****		****				****	

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #559 Pier S Ave & MT Exit

Average Delay (sec/veh): 0.1 Worst Case Level Of Service: B[10.2]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	1	0 1	1	0	0	1	1	0 1	1	0 0	0	1	0	0 1!	0	0
Volume Module:																
Base Vol:	0	234	2		1	361	0		0	0	0		4	0	4	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	234	2		1	361	0		0	0	0		4	0	4	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	234	2		1	361	0		0	0	0		4	0	4	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	0	234	2		1	361	0		0	0	0		4	0	4	
Critical Gap Module:																
Critical Gp:	xxxxx	xxxx	xxxxx		4.1	xxxx	xxxxx		xxxxx	xxxx	xxxxx		6.8	xxxx	6.9	
FollowUpTim:	xxxxx	xxxx	xxxxx		2.2	xxxx	xxxxx		xxxxx	xxxx	xxxxx		3.5	xxxx	3.3	
Capacity Module:																
Cnflict Vol:	xxxx	xxxx	xxxxx		236	xxxx	xxxxx		xxxx	xxxx	xxxxx		418	xxxx	118	
Potent Cap.:	xxxx	xxxx	xxxxx		1343	xxxx	xxxxx		xxxx	xxxx	xxxxx		569	xxxx	918	
Move Cap.:	xxxx	xxxx	xxxxx		1343	xxxx	xxxxx		xxxx	xxxx	xxxxx		568	xxxx	918	
Volume/Cap:	xxxx	xxxx	xxxx		0.00	xxxx	xxxx		xxxx	xxxx	xxxx		0.01	xxxx	0.00	
Level Of Service Module:																
Queue:	xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Stopped Del:	xxxxx	xxxx	xxxxx		7.7	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
LOS by Move:	*	*	*		A	*	*		*	*	*		*	*	*	
Movement:	LT -	LTR -	RT		LT -	LTR -	RT		LT -	LTR -	RT		LT -	LTR -	RT	
Shared Cap.:	xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	702	xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	0.0	xxxxx	
Shrd StpDel:	xxxxx	xxxx	xxxxx		7.7	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	10.2	xxxxx	
Shared LOS:	*	*	*		A	*	*		*	*	*		*	B	*	
ApproachDel:	xxxxxx				xxxxxx				xxxxxx				10.2			
ApproachLOS:	*				*				*				B			

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #560 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.704
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 63 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Include				Ovl				Include				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 0	0	0	1	0 0	0	1	1	0 2	0	0	0	0 2	0	1
Volume Module:																
Base Vol:	0	0	0		274	0	299		189	1141	0		0	1079	287	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		274	0	299		189	1141	0		0	1079	287	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	0	0		274	0	299		189	1141	0		0	1079	287	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		274	0	299		189	1141	0		0	1079	287	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	0	0		274	0	299		189	1141	0		0	1079	287	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		1.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	1.00	
Final Sat.:	0	0	0		1425	0	1425		1425	2850	0		0	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.19	0.00	0.21		0.13	0.40	0.00		0.00	0.38	0.20	
Crit Vol:		0			274				189					539		
Crit Moves:					****				****					****		

Pier T LNG Facility
Existing
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #561 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.555
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 42 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	3	0 1	1	0	3	0 0	0	0	0	0 0	1	0	0	0 1
Volume Module:																
Base Vol:	0	823	235	343	540	0	0	0	0	173	0	320				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	0	823	235	343	540	0	0	0	0	173	0	320				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	0	823	235	343	540	0	0	0	0	173	0	320				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	0	823	235	343	540	0	0	0	0	173	0	320				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Final Vol.:	0	823	235	343	540	0	0	0	0	173	0	320				
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425				
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.00	3.00	1.00	1.00	3.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00				
Final Sat.:	0	4275	1425	1425	4275	0	0	0	0	1425	0	1425				
Capacity Analysis Module:																
Vol/Sat:	0.00	0.19	0.16	0.24	0.13	0.00	0.00	0.00	0.00	0.12	0.00	0.22				
Crit Vol:		274		343				0		173						
Crit Moves:		****		****						****						

Pier T LNG Facility
Year 2010 Base
AM Peak

Scenario Report

Scenario:	2010 Base - AM Peak
Command:	2010 Base - AM Peak
Volume:	2010 Base - AM Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	None
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Base
AM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in V/C	
# 1 SR-47 NB On-Ramp & New Dock St	A	9.1	0.205	A	9.1	0.205	+ 0.000	V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	11.2	0.000	B	11.2	0.000	+ 0.000	D/V
# 3 SR-47 & Ocean Blvd	A	xxxxx	0.578	A	xxxxx	0.578	+ 0.000	V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.649	B	xxxxx	0.649	+ 0.000	V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.266	A	xxxxx	0.266	+ 0.000	V/C
# 6 Pier S Ave & Depot / SERRF Dri	A	9.7	0.000	A	9.7	0.000	+ 0.000	D/V
# 7 Navy Way & Seaside Ave	E	xxxxx	0.934	E	xxxxx	0.934	+ 0.000	V/C
# 8 Henry Ford Ave & TI Freeway Ra	A	xxxxx	0.597	A	xxxxx	0.597	+ 0.000	V/C
# 9 Henry Ford Ave & Anaheim St	C	xxxxx	0.729	C	xxxxx	0.729	+ 0.000	V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.374	A	xxxxx	0.374	+ 0.000	V/C
# 11 Alameda St & Anaheim St	A	xxxxx	0.540	A	xxxxx	0.540	+ 0.000	V/C
# 12 Alameda St & PCH e/o Alameda S	B	xxxxx	0.669	B	xxxxx	0.669	+ 0.000	V/C
# 13 Alameda St & PCH n/o PCH	A	xxxxx	0.596	A	xxxxx	0.596	+ 0.000	V/C

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Base Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 | Critical Vol./Cap. (X): 0.205
Loss Time (sec): 0 (Y+R = 4 sec) | Average Delay (sec/veh): 9.1
Optimal Cycle: 0 | Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	1	0	1 0	0	0	0	0 0	1	1	0	1 0	0	1	0	1 0
Volume Module:																
Base Vol:	24	133	0	0	0	0	260	53	165	0	17	36				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	24	133	0	0	0	0	260	53	165	0	17	36				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Volume:	24	133	0	0	0	0	260	53	0	0	17	36				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	24	133	0	0	0	0	260	53	0	0	17	36				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
Final Vol.:	24	133	0	0	0	0	260	53	0	0	17	36				
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.31	1.69	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	1.00	1.00				
Final Sat.:	191	1073	0	0	0	0	1269	693	0	0	661	758				
Capacity Analysis Module:																
Vol/Sat:	0.13	0.12	xxxx	xxxx	xxxx	xxxx	0.20	0.08	xxxx	xxxx	0.03	0.05				
Crit Moves:	****						****					****				
Delay/Veh:	9.0	8.9	0.0	0.0	0.0	0.0	9.7	8.2	0.0	0.0	8.1	7.5				
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
AdjDel/Veh:	9.0	8.9	0.0	0.0	0.0	0.0	9.7	8.2	0.0	0.0	8.1	7.5				
LOS by Move:	A	A	*	*	*	*	A	A	*	*	A	A				
ApproachDel:	8.9			xxxxxx			9.4				7.7					
Delay Adj:	1.00			xxxxx			1.00				1.00					
ApprAdjDel:	8.9			xxxxxx			9.4				7.7					
LOS by Appr:	A			*			A				A					

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 7.4 | Worst Case Level Of Service: B[11.2]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	1	1	0 0
Volume Module:																
Base Vol:	3	0	17	180	6	423	0	279	0	0	41	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	3	0	17	180	6	423	0	279	0	0	41	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	3	0	17	180	6	423	0	279	0	0	41	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Final Vol.:	3	0	17	180	6	423	0	279	0	0	41	0				
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	7.5	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	303	xxxx	140	181	320	20	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	632	xxxx	889	770	600	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	377	xxxx	889	755	600	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.01	xxxx	0.02	0.24	0.01	0.40	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.1	xxxxx	xxxx	0.7	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	14.6	xxxx	9.1	xxxxx	xxxx	9.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	B	*	A	*	*	A	*	*	*	*	*	*				
Movement:	LT - LTR - RT				LT - LTR - RT				LT - LTR - RT				LT - LTR - RT			
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	887	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	2.3	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	12.3	xxxxx	xxxxx	xxxx	xxxxx	9.0	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	A	*	*				
ApproachDel:	10.0				11.2			xxxxxx			xxxxxx					
ApproachLOS:	A				B			*			*					

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.578
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 69 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Split Phase				Split Phase				Split Phase				Split Phase			
Rights:	Include				Ovl				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0 2	0	1	2	0 0	0	2	2	0 1	1	0	1	0 2	0	1
Volume Module:																
Base Vol:	51	213	83		289	0	1245		737	175	0		0	73	59	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	51	213	83		289	0	1245		737	175	0		0	73	59	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	51	213	83		289	0	1245		737	175	0		0	73	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	51	213	83		289	0	1245		737	175	0		0	73	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	51	213	83		289	0	1245		737	175	0		0	73	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	0.00	2.00		2.00	2.00	0.00		1.00	2.00	1.00	
Final Sat.:	1600	3200	1600		3200	0	3200		3200	3200	0		1600	3200	1600	
Capacity Analysis Module:																
Vol/Sat:	0.03	0.07	0.05		0.09	0.00	0.39		0.23	0.05	0.00		0.00	0.02	0.00	
Crit Moves:		****					****		****					****		

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.649
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 44 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0 0	0	0	2	0 0	0	1	1	0 2	0	0	0	0 2	0	2
Volume Module:																
Base Vol:	0	0	0		121	0	131		104	788	0		0	1286	82	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		121	0	131		104	788	0		0	1286	82	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	0	0	0		121	0	131		104	788	0		0	1286	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		121	0	131		104	788	0		0	1286	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	0	0	0		121	0	131		104	788	0		0	1286	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		2.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	2.00	
Final Sat.:	0	0	0		3200	0	1600		1600	3200	0		0	3200	3200	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.04	0.00	0.08		0.07	0.25	0.00		0.00	0.40	0.00	
Crit Moves:							****		****					****		

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.266
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 31 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	141	94	17	21	87	31	6	182	313	48	171	160
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	141	94	17	21	87	31	6	182	313	48	171	160
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	141	94	17	21	87	31	6	182	0	48	171	160
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	141	94	17	21	87	31	6	182	0	48	171	160
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	141	94	17	21	87	31	6	182	0	48	171	160
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.74	0.26	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1180	420	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.09	0.06	0.01	0.01	0.07	0.07	0.00	0.06	0.00	0.03	0.05	0.10
Crit Moves:	****				****		****					****

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 0.5 Worst Case Level Of Service: A[9.7]

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 1	0	0 1	1 0	1	1 0	0 0	1	0 0	1! 0	0
Volume Module:												
Base Vol:	0	184	6	7	253	0	0	0	0	8	0	9
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	184	6	7	253	0	0	0	0	8	0	9
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	184	6	7	253	0	0	0	0	8	0	9
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	0	184	6	7	253	0	0	0	0	8	0	9
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.8	xxxx	6.9
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	190	xxxx	xxxxx	xxxx	xxxx	xxxxx	328	xxxx	95
Potent Cap.:	xxxx	xxxx	xxxxx	1396	xxxx	xxxxx	xxxx	xxxx	xxxxx	647	xxxx	949
Move Cap.:	xxxx	xxxx	xxxxx	1396	xxxx	xxxxx	xxxx	xxxx	xxxxx	644	xxxx	949
Volume/Cap:	xxxx	xxxx	xxxx	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	0.01	xxxx	0.01
Level Of Service Module:												
Queue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Stopped Del:	xxxxx	xxxx	xxxxx	7.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	777	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.1	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	7.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	9.7	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	*	*	A	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx				9.7	
ApproachLOS:	*			*			*				A	

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 0.934
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Ignore				Include				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2	0	0	0 1	0	0	0	0 0	0	0	3	0 1	2	0	3	0 0
Volume Module:																
Base Vol:	339	0	1087		0	0	0		0	2049	343		266	3432	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	339	0	1087		0	0	0		0	2049	343		266	3432	0	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	339	0	0		0	0	0		0	2049	343		266	3432	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	339	0	0		0	0	0		0	2049	343		266	3432	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.10	1.00	1.00	
Final Vol.:	373	0	0		0	0	0		0	2049	343		293	3432	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	2.00	0.00	1.00		0.00	0.00	0.00		0.00	3.00	1.00		2.00	3.00	0.00	
Final Sat.:	2850	0	1425		0	0	0		0	4275	1425		2850	4275	0	
Capacity Analysis Module:																
Vol/Sat:	0.13	0.00	0.00		0.00	0.00	0.00		0.00	0.48	0.24		0.10	0.80	0.00	
Crit Vol:	186						0			0				1144		
Crit Moves:	****								****					****		

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.597
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 46 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Ignore				Include				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	2	0 1	2	0	1	1 0	1	0	0	1 0	0	1	0	0 1
Volume Module:																
Base Vol:	50	574	81		205	835	164		246	0	81		45	10	247	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	50	574	81		205	835	164		246	0	81		45	10	247	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	50	574	0		205	835	164		246	0	81		45	10	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	50	574	0		205	835	164		246	0	81		45	10	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	0.00		1.10	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	50	574	0		226	835	164		246	0	81		45	10	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	1.67	0.33		1.00	0.00	1.00		0.82	0.18	1.00	
Final Sat.:	1425	2850	1425		2850	2382	468		1425	0	1425		1166	259	1425	
Capacity Analysis Module:																
Vol/Sat:	0.04	0.20	0.00		0.08	0.35	0.35		0.17	0.00	0.06		0.04	0.04	0.00	
Crit Vol:	50					500			246					55		
Crit Moves:	****					****			****					****		

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.729
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 69 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	132	563	114	82	651	8	22	946	442	64	851	77
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	132	563	114	82	651	8	22	946	442	64	851	77
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	132	563	114	82	651	8	22	946	0	64	851	77
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	132	563	114	82	651	8	22	946	0	64	851	77
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	145	563	114	82	651	8	22	946	0	64	851	77
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.96	0.04	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	4223	52	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.10	0.20	0.08	0.06	0.15	0.15	0.02	0.33	0.00	0.04	0.30	0.05
Crit Vol:	282					220		473		64		
Crit Moves:	****					****		****		****		

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.374
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 23 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	3 0	0	0 0	3 0	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	0	583	0	0	671	0	337	0	0	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	583	0	0	671	0	337	0	0	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	583	0	0	671	0	337	0	0	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	583	0	0	671	0	337	0	0	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	583	0	0	671	0	337	0	0	0	0	0
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	3.00	0.00	0.00	3.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Final Sat.:	1500	4500	0	0	4500	0	1500	1500	0	0	1500	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.00	0.00	0.15	0.00	0.22	0.00	0.00	0.00	0.00	0.00
Crit Vol:	0				224		337				0	
Crit Moves:	****				****		****					

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.540
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 40 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Permitted			Protected		
Rights:	Ignore			Ignore			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 0	1	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	28	319	382	30	343	222	148	533	22	300	665	27
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	28	319	382	30	343	222	148	533	22	300	665	27
User Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	28	319	0	30	343	0	148	533	0	300	665	27
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	28	319	0	30	343	0	148	533	0	300	665	27
PCE Adj:	2.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	62	319	0	30	343	0	148	533	0	300	665	27
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	2850	1425	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.02	0.11	0.00	0.02	0.12	0.00	0.10	0.19	0.00	0.21	0.23	0.02
Crit Vol:	31				172			267		300		
Crit Moves:	****				****			****		****		

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.669
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Include			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	0 0	1	1 0	2 0	0	0 0	2 0	1
Volume Module:												
Base Vol:	0	0	0	210	0	288	357	829	0	0	774	134
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	210	0	288	357	829	0	0	774	134
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	210	0	288	357	829	0	0	774	134
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	210	0	288	357	829	0	0	774	134
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	210	0	288	357	829	0	0	774	134
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	1.00
Final Sat.:	0	0	0	1425	0	1425	1425	2850	0	0	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.15	0.00	0.20	0.25	0.29	0.00	0.00	0.27	0.09
Crit Vol:		0		210			357				387	
Crit Moves:				****			****				****	

Pier T LNG Facility
Year 2010 Base
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.596
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 46 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 3	0	1	1	0 3	0	0	0	0 0	0	0	1	0 0	0	1
Volume Module:																
Base Vol:	0	879	229		498	1006	0		0	0	0		59	0	75	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	879	229		498	1006	0		0	0	0		59	0	75	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	879	229		498	1006	0		0	0	0		59	0	75	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	879	229		498	1006	0		0	0	0		59	0	75	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	879	229		498	1006	0		0	0	0		59	0	75	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	3.00	1.00		1.00	3.00	0.00		0.00	0.00	0.00		1.00	0.00	1.00	
Final Sat.:	0	4275	1425		1425	4275	0		0	0	0		1425	0	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.21	0.16		0.35	0.24	0.00		0.00	0.00	0.00		0.04	0.00	0.05	
Crit Vol:		293			498					0			59			
Crit Moves:		****			****								****			

Pier T LNG Facility
Year 2010 Base
MD Peak

Scenario Report

Scenario:	2010 Base - MD Peak
Command:	2010 Base - MD Peak
Volume:	2010 Base - MD Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	None
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Base
MD Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in V/C
# 1 SR-47 NB On-Ramp & New Dock St	B	12.3	0.467	B	12.3	0.467	+ 0.000
# 2 SR-47 SB Off-Ramp & New Dock S	B	13.8	0.000	B	13.8	0.000	+ 0.000
# 3 SR-47 & Ocean Blvd	C	xxxxx	0.776	C	xxxxx	0.776	+ 0.000
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.688	B	xxxxx	0.688	+ 0.000
# 5 Pier S Ave & New Dock St	A	xxxxx	0.280	A	xxxxx	0.280	+ 0.000
# 6 Pier S Ave & Depot / SERRF Dri	B	10.1	0.000	B	10.1	0.000	+ 0.000
# 7 Navy Way & Seaside Ave	C	xxxxx	0.743	C	xxxxx	0.743	+ 0.000
# 8 Henry Ford Ave & TI Freeway Ra	B	xxxxx	0.615	B	xxxxx	0.615	+ 0.000
# 9 Henry Ford Ave & Anaheim St	E	xxxxx	0.930	E	xxxxx	0.930	+ 0.000
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.377	A	xxxxx	0.377	+ 0.000
# 11 Alameda St & Anaheim St	A	xxxxx	0.484	A	xxxxx	0.484	+ 0.000
# 12 Alameda St & PCH e/o Alameda S	C	xxxxx	0.716	C	xxxxx	0.716	+ 0.000
# 13 Alameda St & PCH n/o PCH	B	xxxxx	0.657	B	xxxxx	0.657	+ 0.000

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Base Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.467
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 12.3
Optimal Cycle: 0 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	1	0	1	0	0	0	0	0	1	1	0	1	0	0	1	0	0
Volume Module:																		
Base Vol:	31	244	0		0	0	0		555	23	241		0	10	24	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	31	244	0		0	0	0		555	23	241		0	10	24	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	31	244	0		0	0	0		555	23	0		0	10	24	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	31	244	0		0	0	0		555	23	0		0	10	24	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	31	244	0		0	0	0		555	23	0		0	10	24	
Saturation Flow Module:																		
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.23	1.77	0.00		0.00	0.00	0.00		2.00	1.00	0.00		0.00	1.00	1.00	
Final Sat.:	127	1008	0		0	0	0		1189	645	0		0	568	639	
Capacity Analysis Module:																		
Vol/Sat:	0.24	0.24	xxxx		xxxx	xxxx	xxxx		0.47	0.04	xxxx		xxxx	0.02	0.04	
Crit Moves:	****								****						****	
Delay/Veh:	10.7	10.6	0.0		0.0	0.0	0.0		13.6	8.3	0.0		0.0	8.8	8.2	
Delay Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
AdjDel/Veh:	10.7	10.6	0.0		0.0	0.0	0.0		13.6	8.3	0.0		0.0	8.8	8.2	
LOS by Move:	B	B	*		*	*	*		B	A	*		*	A	A	
ApproachDel:	10.6				xxxxxx				13.4				8.4			
Delay Adj:	1.00				xxxxx				1.00				1.00			
ApprAdjDel:	10.6				xxxxxx				13.4				8.4			
LOS by Appr:	B				*				B				A			

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 7.0 Worst Case Level Of Service: B[13.8]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0	1	0	0	1!	0	1	0	0	2	0	1	0	1	1	0	0
Volume Module:																		
Base Vol:	3	0	15		225	0	397		0	577	2		0	41	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	3	0	15		225	0	397		0	577	2		0	41	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	3	0	15		225	0	397		0	577	2		0	41	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	3	0	15		225	0	397		0	577	2		0	41	0	
Critical Gap Module:																		
Critical Gp:	7.5	xxxx	6.9		7.5	xxxx	6.9		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
FollowUpTim:	3.5	xxxx	3.3		3.5	xxxx	3.3		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Capacity Module:																		
Cnflict Vol:	598	xxxx	289		330	xxxx	20		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
Potent Cap.:	391	xxxx	714		605	xxxx	1059		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
Move Cap.:	244	xxxx	714		592	xxxx	1059		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
Volume/Cap:	0.01	xxxx	0.02		0.38	xxxx	0.37		xxxx	xxxx	xxxx		xxxx	xxxx	xxxx	
Level Of Service Module:																		
Queue:	0.0	xxxx	0.1		xxxxx	xxxx	0.7		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Stopped Del:	19.9	xxxx	10.1		xxxxx	xxxx	9.2		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
LOS by Move:	C	*	B		*	*	A		*	*	*		*	*	*	
Movement:	LT - LTR - RT				LT - LTR - RT				LT - LTR - RT				LT - LTR - RT			
Shared Cap.:	xxxx	xxxx	xxxxx		xxxx	747	xxxxx		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx		xxxxx	3.6	xxxxx		xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx	
Shrd StpDel:	xxxxx	xxxx	xxxxx		xxxxx	16.0	xxxxx		xxxxx	xxxx	xxxxx		9.0	xxxx	xxxxx	
Shared LOS:	*	*	*		*	C	*		*	*	*		A	*	*	
ApproachDel:	11.8				13.8				xxxxxx				xxxxxx			
ApproachLOS:	B				B				*				*			

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.776
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 62 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Split Phase				Split Phase				Split Phase				Split Phase			
Rights:	Include				Ovl				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	2	0 1	2	0	0	0 2	2	0	1	1 0	1	0	2	0 1
Volume Module:																
Base Vol:	67	490	103		341	0	1254		1256	204	0		0	77	96	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	67	490	103		341	0	1254		1256	204	0		0	77	96	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	67	490	103		341	0	1254		1256	204	0		0	77	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	67	490	103		341	0	1254		1256	204	0		0	77	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	67	490	103		341	0	1254		1256	204	0		0	77	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	0.00	2.00		2.00	2.00	0.00		1.00	2.00	1.00	
Final Sat.:	1600	3200	1600		3200	0	3200		3200	3200	0		1600	3200	1600	
Capacity Analysis Module:																
Vol/Sat:	0.04	0.15	0.06		0.11	0.00	0.39		0.39	0.06	0.00		0.00	0.02	0.00	
Crit Moves:		****			****				****					****		

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.688
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 49 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	0	0 0	2	0	0	0 1	1	0	2	0 0	0	0	2	0 2
Volume Module:																
Base Vol:	0	0	0		118	0	128		161	1339	0		0	1303	94	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		118	0	128		161	1339	0		0	1303	94	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	0	0	0		118	0	128		161	1339	0		0	1303	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		118	0	128		161	1339	0		0	1303	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	0	0	0		118	0	128		161	1339	0		0	1303	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		2.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	2.00	
Final Sat.:	0	0	0		3200	0	1600		1600	3200	0		0	3200	3200	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.04	0.00	0.08		0.10	0.42	0.00		0.00	0.41	0.00	
Crit Moves:							****		****					****		

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.280
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 32 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	110	46	99	98	52	0	0	420	152	41	307	152
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	46	99	98	52	0	0	420	152	41	307	152
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	110	46	99	98	52	0	0	420	0	41	307	152
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	110	46	99	98	52	0	0	420	0	41	307	152
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	110	46	99	98	52	0	0	420	0	41	307	152
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	1.00	0.00	1.00	2.00	1.00	1.00	2.01	0.99
Final Sat.:	1600	1600	1600	1600	1600	0	1600	3200	1600	1600	3210	1590
Capacity Analysis Module:												
Vol/Sat:	0.07	0.03	0.06	0.06	0.03	0.00	0.00	0.13	0.00	0.03	0.10	0.10
Crit Moves:			****	****				****		****		

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 0.4 Worst Case Level Of Service: B[10.1]

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 1	0	0 1	1 0	1	1 0	0 0	1	0 0	1! 0	0
Volume Module:												
Base Vol:	0	253	1	1	246	0	0	0	0	9	0	9
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	253	1	1	246	0	0	0	0	9	0	9
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	253	1	1	246	0	0	0	0	9	0	9
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	0	253	1	1	246	0	0	0	0	9	0	9
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.8	xxxx	6.9
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	254	xxxx	xxxxx	xxxx	xxxx	xxxxx	379	xxxx	127
Potent Cap.:	xxxx	xxxx	xxxxx	1323	xxxx	xxxxx	xxxx	xxxx	xxxxx	601	xxxx	906
Move Cap.:	xxxx	xxxx	xxxxx	1323	xxxx	xxxxx	xxxx	xxxx	xxxxx	601	xxxx	906
Volume/Cap:	xxxx	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	xxxx	xxxx	0.01	xxxx	0.01
Level Of Service Module:												
Queue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Stopped Del:	xxxxx	xxxx	xxxxx	7.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	723	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.1	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	7.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	10.1	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	*	*	B	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			10.1		
ApproachLOS:	*			*			*			B		

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 0.743
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 72 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Ignore			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2 0	0 0	1	0 0	0 0	0	0 0	3 0	1	2 0	3 0	0
Volume Module:												
Base Vol:	312	0	1211	0	0	0	0	2473	424	0	2662	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	312	0	1211	0	0	0	0	2473	424	0	2662	0
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	312	0	0	0	0	0	0	2473	424	0	2662	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	312	0	0	0	0	0	0	2473	424	0	2662	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	343	0	0	0	0	0	0	2473	424	0	2662	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	2.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00	1.00	2.00	3.00	0.00
Final Sat.:	2850	0	1425	0	0	0	0	4275	1425	2850	4275	0
Capacity Analysis Module:												
Vol/Sat:	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.30	0.00	0.62	0.00
Crit Vol:	172				0		0				887	
Crit Moves:	****						****				****	

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.615
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 48 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	37	924	61	143	803	116	263	12	92	51	22	262
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	37	924	61	143	803	116	263	12	92	51	22	262
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	37	924	0	143	803	116	263	12	92	51	22	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	37	924	0	143	803	116	263	12	92	51	22	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	37	924	0	157	803	116	263	12	92	51	22	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.75	0.25	1.00	0.12	0.88	0.70	0.30	1.00
Final Sat.:	1425	2850	1425	2850	2490	360	1425	164	1261	996	429	1425
Capacity Analysis Module:												
Vol/Sat:	0.03	0.32	0.00	0.06	0.32	0.32	0.18	0.07	0.07	0.05	0.05	0.00
Crit Vol:		462			79		263				73	
Crit Moves:		****			****		****				****	

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.930
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	122	844	105	75	803	7	25	1130	502	68	1190	84
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	122	844	105	75	803	7	25	1130	502	68	1190	84
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	122	844	105	75	803	7	25	1130	0	68	1190	84
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	122	844	105	75	803	7	25	1130	0	68	1190	84
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	134	844	105	75	803	7	25	1130	0	68	1190	84
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.97	0.03	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	4238	37	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.09	0.30	0.07	0.05	0.19	0.19	0.02	0.40	0.00	0.05	0.42	0.06
Crit Vol:	422					270		565		68		
Crit Moves:	****					****		****		****		

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.377
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 23 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	3 0	0	0 0	3 0	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	0	897	0	0	830	0	266	0	3	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	897	0	0	830	0	266	0	3	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	897	0	0	830	0	266	0	3	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	897	0	0	830	0	266	0	3	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	897	0	0	830	0	266	0	3	0	0	0
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	3.00	0.00	0.00	3.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Final Sat.:	1500	4500	0	0	4500	0	1500	0	1500	0	1500	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.20	0.00	0.00	0.18	0.00	0.18	0.00	0.00	0.00	0.00	0.00
Crit Vol:	299			0			266				0	
Crit Moves:	****			****			****					

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.484
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 51 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Protected		
Rights:	Ignore			Ignore			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 0	1	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	23	202	326	25	316	185	136	437	20	274	1012	24
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	23	202	326	25	316	185	136	437	20	274	1012	24
User Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	23	202	0	25	316	0	136	437	0	274	1012	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	23	202	0	25	316	0	136	437	0	274	1012	24
PCE Adj:	2.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	51	202	0	25	316	0	136	437	0	274	1012	24
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	2850	1425	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.02	0.07	0.00	0.02	0.11	0.00	0.10	0.15	0.00	0.19	0.36	0.02
Crit Vol:	25				158			218			506	
Crit Moves:	****				****						****	

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.716
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 66 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Include			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	0 0	1	1 0	2 0	0	0 0	2 0	1
Volume Module:												
Base Vol:	0	0	0	199	0	305	408	774	0	0	827	137
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	199	0	305	408	774	0	0	827	137
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	199	0	305	408	774	0	0	827	137
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	199	0	305	408	774	0	0	827	137
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	199	0	305	408	774	0	0	827	137
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	1.00
Final Sat.:	0	0	0	1425	0	1425	1425	2850	0	0	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.21	0.29	0.27	0.00	0.00	0.29	0.10
Crit Vol:		0		199			408				414	
Crit Moves:				****			****				****	

Pier T LNG Facility
Year 2010 Base
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.657
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 54 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	3	0 1	1	0	3	0 0	0	0	0	0 0	1	0	0	0 1
Volume Module:																
Base Vol:	0	1107	226	504	1080	0	0	0	0	63	0	74				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	0	1107	226	504	1080	0	0	0	0	63	0	74				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	0	1107	226	504	1080	0	0	0	0	63	0	74				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	0	1107	226	504	1080	0	0	0	0	63	0	74				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Final Vol.:	0	1107	226	504	1080	0	0	0	0	63	0	74				
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425				
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.00	3.00	1.00	1.00	3.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00				
Final Sat.:	0	4275	1425	1425	4275	0	0	0	0	1425	0	1425				
Capacity Analysis Module:																
Vol/Sat:	0.00	0.26	0.16	0.35	0.25	0.00	0.00	0.00	0.00	0.04	0.00	0.05				
Crit Vol:		369		504				0		63						
Crit Moves:		****		****						****						

Pier T LNG Facility
Year 2010 Base
PM Peak

Scenario Report

Scenario:	2010 Base - PM Peak
Command:	2010 Base - PM Peak
Volume:	2010 Base - PM Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	None
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Base
PM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in V/C	
# 1 SR-47 NB On-Ramp & New Dock St	B	11.4	0.429	B	11.4	0.429	+ 0.000	V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	11.8	0.000	B	11.8	0.000	+ 0.000	D/V
# 3 SR-47 & Ocean Blvd	C	xxxxx	0.721	C	xxxxx	0.721	+ 0.000	V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.678	B	xxxxx	0.678	+ 0.000	V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.301	A	xxxxx	0.301	+ 0.000	V/C
# 6 Pier S Ave & Depot / SERRF Dri	B	10.6	0.000	B	10.6	0.000	+ 0.000	D/V
# 7 Navy Way & Seaside Ave	F	xxxxx	1.033	F	xxxxx	1.033	+ 0.000	V/C
# 8 Henry Ford Ave & TI Freeway Ra	B	xxxxx	0.667	B	xxxxx	0.667	+ 0.000	V/C
# 9 Henry Ford Ave & Anaheim St	E	xxxxx	0.930	E	xxxxx	0.930	+ 0.000	V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.374	A	xxxxx	0.374	+ 0.000	V/C
# 11 Alameda St & Anaheim St	B	xxxxx	0.608	B	xxxxx	0.608	+ 0.000	V/C
# 12 Alameda St & PCH e/o Alameda S	B	xxxxx	0.667	B	xxxxx	0.667	+ 0.000	V/C
# 13 Alameda St & PCH n/o PCH	B	xxxxx	0.686	B	xxxxx	0.686	+ 0.000	V/C

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Base Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 | Critical Vol./Cap. (X): 0.429
Loss Time (sec): 0 (Y+R = 4 sec) | Average Delay (sec/veh): 11.4
Optimal Cycle: 0 | Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	T	R		L	T	R		L	T	R		L	T	R	
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	1	0	1	0	0	0	0	0	1	1	0	1	0	0	1	0	0
Volume Module:																
Base Vol:	25	167	0		0	0	0		522	51	129		0	34	63	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	25	167	0		0	0	0		522	51	129		0	34	63	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	25	167	0		0	0	0		522	51	0		0	34	63	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	25	167	0		0	0	0		522	51	0		0	34	63	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	25	167	0		0	0	0		522	51	0		0	34	63	
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.26	1.74	0.00		0.00	0.00	0.00		2.00	1.00	0.00		0.00	1.00	1.00	
Final Sat.:	144	971	0		0	0	0		1216	660	0		0	598	677	
Capacity Analysis Module:																
Vol/Sat:	0.17	0.17	xxxx		xxxx	xxxx	xxxx		0.43	0.08	xxxx		xxxx	0.06	0.09	
Crit Moves:	****								****						****	
Delay/Veh:	10.1	10.0	0.0		0.0	0.0	0.0		12.7	8.5	0.0		0.0	8.8	8.2	
Delay Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
AdjDel/Veh:	10.1	10.0	0.0		0.0	0.0	0.0		12.7	8.5	0.0		0.0	8.8	8.2	
LOS by Move:	B	B	*		*	*	*		B	A	*		*	A	A	
ApproachDel:	10.0				xxxxxx				12.4					8.4		
Delay Adj:	1.00				xxxxx				1.00					1.00		
ApprAdjDel:	10.0				xxxxxx				12.4					8.4		
LOS by Appr:	B				*				B					A		

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 4.0 | Worst Case Level Of Service: B[11.8]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	T	R		L	T	R		L	T	R		L	T	R	
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0	1	0	0	1!	0	1	0	0	2	0	1	0	1	1	0	0
Volume Module:																
Base Vol:	4	0	11		125	5	195		0	566	0		0	59	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	4	0	11		125	5	195		0	566	0		0	59	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	4	0	11		125	5	195		0	566	0		0	59	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	4	0	11		125	5	195		0	566	0		0	59	0	
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9		7.5	6.5	6.9		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
FollowUpTim:	3.5	xxxx	3.3		3.5	4.0	3.3		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Capacity Module:																
Cnflict Vol:	598	xxxx	283		342	625	30		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
Potent Cap.:	390	xxxx	720		593	404	1045		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
Move Cap.:	314	xxxx	720		584	404	1045		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
Volume/Cap:	0.01	xxxx	0.02		0.21	0.01	0.19		xxxx	xxxx	xxxx		xxxx	xxxx	xxxx	
Level Of Service Module:																
Queue:	0.0	xxxx	0.0		xxxxx	xxxx	0.3		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
Stopped Del:	16.6	xxxx	10.1		xxxxx	xxxx	8.8		xxxxx	xxxx	xxxxx		xxxxx	xxxx	xxxxx	
LOS by Move:	C	*	B		*	*	A		*	*	*		*	*	*	
Movement:	LT	-	LTR	-	RT		LT	-	LTR	-	RT		LT	-	LTR	-	RT		LT	-	LTR	-	RT
Shared Cap.:	xxxx	xxxx	xxxxx		xxxx		711	xxxxx	xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx		xxxxx		1.4	xxxxx	xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx	
Shrd StpDel:	xxxxx	xxxx	xxxxx		xxxxx		12.4	xxxxx	xxxxx	xxxx	xxxxx		9.0	xxxx	xxxxx	
Shared LOS:	*	*	*		*		B	*	*	*	*		A	*	*	
ApproachDel:	11.8				11.3				xxxxxx				xxxxxx			
ApproachLOS:	B				B				*				*			

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.721
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 53 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Split Phase				Split Phase				Split Phase				Split Phase			
Rights:	Include				Ovl				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	2	0	1	2	0	0	0	2	2	0	1	1	0	1	0	2	0	1
Volume Module:																				
Base Vol:	52	371	99	175	0	1071	1370	213	0	0	72	176								
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Initial Bse:	52	371	99	175	0	1071	1370	213	0	0	72	176								
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Volume:	52	371	99	175	0	1071	1370	213	0	0	72	0								
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0								
Reduced Vol:	52	371	99	175	0	1071	1370	213	0	0	72	0								
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
Final Vol.:	52	371	99	175	0	1071	1370	213	0	0	72	0								
Saturation Flow Module:																				
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600								
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Lanes:	1.00	2.00	1.00	2.00	0.00	2.00	2.00	2.00	0.00	1.00	2.00	1.00								
Final Sat.:	1600	3200	1600	3200	0	3200	3200	3200	0	1600	3200	1600								
Capacity Analysis Module:																				
Vol/Sat:	0.03	0.12	0.06	0.05	0.00	0.33	0.43	0.07	0.00	0.00	0.02	0.00								
Crit Moves:		****		****			****				****									

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.678
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 47 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	0	0	0	2	0	0	0	1	1	0	2	0	0	0	0	2	0	2
Volume Module:																				
Base Vol:	0	0	0	101	0	182	200	1484	0	0	1085	110								
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Initial Bse:	0	0	0	101	0	182	200	1484	0	0	1085	110								
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Volume:	0	0	0	101	0	182	200	1484	0	0	1085	0								
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0								
Reduced Vol:	0	0	0	101	0	182	200	1484	0	0	1085	0								
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
Final Vol.:	0	0	0	101	0	182	200	1484	0	0	1085	0								
Saturation Flow Module:																				
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600								
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Lanes:	0.00	0.00	0.00	2.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	2.00								
Final Sat.:	0	0	0	3200	0	1600	1600	3200	0	0	3200	3200								
Capacity Analysis Module:																				
Vol/Sat:	0.00	0.00	0.00	0.03	0.00	0.11	0.13	0.46	0.00	0.00	0.34	0.00								
Crit Moves:						****	****				****									

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.301
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 33 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	178	93	116	59	51	14	15	419	260	29	61	46
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	178	93	116	59	51	14	15	419	260	29	61	46
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	178	93	116	59	51	14	15	419	0	29	61	46
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	178	93	116	59	51	14	15	419	0	29	61	46
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	178	93	116	59	51	14	15	419	0	29	61	46
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.78	0.22	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1255	345	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.11	0.06	0.07	0.04	0.04	0.04	0.01	0.13	0.00	0.02	0.02	0.03
Crit Moves:	****				****			****		****		

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Base Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 0.1 Worst Case Level Of Service: B[10.6]

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 1	0	0 1	1 0	1	1 0	0 0	1	0 0	1! 0	0
Volume Module:												
Base Vol:	0	321	2	1	318	0	0	0	0	4	0	4
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	321	2	1	318	0	0	0	0	4	0	4
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	321	2	1	318	0	0	0	0	4	0	4
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	0	321	2	1	318	0	0	0	0	4	0	4
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.8	xxxx	6.9
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	323	xxxx	xxxxx	xxxx	xxxx	xxxxx	483	xxxx	162
Potent Cap.:	xxxx	xxxx	xxxxx	1248	xxxx	xxxxx	xxxx	xxxx	xxxxx	518	xxxx	861
Move Cap.:	xxxx	xxxx	xxxxx	1248	xxxx	xxxxx	xxxx	xxxx	xxxxx	517	xxxx	861
Volume/Cap:	xxxx	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	xxxx	xxxx	0.01	xxxx	0.00
Level Of Service Module:												
Queue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Stopped Del:	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	646	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.0	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	10.6	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	*	*	B	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			10.6		
ApproachLOS:	*			*			*			B		

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 1.033
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Ignore			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2 0	0 0	1	0 0	0 0	0	0 0	3 0	1	2 0	3 0	0
Volume Module:												
Base Vol:	547	0	1687	0	0	0	0	2850	310	80	3514	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	547	0	1687	0	0	0	0	2850	310	80	3514	0
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	547	0	0	0	0	0	0	2850	310	80	3514	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	547	0	0	0	0	0	0	2850	310	80	3514	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	602	0	0	0	0	0	0	2850	310	88	3514	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	2.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00	1.00	2.00	3.00	0.00
Final Sat.:	2850	0	1425	0	0	0	0	4275	1425	2850	4275	0
Capacity Analysis Module:												
Vol/Sat:	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.22	0.03	0.82	0.00
Crit Vol:	301				0		0				1171	
Crit Moves:	****						****				****	

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.667
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	126	1043	47	104	613	625	78	8	153	38	6	181
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	126	1043	47	104	613	625	78	8	153	38	6	181
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	126	1043	0	104	613	625	78	8	153	38	6	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	126	1043	0	104	613	625	78	8	153	38	6	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	126	1043	0	114	613	625	78	8	153	38	6	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.00	1.00	1.00	0.05	0.95	0.86	0.14	1.00
Final Sat.:	1425	2850	1425	2850	1425	1425	1425	71	1354	1231	194	1425
Capacity Analysis Module:												
Vol/Sat:	0.09	0.37	0.00	0.04	0.43	0.44	0.05	0.11	0.11	0.03	0.03	0.00
Crit Vol:	126					625		161		38		
Crit Moves:	****					****		****		****		

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.930
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	384	899	101	105	549	34	20	1146	140	51	1322	114
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	384	899	101	105	549	34	20	1146	140	51	1322	114
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	384	899	101	105	549	34	20	1146	0	51	1322	114
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	384	899	101	105	549	34	20	1146	0	51	1322	114
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	422	899	101	105	549	34	20	1146	0	51	1322	114
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.83	0.17	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	4026	249	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.30	0.32	0.07	0.07	0.14	0.14	0.01	0.40	0.00	0.04	0.46	0.08
Crit Vol:		450				194	20				661	
Crit Moves:		****				****	****				****	

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.374
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 23 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	3 0	0	0 0	3 0	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	4	953	0	0	602	0	243	0	5	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	953	0	0	602	0	243	0	5	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	4	953	0	0	602	0	243	0	5	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	953	0	0	602	0	243	0	5	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	4	953	0	0	602	0	243	0	5	0	0	0
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	3.00	0.00	0.00	3.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Final Sat.:	1500	4500	0	0	4500	0	1500	0	1500	0	1500	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.21	0.00	0.00	0.13	0.00	0.16	0.00	0.00	0.00	0.00	0.00
Crit Vol:		318		0			243				0	
Crit Moves:		****		****			****					

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.608
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 48 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Protected		
Rights:	Ignore			Ignore			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 0	1	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	11	231	479	28	522	234	157	516	15	336	1113	36
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	11	231	479	28	522	234	157	516	15	336	1113	36
User Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	11	231	0	28	522	0	157	516	0	336	1113	36
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	11	231	0	28	522	0	157	516	0	336	1113	36
PCE Adj:	2.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	24	231	0	28	522	0	157	516	0	336	1113	36
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	2850	1425	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.01	0.08	0.00	0.02	0.18	0.00	0.11	0.18	0.00	0.24	0.39	0.03
Crit Vol:	12			261			258			336		
Crit Moves:	****			****			****			****		

Pier T LNG Facility
Year 2010 Base
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Base Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.667
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Include			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	0 0	1	1 0	2 0	0	0 0	2 0	1
Volume Module:												
Base Vol:	0	0	0	73	0	425	395	849	0	0	966	264
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	73	0	425	395	849	0	0	966	264
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	73	0	425	395	849	0	0	966	264
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	73	0	425	395	849	0	0	966	264
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	73	0	425	395	849	0	0	966	264
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	1.00
Final Sat.:	0	0	0	1425	0	1425	1425	2850	0	0	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.05	0.00	0.30	0.28	0.30	0.00	0.00	0.34	0.19
Crit Vol:	0			73			395			483		
Crit Moves:				****			****			****		

```
-------------------------------------------------------------------------------
                              Pier T LNG Facility
                                Year 2010 Base
                                    PM Peak
-------------------------------------------------------------------------------
                     Level Of Service Computation Report
            Circular 212 Planning Method (Base Volume Alternative)
*******************************************************************************
Intersection #13 Alameda St & PCH n/o PCH
*******************************************************************************
Cycle (sec):        100                Critical Vol./Cap. (X):        0.686
Loss Time (sec):      0 (Y+R =  4 sec) Average Delay (sec/veh):      xxxxxx
Optimal Cycle:       59                Level Of Service:                   B
*******************************************************************************
Approach:      North Bound      South Bound       East Bound       West Bound
Movement:     L  -  T  -  R    L  -  T  -  R    L  -  T  -  R    L  -  T  -  R
------------|---------------||---------------||---------------||---------------|
Control:        Protected        Protected         Permitted        Permitted
Rights:           Include          Include          Include           Ovl
Min. Green:     0    0     0     0    0     0     0    0     0     0    0     0
Lanes:        0  0  3  0  1    1  0  3  0  0    0  0  0  0  0    1  0  0  0  1
------------|---------------||---------------||---------------||---------------|
Volume Module:
Base Vol:       0 1127   395   498 1129     0     0    0     0    84    0   180
Growth Adj:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Initial Bse:    0 1127   395   498 1129     0     0    0     0    84    0   180
User Adj:    1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
PHF Volume:     0 1127   395   498 1129     0     0    0     0    84    0   180
Reduct Vol:     0    0     0     0    0     0     0    0     0     0    0     0
Reduced Vol:    0 1127   395   498 1129     0     0    0     0    84    0   180
PCE Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
MLF Adj:     1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Final Vol.:     0 1127   395   498 1129     0     0    0     0    84    0   180
------------|---------------||---------------||---------------||---------------|
Saturation Flow Module:
Sat/Lane:    1425 1425  1425  1425 1425  1425  1425 1425  1425  1425 1425  1425
Adjustment:  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00  1.00 1.00  1.00
Lanes:       0.00 3.00  1.00  1.00 3.00  0.00  0.00 0.00  0.00  1.00 0.00  1.00
Final Sat.:     0 4275  1425  1425 4275     0     0    0     0  1425    0  1425
------------|---------------||---------------||---------------||---------------|
Capacity Analysis Module:
Vol/Sat:     0.00 0.26  0.28  0.35 0.26  0.00  0.00 0.00  0.00  0.06 0.00  0.13
Crit Vol:                 395   498                     0          84
Crit Moves:              ****  ****                             ****
*******************************************************************************
```

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Scenario Report

Scenario:	2010 Construction - AM Peak
Command:	2010 Construction - AM Peak
Volume:	2010 Base - AM Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	AM Peak
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 SR-47 NB On-Ramp & New Dock St	A	9.1	0.205	A	9.1	0.206	+ 0.001 V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	11.2	0.000	B	11.6	0.000	+ 0.372 D/V
# 3 SR-47 & Ocean Blvd	A	xxxxx	0.578	B	xxxxx	0.649	+ 0.071 V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.649	C	xxxxx	0.717	+ 0.069 V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.266	A	xxxxx	0.312	+ 0.047 V/C
# 6 Pier S Ave & Depot / SERRF Dri	A	9.7	0.000	C	17.7	0.000	+ 8.010 D/V
# 7 Navy Way & Seaside Ave	E	xxxxx	0.934	E	xxxxx	0.937	+ 0.003 V/C
# 8 Henry Ford Ave & TI Freeway Ra	A	xxxxx	0.597	B	xxxxx	0.637	+ 0.040 V/C
# 9 Henry Ford Ave & Anaheim St	C	xxxxx	0.729	C	xxxxx	0.760	+ 0.032 V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.374	A	xxxxx	0.399	+ 0.026 V/C
# 11 Alameda St & Anaheim St	A	xxxxx	0.540	A	xxxxx	0.540	+ 0.000 V/C
# 12 Alameda St & PCH e/o Alameda S	B	xxxxx	0.669	B	xxxxx	0.669	+ 0.000 V/C
# 13 Alameda St & PCH n/o PCH	A	xxxxx	0.596	A	xxxxx	0.600	+ 0.003 V/C

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.206
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 9.1
Optimal Cycle: 0 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	1	0	1 0	0	0	0	0 0	1	1	0	1 0	0	1	0	1 0
Volume Module:																
Base Vol:	24	133	0	0	0	0	260	53	165	0	17	36				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	24	133	0	0	0	0	260	53	165	0	17	36				
Added Vol:	0	0	0	0	0	0	1	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	24	133	0	0	0	0	261	53	165	0	17	36				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Volume:	24	133	0	0	0	0	261	53	0	0	17	36				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	24	133	0	0	0	0	261	53	0	0	17	36				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
Final Vol.:	24	133	0	0	0	0	261	53	0	0	17	36				
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.31	1.69	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	1.00	1.00				
Final Sat.:	191	1073	0	0	0	0	1269	693	0	0	661	757				
Capacity Analysis Module:																
Vol/Sat:	0.13	0.12	xxxx	xxxx	xxxx	xxxx	0.21	0.08	xxxx	xxxx	0.03	0.05				
Crit Moves:	****						****					****				
Delay/Veh:	9.0	8.9	0.0	0.0	0.0	0.0	9.7	8.2	0.0	0.0	8.1	7.5				
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
AdjDel/Veh:	9.0	8.9	0.0	0.0	0.0	0.0	9.7	8.2	0.0	0.0	8.1	7.5				
LOS by Move:	A	A	*	*	*	*	A	A	*	*	A	A				
ApproachDel:	8.9			xxxxxx			9.4				7.7					
Delay Adj:	1.00			xxxxx			1.00				1.00					
ApprAdjDel:	8.9			xxxxxx			9.4				7.7					
LOS by Appr:	A			*			A				A					

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 8.0 Worst Case Level Of Service: B[11.6]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	1	1	0 0
Volume Module:																
Base Vol:	3	0	17	180	6	423	0	279	0	0	41	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	3	0	17	180	6	423	0	279	0	0	41	0				
Added Vol:	0	0	0	0	0	102	0	1	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	3	0	17	180	6	525	0	280	0	0	41	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	3	0	17	180	6	525	0	280	0	0	41	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Final Vol.:	3	0	17	180	6	525	0	280	0	0	41	0				
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	7.5	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	304	xxxx	140	181	321	20	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	631	xxxx	889	769	599	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	316	xxxx	889	755	599	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.01	xxxx	0.02	0.24	0.01	0.50	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.1	xxxxx	xxxx	1.0	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	16.5	xxxx	9.1	xxxxx	xxxx	9.5	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	C	*	A	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	903	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	2.8	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	12.8	xxxxx	xxxxx	xxxx	xxxxx	9.0	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	A	*	*				
ApproachDel:	10.2			11.6			xxxxxx			xxxxxx						
ApproachLOS:	B			B			*			*						

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.649
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 91 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Split Phase			Split Phase		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	0 0	2	2 0	1 1	0	1 0	2 0	1
Volume Module:												
Base Vol:	51	213	83	289	0	1245	737	175	0	0	73	59
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	51	213	83	289	0	1245	737	175	0	0	73	59
Added Vol:	0	0	0	14	0	0	0	25	0	0	227	14
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	51	213	83	303	0	1245	737	200	0	0	300	73
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	51	213	83	303	0	1245	737	200	0	0	300	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	51	213	83	303	0	1245	737	200	0	0	300	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	51	213	83	303	0	1245	737	200	0	0	300	0
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	0.00	2.00	2.00	2.00	0.00	1.00	2.00	1.00
Final Sat.:	1600	3200	1600	3200	0	3200	3200	3200	0	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.03	0.07	0.05	0.09	0.00	0.39	0.23	0.06	0.00	0.00	0.09	0.00
Crit Moves:		****				****	****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.717
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 52 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	2 0	0 0	1	1 0	2 0	0	0 0	2 0	2
Volume Module:												
Base Vol:	0	0	0	121	0	131	104	788	0	0	1286	82
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	121	0	131	104	788	0	0	1286	82
Added Vol:	0	0	0	11	0	1	102	14	0	0	14	213
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	132	0	132	206	802	0	0	1300	295
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	0	0	0	132	0	132	206	802	0	0	1300	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	132	0	132	206	802	0	0	1300	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	0	0	0	132	0	132	206	802	0	0	1300	0
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	2.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	2.00
Final Sat.:	0	0	0	3200	0	1600	1600	3200	0	0	3200	3200
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.04	0.00	0.08	0.13	0.25	0.00	0.00	0.41	0.00
Crit Moves:						****	****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.312
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 33 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	141	94	17	21	87	31	6	182	313	48	171	160
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	141	94	17	21	87	31	6	182	313	48	171	160
Added Vol:	0	0	1	0	0	0	0	0	0	102	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	141	94	18	21	87	31	6	182	313	150	171	160
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	141	94	18	21	87	31	6	182	0	150	171	160
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	141	94	18	21	87	31	6	182	0	150	171	160
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	141	94	18	21	87	31	6	182	0	150	171	160
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.74	0.26	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1180	420	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.09	0.06	0.01	0.01	0.07	0.07	0.00	0.06	0.00	0.09	0.05	0.10
Crit Moves:	****				****			****		****		

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 3.7 Worst Case Level Of Service: C[17.7]

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 1	0	0 1	1 0	1	1 0	0 0	1	0 0	1! 0	0
Volume Module:												
Base Vol:	0	184	6	7	253	0	0	0	0	8	0	9
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	184	6	7	253	0	0	0	0	8	0	9
Added Vol:	315	0	0	0	0	102	1	0	12	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	315	184	6	7	253	102	1	0	12	8	0	9
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	315	184	6	7	253	102	1	0	12	8	0	9
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	315	184	6	7	253	102	1	0	12	8	0	9
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.5	xxxx	6.9	7.5	xxxx	6.9
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	xxxx	3.3	3.5	xxxx	3.3
Capacity Module:												
Cnflict Vol:	355	xxxx	xxxxx	190	xxxx	xxxxx	989	xxxx	127	957	xxxx	95
Potent Cap.:	1215	xxxx	xxxxx	1396	xxxx	xxxxx	204	xxxx	907	215	xxxx	949
Move Cap.:	1215	xxxx	xxxxx	1396	xxxx	xxxxx	161	xxxx	907	169	xxxx	949
Volume/Cap:	0.26	xxxx	xxxx	0.01	xxxx	xxxx	0.01	xxxx	0.01	0.05	xxxx	0.01
Level Of Service Module:												
Queue:	1.0	xxxx	xxxxx	0.0	xxxx	xxxxx	0.0	xxxx	0.0	xxxxx	xxxx	xxxxx
Stopped Del:	9.0	xxxx	xxxxx	7.6	xxxx	xxxxx	27.5	xxxx	9.0	xxxxx	xxxx	xxxxx
LOS by Move:	A	*	*	A	*	*	D	*	A	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	299	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.2	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	7.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	17.7	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	*	*	C	*
ApproachDel:	xxxxxx			xxxxxx			10.4			17.7		
ApproachLOS:	*			*			B			C		

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 0.937
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Ignore				Include				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2	0	0	0 1	0	0	0	0 0	0	0	3	0 1	2	0	3	0 0
Volume Module:																
Base Vol:	339	0	1087		0	0	0		0	2049	343		266	3432	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	339	0	1087		0	0	0		0	2049	343		266	3432	0	
Added Vol:	0	0	0		0	0	0		0	115	0		0	14	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	339	0	1087		0	0	0		0	2164	343		266	3446	0	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	339	0	0		0	0	0		0	2164	343		266	3446	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	339	0	0		0	0	0		0	2164	343		266	3446	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.10	1.00	1.00	
Final Vol.:	373	0	0		0	0	0		0	2164	343		293	3446	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	2.00	0.00	1.00		0.00	0.00	0.00		0.00	3.00	1.00		2.00	3.00	0.00	
Final Sat.:	2850	0	1425		0	0	0		0	4275	1425		2850	4275	0	
Capacity Analysis Module:																
Vol/Sat:	0.13	0.00	0.00		0.00	0.00	0.00		0.00	0.51	0.24		0.10	0.81	0.00	
Crit Vol:	186						0			0				1149		
Crit Moves:	****								****					****		

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.637
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 51 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Ignore				Include				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	2	0 1	2	0	1	1 0	1	0	0	1 0	0	1	0	0 1
Volume Module:																
Base Vol:	50	574	81		205	835	164		246	0	81		45	10	247	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	50	574	81		205	835	164		246	0	81		45	10	247	
Added Vol:	0	14	0		0	115	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	50	588	81		205	950	164		246	0	81		45	10	247	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	50	588	0		205	950	164		246	0	81		45	10	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	50	588	0		205	950	164		246	0	81		45	10	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	0.00		1.10	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	50	588	0		226	950	164		246	0	81		45	10	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	1.71	0.29		1.00	0.00	1.00		0.82	0.18	1.00	
Final Sat.:	1425	2850	1425		2850	2430	420		1425	0	1425		1166	259	1425	
Capacity Analysis Module:																
Vol/Sat:	0.04	0.21	0.00		0.08	0.39	0.39		0.17	0.00	0.06		0.04	0.04	0.00	
Crit Vol:	50						557		246					55		
Crit Moves:	****						****		****					****		

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.760
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 78 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	132	563	114	82	651	8	22	946	442	64	851	77
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	132	563	114	82	651	8	22	946	442	64	851	77
Added Vol:	0	14	0	0	115	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	132	577	114	82	766	8	22	946	442	64	851	77
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	132	577	114	82	766	8	22	946	0	64	851	77
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	132	577	114	82	766	8	22	946	0	64	851	77
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	145	577	114	82	766	8	22	946	0	64	851	77
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.97	0.03	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	4231	44	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.10	0.20	0.08	0.06	0.18	0.18	0.02	0.33	0.00	0.04	0.30	0.05
Crit Vol:	289			258			473			64		
Crit Moves:	****			****			****			****		

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.399
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 24 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	3 0	0	0 0	3 0	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	0	583	0	0	671	0	337	0	0	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	583	0	0	671	0	337	0	0	0	0	0
Added Vol:	0	14	0	0	115	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	597	0	0	786	0	337	0	0	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	597	0	0	786	0	337	0	0	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	597	0	0	786	0	337	0	0	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	597	0	0	786	0	337	0	0	0	0	0
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	3.00	0.00	0.00	3.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Final Sat.:	1500	4500	0	0	4500	0	1500	1500	0	0	1500	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.00	0.00	0.17	0.00	0.22	0.00	0.00	0.00	0.00	0.00
Crit Vol:	0			262			337			0		
Crit Moves:	****			****			****					

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.540
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 40 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Permitted				Protected			
Rights:	Ignore				Ignore				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	1	1	0 1	1	0	2	0 1	1	0	2	0 1	1	0	2	0 1
Volume Module:																
Base Vol:	28	319	382		30	343	222		148	533	22		300	665	27	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	28	319	382		30	343	222		148	533	22		300	665	27	
Added Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	28	319	382		30	343	222		148	533	22		300	665	27	
User Adj:	1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	28	319	0		30	343	0		148	533	0		300	665	27	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	28	319	0		30	343	0		148	533	0		300	665	27	
PCE Adj:	2.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	62	319	0		30	343	0		148	533	0		300	665	27	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		1.00	2.00	1.00		1.00	2.00	1.00		1.00	2.00	1.00	
Final Sat.:	1425	2850	1425		1425	2850	1425		1425	2850	1425		1425	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.02	0.11	0.00		0.02	0.12	0.00		0.10	0.19	0.00		0.21	0.23	0.02	
Crit Vol:	31				172				267				300			
Crit Moves:	****				****				****				****			

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.669
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Include				Ovl				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	0	0 0	1	0	0	0 1	1	0	2	0 0	0	0	2	0 1
Volume Module:																
Base Vol:	0	0	0		210	0	288		357	829	0		0	774	134	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		210	0	288		357	829	0		0	774	134	
Added Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	0	0		210	0	288		357	829	0		0	774	134	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	0	0		210	0	288		357	829	0		0	774	134	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		210	0	288		357	829	0		0	774	134	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	0	0		210	0	288		357	829	0		0	774	134	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		1.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	1.00	
Final Sat.:	0	0	0		1425	0	1425		1425	2850	0		0	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.15	0.00	0.20		0.25	0.29	0.00		0.00	0.27	0.09	
Crit Vol:	0				210				357				387			
Crit Moves:					****				****				****			

Pier T LNG Facility
Year 2010 Construction Scenario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.600
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 46 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	3	0 1	1	0	3	0 0	0	0	0	0 0	1	0	0	0 1
Volume Module:																
Base Vol:	0	879	229	498	1006	0	0	0	0	59	0	75				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	0	879	229	498	1006	0	0	0	0	59	0	75				
Added Vol:	0	14	0	0	115	0	0	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	0	893	229	498	1121	0	0	0	0	59	0	75				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	0	893	229	498	1121	0	0	0	0	59	0	75				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	0	893	229	498	1121	0	0	0	0	59	0	75				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Final Vol.:	0	893	229	498	1121	0	0	0	0	59	0	75				
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425				
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.00	3.00	1.00	1.00	3.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00				
Final Sat.:	0	4275	1425	1425	4275	0	0	0	0	1425	0	1425				
Capacity Analysis Module:																
Vol/Sat:	0.00	0.21	0.16	0.35	0.26	0.00	0.00	0.00	0.00	0.04	0.00	0.05				
Crit Vol:		298		498				0		59						
Crit Moves:		****		****						****						

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Scenario Report

Scenario:	2010 Construction - MD Peak
Command:	2010 Construction - MD Peak
Volume:	2010 Base - MD Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	MD Peak
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 SR-47 NB On-Ramp & New Dock St	B	12.3	0.467	B	13.9	0.553	+ 0.086 V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	13.8	0.000	B	14.8	0.000	+ 1.052 D/V
# 3 SR-47 & Ocean Blvd	C	xxxxx	0.776	C	xxxxx	0.788	+ 0.012 V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.688	C	xxxxx	0.757	+ 0.069 V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.280	A	xxxxx	0.344	+ 0.064 V/C
# 6 Pier S Ave & Depot / SERRF Dri	B	10.1	0.000	B	12.4	0.000	+ 2.300 D/V
# 7 Navy Way & Seaside Ave	C	xxxxx	0.743	C	xxxxx	0.770	+ 0.027 V/C
# 8 Henry Ford Ave & TI Freeway Ra	B	xxxxx	0.615	B	xxxxx	0.656	+ 0.040 V/C
# 9 Henry Ford Ave & Anaheim St	E	xxxxx	0.930	E	xxxxx	0.973	+ 0.044 V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.377	A	xxxxx	0.402	+ 0.026 V/C
# 11 Alameda St & Anaheim St	A	xxxxx	0.484	A	xxxxx	0.484	+ 0.000 V/C
# 12 Alameda St & PCH e/o Alameda S	C	xxxxx	0.716	C	xxxxx	0.716	+ 0.000 V/C
# 13 Alameda St & PCH n/o PCH	B	xxxxx	0.657	B	xxxxx	0.684	+ 0.027 V/C

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.553
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 13.9
Optimal Cycle: 0 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	1	0	1 0	0	0	0	0 0	1	1	0	1 0	0	1	0	1 0
Volume Module:																
Base Vol:	31	244	0	0	0	0	555	23	241	0	10	24				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	31	244	0	0	0	0	555	23	241	0	10	24				
Added Vol:	0	0	0	0	0	0	102	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	31	244	0	0	0	0	657	23	241	0	10	24				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Volume:	31	244	0	0	0	0	657	23	0	0	10	24				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	31	244	0	0	0	0	657	23	0	0	10	24				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
Final Vol.:	31	244	0	0	0	0	657	23	0	0	10	24				
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.23	1.77	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	1.00	1.00				
Final Sat.:	122	971	0	0	0	0	1189	644	0	0	552	619				
Capacity Analysis Module:																
Vol/Sat:	0.25	0.25	xxxx	xxxx	xxxx	xxxx	0.55	0.04	xxxx	xxxx	0.02	0.04				
Crit Moves:	****						****					****				
Delay/Veh:	11.1	11.0	0.0	0.0	0.0	0.0	15.6	8.4	0.0	0.0	9.0	8.4				
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
AdjDel/Veh:	11.1	11.0	0.0	0.0	0.0	0.0	15.6	8.4	0.0	0.0	9.0	8.4				
LOS by Move:	B	B	*	*	*	*	C	A	*	*	A	A				
ApproachDel:	11.0			xxxxxx			15.4				8.5					
Delay Adj:	1.00			xxxxx			1.00				1.00					
ApprAdjDel:	11.0			xxxxxx			15.4				8.5					
LOS by Appr:	B			*			C				A					

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 7.0 Worst Case Level Of Service: B[14.8]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	1	1	0 0
Volume Module:																
Base Vol:	3	0	15	225	0	397	0	577	2	0	41	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	3	0	15	225	0	397	0	577	2	0	41	0				
Added Vol:	0	0	0	0	0	1	0	102	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	3	0	15	225	0	398	0	679	2	0	41	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	3	0	15	225	0	398	0	679	2	0	41	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Final Vol.:	3	0	15	225	0	398	0	679	2	0	41	0				
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	7.5	xxxx	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	3.5	xxxx	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	700	xxxx	340	381	xxxx	20	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	330	xxxx	662	557	xxxx	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	206	xxxx	662	544	xxxx	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.01	xxxx	0.02	0.41	xxxx	0.38	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.1	xxxxx	xxxx	0.7	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	22.7	xxxx	10.6	xxxxx	xxxx	9.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	C	*	B	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	705	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	4.1	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	17.5	xxxxx	xxxxx	xxxx	xxxxx	9.0	xxxx	xxxxx				
Shared LOS:	*	*	*	*	C	*	*	*	*	A	*	*				
ApproachDel:	12.6			14.8			xxxxxx			xxxxxx						
ApproachLOS:	B			B			*			*						

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.788
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 64 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Split Phase				Split Phase				Split Phase				Split Phase			
Rights:	Include				Ovl				Include				Ignore			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 2	0 1		2	0 0	0 2		2	0 1	1 0		1	0 2	0 1	
Volume Module:																
Base Vol:	67	490	103		341	0	1254		1256	204	0		0	77	96	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	67	490	103		341	0	1254		1256	204	0		0	77	96	
Added Vol:	0	0	0		14	0	0		0	227	0		0	25	14	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	67	490	103		355	0	1254		1256	431	0		0	102	110	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	67	490	103		355	0	1254		1256	431	0		0	102	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	67	490	103		355	0	1254		1256	431	0		0	102	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	67	490	103		355	0	1254		1256	431	0		0	102	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	0.00	2.00		2.00	2.00	0.00		1.00	2.00	1.00	
Final Sat.:	1600	3200	1600		3200	0	3200		3200	3200	0		1600	3200	1600	
Capacity Analysis Module:																
Vol/Sat:	0.04	0.15	0.06		0.11	0.00	0.39		0.39	0.13	0.00		0.00	0.03	0.00	
Crit Moves:		****			****				****					****		

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.757
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 58 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Ignore			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 0	0 0		2	0 0	0 1		1	0 2	0 0		0	0 2	0 2	
Volume Module:																
Base Vol:	0	0	0		118	0	128		161	1339	0		0	1303	94	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		118	0	128		161	1339	0		0	1303	94	
Added Vol:	0	0	0		213	0	102		1	14	0		0	14	11	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	0	0		331	0	230		162	1353	0		0	1317	105	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	0	0	0		331	0	230		162	1353	0		0	1317	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		331	0	230		162	1353	0		0	1317	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	0	0	0		331	0	230		162	1353	0		0	1317	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		2.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	2.00	
Final Sat.:	0	0	0		3200	0	1600		1600	3200	0		0	3200	3200	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.10	0.00	0.14		0.10	0.42	0.00		0.00	0.41	0.00	
Crit Moves:							****		****					****		

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.344
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 35 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	110	46	99	98	52	0	0	420	152	41	307	152
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	110	46	99	98	52	0	0	420	152	41	307	152
Added Vol:	0	0	102	0	0	0	0	0	0	1	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	110	46	201	98	52	0	0	420	152	42	307	152
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	110	46	201	98	52	0	0	420	0	42	307	152
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	110	46	201	98	52	0	0	420	0	42	307	152
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	110	46	201	98	52	0	0	420	0	42	307	152
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	1.00	0.00	1.00	2.00	1.00	1.00	2.01	0.99
Final Sat.:	1600	1600	1600	1600	1600	0	1600	3200	1600	1600	3210	1590
Capacity Analysis Module:												
Vol/Sat:	0.07	0.03	0.13	0.06	0.03	0.00	0.00	0.13	0.00	0.03	0.10	0.10
Crit Moves:			****	****				****		****		

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 5.4 Worst Case Level Of Service: B[12.4]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	T	R		L	T	R		L	T	R		L	T	R	
Control:	Uncontrolled				Uncontrolled				Stop Sign				Stop Sign			
Rights:	Include				Include				Include				Include			
Lanes:	1 0	1 1	0		0 1	1 0	1		1 0	0 0	1		0 0	1! 0	0	
Volume Module:																
Base Vol:	0	253	1		1	246	0		0	0	0		9	0	9	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	253	1		1	246	0		0	0	0		9	0	9	
Added Vol:	12	0	0		0	0	1		102	0	315		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	12	253	1		1	246	1		102	0	315		9	0	9	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	12	253	1		1	246	1		102	0	315		9	0	9	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Final Vol.:	12	253	1		1	246	1		102	0	315		9	0	9	
Critical Gap Module:																
Critical Gp:	4.1	xxxx	xxxxx		4.1	xxxx	xxxxx		7.5	xxxx	6.9		7.5	xxxx	6.9	
FollowUpTim:	2.2	xxxx	xxxxx		2.2	xxxx	xxxxx		3.5	xxxx	3.3		3.5	xxxx	3.3	
Capacity Module:																
Cnflict Vol:	247	xxxx	xxxxx		254	xxxx	xxxxx		399	xxxx	123		403	xxxx	127	
Potent Cap.:	1331	xxxx	xxxxx		1323	xxxx	xxxxx		541	xxxx	911		537	xxxx	906	
Move Cap.:	1331	xxxx	xxxxx		1323	xxxx	xxxxx		532	xxxx	911		349	xxxx	906	
Volume/Cap:	0.01	xxxx	xxxx		0.00	xxxx	xxxx		0.19	xxxx	0.35		0.03	xxxx	0.01	
Level Of Service Module:																
Queue:	0.0	xxxx	xxxxx		0.0	xxxx	xxxxx		0.7	xxxx	1.6		xxxxx	xxxx	xxxxx	
Stopped Del:	7.7	xxxx	xxxxx		7.7	xxxx	xxxxx		13.4	xxxx	11.0		xxxxx	xxxx	xxxxx	
LOS by Move:	A	*	*		A	*	*		B	*	B		*	*	*	
Movement:	LT -	LTR -	RT		LT -	LTR -	RT		LT -	LTR -	RT		LT -	LTR -	RT	
Shared Cap.:	xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	xxxx	xxxxx		xxxx	504	xxxxx	
SharedQueue:	xxxxx	xxxx	xxxxx		0.0	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	0.1	xxxxx	
Shrd StpDel:	xxxxx	xxxx	xxxxx		7.7	xxxx	xxxxx		xxxxx	xxxx	xxxxx		xxxxx	12.4	xxxxx	
Shared LOS:	*	*	*		A	*	*		*	*	*		*	B	*	
ApproachDel:	xxxxxx				xxxxxx				11.6				12.4			
ApproachLOS:	*				*				B				B			

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 0.770
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 81 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Ignore			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2 0	0 0	1	0 0	0 0	0	0 0	3 0	1	2 0	3 0	0
Volume Module:												
Base Vol:	312	0	1211	0	0	0	0	2473	424	0	2662	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	312	0	1211	0	0	0	0	2473	424	0	2662	0
Added Vol:	0	0	0	0	0	0	0	14	0	0	115	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	312	0	1211	0	0	0	0	2487	424	0	2777	0
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	312	0	0	0	0	0	0	2487	424	0	2777	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	312	0	0	0	0	0	0	2487	424	0	2777	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	343	0	0	0	0	0	0	2487	424	0	2777	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	2.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00	1.00	2.00	3.00	0.00
Final Sat.:	2850	0	1425	0	0	0	0	4275	1425	2850	4275	0
Capacity Analysis Module:												
Vol/Sat:	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.30	0.00	0.65	0.00
Crit Vol:	172				0		0				926	
Crit Moves:	****						****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.656
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 54 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	37	924	61	143	803	116	263	12	92	51	22	262
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	37	924	61	143	803	116	263	12	92	51	22	262
Added Vol:	0	115	0	0	14	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	37	1039	61	143	817	116	263	12	92	51	22	262
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	37	1039	0	143	817	116	263	12	92	51	22	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	37	1039	0	143	817	116	263	12	92	51	22	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	37	1039	0	157	817	116	263	12	92	51	22	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.75	0.25	1.00	0.12	0.88	0.70	0.30	1.00
Final Sat.:	1425	2850	1425	2850	2496	354	1425	164	1261	996	429	1425
Capacity Analysis Module:												
Vol/Sat:	0.03	0.36	0.00	0.06	0.33	0.33	0.18	0.07	0.07	0.05	0.05	0.00
Crit Vol:		520		79			263				73	
Crit Moves:		****		****			****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.973
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Split Phase				Split Phase				Permitted				Permitted			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	1 1	0	1	1	0 2	1	0	1	0 2	0	1	1	0 2	0	1
Volume Module:																
Base Vol:	122	844	105		75	803	7		25	1130	502		68	1190	84	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	122	844	105		75	803	7		25	1130	502		68	1190	84	
Added Vol:	0	115	0		0	14	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	122	959	105		75	817	7		25	1130	502		68	1190	84	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	122	959	105		75	817	7		25	1130	0		68	1190	84	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	122	959	105		75	817	7		25	1130	0		68	1190	84	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	134	959	105		75	817	7		25	1130	0		68	1190	84	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		1.00	2.97	0.03		1.00	2.00	1.00		1.00	2.00	1.00	
Final Sat.:	1425	2850	1425		1425	4239	36		1425	2850	1425		1425	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.09	0.34	0.07		0.05	0.19	0.19		0.02	0.40	0.00		0.05	0.42	0.06	
Crit Vol:	480				275				565				68			
Crit Moves:	****				****				****				****			

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.402
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 24 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Permitted				Permitted			
Rights:	Include				Include				Include				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 3	0	0	0	0 3	0	0	1	0 0	1	0	0	0 1!	0	0
Volume Module:																
Base Vol:	0	897	0		0	830	0		266	0	3		0	0	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	897	0		0	830	0		266	0	3		0	0	0	
Added Vol:	0	115	0		0	14	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	1012	0		0	844	0		266	0	3		0	0	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	1012	0		0	844	0		266	0	3		0	0	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	1012	0		0	844	0		266	0	3		0	0	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	1012	0		0	844	0		266	0	3		0	0	0	
Saturation Flow Module:																
Sat/Lane:	1500	1500	1500		1500	1500	1500		1500	1500	1500		1500	1500	1500	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	3.00	0.00		0.00	3.00	0.00		1.00	0.00	1.00		0.00	1.00	0.00	
Final Sat.:	1500	4500	0		0	4500	0		1500	0	1500		0	1500	0	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.22	0.00		0.00	0.19	0.00		0.18	0.00	0.00		0.00	0.00	0.00	
Crit Vol:	337				0				266					0		
Crit Moves:	****				****				****							

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.484
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 51 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Permitted			Protected		
Rights:	Ignore			Ignore			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 0	1	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	23	202	326	25	316	185	136	437	20	274	1012	24
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	23	202	326	25	316	185	136	437	20	274	1012	24
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	23	202	326	25	316	185	136	437	20	274	1012	24
User Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	23	202	0	25	316	0	136	437	0	274	1012	24
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	23	202	0	25	316	0	136	437	0	274	1012	24
PCE Adj:	2.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	51	202	0	25	316	0	136	437	0	274	1012	24
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	2850	1425	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.02	0.07	0.00	0.02	0.11	0.00	0.10	0.15	0.00	0.19	0.36	0.02
Crit Vol:	25				158			218			506	
Crit Moves:	****				****						****	

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.716
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 66 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Include			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	0 0	1	1 0	2 0	0	0 0	2 0	1
Volume Module:												
Base Vol:	0	0	0	199	0	305	408	774	0	0	827	137
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	199	0	305	408	774	0	0	827	137
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	199	0	305	408	774	0	0	827	137
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	199	0	305	408	774	0	0	827	137
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	199	0	305	408	774	0	0	827	137
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	199	0	305	408	774	0	0	827	137
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	1.00
Final Sat.:	0	0	0	1425	0	1425	1425	2850	0	0	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.14	0.00	0.21	0.29	0.27	0.00	0.00	0.29	0.10
Crit Vol:		0			199			408			414	
Crit Moves:				****			****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
MD Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.684
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 59 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 3	0	1	1	0 3	0	0	0	0 0	0	0	1	0 0	0	1
Volume Module:																
Base Vol:	0	1107	226		504	1080	0		0	0	0		63	0	74	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	1107	226		504	1080	0		0	0	0		63	0	74	
Added Vol:	0	115	0		0	14	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	1222	226		504	1094	0		0	0	0		63	0	74	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	1222	226		504	1094	0		0	0	0		63	0	74	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	1222	226		504	1094	0		0	0	0		63	0	74	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	1222	226		504	1094	0		0	0	0		63	0	74	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	3.00	1.00		1.00	3.00	0.00		0.00	0.00	0.00		1.00	0.00	1.00	
Final Sat.:	0	4275	1425		1425	4275	0		0	0	0		1425	0	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.29	0.16		0.35	0.26	0.00		0.00	0.00	0.00		0.04	0.00	0.05	
Crit Vol:		407			504					0			63			
Crit Moves:		****			****								****			

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Scenario Report

Scenario:	2010 Construction - PM Peak
Command:	2010 Construction - PM Peak
Volume:	2010 Base - PM Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	PM Peak
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 SR-47 NB On-Ramp & New Dock St	B	11.4	0.429	B	12.7	0.514	+ 0.084 V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	11.8	0.000	B	12.7	0.000	+ 0.881 D/V
# 3 SR-47 & Ocean Blvd	C	xxxxx	0.721	C	xxxxx	0.733	+ 0.012 V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.678	C	xxxxx	0.747	+ 0.069 V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.301	A	xxxxx	0.323	+ 0.022 V/C
# 6 Pier S Ave & Depot / SERRF Dri	B	10.6	0.000	B	13.6	0.000	+ 2.911 D/V
# 7 Navy Way & Seaside Ave	F	xxxxx	1.033	F	xxxxx	1.060	+ 0.027 V/C
# 8 Henry Ford Ave & TI Freeway Ra	B	xxxxx	0.667	B	xxxxx	0.667	+ 0.001 V/C
# 9 Henry Ford Ave & Anaheim St	E	xxxxx	0.930	E	xxxxx	0.973	+ 0.044 V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.374	A	xxxxx	0.399	+ 0.026 V/C
# 11 Alameda St & Anaheim St	B	xxxxx	0.608	B	xxxxx	0.608	+ 0.000 V/C
# 12 Alameda St & PCH e/o Alameda S	B	xxxxx	0.667	B	xxxxx	0.667	+ 0.000 V/C
# 13 Alameda St & PCH n/o PCH	B	xxxxx	0.686	B	xxxxx	0.699	+ 0.013 V/C

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.514
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 12.7
Optimal Cycle: 0 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	1	0	1 0	0	0	0	0 0	1	1	0	1 0	0	1	0	1 0
Volume Module:																
Base Vol:	25	167	0	0	0	0	522	51	129	0	34	63				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	25	167	0	0	0	0	522	51	129	0	34	63				
Added Vol:	0	0	0	0	0	0	102	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	25	167	0	0	0	0	624	51	129	0	34	63				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Volume:	25	167	0	0	0	0	624	51	0	0	34	63				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	25	167	0	0	0	0	624	51	0	0	34	63				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
Final Vol.:	25	167	0	0	0	0	624	51	0	0	34	63				
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.26	1.74	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	1.00	1.00				
Final Sat.:	139	939	0	0	0	0	1214	659	0	0	582	657				
Capacity Analysis Module:																
Vol/Sat:	0.18	0.18	xxxx	xxxx	xxxx	xxxx	0.51	0.08	xxxx	xxxx	0.06	0.10				
Crit Moves:	****						****					****				
Delay/Veh:	10.4	10.3	0.0	0.0	0.0	0.0	14.5	8.5	0.0	0.0	8.9	8.4				
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
AdjDel/Veh:	10.4	10.3	0.0	0.0	0.0	0.0	14.5	8.5	0.0	0.0	8.9	8.4				
LOS by Move:	B	B	*	*	*	*	B	A	*	*	A	A				
ApproachDel:	10.3			xxxxxx			14.0				8.6					
Delay Adj:	1.00			xxxxx			1.00				1.00					
ApprAdjDel:	10.3			xxxxxx			14.0				8.6					
LOS by Appr:	B			*			B				A					

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 3.8 Worst Case Level Of Service: B[12.7]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	1	1	0 0
Volume Module:																
Base Vol:	4	0	11	125	5	195	0	566	0	0	59	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	4	0	11	125	5	195	0	566	0	0	59	0				
Added Vol:	0	0	0	0	0	1	0	102	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	4	0	11	125	5	196	0	668	0	0	59	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	4	0	11	125	5	196	0	668	0	0	59	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Final Vol.:	4	0	11	125	5	196	0	668	0	0	59	0				
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	7.5	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	700	xxxx	334	393	727	30	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	330	xxxx	668	546	353	1045	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	265	xxxx	668	537	353	1045	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.02	xxxx	0.02	0.23	0.01	0.19	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.1	xxxxx	xxxx	0.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	18.8	xxxx	10.5	xxxxx	xxxx	8.8	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	C	*	B	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	669	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	1.5	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	13.1	xxxxx	xxxxx	xxxx	xxxxx	9.0	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	A	*	*				
ApproachDel:	12.7			11.8			xxxxxx			xxxxxx						
ApproachLOS:	B			B			*			*						

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.733
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 55 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Split Phase			Split Phase		
Rights:	Include			Ovl			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 2	0	1	2 0	0	0 2	2 0	1	1 0	1 0	2	0 1
Volume Module:												
Base Vol:	52	371	99	175	0	1071	1370	213	0	0	72	176
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	52	371	99	175	0	1071	1370	213	0	0	72	176
Added Vol:	0	0	0	14	0	0	0	227	0	0	25	14
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	52	371	99	189	0	1071	1370	440	0	0	97	190
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	52	371	99	189	0	1071	1370	440	0	0	97	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	52	371	99	189	0	1071	1370	440	0	0	97	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	52	371	99	189	0	1071	1370	440	0	0	97	0
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	0.00	2.00	2.00	2.00	0.00	1.00	2.00	1.00
Final Sat.:	1600	3200	1600	3200	0	3200	3200	3200	0	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.03	0.12	0.06	0.06	0.00	0.33	0.43	0.14	0.00	0.00	0.03	0.00
Crit Moves:		****		****			****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.747
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 57 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Permitted		
Rights:	Include			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0	0	2 0	0	0 1	1 0	2	0 0	0 0	2	0 2
Volume Module:												
Base Vol:	0	0	0	101	0	182	200	1484	0	0	1085	110
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	101	0	182	200	1484	0	0	1085	110
Added Vol:	0	0	0	213	0	102	1	14	0	0	14	11
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	314	0	284	201	1498	0	0	1099	121
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	0	0	0	314	0	284	201	1498	0	0	1099	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	314	0	284	201	1498	0	0	1099	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	0	0	0	314	0	284	201	1498	0	0	1099	0
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	2.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	2.00
Final Sat.:	0	0	0	3200	0	1600	1600	3200	0	0	3200	3200
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.10	0.00	0.18	0.13	0.47	0.00	0.00	0.34	0.00
Crit Moves:						****	****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.323
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 34 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	178	93	116	59	51	14	15	419	260	29	61	46
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	178	93	116	59	51	14	15	419	260	29	61	46
Added Vol:	0	0	102	0	0	0	0	0	0	1	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	178	93	218	59	51	14	15	419	260	30	61	46
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	178	93	218	59	51	14	15	419	0	30	61	46
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	178	93	218	59	51	14	15	419	0	30	61	46
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	178	93	218	59	51	14	15	419	0	30	61	46
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.78	0.22	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1255	345	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.11	0.06	0.14	0.04	0.04	0.04	0.01	0.13	0.00	0.02	0.02	0.03
Crit Moves:			****	****				****		****		

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 5.0 Worst Case Level Of Service: B[13.6]

Approach:	North Bound						South Bound						East Bound						West Bound					
Movement:	L -	T -	R				L -	T -	R				L -	T -	R				L -	T -	R			
Control:	Uncontrolled						Uncontrolled						Stop Sign						Stop Sign					
Rights:	Include						Include						Include						Include					
Lanes:	1 0	1 1	0				0 1	1 0	1				1 0	0 0	1				0 0	1! 0	0			
Volume Module:																								
Base Vol:	0	321	2				1	318	0				0	0	0				4	0	4			
Growth Adj:	1.00	1.00	1.00				1.00	1.00	1.00				1.00	1.00	1.00				1.00	1.00	1.00			
Initial Bse:	0	321	2				1	318	0				0	0	0				4	0	4			
Added Vol:	12	0	0				0	0	1				102	0	315				0	0	0			
PasserByVol:	0	0	0				0	0	0				0	0	0				0	0	0			
Initial Fut:	12	321	2				1	318	1				102	0	315				4	0	4			
User Adj:	1.00	1.00	1.00				1.00	1.00	1.00				1.00	1.00	1.00				1.00	1.00	1.00			
PHF Adj:	1.00	1.00	1.00				1.00	1.00	1.00				1.00	1.00	1.00				1.00	1.00	1.00			
PHF Volume:	12	321	2				1	318	1				102	0	315				4	0	4			
Reduct Vol:	0	0	0				0	0	0				0	0	0				0	0	0			
Final Vol.:	12	321	2				1	318	1				102	0	315				4	0	4			
Critical Gap Module:																								
Critical Gp:	4.1	xxxx	xxxxx				4.1	xxxx	xxxxx				7.5	xxxx					6.9	7.5	xxxx			
FollowUpTim:	2.2	xxxx	xxxxx				2.2	xxxx	xxxxx				3.5	xxxx					3.3	3.5	xxxx			
Capacity Module:																								
Cnflict Vol:	319	xxxx	xxxxx				323	xxxx	xxxxx				505	xxxx					159	507	xxxx			
Potent Cap.:	1252	xxxx	xxxxx				1248	xxxx	xxxxx				455	xxxx					864	453	xxxx			
Move Cap.:	1252	xxxx	xxxxx				1248	xxxx	xxxxx				449	xxxx					864	286	xxxx			
Volume/Cap:	0.01	xxxx	xxxx				0.00	xxxx	xxxx				0.23	xxxx					0.36	0.01	xxxx			
Level Of Service Module:																								
Queue:	0.0	xxxx	xxxxx				0.0	xxxx	xxxxx				0.9	xxxx					1.7	xxxxx	xxxx	xxxxx		
Stopped Del:	7.9	xxxx	xxxxx				7.9	xxxx	xxxxx				15.4	xxxx					11.5	xxxxx	xxxx	xxxxx		
LOS by Move:	A	*	*				A	*	*				C	*					B	*	*	*		
Movement:	LT -	LTR -	RT				LT -	LTR -	RT				LT -	LTR -	RT				LT -	LTR -	RT			
Shared Cap.:	xxxx	xxxx	xxxxx				xxxx	xxxx	xxxxx				xxxx	xxxx	xxxxx				xxxx	429	xxxxx			
SharedQueue:	xxxxx	xxxx	xxxxx				0.0	xxxx	xxxxx				xxxxx	xxxx	xxxxx				xxxxx	0.1	xxxxx			
Shrd StpDel:	xxxxx	xxxx	xxxxx				7.9	xxxx	xxxxx				xxxxx	xxxx	xxxxx				xxxxx	13.6	xxxxx			
Shared LOS:	*	*	*				A	*	*				*	*					*	B	*			
ApproachDel:	xxxxxx						xxxxxx						12.5						13.6					
ApproachLOS:	*						*						B						B					

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 1.060
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Ignore			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2 0	0 0	1	0 0	0 0	0	0 0	3 0	1	2 0	3 0	0
Volume Module:												
Base Vol:	547	0	1687	0	0	0	0	2850	310	80	3514	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	547	0	1687	0	0	0	0	2850	310	80	3514	0
Added Vol:	0	0	0	0	0	0	0	14	0	0	115	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	547	0	1687	0	0	0	0	2864	310	80	3629	0
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	547	0	0	0	0	0	0	2864	310	80	3629	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	547	0	0	0	0	0	0	2864	310	80	3629	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	602	0	0	0	0	0	0	2864	310	88	3629	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	2.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00	1.00	2.00	3.00	0.00
Final Sat.:	2850	0	1425	0	0	0	0	4275	1425	2850	4275	0
Capacity Analysis Module:												
Vol/Sat:	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.22	0.03	0.85	0.00
Crit Vol:	301				0		0				1210	
Crit Moves:	****						****				****	

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.667
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	126	1043	47	104	613	625	78	8	153	38	6	181
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	126	1043	47	104	613	625	78	8	153	38	6	181
Added Vol:	0	115	0	0	14	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	126	1158	47	104	627	625	78	8	153	38	6	181
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	126	1158	0	104	627	625	78	8	153	38	6	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	126	1158	0	104	627	625	78	8	153	38	6	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	126	1158	0	114	627	625	78	8	153	38	6	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.00	1.00	1.00	0.05	0.95	0.86	0.14	1.00
Final Sat.:	1425	2850	1425	2850	1427	1423	1425	71	1354	1231	194	1425
Capacity Analysis Module:												
Vol/Sat:	0.09	0.41	0.00	0.04	0.44	0.44	0.05	0.11	0.11	0.03	0.03	0.00
Crit Vol:	126					626		161		38		
Crit Moves:	****					****		****		****		

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.973
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Split Phase				Split Phase				Permitted				Permitted			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	1 1	0	1	1	0 2	1	0	1	0 2	0	1	1	0 2	0	1
Volume Module:																
Base Vol:	384	899	101		105	549	34		20	1146	140		51	1322	114	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	384	899	101		105	549	34		20	1146	140		51	1322	114	
Added Vol:	0	115	0		0	14	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	384	1014	101		105	563	34		20	1146	140		51	1322	114	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	384	1014	101		105	563	34		20	1146	0		51	1322	114	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	384	1014	101		105	563	34		20	1146	0		51	1322	114	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	422	1014	101		105	563	34		20	1146	0		51	1322	114	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		1.00	2.83	0.17		1.00	2.00	1.00		1.00	2.00	1.00	
Final Sat.:	1425	2850	1425		1425	4032	243		1425	2850	1425		1425	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.30	0.36	0.07		0.07	0.14	0.14		0.01	0.40	0.00		0.04	0.46	0.08	
Crit Vol:	507				199				20				661			
Crit Moves:	****				****				****				****			

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.399
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 24 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Permitted				Permitted			
Rights:	Include				Include				Include				Include			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 3	0	0	0	0 3	0	0	1	0 0	1	0	0	0 1!	0	0
Volume Module:																
Base Vol:	4	953	0		0	602	0		243	0	5		0	0	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	4	953	0		0	602	0		243	0	5		0	0	0	
Added Vol:	0	115	0		0	14	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	4	1068	0		0	616	0		243	0	5		0	0	0	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	4	1068	0		0	616	0		243	0	5		0	0	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	4	1068	0		0	616	0		243	0	5		0	0	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	4	1068	0		0	616	0		243	0	5		0	0	0	
Saturation Flow Module:																
Sat/Lane:	1500	1500	1500		1500	1500	1500		1500	1500	1500		1500	1500	1500	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	3.00	0.00		0.00	3.00	0.00		1.00	0.00	1.00		0.00	1.00	0.00	
Final Sat.:	1500	4500	0		0	4500	0		1500	0	1500		0	1500	0	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.24	0.00		0.00	0.14	0.00		0.16	0.00	0.00		0.00	0.00	0.00	
Crit Vol:	356				0				243					0		
Crit Moves:	****				****				****							

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.608
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 48 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Permitted			Protected		
Rights:	Ignore			Ignore			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 0	1	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	11	231	479	28	522	234	157	516	15	336	1113	36
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	11	231	479	28	522	234	157	516	15	336	1113	36
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	11	231	479	28	522	234	157	516	15	336	1113	36
User Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	11	231	0	28	522	0	157	516	0	336	1113	36
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	11	231	0	28	522	0	157	516	0	336	1113	36
PCE Adj:	2.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	24	231	0	28	522	0	157	516	0	336	1113	36
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	2850	1425	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.01	0.08	0.00	0.02	0.18	0.00	0.11	0.18	0.00	0.24	0.39	0.03
Crit Vol:	12			261			258			336		
Crit Moves:	****			****			****			****		

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.667
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Include			Ovl			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 0	0	1 0	0 0	1	1 0	2 0	0	0 0	2 0	1
Volume Module:												
Base Vol:	0	0	0	73	0	425	395	849	0	0	966	264
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	0	0	73	0	425	395	849	0	0	966	264
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	0	0	73	0	425	395	849	0	0	966	264
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	0	0	73	0	425	395	849	0	0	966	264
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	0	0	73	0	425	395	849	0	0	966	264
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	0	0	73	0	425	395	849	0	0	966	264
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	0.00	0.00	0.00	1.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	1.00
Final Sat.:	0	0	0	1425	0	1425	1425	2850	0	0	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.00	0.00	0.00	0.05	0.00	0.30	0.28	0.30	0.00	0.00	0.34	0.19
Crit Vol:	0			73			395			483		
Crit Moves:				****			****			****		

Pier T LNG Facility
Year 2010 Construction Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.699
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 62 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	3	0 1	1	0	3	0 0	0	0	0	0 0	1	0	0	0 1
Volume Module:																
Base Vol:	0	1127	395	498	1129	0	0	0	0	84	0	180				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	0	1127	395	498	1129	0	0	0	0	84	0	180				
Added Vol:	0	115	0	0	14	0	0	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	0	1242	395	498	1143	0	0	0	0	84	0	180				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	0	1242	395	498	1143	0	0	0	0	84	0	180				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	0	1242	395	498	1143	0	0	0	0	84	0	180				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Final Vol.:	0	1242	395	498	1143	0	0	0	0	84	0	180				
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425				
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.00	3.00	1.00	1.00	3.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00				
Final Sat.:	0	4275	1425	1425	4275	0	0	0	0	1425	0	1425				
Capacity Analysis Module:																
Vol/Sat:	0.00	0.29	0.28	0.35	0.27	0.00	0.00	0.00	0.00	0.06	0.00	0.13				
Crit Vol:		414		498				0		84						
Crit Moves:		****		****						****						

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Scenario Report

Scenario:	2010 Operations - AM Peak
Command:	2010 Operations - AM Peak
Volume:	2010 Base - AM Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	AM Peak
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 SR-47 NB On-Ramp & New Dock St	A	9.1	0.205	A	9.1	0.205	+ 0.000 V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	11.2	0.000	B	11.2	0.000	+ 0.000 D/V
# 3 SR-47 & Ocean Blvd	A	xxxxx	0.578	A	xxxxx	0.580	+ 0.001 V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.649	B	xxxxx	0.650	+ 0.001 V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.266	A	xxxxx	0.266	+ 0.000 V/C
# 6 Pier S Ave & Depot / SERRF Dri	A	9.7	0.000	A	9.7	0.000	+ 0.000 D/V
# 7 Navy Way & Seaside Ave	E	xxxxx	0.934	E	xxxxx	0.935	+ 0.001 V/C
# 8 Henry Ford Ave & TI Freeway Ra	A	xxxxx	0.597	A	xxxxx	0.598	+ 0.001 V/C
# 9 Henry Ford Ave & Anaheim St	C	xxxxx	0.729	C	xxxxx	0.731	+ 0.002 V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.374	A	xxxxx	0.375	+ 0.001 V/C
# 11 Alameda St & Anaheim St	A	xxxxx	0.540	A	xxxxx	0.540	+ 0.000 V/C
# 12 Alameda St & PCH e/o Alameda S	B	xxxxx	0.669	B	xxxxx	0.669	+ 0.000 V/C
# 13 Alameda St & PCH n/o PCH	A	xxxxx	0.596	A	xxxxx	0.597	+ 0.001 V/C

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.205
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 9.1
Optimal Cycle: 0 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	1	0	1 0	0	0	0	0 0	1	1	0	1 0	0	1	0	1 0
Volume Module:																
Base Vol:	24	133	0	0	0	0	260	53	165	0	17	36				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	24	133	0	0	0	0	260	53	165	0	17	36				
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	24	133	0	0	0	0	260	53	165	0	17	36				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Volume:	24	133	0	0	0	0	260	53	0	0	17	36				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	24	133	0	0	0	0	260	53	0	0	17	36				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
Final Vol.:	24	133	0	0	0	0	260	53	0	0	17	36				
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.31	1.69	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	1.00	1.00				
Final Sat.:	191	1073	0	0	0	0	1269	693	0	0	661	758				
Capacity Analysis Module:																
Vol/Sat:	0.13	0.12	xxxx	xxxx	xxxx	xxxx	0.20	0.08	xxxx	xxxx	0.03	0.05				
Crit Moves:	****						****					****				
Delay/Veh:	9.0	8.9	0.0	0.0	0.0	0.0	9.7	8.2	0.0	0.0	8.1	7.5				
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
AdjDel/Veh:	9.0	8.9	0.0	0.0	0.0	0.0	9.7	8.2	0.0	0.0	8.1	7.5				
LOS by Move:	A	A	*	*	*	*	A	A	*	*	A	A				
ApproachDel:	8.9			xxxxxx			9.4				7.7					
Delay Adj:	1.00			xxxxx			1.00				1.00					
ApprAdjDel:	8.9			xxxxxx			9.4				7.7					
LOS by Appr:	A			*			A				A					

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 7.4 Worst Case Level Of Service: B[11.2]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	1	1	0 0
Volume Module:																
Base Vol:	3	0	17	180	6	423	0	279	0	0	41	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	3	0	17	180	6	423	0	279	0	0	41	0				
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	3	0	17	180	6	423	0	279	0	0	41	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	3	0	17	180	6	423	0	279	0	0	41	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Final Vol.:	3	0	17	180	6	423	0	279	0	0	41	0				
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	7.5	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	303	xxxx	140	181	320	20	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	632	xxxx	889	770	600	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	377	xxxx	889	755	600	1059	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.01	xxxx	0.02	0.24	0.01	0.40	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.1	xxxxx	xxxx	0.7	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	14.6	xxxx	9.1	xxxxx	xxxx	9.2	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	B	*	A	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	887	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	2.3	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	12.3	xxxxx	xxxxx	xxxx	xxxxx	9.0	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	A	*	*				
ApproachDel:	10.0			11.2			xxxxxx			xxxxxx						
ApproachLOS:	A			B			*			*						

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.580
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 69 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Split Phase					Split Phase					Split Phase					Split Phase				
Rights:	Include					Ovl					Include					Ignore				
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	2	0	1	2	0	0	0	2	2	0	1	1	0	1	0	2	0	1
Volume Module:																				
Base Vol:	51	213	83	289	0	1245	737	175	0	0	73	59								
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Initial Bse:	51	213	83	289	0	1245	737	175	0	0	73	59								
Added Vol:	0	0	0	4	0	0	0	4	0	0	4	4								
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0								
Initial Fut:	51	213	83	293	0	1245	737	179	0	0	77	63								
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Volume:	51	213	83	293	0	1245	737	179	0	0	77	0								
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0								
Reduced Vol:	51	213	83	293	0	1245	737	179	0	0	77	0								
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
Final Vol.:	51	213	83	293	0	1245	737	179	0	0	77	0								
Saturation Flow Module:																				
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600								
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Lanes:	1.00	2.00	1.00	2.00	0.00	2.00	2.00	2.00	0.00	1.00	2.00	1.00								
Final Sat.:	1600	3200	1600	3200	0	3200	3200	3200	0	1600	3200	1600								
Capacity Analysis Module:																				
Vol/Sat:	0.03	0.07	0.05	0.09	0.00	0.39	0.23	0.06	0.00	0.00	0.02	0.00								
Crit Moves:		****				****	****				****									

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.650
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 44 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Permitted					Permitted					Protected					Permitted				
Rights:	Include					Include					Include					Ignore				
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	0	0	0	2	0	0	0	1	1	0	2	0	0	0	0	2	0	2
Volume Module:																				
Base Vol:	0	0	0	121	0	131	104	788	0	0	1286	82								
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Initial Bse:	0	0	0	121	0	131	104	788	0	0	1286	82								
Added Vol:	0	0	0	0	0	0	0	4	0	0	4	0								
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0								
Initial Fut:	0	0	0	121	0	131	104	792	0	0	1290	82								
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
PHF Volume:	0	0	0	121	0	131	104	792	0	0	1290	0								
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0								
Reduced Vol:	0	0	0	121	0	131	104	792	0	0	1290	0								
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00								
Final Vol.:	0	0	0	121	0	131	104	792	0	0	1290	0								
Saturation Flow Module:																				
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600								
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00								
Lanes:	0.00	0.00	0.00	2.00	0.00	1.00	1.00	2.00	0.00	0.00	2.00	2.00								
Final Sat.:	0	0	0	3200	0	1600	1600	3200	0	0	3200	3200								
Capacity Analysis Module:																				
Vol/Sat:	0.00	0.00	0.00	0.04	0.00	0.08	0.07	0.25	0.00	0.00	0.40	0.00								
Crit Moves:						****	****				****									

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.266
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 31 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	141	94	17	21	87	31	6	182	313	48	171	160
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	141	94	17	21	87	31	6	182	313	48	171	160
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	141	94	17	21	87	31	6	182	313	48	171	160
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	141	94	17	21	87	31	6	182	0	48	171	160
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	141	94	17	21	87	31	6	182	0	48	171	160
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	141	94	17	21	87	31	6	182	0	48	171	160
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.74	0.26	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1180	420	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.09	0.06	0.01	0.01	0.07	0.07	0.00	0.06	0.00	0.03	0.05	0.10
Crit Moves:	****				****		****					****

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 0.5 Worst Case Level Of Service: A[9.7]

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 1	0	0 1	1 0	1	1 0	0 0	1	0 0	1! 0	0
Volume Module:												
Base Vol:	0	184	6	7	253	0	0	0	0	8	0	9
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	184	6	7	253	0	0	0	0	8	0	9
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	184	6	7	253	0	0	0	0	8	0	9
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	184	6	7	253	0	0	0	0	8	0	9
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	0	184	6	7	253	0	0	0	0	8	0	9
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.8	xxxx	6.9
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	190	xxxx	xxxxx	xxxx	xxxx	xxxxx	328	xxxx	95
Potent Cap.:	xxxx	xxxx	xxxxx	1396	xxxx	xxxxx	xxxx	xxxx	xxxxx	647	xxxx	949
Move Cap.:	xxxx	xxxx	xxxxx	1396	xxxx	xxxxx	xxxx	xxxx	xxxxx	644	xxxx	949
Volume/Cap:	xxxx	xxxx	xxxx	0.01	xxxx	xxxx	xxxx	xxxx	xxxx	0.01	xxxx	0.01
Level Of Service Module:												
Queue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Stopped Del:	xxxxx	xxxx	xxxxx	7.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	777	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.1	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	7.6	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	9.7	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	*	*	A	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			9.7		
ApproachLOS:	*			*			*			A		

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 0.935
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Ignore				Include				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2	0	0	0 1	0	0	0	0 0	0	0	3	0 1	2	0	3	0 0
Volume Module:																
Base Vol:	339	0	1087		0	0	0		0	2049	343		266	3432	0	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	339	0	1087		0	0	0		0	2049	343		266	3432	0	
Added Vol:	0	0	0		0	0	0		0	4	0		0	4	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	339	0	1087		0	0	0		0	2053	343		266	3436	0	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	339	0	0		0	0	0		0	2053	343		266	3436	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	339	0	0		0	0	0		0	2053	343		266	3436	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.10	1.00	1.00	
Final Vol.:	373	0	0		0	0	0		0	2053	343		293	3436	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	2.00	0.00	1.00		0.00	0.00	0.00		0.00	3.00	1.00		2.00	3.00	0.00	
Final Sat.:	2850	0	1425		0	0	0		0	4275	1425		2850	4275	0	
Capacity Analysis Module:																
Vol/Sat:	0.13	0.00	0.00		0.00	0.00	0.00		0.48	0.24	0.10		0.80	0.00		
Crit Vol:	186						0			0				1145		
Crit Moves:	****									****				****		

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.598
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 46 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Ignore				Include				Include				Ignore			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	2	0 1	2	0	1	1 0	1	0	0	1 0	0	1	0	0 1
Volume Module:																
Base Vol:	50	574	81		205	835	164		246	0	81		45	10	247	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	50	574	81		205	835	164		246	0	81		45	10	247	
Added Vol:	0	4	0		0	4	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	50	578	81		205	839	164		246	0	81		45	10	247	
User Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	50	578	0		205	839	164		246	0	81		45	10	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	50	578	0		205	839	164		246	0	81		45	10	0	
PCE Adj:	1.00	1.00	0.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	0.00		1.10	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	50	578	0		226	839	164		246	0	81		45	10	0	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	1.67	0.33		1.00	0.00	1.00		0.82	0.18	1.00	
Final Sat.:	1425	2850	1425		2850	2384	466		1425	0	1425		1166	259	1425	
Capacity Analysis Module:																
Vol/Sat:	0.04	0.20	0.00		0.08	0.35	0.35		0.17	0.00	0.06		0.04	0.04	0.00	
Crit Vol:	50						502		246					55		
Crit Moves:	****						****		****					****		

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.731
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 69 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	132	563	114	82	651	8	22	946	442	64	851	77
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	132	563	114	82	651	8	22	946	442	64	851	77
Added Vol:	0	4	0	0	4	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	132	567	114	82	655	8	22	946	442	64	851	77
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	132	567	114	82	655	8	22	946	0	64	851	77
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	132	567	114	82	655	8	22	946	0	64	851	77
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	145	567	114	82	655	8	22	946	0	64	851	77
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.96	0.04	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	4223	52	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.10	0.20	0.08	0.06	0.16	0.16	0.02	0.33	0.00	0.04	0.30	0.05
Crit Vol:	284					221		473		64		
Crit Moves:	****					****		****		****		

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.375
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 23 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	3 0	0	0 0	3 0	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	0	583	0	0	671	0	337	0	0	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	583	0	0	671	0	337	0	0	0	0	0
Added Vol:	0	4	0	0	4	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	587	0	0	675	0	337	0	0	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	587	0	0	675	0	337	0	0	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	587	0	0	675	0	337	0	0	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	0	587	0	0	675	0	337	0	0	0	0	0
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	3.00	0.00	0.00	3.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Final Sat.:	1500	4500	0	0	4500	0	1500	1500	0	0	1500	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.13	0.00	0.00	0.15	0.00	0.22	0.00	0.00	0.00	0.00	0.00
Crit Vol:	0				225		337				0	
Crit Moves:	****				****		****					

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.540
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 40 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Permitted				Protected			
Rights:	Ignore				Ignore				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	1	1	0 1	1	0	2	0 1	1	0	2	0 1	1	0	2	0 1
Volume Module:																
Base Vol:	28	319	382		30	343	222		148	533	22		300	665	27	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	28	319	382		30	343	222		148	533	22		300	665	27	
Added Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	28	319	382		30	343	222		148	533	22		300	665	27	
User Adj:	1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	28	319	0		30	343	0		148	533	0		300	665	27	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	28	319	0		30	343	0		148	533	0		300	665	27	
PCE Adj:	2.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	62	319	0		30	343	0		148	533	0		300	665	27	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		1.00	2.00	1.00		1.00	2.00	1.00		1.00	2.00	1.00	
Final Sat.:	1425	2850	1425		1425	2850	1425		1425	2850	1425		1425	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.02	0.11	0.00		0.02	0.12	0.00		0.10	0.19	0.00		0.21	0.23	0.02	
Crit Vol:	31				172				267				300			
Crit Moves:	****				****				****				****			

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.669
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Include				Ovl				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	0	0 0	1	0	0	0 1	1	0	2	0 0	0	0	2	0 1
Volume Module:																
Base Vol:	0	0	0		210	0	288		357	829	0		0	774	134	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		210	0	288		357	829	0		0	774	134	
Added Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	0	0		210	0	288		357	829	0		0	774	134	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	0	0		210	0	288		357	829	0		0	774	134	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		210	0	288		357	829	0		0	774	134	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	0	0		210	0	288		357	829	0		0	774	134	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		1.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	1.00	
Final Sat.:	0	0	0		1425	0	1425		1425	2850	0		0	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.15	0.00	0.20		0.25	0.29	0.00		0.00	0.27	0.09	
Crit Vol:	0				210				357				387			
Crit Moves:					****				****				****			

Pier T LNG Facility
Year 2010 Operation Scneario
AM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.597
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 46 Level Of Service: A

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 3	0	1	1	0 3	0	0	0	0 0	0	0	1	0 0	0	1
Volume Module:																
Base Vol:	0	879	229		498	1006	0		0	0	0		59	0	75	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	879	229		498	1006	0		0	0	0		59	0	75	
Added Vol:	0	4	0		0	4	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	883	229		498	1010	0		0	0	0		59	0	75	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	883	229		498	1010	0		0	0	0		59	0	75	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	883	229		498	1010	0		0	0	0		59	0	75	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	883	229		498	1010	0		0	0	0		59	0	75	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	3.00	1.00		1.00	3.00	0.00		0.00	0.00	0.00		1.00	0.00	1.00	
Final Sat.:	0	4275	1425		1425	4275	0		0	0	0		1425	0	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.21	0.16		0.35	0.24	0.00		0.00	0.00	0.00		0.04	0.00	0.05	
Crit Vol:		294			498					0			59			
Crit Moves:		****			****								****			

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Scenario Report

Scenario:	2010 Operations - PM Peak
Command:	2010 Operations - PM Peak
Volume:	2010 Base - PM Peak
Geometry:	Default Geometry
Impact Fee:	Default Impact Fee
Trip Generation:	PM Peak
Trip Distribution:	Default Trip Distribution
Paths:	Default Paths
Routes:	Default Routes
Configuration:	Default Configuration

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 SR-47 NB On-Ramp & New Dock St	B	11.4	0.429	B	11.4	0.429	+ 0.000 V/C
# 2 SR-47 SB Off-Ramp & New Dock S	B	11.8	0.000	B	11.8	0.000	+ 0.000 D/V
# 3 SR-47 & Ocean Blvd	C	xxxxx	0.721	C	xxxxx	0.724	+ 0.003 V/C
# 4 Pier S Ave & Ocean Blvd	B	xxxxx	0.678	B	xxxxx	0.679	+ 0.001 V/C
# 5 Pier S Ave & New Dock St	A	xxxxx	0.301	A	xxxxx	0.301	+ 0.000 V/C
# 6 Pier S Ave & Depot / SERRF Dri	B	10.6	0.000	B	10.6	0.000	+ 0.000 D/V
# 7 Navy Way & Seaside Ave	F	xxxxx	1.033	F	xxxxx	1.034	+ 0.001 V/C
# 8 Henry Ford Ave & TI Freeway Ra	B	xxxxx	0.667	B	xxxxx	0.667	+ 0.000 V/C
# 9 Henry Ford Ave & Anaheim St	E	xxxxx	0.930	E	xxxxx	0.932	+ 0.002 V/C
# 10 Henry Ford Ave & Deni St	A	xxxxx	0.374	A	xxxxx	0.375	+ 0.001 V/C
# 11 Alameda St & Anaheim St	B	xxxxx	0.608	B	xxxxx	0.608	+ 0.000 V/C
# 12 Alameda St & PCH e/o Alameda S	B	xxxxx	0.667	B	xxxxx	0.667	+ 0.000 V/C
# 13 Alameda St & PCH n/o PCH	B	xxxxx	0.686	B	xxxxx	0.686	+ 0.000 V/C

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

Intersection #1 SR-47 NB On-Ramp & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.429
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): 11.4
Optimal Cycle: 0 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Stop Sign				Stop Sign			
Rights:	Include				Include				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	1	0	1 0	0	0	0	0 0	1	1	0	1 0	0	1	0	1 0
Volume Module:																
Base Vol:	25	167	0	0	0	0	522	51	129	0	34	63				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	25	167	0	0	0	0	522	51	129	0	34	63				
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	25	167	0	0	0	0	522	51	129	0	34	63				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
PHF Volume:	25	167	0	0	0	0	522	51	0	0	34	63				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Reduced Vol:	25	167	0	0	0	0	522	51	0	0	34	63				
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00				
Final Vol.:	25	167	0	0	0	0	522	51	0	0	34	63				
Saturation Flow Module:																
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Lanes:	0.26	1.74	0.00	0.00	0.00	0.00	2.00	1.00	0.00	0.00	1.00	1.00				
Final Sat.:	144	971	0	0	0	0	1216	660	0	0	598	677				
Capacity Analysis Module:																
Vol/Sat:	0.17	0.17	xxxx	xxxx	xxxx	xxxx	0.43	0.08	xxxx	xxxx	0.06	0.09				
Crit Moves:	****						****					****				
Delay/Veh:	10.1	10.0	0.0	0.0	0.0	0.0	12.7	8.5	0.0	0.0	8.8	8.2				
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
AdjDel/Veh:	10.1	10.0	0.0	0.0	0.0	0.0	12.7	8.5	0.0	0.0	8.8	8.2				
LOS by Move:	B	B	*	*	*	*	B	A	*	*	A	A				
ApproachDel:	10.0			xxxxxx			12.4				8.4					
Delay Adj:	1.00			xxxxx			1.00				1.00					
ApprAdjDel:	10.0			xxxxxx			12.4				8.4					
LOS by Appr:	B			*			B				A					

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #2 SR-47 SB Off-Ramp & New Dock St

Average Delay (sec/veh): 4.0 Worst Case Level Of Service: B[11.8]

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Stop Sign				Stop Sign				Uncontrolled				Uncontrolled			
Rights:	Include				Include				Include				Include			
Lanes:	1	0	0	0 1	0	0	1!	0 1	0	0	2	0 1	0	1	1	0 0
Volume Module:																
Base Vol:	4	0	11	125	5	195	0	566	0	0	59	0				
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
Initial Bse:	4	0	11	125	5	195	0	566	0	0	59	0				
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0				
Initial Fut:	4	0	11	125	5	195	0	566	0	0	59	0				
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
PHF Volume:	4	0	11	125	5	195	0	566	0	0	59	0				
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0				
Final Vol.:	4	0	11	125	5	195	0	566	0	0	59	0				
Critical Gap Module:																
Critical Gp:	7.5	xxxx	6.9	7.5	6.5	6.9	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	3.5	xxxx	3.3	3.5	4.0	3.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																
Cnflict Vol:	598	xxxx	283	342	625	30	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	390	xxxx	720	593	404	1045	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	314	xxxx	720	584	404	1045	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	0.01	xxxx	0.02	0.21	0.01	0.19	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																
Queue:	0.0	xxxx	0.0	xxxxx	xxxx	0.3	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Stopped Del:	16.6	xxxx	10.1	xxxxx	xxxx	8.8	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	C	*	B	*	*	A	*	*	*	*	*	*				
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT				
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	711	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx	xxxxx	1.4	xxxxx	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx				
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	12.4	xxxxx	xxxxx	xxxx	xxxxx	9.0	xxxx	xxxxx				
Shared LOS:	*	*	*	*	B	*	*	*	*	A	*	*				
ApproachDel:	11.8			11.3			xxxxxx			xxxxxx						
ApproachLOS:	B			B			*			*						

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #3 SR-47 & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.724
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 53 Level Of Service: C

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Split Phase				Split Phase				Split Phase				Split Phase			
Rights:	Include				Ovl				Include				Ignore			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	1	0 2	0 1		2	0 0	0 2		2	0 1	1 0		1	0 2	0 1	
Volume Module:																
Base Vol:	52	371	99		175	0	1071		1370	213	0		0	72	176	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	52	371	99		175	0	1071		1370	213	0		0	72	176	
Added Vol:	0	0	0		4	0	0		0	4	0		0	4	4	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	52	371	99		179	0	1071		1370	217	0		0	76	180	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	52	371	99		179	0	1071		1370	217	0		0	76	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	52	371	99		179	0	1071		1370	217	0		0	76	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	52	371	99		179	0	1071		1370	217	0		0	76	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		2.00	0.00	2.00		2.00	2.00	0.00		1.00	2.00	1.00	
Final Sat.:	1600	3200	1600		3200	0	3200		3200	3200	0		1600	3200	1600	
Capacity Analysis Module:																
Vol/Sat:	0.03	0.12	0.06		0.06	0.00	0.33		0.43	0.07	0.00		0.00	0.02	0.00	
Crit Moves:		****			****				****					****		

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #4 Pier S Ave & Ocean Blvd

Cycle (sec): 100 Critical Vol./Cap. (X): 0.679
Loss Time (sec): 10 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 48 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Permitted				Permitted				Protected				Permitted			
Rights:	Include				Include				Include				Ignore			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 0	0 0		2	0 0	0 1		1	0 2	0 0		0	0 2	0 2	
Volume Module:																
Base Vol:	0	0	0		101	0	182		200	1484	0		0	1085	110	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		101	0	182		200	1484	0		0	1085	110	
Added Vol:	0	0	0		0	0	0		0	4	0		0	4	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	0	0		101	0	182		200	1488	0		0	1089	110	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
PHF Volume:	0	0	0		101	0	182		200	1488	0		0	1089	0	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		101	0	182		200	1488	0		0	1089	0	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	0.00	
Final Vol.:	0	0	0		101	0	182		200	1488	0		0	1089	0	
Saturation Flow Module:																
Sat/Lane:	1600	1600	1600		1600	1600	1600		1600	1600	1600		1600	1600	1600	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		2.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	2.00	
Final Sat.:	0	0	0		3200	0	1600		1600	3200	0		0	3200	3200	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.03	0.00	0.11		0.13	0.47	0.00		0.00	0.34	0.00	
Crit Moves:							****		****					****		

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Future Volume Alternative)

Intersection #5 Pier S Ave & New Dock St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.301
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 33 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 0	1	1 0	0 1	0	1 0	2 0	1	1 0	2 1	0
Volume Module:												
Base Vol:	178	93	116	59	51	14	15	419	260	29	61	46
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	178	93	116	59	51	14	15	419	260	29	61	46
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	178	93	116	59	51	14	15	419	260	29	61	46
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	178	93	116	59	51	14	15	419	0	29	61	46
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	178	93	116	59	51	14	15	419	0	29	61	46
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	178	93	116	59	51	14	15	419	0	29	61	46
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	1.00	1.00	1.00	0.78	0.22	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1600	1600	1600	1600	1255	345	1600	3200	1600	1600	3200	1600
Capacity Analysis Module:												
Vol/Sat:	0.11	0.06	0.07	0.04	0.04	0.04	0.01	0.13	0.00	0.02	0.02	0.03
Crit Moves:	****				****			****		****		

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #6 Pier S Ave & Depot / SERRF Driveway

Average Delay (sec/veh): 0.1 Worst Case Level Of Service: B[10.6]

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	1 1	0	0 1	1 0	1	1 0	0 0	1	0 0	1! 0	0
Volume Module:												
Base Vol:	0	321	2	1	318	0	0	0	0	4	0	4
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	0	321	2	1	318	0	0	0	0	4	0	4
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	0	321	2	1	318	0	0	0	0	4	0	4
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	0	321	2	1	318	0	0	0	0	4	0	4
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	0	321	2	1	318	0	0	0	0	4	0	4
Critical Gap Module:												
Critical Gp:	xxxxx	xxxx	xxxxx	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx	6.8	xxxx	6.9
FollowUpTim:	xxxxx	xxxx	xxxxx	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx	3.5	xxxx	3.3
Capacity Module:												
Cnflict Vol:	xxxx	xxxx	xxxxx	323	xxxx	xxxxx	xxxx	xxxx	xxxxx	483	xxxx	162
Potent Cap.:	xxxx	xxxx	xxxxx	1248	xxxx	xxxxx	xxxx	xxxx	xxxxx	518	xxxx	861
Move Cap.:	xxxx	xxxx	xxxxx	1248	xxxx	xxxxx	xxxx	xxxx	xxxxx	517	xxxx	861
Volume/Cap:	xxxx	xxxx	xxxx	0.00	xxxx	xxxx	xxxx	xxxx	xxxx	0.01	xxxx	0.00
Level Of Service Module:												
Queue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
Stopped Del:	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	*	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	646	xxxxx
SharedQueue:	xxxxx	xxxx	xxxxx	0.0	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	0.0	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	7.9	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	10.6	xxxxx
Shared LOS:	*	*	*	A	*	*	*	*	*	*	B	*
ApproachDel:	xxxxxx			xxxxxx			xxxxxx			10.6		
ApproachLOS:	*			*			*			B		

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #7 Navy Way & Seaside Ave

Cycle (sec): 100 Critical Vol./Cap. (X): 1.034
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: F

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Protected			Protected		
Rights:	Ignore			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2 0	0 0	1	0 0	0 0	0	0 0	3 0	1	2 0	3 0	0
Volume Module:												
Base Vol:	547	0	1687	0	0	0	0	2850	310	80	3514	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	547	0	1687	0	0	0	0	2850	310	80	3514	0
Added Vol:	0	0	0	0	0	0	0	4	0	0	4	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	547	0	1687	0	0	0	0	2854	310	80	3518	0
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	547	0	0	0	0	0	0	2854	310	80	3518	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	547	0	0	0	0	0	0	2854	310	80	3518	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.10	1.00	1.00
Final Vol.:	602	0	0	0	0	0	0	2854	310	88	3518	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	2.00	0.00	1.00	0.00	0.00	0.00	0.00	3.00	1.00	2.00	3.00	0.00
Final Sat.:	2850	0	1425	0	0	0	0	4275	1425	2850	4275	0
Capacity Analysis Module:												
Vol/Sat:	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.22	0.03	0.82	0.00
Crit Vol:	301				0		0				1173	
Crit Moves:	****						****				****	

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #8 Henry Ford Ave & TI Freeway Ramps

Cycle (sec): 100 Critical Vol./Cap. (X): 0.667
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Ignore			Include			Include			Ignore		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	2 0	1 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	126	1043	47	104	613	625	78	8	153	38	6	181
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	126	1043	47	104	613	625	78	8	153	38	6	181
Added Vol:	0	4	0	0	4	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	126	1047	47	104	617	625	78	8	153	38	6	181
User Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
PHF Volume:	126	1047	0	104	617	625	78	8	153	38	6	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	126	1047	0	104	617	625	78	8	153	38	6	0
PCE Adj:	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
MLF Adj:	1.00	1.00	0.00	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Final Vol.:	126	1047	0	114	617	625	78	8	153	38	6	0
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	2.00	1.00	1.00	1.00	0.05	0.95	0.86	0.14	1.00
Final Sat.:	1425	2850	1425	2850	1425	1425	1425	71	1354	1231	194	1425
Capacity Analysis Module:												
Vol/Sat:	0.09	0.37	0.00	0.04	0.43	0.44	0.05	0.11	0.11	0.03	0.03	0.00
Crit Vol:	126					625		161		38		
Crit Moves:	****					****		****		****		

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #9 Henry Ford Ave & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.932
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 180 Level Of Service: E

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Split Phase			Split Phase			Permitted			Permitted		
Rights:	Include			Include			Ignore			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 1	1 0	1	1 0	2 1	0	1 0	2 0	1	1 0	2 0	1
Volume Module:												
Base Vol:	384	899	101	105	549	34	20	1146	140	51	1322	114
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	384	899	101	105	549	34	20	1146	140	51	1322	114
Added Vol:	0	4	0	0	4	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	384	903	101	105	553	34	20	1146	140	51	1322	114
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
PHF Volume:	384	903	101	105	553	34	20	1146	0	51	1322	114
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	384	903	101	105	553	34	20	1146	0	51	1322	114
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
MLF Adj:	1.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00
Final Vol.:	422	903	101	105	553	34	20	1146	0	51	1322	114
Saturation Flow Module:												
Sat/Lane:	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.00	1.00	1.00	2.83	0.17	1.00	2.00	1.00	1.00	2.00	1.00
Final Sat.:	1425	2850	1425	1425	4027	248	1425	2850	1425	1425	2850	1425
Capacity Analysis Module:												
Vol/Sat:	0.30	0.32	0.07	0.07	0.14	0.14	0.01	0.40	0.00	0.04	0.46	0.08
Crit Vol:	452					196	20				661	
Crit Moves:	****					****	****				****	

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #10 Henry Ford Ave & Deni St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.375
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 23 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	3 0	0	0 0	3 0	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	4	953	0	0	602	0	243	0	5	0	0	0
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	4	953	0	0	602	0	243	0	5	0	0	0
Added Vol:	0	4	0	0	4	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	4	957	0	0	606	0	243	0	5	0	0	0
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Volume:	4	957	0	0	606	0	243	0	5	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	4	957	0	0	606	0	243	0	5	0	0	0
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Vol.:	4	957	0	0	606	0	243	0	5	0	0	0
Saturation Flow Module:												
Sat/Lane:	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	3.00	0.00	0.00	3.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
Final Sat.:	1500	4500	0	0	4500	0	1500	0	1500	0	1500	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.21	0.00	0.00	0.13	0.00	0.16	0.00	0.00	0.00	0.00	0.00
Crit Vol:	319			0			243				0	
Crit Moves:	****			****			****					

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #11 Alameda St & Anaheim St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.608
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 48 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Permitted				Protected			
Rights:	Ignore				Ignore				Ignore				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	1	1	0 1	1	0	2	0 1	1	0	2	0 1	1	0	2	0 1
Volume Module:																
Base Vol:	11	231	479		28	522	234		157	516	15		336	1113	36	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	11	231	479		28	522	234		157	516	15		336	1113	36	
Added Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	11	231	479		28	522	234		157	516	15		336	1113	36	
User Adj:	1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
PHF Volume:	11	231	0		28	522	0		157	516	0		336	1113	36	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	11	231	0		28	522	0		157	516	0		336	1113	36	
PCE Adj:	2.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
MLF Adj:	1.10	1.00	0.00		1.00	1.00	0.00		1.00	1.00	0.00		1.00	1.00	1.00	
Final Vol.:	24	231	0		28	522	0		157	516	0		336	1113	36	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	1.00	2.00	1.00		1.00	2.00	1.00		1.00	2.00	1.00		1.00	2.00	1.00	
Final Sat.:	1425	2850	1425		1425	2850	1425		1425	2850	1425		1425	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.01	0.08	0.00		0.02	0.18	0.00		0.11	0.18	0.00		0.24	0.39	0.03	
Crit Vol:	12				261				258				336			
Crit Moves:	****				****				****				****			

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #12 Alameda St & PCH e/o Alameda St

Cycle (sec): 100 Critical Vol./Cap. (X): 0.667
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 56 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	-	T	- R	L	-	T	- R	L	-	T	- R	L	-	T	- R
Control:	Permitted				Permitted				Protected				Protected			
Rights:	Include				Ovl				Include				Include			
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0	0	0	0 0	1	0	0	0 1	1	0	2	0 0	0	0	2	0 1
Volume Module:																
Base Vol:	0	0	0		73	0	425		395	849	0		0	966	264	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	0	0		73	0	425		395	849	0		0	966	264	
Added Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	0	0		73	0	425		395	849	0		0	966	264	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	0	0		73	0	425		395	849	0		0	966	264	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	0	0		73	0	425		395	849	0		0	966	264	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	0	0		73	0	425		395	849	0		0	966	264	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	0.00	0.00		1.00	0.00	1.00		1.00	2.00	0.00		0.00	2.00	1.00	
Final Sat.:	0	0	0		1425	0	1425		1425	2850	0		0	2850	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.00	0.00		0.05	0.00	0.30		0.28	0.30	0.00		0.00	0.34	0.19	
Crit Vol:	0				73				395				483			
Crit Moves:					****				****				****			

Pier T LNG Facility
Year 2010 Operation Scenario
PM Peak

Level Of Service Computation Report
Circular 212 Planning Method (Future Volume Alternative)

Intersection #13 Alameda St & PCH n/o PCH

Cycle (sec): 100 Critical Vol./Cap. (X): 0.686
Loss Time (sec): 0 (Y+R = 4 sec) Average Delay (sec/veh): xxxxxx
Optimal Cycle: 59 Level Of Service: B

Approach:	North Bound				South Bound				East Bound				West Bound			
Movement:	L	- T	- R		L	- T	- R		L	- T	- R		L	- T	- R	
Control:	Protected				Protected				Permitted				Permitted			
Rights:	Include				Include				Include				Ovl			
Min. Green:	0	0	0		0	0	0		0	0	0		0	0	0	
Lanes:	0	0 3	0	1	1	0 3	0	0	0	0 0	0	0	1	0 0	0	1
Volume Module:																
Base Vol:	0	1127	395		498	1129	0		0	0	0		84	0	180	
Growth Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Initial Bse:	0	1127	395		498	1129	0		0	0	0		84	0	180	
Added Vol:	0	4	0		0	4	0		0	0	0		0	0	0	
PasserByVol:	0	0	0		0	0	0		0	0	0		0	0	0	
Initial Fut:	0	1131	395		498	1133	0		0	0	0		84	0	180	
User Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
PHF Volume:	0	1131	395		498	1133	0		0	0	0		84	0	180	
Reduct Vol:	0	0	0		0	0	0		0	0	0		0	0	0	
Reduced Vol:	0	1131	395		498	1133	0		0	0	0		84	0	180	
PCE Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
MLF Adj:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Final Vol.:	0	1131	395		498	1133	0		0	0	0		84	0	180	
Saturation Flow Module:																
Sat/Lane:	1425	1425	1425		1425	1425	1425		1425	1425	1425		1425	1425	1425	
Adjustment:	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00	
Lanes:	0.00	3.00	1.00		1.00	3.00	0.00		0.00	0.00	0.00		1.00	0.00	1.00	
Final Sat.:	0	4275	1425		1425	4275	0		0	0	0		1425	0	1425	
Capacity Analysis Module:																
Vol/Sat:	0.00	0.26	0.28		0.35	0.27	0.00		0.00	0.00	0.00		0.06	0.00	0.13	
Crit Vol:			395		498					0			84			
Crit Moves:			****		****								****			

APPENDIX E

DRAFT GENERAL CONFORMITY DETERMINATION
FOR THE LONG BEACH LNG IMPORT PROJECT

TABLE OF CONTENTS

Long Beach LNG Import Project
Draft General Conformity Determination

1.0 INTRODUCTION TO THE PROPOSED ACTION E-1
2.0 GENERAL CONFORMITY - REGULATORY BACKGROUND E-1
2.1 GENERAL CONFORMITY REQUIREMENTS E-1
2.2 GENERAL CONFORMITY APPLICABILITY E-2
3.0 ASSESSMENT OF THE PROJECT EMISSIONS E-2
4.0 GENERAL CONFORMITY DETERMINATION E-4
4.1 REQUIREMENTS OF THE 1997/1999 SIP AND 2003 AQMP E-4
4.2 EMISSIONS BUDGETS/ATTAINMENT DEMONSTRATION FOR THE SCAB E-6
4.3 PROJECT EMISSIONS OFFSETTING E-6
4.4 AREA-WIDE AND/OR LOCAL AIR QUALITY MODELING ANALYSIS E-6
5.0 FINDING OF CONFORMITY E-6

List of Tables

TABLE 3-1 Construction Emission Rates Associated with the Long Beach LNG Import Project E-3
TABLE 3-2 Operational Emission Rates Associated with the Long Beach LNG Import Project E-3
TABLE 4-1 Control Measures in the SCAB Non-attainment Area Associated with the Long Beach LNG Import Project E-5

1.0 INTRODUCTION TO THE PROPOSED ACTION

On January 26, 2004, Sound Energy Solutions (SES) filed an application with the Federal Energy Regulatory Commission (Commission or FERC) under section 3 of the Natural Gas Act and Part 153 of the Commission's regulations. SES seeks authorization from the FERC to site, construct, and operate a liquefied natural gas (LNG) receiving terminal and associated facilities in the Port of Long Beach (POLB or Port) in Long Beach, California as a place of entry for the importation of LNG. SES submitted an application to the POLB for a Harbor Development Permit on July 25, 2003, seeking approval for a development project within the Port.

SES' proposal, referred to as the Long Beach LNG Import Project, would involve the construction and operation of LNG terminal facilities consisting of a ship berth and unloading facility, two LNG storage tanks, vaporization and vapor handling systems, a natural gas liquids recovery system, an LNG trailer truck loading facility, 2.3 miles of 36-inch-diameter pipeline, one pig launcher and receiver, a meter station, an odorization system, and various other facility components.

Additional facilities associated with the project include 4.6 miles of 10-inch-diameter pipeline to transport vaporized ethane from the LNG terminal to ConocoPhillips' existing Los Angeles Refinery Carson Plant, a meter station, one pig launcher and receiver, and approximately 0.8 mile of 66 kilovolt electric distribution lines and a new substation to connect the LNG terminal to two of Southern California Edison's existing substation taps.

The proposed LNG terminal and associated facilities are described in detail in section 2.0 of the draft environmental impact statement/environmental impact report (EIS/EIR) for the Long Beach LNG Import Project.

2.0 GENERAL CONFORMITY - REGULATORY BACKGROUND

The U.S. Environmental Protection Agency (EPA) promulgated the General Conformity Rule on November 30, 1993 to implement the conformity provision of Title I, section 176(c)(1) of the federal Clean Air Act (CAA). Section 176(c)(1) requires that the federal government not engage, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved CAA implementation plan. In the South Coast Air Basin (SCAB), the applicable State Implementation Plan (SIP) is the *1999 Amendment to the 1997 Ozone SIP Revision for the South Coast Air Basin*. The SCAB's SIP has been approved by the EPA for the regulation of air emissions and enforcement of air quality rules to attain the ozone National Ambient Air Quality Standards (NAAQS).

Additionally, the South Coast Air Quality Management District (SCAQMD) adopted the federal General Conformity regulations, as Regulation XIX, Rules 1901, on September 9, 1994.

2.1 GENERAL CONFORMITY REQUIREMENTS

Title I, section 176(c)(1), of the CAA defines conformity as the upholding of "an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving attainment of such standards." Conforming activities or actions should not, through additional air pollutant emissions:

- cause or contribute to new violations of any NAAQS in any area;
- increase the frequency or severity of any existing violation of any NAAQS; or

- delay timely attainment of any NAAQS or interim emission reductions.

The General Conformity Rule establishes conformity in coordination with and as part of the National Environmental Policy Act process. The rule takes into account air pollutant emissions associated with actions that are federally funded, licensed, permitted, or approved, and ensures emissions do not contribute to air quality degradation, thus preventing the achievement of state and federal air quality goals. In short, General Conformity refers to the process of evaluating plans, programs, and projects to determine and demonstrate that they meet the requirements of the CAA and applicable SIP.

2.2 GENERAL CONFORMITY APPLICABILITY

Pursuant to the General Conformity Rule, a federal agency must make a General Conformity Determination for all federal actions in non-attainment or maintenance areas where the total of direct and indirect emissions of a non-attainment pollutant or its precursors exceeds levels established by the regulations.

The Long Beach LNG Import Project area is designated as a severe non-attainment area for the 8-hour NAAQS for ozone. The project area is also currently designated as a serious non-attainment area for carbon monoxide (CO) and particulate matter having an aerodynamic diameter of 10 microns or less (PM_{10}) and a non-attainment area for particulate matter having an aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$). The project area is in attainment with the NAAQS for all other criteria pollutants. A General Conformity Determination in a severe ozone non-attainment area that is also a serious CO and PM_{10} non-attainment area, is required for any project that would result in combined direct and indirect emissions of either nitrogen oxides (NO_x) or volatile organic compounds equal to or greater than 25 tons per year (tpy) for the severe 8-hour designation for ozone, CO equal to or greater than 100 tpy, or PM_{10} equal to or greater than 70 tpy. There is currently no General Conformity applicability threshold listed for $PM_{2.5}$ non-attainment areas; however, as recommended in a March 2005 EPA memorandum regarding the implementation of the New Source Review requirements in $PM_{2.5}$ non-attainment areas, a surrogate threshold of 100 tpy for PM_{10} moderate non-attainment areas was used in this analysis. A General Conformity Determination is not required for actions where the total of direct and indirect emissions is below these emissions levels and does not represent 10 percent or more of a non-attainment or maintenance area's total emissions of those pollutants.

Emissions authorized through the federal Non-attainment New Source Review permitting process are exempt from being included in the total sum of direct and indirect emissions to evaluate federal General Conformity applicability.

This draft General Conformity Determination has been prepared pursuant to the CAA, section 176(c)(1) to assess whether the emissions that would result from the FERC's action in authorizing the Long Beach LNG Import Project would be in conformity with the SIP.

3.0 ASSESSMENT OF THE PROJECT EMISSIONS

The predicted air emissions for the Long Beach LNG Import Project were prepared using widely accepted methods. Emissions were estimated for both construction and operation of the proposed project. In general, the land- and marine-based construction equipment emissions were estimated by multiplying emission factors for each engine type by the amount of power produced and by operating hours. Mobile source emissions from construction vehicles and truck traffic (operation) were estimated using a combination of the procedures contained in the SCAQMD's California Environmental Quality Act Air Quality Handbook and EPA AP-42 emission factors. Emissions from LNG ships, tug boats, pilot boats,

and escort boats were estimated using emission factors for existing, similar facilities and proposed fuel/energy input to the ships during roundtrip operation in state waters. Because they would not occur simultaneously, a separate General Conformity applicability review of the total estimated project emissions for each pollutant resulting from both construction and operation was performed and is provided in tables 3-1 and 3-2.

TABLE 3-1

Construction Emission Rates Associated with the Long Beach LNG Import Project [a]

Emissions Source Category	Emission Rate (tons per year)				
	NO_x	ROC/VOC [b]	PM_{10}	$PM_{2.5}$ [c]	CO
Marine Dredges	2.4	0.4	---	---	2.0
Welding Machines	14.4	1.6	1.6	1.6	17.2
Electric Generators	4.8	0.4	0.4	0.4	5.6
Materials Trucks/Deliveries	15.2	1.2	0.4	0.4	8.8
Fugitive Dust	---	---	62.8	62.8	---
Construction Equipment (e.g., cranes, front-end loaders)	28.8	2.4	2.0	2.0	13.2
Workers (commuting)	6.4	6.4	0.4	0.4	60.8
Total	72.0	12.4	67.6	67.6	107.6
Conformity Applicability Threshold	25	25	70	100	100
Exceedance of Threshold	Yes	No	No	No	Yes

[a] Emission rates are based on information presented in table 4.9.4-2 of the Long Beach LNG Import Project draft EIS/EIR.

[b] VOC are identified as ROC by the California Air Resources Board and local air quality agencies. Therefore, the term ROC is used in the text of the Long Beach LNG Import Project draft EIS/EIR to describe VOC emissions.

[c] To be conservative, $PM_{2.5}$ emissions have been assumed to be equal to the estimated PM_{10} emissions.

TABLE 3-2

Operational Emission Rates Associated with the Long Beach LNG Import Project [a]

Emissions Source Category	Emission Rate (tons per year)				
	NO_x	ROC/VOC [b]	PM_{10}	$PM_{2.5}$ [c]	CO
Stationary Sources [d]	[e]	[e]	10.4	10.4	21.4
Fugitive Equipment Leaks	[e]	[e]	---	---	---
LNG Ships	15.6	0.3	4.5	4.5	0.1
Tugboats/Pilot Boats/Coast Guard Escort Boats	4.7	0.6	0.22	0.22	3.1
Employee and Visitor Light Duty Vehicles (gasoline)	0.7	0.2	0.02	0.02	6.6
Delivery Trucks (diesel)	0.04	<0.01	<0.001	<0.001	0.2
LNG Trailer Trucks	0.9	0.8	0.1	0.1	0.4
Total	21.9	1.7	15.2	15.2	36.8
Conformity Applicability Threshold	25	25	70	100	100
Exceedance of Threshold	No	No	No	No	No

[a] Emission rates are based on information presented in table 4.9.5-2 of the Long Beach LNG Import Project draft EIS/EIR.

[b] VOC are identified as ROC by the California Air Resources Board and local air quality agencies. Therefore, the term ROC is used in the text of the Long Beach LNG Import Project draft EIS/EIR to describe VOC emissions.

[c] To be conservative, $PM_{2.5}$ emissions have been assumed to be equal to the estimated PM_{10} emissions.

[d] Stationary source emissions include those from terminal vaporization and emergency equipment as well as LNG ship hotelling and non-propulsion shipping activities.

[e] Emissions would be authorized through the federal Non-attainment New Source Review permitting process and, therefore, are exempt in accordance with Title 40 CFR Part 51.853(d)(1) from being included in the total sum of direct and indirect emissions to evaluate federal General Conformity applicability.

Based on an evaluation of the direct and indirect emissions associated with construction of the project, the estimated annual emission rates of NO_x and CO would exceed the 25 and 100 tpy applicability thresholds, respectively. However, based on an evaluation of the direct and indirect emissions associated with operation of the project, none of the estimated annual emission rates would exceed the applicability thresholds. Therefore, a General Conformity Determination is only required for construction of the project.

4.0 GENERAL CONFORMITY DETERMINATION

The California Air Resources Board (CARB) submitted to the EPA an attainment plan in December of 1999 titled *1999 Amendment to the 1997 Ozone SIP Revision for the South Coast Air Basin*. The 1999 Amendment provided revisions to the ozone portion of the 1997 Air Quality Management Plan (AQMP) that was submitted to the EPA as a revision to the SCAB portion of the 1994 California Ozone SIP. This SIP was approved by the EPA in April 2000.

The SCAQMD's Governing Board adopted the 2003 AQMP on August 1, 2003. The SCAQMD's AQMP addresses federal CAA requirements for SIPs as well as California CAA requirements. The SIP component revises the region's demonstration of attainment for both the federal 1-hour ozone standard by 2010 and the federal PM_{10} standard by 2006. The 2003 AQMP provides a basis for a maintenance plan for CO for the future, and updates the maintenance plan for the federal nitrogen dioxide standard that the SCAB has met since 1992. Upon local, state, and federal approval, the 2003 AQMP will replace the existing 1997/1999 Ozone SIP and 1997 PM_{10} SIP for the SCAB. Subsequently, the CARB submitted to the EPA a revised attainment plan in January of 2004 titled *Final 2003 State and Federal Strategy (Statewide Strategy) for the California State Implementation Plan*. This supplement identifies the latest emission budgets, control measures, and regulations that will be implemented in the SCAB.

It should also be noted that a SIP demonstrating attainment with the 8-hour standard is being developed and will be adopted by the SCAQMD and CARB and submitted to the EPA for approval by June 15, 2007.

The General Conformity Determination will be based on the 1997/1999 SIP and/or 2003 AQMP currently in place for the SCAB.

4.1 REQUIREMENTS OF THE 1997/1999 SIP AND 2003 AQMP

Emission control measures and regulations that have been included in the 1997/1999 SIP and 2003 AQMP that may potentially apply to the Long Beach LNG Import Project are summarized in table 4-1.

Several of the control measures identified in table 4-1 would indirectly affect the emissions from the proposed Long Beach LNG Import Project by implementing new standards for refineries and engine manufacturers. These include the heavy duty on-road diesel engine, non-road diesel engine, and federal marine engine rules. SES would use construction equipment powered by diesel engines during construction of the facilities subject to these federal programs. Implementation and compliance with these programs would be required by the engine manufacturers, not SES. Therefore, it is assumed that the Long Beach LNG Import Project would be in compliance with these regulations. Also being implemented is the California low emission vehicle and the enhanced inspection and maintenance programs that would only apply to light- and medium-duty vehicles.

TABLE 4-1

Control Measures in the SCAB Non-attainment Area Associated with the Long Beach LNG Import Project

Name of Control Measure	Type	Applicability to the Long Beach LNG Import Project
Low Emission Vehicle II Program	State Rule	Potentially applicable to project-related vehicles
Medium Duty Vehicles	State Rule	Potentially applicable to project-related vehicles
Moyer Program (Clean Engine Incentives)	State Rule	Potentially applicable to project-related vehicles
California Heavy Duty Diesel Vehicle Standards	State Rule	Potentially applicable to project-related vehicles
California Heavy Duty Gasoline Vehicle Standards	State Rule	Potentially applicable to project-related vehicles
Federal Heavy Duty Diesel Vehicle Standards	Federal Rule	Potentially applicable to project-related vehicles
California Heavy Duty Off-road Diesel Engine Standards	State Rule	Potentially applicable to project-related construction vehicle engines
National Heavy Duty Off-road Diesel Engine Standards	Federal Rule	Potentially applicable to project-related construction vehicle engines
California Large Off-road Gas/LPG Engine Standards	State Rule	Potentially applicable to project-related construction vehicle engines
National Large Off-road Gas/LPG Engine Standards	Federal Rule	Potentially applicable to project-related construction vehicle engines
Federal Marine Vessel Standards	Federal Rule	Potentially applicable to tugboat, pilot boat, and escort boat engines
Clean Fuel Measures	State Rule	Potentially applicable to project-related vehicles
California Medium/Heavy Duty Gasoline Vehicle Standards	State Rule	Potentially applicable to project-related vehicles
Small Off-road Engine Standards	State Rule	Potentially applicable to project-related vehicles
Enhanced I/M Smog Check for Passenger and Cargo Vehicles	State Rule	Potentially applicable to project-related vehicles
California Cleaner Engines and Fuels for Existing Harbor Craft Fleet	State Rule	Potentially applicable to project-related tugboats, pilot boats, and escort boats
Reductions to Land Based Port Emissions – Alternative Fuels, Cleaner Engines, etc.	State Rule	Potentially applicable to project-related vehicles
Reductions from Fugitive Dust Sources	State Rule	Potentially applicable to construction activities
Regional Clean Air Incentives Market	State Rule	NO_x and SO_2 Emissions Trading Program applicable to the LNG terminal facility emission sources

The SCAQMD also implemented emission requirements for stationary sources including emissions trading programs and reasonably available control technology and/or best available control technology requirements. The stationary sources at the proposed LNG terminal would require an air permit from the SCAQMD that would ensure compliance with these requirements, if applicable. As such, the emissions generated by the Long Beach LNG Import Project would comply with the SIP provisions.

Additional control and mitigation measures that would be implemented during construction and operation of the project are provided in sections 4.9.4 and 4.9.5 of the Long Beach LNG Import Project draft EIS/EIR.

The only remaining criteria that must be met to demonstrate conformity with the SIP is to either demonstrate that: 1) project construction emissions of NO_x and CO are specifically identified and accounted for in the SIP's attainment demonstration; 2) project construction emissions would be completely offset through a revision in the SIP or similar enforceable measure so that there is no net increase in emissions in the SCAB; or 3) project construction emissions of CO do not cause or contribute to any new violation of any standard or increase the frequency or severity of any existing violation of any standard in the area through an area-wide and/or local air quality modeling analysis.

4.2 EMISSIONS BUDGETS/ATTAINMENT DEMONSTRATION FOR THE SCAB

The projected emissions identified in the 1997/1999 SIP and 2003 AQMP are the emission budgets for the SCAB as it plans to meet the 1-hour ozone and CO standards. The project's estimated emissions were not specifically identified or accounted for in the SIP or the 2003 AQMP and the SCAQMD has not committed to revising the budgets to accommodate them. However, the emissions budgets for the SIP being prepared to demonstrate attainment with the 8-hour standard for ozone are under development. Should agreement of certain commitments under Title 40 Code of Federal Regulations Part 93.158(a)(5)(i)(B) be used to demonstrate conformity with the 8-hour standard, the commitments would be provided to the FERC and included in the final General Conformity Determination. SES is currently discussing this option with the SCAQMD.

4.3 PROJECT EMISSIONS OFFSETTING

SES is evaluating the possibility of fully offsetting the project construction emissions through the acquisition of emission credits or an equally enforceable measure that would result in emissions reductions equal to or greater than the project emissions so that there is no net increase. If SES chooses to demonstrate conformity through offsetting, SES would be required to provide the FERC with documentation necessary to support the emissions reductions approved by the SCAQMD. This information would be included in the FERC's final General Conformity Determination.

4.4 AREA-WIDE AND/OR LOCAL AIR QUALITY MODELING ANALYSIS

For CO, conformity can be demonstrated through the use of an area-wide and/or local air quality modeling analysis that shows that project emissions would not cause or contribute to any new violation of any standard or increase the frequency or severity of any existing violation of any standard in any area.

SES is evaluating the possibility of conducting an air quality modeling analysis to demonstrate conformity of project construction emissions for CO. If SES chooses to demonstrate conformity through a modeling analysis, SES would be required to provide detailed information on the analysis documenting the inputs, methodology, and results to the FERC. This information would be included in the FERC's final General Conformity Determination.

5.0 FINDING OF CONFORMITY

Documentation supporting conformity with the applicable SIP and AQMP has not been filed with the FERC. Until this information is provided by SES, the Long Beach LNG Import Project is deemed to not conform with the applicable SIP and AQMP. SES must complete a full analysis and identify any mitigation requirements necessary for a finding of conformity before a determination of conformity can be made. The FERC staff has recommended in the draft EIS/EIR for the Long Beach LNG Import Project that SES submit documentation supporting conformity with the applicable SIP and AQMP to the FERC for analysis in the final EIS/EIR. Upon receipt of the required information from SES, the FERC will complete the analysis and issue a final General Conformity Determination for the Long Beach LNG Import Project.

APPENDIX F

HAZARDS ANALYSIS OF A PROPOSED LNG IMPORT TERMINAL IN THE PORT OF LONG BEACH, CALIFORNIA

HAZARDS ANALYSIS
OF A PROPOSED LNG IMPORT TERMINAL
IN THE PORT OF LONG BEACH, CALIFORNIA

Prepared For

The Port of Long Beach
925 Harbor Plaza
Long Beach, California 90802

Prepared By

Quest Consultants Inc.®
908 26th Avenue N.W.
Norman, Oklahoma 73069
Telephone: 405-329-7475
Fax: 405-329-7734

05-08-6521
August 30, 2005

QUEST

QUEST

HAZARDS ANALYSIS
OF A PROPOSED LNG IMPORT TERMINAL
IN THE PORT OF LONG BEACH, CALIFORNIA

Table of Contents

Page

1.0 Introduction 1-1
- 1.1 LNG Import Terminal Overview 1-1
- 1.2 Scope of Study 1-3
- 1.3 Limitations of Study 1-4

2.0 Potential Hazards 2-1
- 2.1 Hazards Identification 2-1
- 2.2 Introduction to Physiological Effects of Fires and Overpressure 2-1
  - 2.2.1 Physiological Effects of Exposure to Fires 2-1
  - 2.2.2 Physiological Effects of Overpressures 2-2
  - 2.2.3 Hazard Endpoint Criteria 2-2
- 2.3 Selection of Accidental Release Case Studies Involving the LNG Terminal 2-3
- 2.4 Selection of Accidental Release Case Studies Involving LNG Tank Ships 2-4
- 2.5 Selection of Intentional Release Case Studies 2-5
  - 2.5.1 Identification of Primary Targets of an Intentional Event 2-7
  - 2.5.2 Description of Intentional Release Events 2-7
    - 2.5.2.1 Crash of Commercial Jet into LNG Storage Tanks 2-8
    - 2.5.2.2 Detonation of Truck Bomb by the Base of an LNG Storage Tank 2-10
    - 2.5.2.3 Firing a Rocket-propelled Grenade Into an LNG Storage Tank 2-10
    - 2.5.2.4 Detonation of Satchel Charge by Process Equipment 2-11
    - 2.5.2.5 Crash of Commercial Jet Into LNG Tank Ship While at LNG Terminal 2-12
    - 2.5.2.6 Detonation of Boat Bomb Near the LNG Tank Ship While at LNG Terminal 2-13
    - 2.5.2.7 Firing an RPG Into an LNG Tank Ship While at LNG Terminal 2-14
    - 2.5.2.8 Terrorist Controlled Ship Collides with LNG Tank Ship 2-15

3.0 Development of Incident Probabilities 3-1
- 3.1 Accidental Releases of LNG, Natural Gas, or Other Hydrocarbon Fluids in the LNG Terminal 3-1
  - 3.1.1 Example – Development of Event Tree for an Accidental Release from LNG Process Equipment 3-2
- 3.2 Accidental Releases of LNG from LNG Storage Tanks and Tank Ships 3-5
  - 3.2.1 Earthquake-induced Failure of Both LNG Storage Tanks 3-5

Table of Contents
(Continued)

			Page
		3.2.2 Release of LNG from Ship's Cargo Tank as a Result of Colliding with the Breakwater	3-6
		3.2.3 Release of LNG from Ship's Cargo Tank(s) as a Result of Colliding with Another Ship	3-7
	3.3	Terrorist-Induced Releases of LNG, Natural Gas, or Other Hydrocarbon Fluids in the LNG Terminal	3-9
	3.4	Security of the LNG Import Terminal	3-13
4.0	Consequence Analysis		4-1
	4.1	Development of Release Sizes for Accidental Events	4-1
		4.1.1 Size of Release Area Following Accidental Failure of Process Equipment	4-1
		4.1.2 Size of Release Area Following Failure of LNG Storage Tanks Due to an Earthquake	4-1
		4.1.3 Size of Release Area in LNG Tank Ship Following Collision with Breakwater	4-1
		4.1.4 Size of Release Area in LNG Tank Ship Following Collision with Another Ship	4-2
	4.2	Development of Release Sizes for Intentionally-Induced Events	4-2
		4.2.1 Size of Release Area Following Intentionally-Induced Failures in Process Equipment	4-2
		4.2.2 Size of Release Area Following Commercial Airplane Crash into LNG Storage Tank	4-2
		4.2.3 Release From an LNG Storage Tank Following a Truck Bomb	4-3
		4.2.4 Release From an LNG Storage Tank Following the Impact of a Rocket-propelled Grenade	4-4
		4.2.5 Release From LNG Tank Ship Following Crash of Commercial Airplane	4-4
		4.2.6 Release From an LNG Tank Ship Following a Boat Bomb	4-5
		4.2.7 Release From an LNG Tank Ship Following the Impact of a Rocket-propelled Grenade	4-5
		4.2.8 Release From an LNG Tank Ship Following a Collision with Another Ship	4-5
		4.2.9 Summary of Release Sizes Due to Intentional Events	4-6
	4.3	Consequence Analysis Models	4-7
		4.3.1 FERC Model for LNG Spills onto Water	4-7
		4.3.2 DEGADIS	4-7
		4.3.3 LNGFIRE3	4-8
		4.3.4 CANARY by Quest	4-8
		4.3.5 Application of Consequence Models	4-9
	4.4	Release Rate Calculations	4-9
		4.4.1 Release Rate Calculations for Process Equipment Releases	4-12
		4.4.2 Release Rate Calculations for Storage Tank Failures Due to an Earthquake	4-12
		4.4.3 Release Rate Calculations from an LNG Tank Ship Following Collision with the Breakwater	4-14
		4.4.4 Release Rates Summary	4-14

Table of Contents
(Continued)

				Page
	4.5	Liquid Spreading and Vaporization Calculations		4-15
		4.5.1	Liquid Spreading Calculations for Process Equipment Releases	4-15
		4.5.2	Liquid Spreading Calculations for Storage Tank Failures Due to an Earthquake	4-15
		4.5.3	Liquid Spreading Calculations from LNG Tank Ship Following Collision with the Breakwater	4-16
	4.6	Fire Radiation Calculations		4-17
		4.6.1	Hazard Footprints and Vulnerability Zones	4-17
		4.6.2	Fire Radiation Calculations for Storage Tank Failures Due to an Earthquake	4-18
		4.6.3	Fire Radiation Calculations for an LNG Tank Ship Collision with the Breakwater	4-21
		4.6.4	Summary of Fire Radiation Calculations	4-21
	4.7	Flammable Vapor Cloud Dispersion Calculations		4-21
		4.7.1	Flammable Vapor Cloud Dispersion Calculations for Process Equipment Releases	4-33
		4.7.2	Flammable Vapor Cloud Dispersion Calculations for Storage Tank Failures Due to an Earthquake	4-33
		4.7.3	Flammable Vapor Dispersion Calculations from LNG Tank Ship Following Collision with the Breakwater	4-35
	4.8	Vapor Cloud Explosion Overpressure Calculations		4-36
5.0	Potential Impacts to Neighboring Facilities			5-1
	5.1	Neighboring Facilities		5-1
	5.2	Impact Levels on Industrial Equipment		5-1
		5.2.1	Vulnerability of Structures and Plant Equipment to Radiant Energy	5-1
			5.2.1.1 Radiant Flux Endpoint Criteria	5-1
			5.2.1.2 Radiant Energy Vulnerability Zones – Industrial Equipment Impact	5-3
		5.2.2	Vulnerability of Structures and Plant Equipment to Overpressure	5-3
			5.2.2.1 Explosion Overpressure Endpoint Criteria	5-17
			5.2.2.2 Explosion Overpressure Vulnerability Zones – Industrial Equipment Impact	5-17
6.0	Worst-case Hazards Associated with Other Flammable Fuel Facilities			6-1
	6.1	Flammable Fuel Facilities		6-1
	6.2	Propane Storage Terminal, Elk Grove, California		6-1
		6.2.1	Description of the Major Components in the Propane Terminal	6-1
		6.2.2	Potential Hazards Associated with the Propane Terminal	6-2
		6.2.3	Potential Release Events Associated with the Propane Terminal	6-2
	6.3	Petroleum Product Bulk Storage Terminals, Southern California		6-4
		6.3.1	Description of the Terminals	6-4
		6.3.2	Potential Release Events Associated with the Bulk Terminals	6-4
	6.4	LNG Import Terminal, Mexico		6-6
		6.4.1	Description of the Major Components in the LNG Import Terminal	6-6
		6.4.2	Potential Hazards Associated with the LNG Import Terminal	6-6
		6.4.3	Potential Release Events Associated with the LNG Terminal	6-6

Table of Contents
(Continued)

		Page
6.5	Comparison of Flammable Fuels Facilities Potential for Off-site Impacts	6-8
6.6	Fire Hazards Associated With Storage of LPG in the Long Beach Area	6-9
6.7	Comparison of Risk	6-11
7.0	Conclusions	7-1
7.1	Limitations of Study	7-1
7.2	Development of Flammable Fuel Release Sequences and Probabilities	7-1
7.3	Consequence Analysis for Worst-Case Releases	7-2
7.3.1	Flammable Cloud Travel Distances	7-3
7.3.2	Vapor Cloud Explosion Hazard Distances	7-5
7.3.3	LNG Pool Fire Radiant Hazard Distances	7-6
7.4	Potential Impact to Neighboring Facilities	7-6
7.5	Comparison to Other Flammable Fuels Facilities	7-8
7.6	Summary	7-10
8.0	References	8-1
Appendix A	Failure Rate Data References	A-1
Appendix B	CANARY by Quest® Model Descriptions	B-1
Appendix C	Base Parameters for Consequence Modeling	C-1

List of Figures

Figure		Page
1-1	Plot Plan	1-2
3-1	Example Event Tree for a Flammable Release of LNG from Process Equipment Piping	3-3
3-2	Ship Speed Restrictions for POLB	3-8
4-1	Release Rate from Process Equipment F	4-12
4-2	Release Rate from Failure of Full LNG Storage Tank Following an Earthquake	4-13
4-3	Release Rate from Failure of a Half-Full LNG Storage Tank Following an Earthquake	4-13
4-4	Release Rate from Failure of One Membrane Tank and from Sequential Failure of Five Membrane Tanks on an LNG Tank Ship Following Collision with the Breakwater	4-14
4-5	LNG Vaporization Rate for Land-Based Pool Following Tank Failure Due to an Earthquake	4-15
4-6	Vaporization Rate History from LNG Reaching Water Surface Following Failure of LNG Storage Tanks After an Earthquake (Modified FERC Model - Non-Burning Case)	4-16
4-7	Vaporization Rate History from Failure of One Full Membrane Tank and from Sequential Failure of Five Full Membrane Tanks on an LNG Storage Tank Ship Following Collision with the Breakwater (Modified FERC Model - Non-Burning Case)	4-17
4-8	1,600 Btu/(hr⋅ft^2) Hazard Footprint and Vulnerability Zone for a Release from Process Equipment F	4-19
4-9	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tanks Following an Earthquake	4-20
4-10	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship Following Collision with Breakwater; 1 Tank Fails	4-22
4-11	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship Following Collision with Breakwater; 5 Tanks Fail	4-23
4-12	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tank After Plane Crash	4-26
4-13	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tank After Truck Bomb	4-27
4-14	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Plane Crash; 2 Tanks Fail	4-28
4-15	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Plane Crash; 5 Tanks Fail	4-29
4-16	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Boat Bomb; 1 Tank Fails	4-30
4-17	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Boat Bomb; 5 Tanks Fail	4-31
4-18	Flammable Hazard Footprint and Vulnerability Zone Following Accidental Rupture of Process Equipment F	4-34
5-1	Facility Plot Plan	5-2
5-2	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from Process Equipment F	5-6
5-3	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tanks Following Earthquake	5-6

List of Figures
(Continued)

Figure		Page
5-4	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship Following Collision with Breakwater; 1 Tank Fails	5-8
5-5	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship Following Collision with Breakwater; 5 Tanks Fail	5-9
5-6	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tank After Plane Crash	5-10
5-7	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tank After Truck Bomb	5-11
5-8	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Plane Crash; 2 Tanks Fail	5-12
5-9	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Plane Crash; 5 Tanks Fail	5-13
5-10	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Boat Bomb; 1 Tank Fails	5-14
5-11	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Tank Ship After Boat Bomb; 5 Tanks Fail	5-15
5-12	2.3 psig Vulnerability Zone for a Release from Process Equipment F	5-18
7-1	10,000 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tanks Following Earthquake	7-9
7-2	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tanks Following an Earthquake	7-15
7-3	1,600 Btu/(hr⋅ft^2) Vulnerability Zone for a Release from LNG Storage Tank After Truck Bomb	7-16

List of Tables

Table		Page
2-1	Consequence Analysis Hazard Levels (Endpoint Criteria for Consequence Analysis)	2-2
2-2	Initial Fluid Conditions for Selected Accidental Release Scenarios; LNG Terminal	2-5
2-3	Probabilities Ranges	2-7
2-4	Intentional Release Scenarios	2-7
2-5	Terrorist-Hijacked Aircraft Crashing into One or both LNG Tanks	2-8
2-6	Terrorist Detonates Truck Bomb Near LNG Tank	2-10
2-7	Terrorist Fires Rocket-propelled Grenade (RPG) Into One or both LNG Tanks	2-11
2-8	Terrorist Detonates Satchel Charge by Equipment	2-12
2-9	Terrorist-Hijacked Aircraft Crashing Into Berthed LNG Tank Ship	2-12
2-10	Terrorists Place Boat Bomb Beside LNG Tank Ship	2-14
2-11	Terrorist Fires Rocket-propelled Grenade (RPG) Into LNG Tank Ship	2-14
2-12	Terrorist-Controlled Ship Collides with LNG Tank Ship	2-16
3-1	Accidental Release and Final Outcome Probabilities	3-4
3-2	EPA RMP Data for Facilities with Toxic Chemicals	3-11
3-3	EPA RMP Data for Facilities with Flammable Chemicals	3-11
3-4	EPA RMP Data for all Facilities	3-12
4-1	Accidental Releases from LNG Storage Tanks and LNG Tank Ships	4-2
4-2	Terrorist-Hijacked Airplane Crashing Into One or Both LNG Tanks	4-3
4-3	Terrorist Detonates Truck Bomb Near an LNG Tank	4-3
4-4	Terrorist Fires Rocket-propelled Grenade (RPG) Into One or Both LNG Tanks	4-4
4-5	Terrorist-Hijacked Airplane Crashing Into an LNG Tank Ship	4-4
4-6	Terrorists Place Boat Bomb Beside an LNG Tank Ship	4-5
4-7	Terrorist Fires Rocket-propelled Grenade (RPG) Into LNG Tank Ship	4-5
4-8	Terrorist-Controlled Ship Collides with an LNG Tank Ship	4-6
4-9	Intentionally Caused Releases from LNG Storage Tanks and LNG Tank Ships	4-6
4-10	Consequence Models Used in Analysis Facility = LNG Import Terminal at Port of Long Beach, California	4-10
4-11	Consequence Analysis Results Facility = LNG Import Terminal at Port of Long Beach, California	4-24
4-12	Ability of Release Events to Allow Vapor Cloud Development	4-32
5-1	Consequence Analysis Results – Equipment Impact Facility = LNG Import Terminal at Port of Long Beach, California	5-4
5-2	Damage Produced by Blast [Clancey, 1972]	5-16
6-1	Consequence Analysis Results Facility = Propane Terminal Near Sacramento, California	6-3
6-2	Consequence Analysis Results Facility = Flammable Fuel Depots, Southern California	6-5
6-3	Consequence Analysis Results Facility = LNG Import Terminal, Altamira, Mexico	6-7
6-4	Comparison of Worst-Case Impacts from Four Flammable Fuel Facilities	6-8
6-5	Radiant Impact Distances for Common LPG Storage and Transport Vessels	6-10
6-6	Individual Risk of Early Fatality by Various Causes [National Safety Council, 1997]	6-12

List of Tables
(Continued)

Table		Page
7-1	Largest Consequence Analysis Results Facility = LNG Import Terminal at Port of Long Beach, California	7-4
7-2	Largest Consequence Analysis Results – Equipment Impact Facility = LNG Import Terminal at Port of Long Beach, California	7-7
7-3	Comparison of Worst-Case Impacts from Four Flammable Fuel Facilities	7-10

SECTION 1
INTRODUCTION

The possibility of large spills of liquefied natural gas (LNG) from large insulated storage tanks or ocean-going LNG tank ships has received increased attention as the demand for natural gas in the United States requires increased importation from foreign sources. This attention has resulted because:

- LNG is a relatively new commodity in many parts of the U.S.,
- LNG has hazardous properties,
- LNG is stored at very low temperatures in large insulated storage tanks, and
- LNG is transported in large, highly visible ships.

LNG spills are considered serious events because the spill surface provides a large heat source that will rapidly vaporize the LNG. The resultant flammable vapor cloud can travel downwind before diluting to safe concentrations. If the flammable vapor is ignited, a vapor cloud fire followed by a pool fire can occur.

1.1 LNG Import Terminal Overview

Sound Energy Solutions (SES) proposes to build an LNG import terminal in the Port of Long Beach in Long Beach, California. The proposed terminal is to be located on Pier T East. The terminal will receive LNG via LNG tank ships on a regular basis. Once the LNG is unloaded from the LNG tank ships into two insulated storage tanks, it will be vaporized for introduction to the local gas transmission pipeline grid or exported by tank truck to regional locations where the LNG is used for vehicular fuel.

Depending on the overseas source of the LNG, a portion of LNG may have to be processed to reduce the amount of the heavier hydrocarbon components of the fluid (e.g., propane and butane) so that the vaporized LNG (natural gas) and product LNG (vehicular fuel) will meet fuel specifications.

The LNG tank ship used in the release and consequence modeling conducted in this work is a 125,000 m^3 membrane tank ship. A membrane tank ship was chosen based on a review of the spherical (Moss) tank ship design data that indicates that the spherical design may be more effective in responding to certain types of LNG ship accidents without loss of product [Glasfeld, 1979]. The choice of the membrane design instead of the spherical design as the basis of one of the project's components will not significantly affect the calculations made for, or conclusions drawn from, this study.

The primary components of the proposed terminal are shown on the plot plan presented in Figure 1-1. A detailed description of the LNG operations, including the process flow diagrams, material balances, etc., was provided for reference in this work but is not repeated in this document. Additional data used as a baseline or reference for this study are contained in Appendix C.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 1-2
Figure 1-1

Public access for the above information is available only through the Public Reference Room, or by e-mail at public.referenceroom@ferc.gov

1.2 Scope of Study

The Port of Long Beach (POLB) retained Quest Consultants Inc. to identify the "worst-case" hazards that would result from an accidental or intentional (e.g., terrorist-induced) release of LNG in or near Sound Energy Solutions' proposed import terminal in Long Beach Harbor.

The study consisted of five primary tasks.

Task 1. Identify a range of potential releases, accidental and intentional, that could result in the largest potential impacts outside the import terminal boundary.

The POLB required the following three types of events to be evaluated . Additional events, both accidental and intentional in origin, were included following a review of project data.

Releases from an LNG tank in the import terminal

- A projectile, such as an airplane or missile, striking one or both tanks and causing a release.
- An explosive charge detonated adjacent to the tanks, causing a release.
- A release from on-site piping by any means (accidental or intentional).

Releases from an LNG tank ship at berth

- A projectile, such as an airplane or missile, striking the ship and causing a release.
- An explosive charge in a small boat detonated adjacent to the ship, causing a release.

Releases from an LNG tank ship in transit

- A grounding on, or collision with, the outer breakwater resulting in the rupture of a cargo tank.
- A collision with another vessel outside the breakwater.

Task 2. Calculate or estimate the probability of each release identified in Task 1.

Failure rate data for process equipment, tanks, and shipping transfers are available from historical data bases and industry experience for both the land-based terminal and the LNG shipping fleet. In instances where the specific release has no historical basis (i.e., an event that has never occurred during the lifetime of the industry), an estimate can be made based on the historical record of similar industries.

When estimating the probability of an intentional act resulting in a release of LNG, there is very little hard data available for review. Using historical data for a range of terrorist activities, an estimate of the probability of a terrorist attack on a flammable fuels facility in the United States can be made.

In Task 2, the mitigation systems in place that may modify the probability of an event occurring were addressed in the analysis.

Task 3. Calculate the size of the hazard zones under worst-case conditions of each release identified in Task 1.

Several consequence models were used to determine the size of the radiant energy and explosive overpressure hazard zones following a release and ignition of a flammable fluid from the LNG terminal or LNG tank ship. Four primary models or suites of models were used in the analysis. All models have limitations and restrictions. In some cases a model was modified to perform in an alternate manner than that for which it was originally intended. The models used in the analysis are:

FERC's LNG spill onto water model
LNGFIRE3
DEGADIS
CANARY by Quest®

Task 4. Determine impacts on neighboring industrial facilities due to the worst-case events

The POLB identified two crude oil berths – the existing berth at T-121 and a proposed berth at T-124 – as industrial neighbors to the LNG import terminal. In general, for LNG import terminals, the primary hazard produced by a release of LNG or other flammable fluid that would affect a neighboring industrial facility is radiation from a continuous fire. The potential radiant impacts on these and other neighboring port facilities were calculated for the releases identified in Task 1.

Task 5. Compare the LNG terminal worst-case analysis to other large-scale flammable fuel facilities

Consequence modeling results for the following large-scale flammable fuel facilities were compared to the LNG import terminal results.

Facility #1 The largest refrigerated propane terminal in northern California. This terminal has two 12,000,000-gallon refrigerated propane storage tanks and four 60,000-gallon pressurized ambient temperature storage tanks.

Facility #2 Refined petroleum tank farms, located in southern California, with large capacity storage tanks containing a variety of petroleum products.

Facility #3 A 10 million tons per annum (10 mtpa) LNG import terminal in Mexico. This terminal will have a peak natural gas generation capacity of 2.4 billion cubic feet per day (10 bcfd). Four 150,000-m^3 storage tanks will be located on site when the project is fully developed.

In addition, for comparison purposes, the flammable hazards associated with a range of LPG storage vessels were calculated. The LPG vessel sizes ranged from a 5 gallon backyard grill propane bottle to a 12,500 barrel LPG storage sphere that would be located in refinery.

1.3 Limitations of Study

The overall scope and execution of the study is limited by two necessary restrictions. First, the study is not a full quantitative risk analysis as it was designed to focus only on the largest releases. Thus, not all possible events are identified, quantified, and incorporated into the study. Instead, the events evaluated in this study cover a range of the largest accidental and intentionally-induced releases that could occur in the facility and tank ship operations. Essentially, because the study evaluates a set of representative worst-case impacts, the consequences of any event that was not specifically identified could still be expected to fall within the range described in this study.

Secondly, all the data used to develop the releases, resultant consequences, and associated probabilities are drawn from publicly available resources. No use of proprietary, confidential, or not-to-be-publicly-disclosed information was used in this study.

SECTION 2
POTENTIAL HAZARDS

2.1 Hazards Identification

Quest reviewed the preliminary design and other public information related to Sound Energy Solutions' proposed LNG Import Terminal in the Port of Long Beach. Using that information, applicable codes and standards, knowledge of and experience with similar LNG terminals, and good engineering practices, a range of large release events that have some potential to occur in the terminal was selected for analysis. In general, these large events can be divided into two categories.

(1) Large releases (ruptures), characterized by a hole with a diameter equal to the pipe diameter or, for vessels and certain process equipment, a hole with a diameter equal to the diameter of the largest attached pipe.
(2) Catastrophic failure of a vessel, characterized by a rapid release of its contents.

Potential releases of LNG, natural gas, or other hydrocarbon fluids were considered for each area within the proposed terminal, as were releases from the LNG tank ship.

2.2 Introduction to Physiological Effects of Fires and Overpressure

The consequence analysis performed for the proposed LNG terminal involved the evaluation of a range of refrigerated and superheated liquid releases, as well as releases of ambient temperature and cold natural gas. Each potential release could result in one or more of the following hazards.

- Exposure to thermal radiation from a torch fire, which is the result of ignition of a high velocity release of natural gas, LNG, or other hydrocarbons.
- Exposure to thermal radiation from a pool fire, which is the result of ignition of a pool of LNG or other hydrocarbons.
- Direct contact with flames due to a flash fire, which is the result of delayed ignition of a flammable vapor cloud following a release of natural gas, LNG, or other hydrocarbons.
- Exposure to overpressure, which may be a result of delayed ignition of a flammable vapor cloud created by a release of natural gas, LNG, or other hydrocarbons.

In order to compare the impacts associated with each type of hazard listed above, a common measure of consequence must be defined. In this study, the primary consequence of interest is the effect of the hazard on humans. For each of the fire and overpressure hazards listed above, there are benchmarks available that define these effects. The exposure levels for the various hazards are discussed in the following sections.

2.2.1 Physiological Effects of Exposure to Fires

The physiological effect of fire on humans depends on the rate at which heat is transferred from the fire to the person, and the time the person is exposed to the fire. Skin that is in contact with flames can be seriously injured even if the duration of the exposure is just a few seconds. Thus, a person wearing normal clothing is likely to receive serious burns to unprotected areas of the skin when directly exposed to the flames from a flash fire (vapor cloud fire).

People in the vicinity of a flash fire, pool fire, or torch fire, but not in contact with the flames, will receive heat from the fire in the form of thermal radiation. Radiant heat flux decreases with increasing distance from the fire, so persons close to the fire will receive thermal radiation at a higher rate than persons who are farther away. The ability of a fire to cause skin burns due to radiant heating depends on the radiant heat flux to which the skin is exposed, and the duration of the exposure. Thus, short-term exposure to high radiant heat flux levels can be injurious, but if a person is far enough from the fire, the radiant heat flux will be so low that it is incapable of causing injury, regardless of exposure time.

2.2.2 Physiological Effects of Overpressures

In the event of an ignition and deflagration of a flammable gas or aerosol cloud, the overpressure levels necessary to cause injury to people are often defined as a function of peak overpressure. Unlike potential fire hazards, persons who are exposed to overpressure have no time to react or take shelter; thus, time does not enter into the hazard relationship.

The physiological effects of overpressures depend on the peak overpressure that reaches a person. Exposure to high overpressure levels may be fatal. Persons located outside the flammable cloud when it ignites will be exposed to lower overpressure levels than persons inside the flammable cloud. If the person is far enough from the source of the overpressure, the overpressure is incapable of causing injuries.

2.2.3 Hazard Endpoint Criteria

The hazard endpoint criteria defined in this study correspond to hazard levels that might cause an injury. With this definition, the injury level is defined for each type of hazard (radiant heat or overpressure exposure). Table 2-1 presents the endpoint hazard criteria approved by the South Coast Air Quality Management District (SCAQMD) for previous work of this nature [SCAQMD, 2001].

Table 2-1
Consequence Analysis Hazard Levels
(Endpoint Criteria for Consequence Analysis)

Hazard Type	Injury Threshold		
	Exposure Duration	Hazard Level	Reference
Radiant heat exposure (torch and pool fires)	40 sec	1,600 Btu/(hr·ft^2) † [5 kW/m^2]	40 CFR 68 [EPA, 1996]
Explosion overpressure	Instantaneous	1.0 psig ‡	40 CFR 68 [EPA, 1996]
Flash fires (flammable vapor clouds)	Instantaneous	Lower Flammable Limit	40 CFR 68 [EPA, 1996]

40 CFR 68. United States Environmental Protection Agency RMP endpoints.

† Corresponds to second-degree skin burns.
‡ Corresponds to partial demolition of houses, which might cause injuries to inhabitants.

2.3 Selection of Accidental Release Case Studies Involving the LNG Terminal

The purpose of the accidental hazard case selection methodology is to define the maximum credible hazard scenarios that might result in an impact to the public. The methodology is developed in five increments:

- Initial review of available documentation
- Detailed review of process flow diagrams (PFDs)
- Development of hazard scenarios
- Screening of hazard scenarios via hazards analysis
- Final selection of hazard cases

Written descriptions of the processes were studied to determine the physical and chemical transformations occurring and the general flow of material in the facility. Process flow diagrams (PFDs) were then reviewed and compared to the written descriptions. Each of the major flow lines was evaluated individually to determine the potential for producing a major hazard if a leak or rupture occurred.

The initial selection of hazard areas considered:

- Flammability and/or toxic nature of the chemicals
- Potential for aerosol formation (releases of streams considerably above their atmospheric boiling point)
- Size of a line
- Normal flow rate in the line
- Inventory
- Severity of the process conditions

These factors were not weighted equally in the evaluation: flammability and/or toxic nature, potential for aerosol formation, and process conditions were given more weight than the other factors.

The list of potential hazard areas was constructed using the preceding analysis. The data sheet for each scenario contains the following information:

- Case number
- Description of the area where release would originate (process equipment, vessel, etc.)
- Stream number found on the PFDs
- Stream or vessel temperature
- Stream or vessel pressure
- Physical state of the stream (gas, liquid, two-phase)
- Total volume of the vessel or the nearest vessel
- Liquid volume of the vessel or the nearest vessel
- Line size
- Normal flow rate of the line or vessel

The hazard zones resulting from the worst-case releases of similar hazard scenarios were evaluated using the CANARY consequence modeling software (Section 4) to determine which ones would have the greatest potential for off-site impact (e.g., flash fire, pool fire, torch fire, overpressure).

The final selection of hazard cases was made. These selections generally defined the maximum extent of any credible potential hazard that could occur in the facility. In addition to the hazard cases selected during the

analysis described above, the failure of both LNG storage tanks as a result of a severe earthquake was selected for inclusion as a possible worst-case event.

In addition to evaluating the consequences of a severe earthquake, the impact of a tsunami on the terminal was evaluated. Tsunamis are long-period oceanic waves generally caused by seismic activity. The magnitude of the potential hazard is a function of the coastline configuration, sea floor topography, individual wave characteristics, magnitude of the initiating event, and distance and direction from the source.

The largest recorded tsunami in the Long Beach or Los Angeles harbor areas had a run-up height of approximately 5 feet. This tsunami was the result of the 1960 Chile earthquake of magnitude 9.5 on the Richter scale. This is the largest recorded earthquake. Smaller tsunamis were also recorded in the area from 1812 to 1975 [McCulloch, 1985].

Various estimates of tsunami run-up heights, primarily from distant sources, have been developed for the project area. Synolakis [2003] estimated a 100-year run-up height of 8 feet and a 500-year run-up height of 15 feet for the POLB area. More recently, [Borrero, et al., 2005] estimated that a tsunami of approximately 13 feet could occur at the LNG terminal site as the result of a large, submarine landslide located 10 miles southwest of the LNG terminal site.

The tidal range in Long Beach Harbor generally varies between elevations -2 and +7 feet from mean lower low water (MLLW) elevation, with an average water level of -4.8 feet MLLW.

The surface elevation of the proposed LNG terminal site is approximately +20 to +25 feet MLLW, which is well above the estimated elevation of the 100-year tsunami (+8 feet), even if it were to occur during a very high tide. When the 500-year tsunami is considered (+15 feet), the site might experience flooding on the order of 2 feet. Therefore, a tsunami impacting the LNG terminal site is not considered an event that could cause significant plant damage.

The initial fluid conditions for the largest accidental release scenarios identified for this analysis are given in Table 2-2. For each case identified, several potential hazardous outcomes might be possible (i.e., flash fire, torch fire, pool fire, vapor cloud explosion).

2.4 Selection of Accidental Release Case Studies Involving LNG Tank Ships

A release of LNG from an LNG tank ship, either when the ship is approaching the LNG terminal or when it is berthed at the terminal, could produce hazard zones that could affect persons and property outside the boundaries of the proposed LNG terminal. Five such accident scenarios were selected for inclusion in this study.

The first set of accidental release cases for LNG ships are based on the LNG ship striking a breakwater as the ship is entering the port. If the water depth at the breakwater is sufficient, the LNG ship could strike the breakwater bow first. For the purposes of this study, it was assumed that – under certain conditions – this event could result in a release of LNG from the cargo tank nearest the bow of the ship, which might escalate until it involved all cargo tanks on the ship. Groundings in the approach area (precautionary zone and main channel) to the Port of Long Beach or in the Port waters were not considered credible events.

Table 2-2
Initial Fluid Conditions for Selected Accidental Release Scenarios; LNG Terminal

Description	Fluid Temperature (EF)	Fluid Pressure (psia)	Fluid State	Normal Flow Rate (lb/sec)
Rupture of process equipment - location A*	-252.8	109.6	Liquid	4,773.0
Rupture of process equipment - location B*	-248.6	116.0	Liquid	75.0
Rupture of process equipment - location C*	-167.3	567.2	Liquid	60.7
Rupture of process equipment - location D*	-121.2	735.0	Liquid	121.4
Rupture of process equipment - location E*	54.8	689.9	Gas	364.1
Release from process equipment - location F*	123.4	579.8	Liquid	76.0
Release from process equipment - location G*	-9.4	207.0	Liquid	75.2
Release from LNG storage tanks following earthquake	-254.0	16.7	Liquid	—

* Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII)[1] by the FERC

Another such accident is a collision involving an LNG tank ship and another ship. Under certain conditions, a collision could have the potential to cause a release of LNG from one or more of the cargo tanks on the LNG ship. Thus, the loss of LNG from one cargo tank, as the result of a collision, was included in the analysis. For the purposes of this study, it was assumed that – under certain conditions – this event could result in a release of LNG from the cargo tank nearest the bow of the ship, which might escalate until it involved all cargo tanks on the ship.

If an LNG tank ship were to be unloading when a 500-year tsunami were to occur, the ship could elevate up to 15 feet. The ship's motion would result in several responses. First, the Powered Emergency Release Couplings (PERCs) on the loading arm would close due to the arms moving outside of their envelope of operation. This would result in a release of a few liters of LNG (fluid between the closed valves). A second result could be the breaking of the mooring lines due to the ship's elevation. At this point, the ship may hit another structure, ground on an object, or be hit by another ship. In all instances, the consequences associated with these events would be no larger than those evaluated in the scenarios described above involving ship collisions, etc.

2.5 Selection of Intentional Release Case Studies

Selecting releases that could be intentionally created by one or more persons required a different approach than that used to define accidental releases. Accidental releases are defined as those that:

---

[1]Critical Energy Infrastructure Information (CEII) Defined:

CEII is information concerning proposed or existing critical infrastructure (physical or virtual) that:

1. *Relates to the production, generation, transmission or distribution of energy;*
2. *Could be useful to a person planning an attack on critical infrastructure;*
3. *Is exempt from mandatory disclosure under the Freedom of Information Act; and*
4. *Gives strategic information beyond the location of the critical infrastructure.*

- have occurred in an LNG facility, or
- have occurred in an industry using similar types of equipment, or
- could reasonably be argued could occur in an LNG facility.

Conversely, selecting intentionally created releases of LNG or natural gas, due to sabotage or terrorism, requires a broader, more creative approach. In order to define a representative list of intentionally created releases, the following factors were considered.

- The primary target of the action (based on inventory, accessability, location, etc.)
- The obstacles to overcome in order to effect a release from the target

It is important to recognize the distinction between selecting accidental release scenarios and selecting intentional release scenarios. It is best summarized by the following statements.

- Accidental release scenarios are based on credible events, but not incredible events.
- Intentional release scenarios are based on possible events, but not impossible events.

The distinction between these selection criteria is critical to understanding the basis of the following analysis. Credible events are often defined as those that have some reasonable probability of occurring. This probability is often based on the historical record of the industry (and similar industries) and is often described in numerical and qualitative terms. For example, a release that might occur once in the lifetime of a facility would be considered a credible accidental event. One example of how qualitative descriptions can be associated with numerical values is presented in Table 2-3 [EN1473, 1997].

In general, releases that have the possibility to occur, but are considered to have a very low probability of occurrence, are not considered in an accidental analysis. These events may be defined as incredible. An example would be the failure of an LNG storage tank because it was hit by a meteorite. The probability is not zero, it is simply very, very low.

A second class of events that have a non-zero probability of occurrence, but a higher probability than that associated with being hit by a meteorite, might not be included in an accidental release analysis because their probabilities are below a predefined value. For example, if the probability of an event is less than 1.0×10^{-6} per year, it might be excluded from an accidental analysis. When this approach is taken, some large consequence/low probability events are excluded from an accidental analysis. An example of this would be the accidental crash of a commercial jet into the LNG terminal. As with the meteorite example, the probability of this event is not zero, it is simply so low that it is not often considered a credible event.

When discussing intentional acts, it may not be possible to assign a numerical value to the probability of a specific intentional act. In light of this, the discussion changes from credible/incredible to possible/impossible. In the following section, several intentional events are described. The descriptions include discussion of various obstacles that might need to be overcome in order to effect a release from the LNG terminal. In each case, the sequence of events and the final outcome are defined as possible. This does not mean they are likely or even credible, they are simply possible.

Using this definition - that an intentional event is simply possible - the following events have been identified for evaluation.

Table 2-3
Probabilities Ranges

Range	*Description*	*Probability of Occurrence*
1	*Frequent or quasi-certain event.*	*more than 10^{-2}/year*
2	*Possible but not very frequent event.*	*10^{-2} up to 10^{-4}/year*
3	*Rare Event.*	*10^{-4} up to 10^{-6}/year*
4	*Extremely rare event.*	*10^{-6} up to 10^{-8}/year*
5	*Improbable event.*	*less than 10^{-8}/year*
6	*Event of non-quantifiable probability (falling of meteorite, attempt on life or property, etc.).*	*Unknown*

2.5.1 Identification of Primary Targets of an Intentional Event

The LNG import terminal is divided into three main operations; LNG storage, LNG and natural gas liquids processing, and LNG transport by tank ship. Using these three operations as a guide, the following intentional release base scenarios were identified as possible.

Table 2-4
Intentional Release Scenarios

Target	Mechanism to effect release of LNG, natural gas, or other hydrocarbon
LNG Storage Tank	Crash of commercial jet Truck bomb near base of storage tank Rocket-propelled grenade
LNG Process Equipment	Satchel charge placed by equipment
LNG Tank Ship	Crash of commercial jet Boat bomb while tank ship is docked Rocket-propelled grenade Collision with another ship

These eight intentional base events cover a range of potential impacts, as well as a varying degree of difficulty in regard to effecting a release of LNG, natural gas, or other hydrocarbons. This list is not intended to identify all possible intentional (terrorist or sabotage) events. It does represent a range of events, all of which are possible to some degree, but many of which are extremely unlikely simply due to obstacles that would need to be overcome by the perpetrators.

2.5.2 Description of Intentional Release Events

A description of how each of the listed intentional events might unfold is provided below. At several points in each scenario, several possible actions are listed. Generally, only one of the possible actions allows the

sequence of events to proceed toward effecting a release from the target. This action is presented in italics in each event sequence table.

In most cases, it is impossible to define or calculate a specific conditional probability for each potential action choice. For instance, assuming a commercial jet is successfully highjacked following take off, and that the highjackers intend to crash the plane into one of the LNG storage tanks, what is the probability that the plane will be shot down by the U.S. military? Such values cannot be known, although it is reasonable to assume that the probability is not 100%.

The descriptions of intentional release events end with the release of LNG, natural gas, or flammable hydrocarbons from the facility. The development of the probability of a successful intentional act is presented in Section 3. Calculations of the magnitude and potential impacts of a release of LNG, natural gas, or other hydrocarbons following the listed intentional acts are presented in Section 4.

The list of intentional events is not meant to be all-inclusive, rather it is meant to span the range of intentional events that can be described as possible for the LNG terminal.

2.5.2.1 Crash of Commercial Jet into LNG Storage Tanks

The premise behind this intentional event is that one or more individuals commandeer a commercial jet and crash the plane into the LNG facility with the intention of hitting one or both of the LNG storage tanks.

Table 2-5
Terrorist-Hijacked Aircraft Crashing into One or both LNG Tanks

Action	Notes
Terrorists avoid airport security	
Unsuccessful - terrorists stopped; flight canceled or delayed *Successful - terrorists board aircraft*	There have been approximately 30 million commercial flights (U.S. carriers) in the US since September 11, 2001, without a hijacking. [NTSB, 5]
Terrorists commandeer the aircraft	
Unsuccessful - aircraft lands Unsuccessful - aircraft crashes *Successful - aircraft commandeered*	Post- September 11, 2001, additional in-flight security measures (e.g., Air Marshals, cockpit doors) have been added to impede hijacking. *Assume* Boeing 767 is the hijacked aircraft.
Aircraft eludes US Air Force	
Unsuccessful - aircraft forced to land Unsuccessful - aircraft shot down *Successful - aircraft continues toward Long Beach*	Whether this will be effective depends on response time and clarity of threat.

Table 2-5
Terrorist-Hijacked Aircraft Crashing into One or both LNG Tanks
(Continued)

Action	Notes
Terrorists hit the side of tank with aircraft	
Unsuccessful - aircraft misses tank(s) altogether, crashes nearby Unsuccessful - aircraft is too high, hits top of tank, and does not breach tank walls *Successful - aircraft hits side of tank*	Flying very low to the ground at high speed in a large jet takes considerable skill and there is a small margin for error. The LNG tanks are "small" targets in comparison to the World Trade Center or the Pentagon.
One jet engine hits side of LNG storage tank	
Unsuccessful - aircraft's jet engines do not hit tank wall *Successful - one of the aircraft's jet engines does hit side of tank wall*	Aircraft bodies, with the exception of a few parts like the engines, are "soft" in comparison to the full containment tank walls. Note that significant aircraft debris did not exit the World Trade Center buildings. Only the jet engine core is considered capable of penetrating full containment tank wall. Jet engines can hit only one LNG storage tank since the engines are approximately 50 feet apart and the LNG storage tanks are spaced approximately 120 feet apart (shell-to-shell). There is no mechanism for each engine to hit a different LNG tank at a near perpendicular angle.
Jet engine hits tank at near perpendicular angle	
Unsuccessful - aircraft's jet engine(s) hit tank wall at obtuse angle *Successful - one of the aircraft's jet engines hits tank wall at an angle such that the tank wall is penetrated*	If an engine does not hit the tank wall at a near perpendicular angle, the engine may deflect off the tank wall. If the aircraft engine is assumed to be a solid projectile (a conservative assumption), then impact analysis on the tank wall will determine whether the engine can penetrate the tank wall.

2.5.2.2 Detonation of Truck Bomb by the Base of an LNG Storage Tank

The premise behind this intentional act is that one or more individuals drive a moderate sized truck containing explosives into the LNG facility, park the truck by one of the LNG storage tanks, then detonate the explosives.

Table 2-6
Terrorist Detonates Truck Bomb Near LNG Tank

Action	Notes
Terrorists avoid POLB security	To be successful, the terrorists must either avoid or neutralize POLB security.
Unsuccessful - terrorists stopped, truck confiscated *Successful - entrance to POLB*	
Terrorists avoid SES security	To be successful, the terrorists must either avoid or neutralize SES security.
Unsuccessful - terrorists stopped, truck confiscated *Successful - entrance into SES LNG terminal; terrorists drive truck toward LNG tank area*	
Terrorists drive truck over impoundment wall toward tanks	Security wall is approximately 20-ft tall. Vehicular access to the area bounded by the security wall is limited to one sloped roadway.
Unsuccessful - unable to drive truck over impoundment wall *Successful - truck enters impoundment area*	
Terrorists park truck very near LNG tank wall	Tank layout will determine how close a truck can approach an LNG tank.
Unsuccessful - truck cannot be parked close enough to LNG tank *Successful - truck parked against or very close to LNG tank wall*	
Terrorists detonate explosives in truck	Small probability that detonation will not take place.
Unsuccessful - explosives fail to detonate *Successful - explosives detonate*	

2.5.2.3 Firing a Rocket-propelled Grenade Into an LNG Storage Tank

The premise behind this intentional act is that one or more individuals fire a rocket-propelled grenade (RPG) at one of the LNG storage tanks.

Table 2-7
Terrorist Fires Rocket-propelled Grenade (RPG) Into One or both LNG Tanks

Action	Notes
Scenario A - Land-based approach	
Terrorists avoid POLB security	To be successful, the terrorists must either avoid or neutralize POLB security.
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - proceed to LNG facility*	
Terrorists avoid SES security	To be successful, the terrorists must either avoid or neutralize SES security.
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - enters SES LNG terminal grounds and moves toward LNG tank area*	
Terrorists hit LNG tank with RPG	
Unsuccessful - RPG misses tank Unsuccessful - RPG hits tank at an oblique angle and does not penetrate concrete wall *Successful - RPG hits tank at near perpendicular angle and penetrates concrete wall.*	
Scenario B - Water-based approach	
Terrorists avoid POLB, City of Long Beach (COLB), and United States Coast Guard (USCG) security	To be successful, the terrorists must either avoid or neutralize three levels of non-project security.
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - enters West Basin*	
Terrorists avoid SES security	To be successful, the terrorists must either avoid or neutralize SES security.
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - enters SES LNG terminal grounds and moves toward LNG tank area*	
Terrorists hit LNG tank with RPG	
Unsuccessful - RPG misses tank Unsuccessful - RPG hits tank at an oblique angle and does not penetrate concrete wall *Successful - RPG hits tank at near perpendicular angle and penetrates concrete wall.*	

2.5.2.4 Detonation of Satchel Charge by Process Equipment

The premise behind this intentional act is that one or more individuals place small explosive charges (satchel charges) next to one or more pieces of equipment in the LNG terminal.

Table 2-8
Terrorist Detonates Satchel Charge by Equipment

Action	Notes
Terrorists avoid POLB security	To be successful, the terrorists must either avoid or neutralize POLB security.
Unsuccessful - terrorists stopped, explosives confiscated *Successful - entrance to POLB*	
Terrorists avoid SES security	To be successful, the terrorists must either avoid or neutralize SES security.
Unsuccessful - terrorists stopped, explosives confiscated *Successful - terrorists enter SES LNG terminal and proceed to LNG equipment area*	
Terrorists place satchel charge very near important LNG equipment	Assumes terrorists know which equipment would produce a significant hazard if damaged.
Unsuccessful - choose minor equipment as target Unsuccessful - satchel charge placed too far away from important equipment to cause a failure *Successful - satchel charge placed against or very close to important LNG equipment*	
Terrorists detonate satchel charge	Small probability that detonation will not take place.
Unsuccessful - explosives fail to detonate *Successful - explosives detonate, resulting in failure of LNG equipment (e.g. pipe, pump)*	

2.5.2.5 Crash of Commercial Jet Into LNG Tank Ship While at LNG Terminal

The premise behind this intentional event is that one or more individuals commandeer a commercial jet and crash the plane into an LNG tank ship while it is docked at the terminal. The required sequence of events for this act is similar to those for crashing a commercial jet into the LNG storage tanks.

Table 2-9
Terrorist-Hijacked Aircraft Crashing Into Berthed LNG Tank Ship

Action	Notes
Terrorists avoid airport security	There have been approximately 30 million commercial flights (U.S. carriers) in the US since September 11, 2001, without a hijacking. [NTSB, 5]
Unsuccessful - terrorists stopped, flight canceled *Successful - terrorists board aircraft*	

Table 2-9
Terrorist-Hijacked Aircraft Crashing Into Berthed LNG Tank Ship
(Continued)

Action	Notes
Terrorists commandeer the aircraft	
Unsuccessful - aircraft lands Unsuccessful - aircraft crashes *Successful - aircraft commandeered*	Post- September 11, 2001, additional in-flight security measures (e.g., Air Marshals, cockpit doors) have been added to impede hijacking. *Assume* Boeing 767 is the hijacked aircraft.
Aircraft eludes US military	
Unsuccessful - aircraft forced to land Unsuccessful - aircraft shot down *Successful - aircraft continues toward Long Beach*	Whether this will be effective depends on response time and clarity of threat.
Aircraft approaches loaded LNG tank ship at berth	
Unsuccessful - LNG tank ship is not berthed Unsuccessful - LNG tank ship at berth, but contains little cargo *Successful - loaded LNG tank ship is berthed at terminal*	The LNG tank ship may not be at berth or it may be nearly empty and at the end of its unloading operation.
Terrorists hit the LNG tank ship with aircraft	
Unsuccessful - aircraft is too high and misses LNG tank ship altogether Unsuccessful - aircraft is too low and crashes before hitting LNG tank ship *Successful - aircraft hits side or top of LNG tank ship*	Flying very low to the ground at high speed in a large jet takes considerable skill and there is a small margin of error. LNG tank ships are “small” targets in comparison to the World Trade Center or the Pentagon

2.5.2.6 Detonation of Boat Bomb Near the LNG Tank Ship While at LNG Terminal

The premise behind this intentional act is that one or more individuals pilot a small boat containing explosives up to the LNG tank ship while it is docked at the LNG facility, then detonate the explosives.

Table 2-10
Terrorists Place Boat Bomb Beside LNG Tank Ship

Action	Notes
Terrorists avoid POLB, COLB, and USCG security	To be successful, the terrorists must either avoid or neutralize three levels of non-project security.
Unsuccessful - terrorists stopped, explosives confiscated *Successful - enters West Basin*	
Terrorists avoid SES security	To be successful, the terrorists must either avoid or neutralize SES security.
Unsuccessful, terrorists stopped, explosives confiscated *Successful - approaches LNG tank ship mooring area*	
Terrorists detonate bomb	How close the boat bomb must be to the ship depends on the "size" of the bomb.
Unsuccessful - explosives do not go off Unsuccessful - explosives set off too far from LNG tank ship to damage outer hull Unsuccessful - explosives set off such that outer hull is breeched, but inner hull is not breached *Successful - outer hull, inner hull, and cargo tank breeched by blast*	

2.5.2.7 Firing an RPG Into an LNG Tank Ship While at LNG Terminal

The premise behind this intentional act is that one or more individuals fire an RPG at the LNG tank ship while it is docked at the LNG facility.

Table 2-11
Terrorist Fires Rocket-propelled Grenade (RPG) Into LNG Tank Ship

Action	Notes
Scenario A - Land-based approach	
Terrorists avoid POLB security	To be successful, the terrorists must either avoid or neutralize POLB security.
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - entrance to POLB*	

Table 2-11
Terrorist Fires Rocket-propelled Grenade (RPG) Into LNG Tank Ship
(Continued)

Action	Notes
Terrorists hit LNG tank ship with RPG	
Unsuccessful - RPG misses tank ship Unsuccessful - RPG hits deck at an oblique angle and does not penetrate deck Unsuccessful - RPG hits outer hull of tank ship at an oblique angle and does not penetrate hull Unsuccessful - RPG hits outer hull of tank ship at near perpendicular angle and penetrates outer hull but not inner hull *Successful - RPG hits outer hull of tank ship at near perpendicular angle and penetrates outer hull and inner hull.*	
Scenario B - Water-based approach	
Terrorists avoid POLB, COLB, and USCG security	
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - enters West Basin*	To be successful, the terrorists must either avoid or neutralize three levels of non-project security.
Terrorists avoid SES security	
Unsuccessful - terrorists stopped; RPGs confiscated *Successful - entrance into water near LNG tank ship*	To be successful, the terrorists must either avoid or neutralize SES security.
Terrorists hit LNG tank ship with RPG	
Unsuccessful - RPG misses tank ship Unsuccessful - RPG hits outer hull of tank ship at an oblique angle and does not penetrate outer hull Unsuccessful - RPG hits outer hull of tank ship at near perpendicular angle and penetrates outer hull but not inner hull *Successful - RPG hits outer hull of tank ship at near perpendicular angle and penetrates outer hull and inner hull*	

2.5.2.8 Terrorist Controlled Ship Collides with LNG Tank Ship

The premise behind this intentional event is that one or more individuals commandeer a ship and cause it to collide with an LNG tank ship.

Table 2-12
Terrorist-Controlled Ship Collides with LNG Tank Ship

Action	Notes
Terrorists commandeer a ship	Terrorists would need to overcome crew before crew could contact USCG.
Unsuccessful - terrorists stopped by crew or USCG *Successful -terrorists gain control of ship.*	
Terrorists sail ship toward full LNG tank ship	To increase the odds of success, the terrorists would need to avoid being detected by the USCG and would need to calculate successful course.
Unsuccessful - USCG foils attempt before LNG ship arrives Unsuccessful - terrorists lack the knowledge needed to control the ship *Successful - terrorist-controlled ship on collision course with LNG tank ship*	
Terrorist-controlled ship collides with full LNG tank ship	
Unsuccessful - error by terrorists causes their ship to miss LNG tank ship Unsuccessful - evasive maneuvers by LNG tank ship result in near miss *Successful - ships collide, causing damage to both ships*	
Collision between terrorist-controlled ship and LNG tank ship results in failure of one LNG cargo tank	
Unsuccessful - terrorist ship does not hit the cargo section of LNG ship Unsuccessful - momentum of terrorist ship not sufficient to cause failure of a cargo tank Unsuccessful - terrorist ship strikes LNG ship at an angle too far from perpendicular and does not penetrate outer hull *Successful - bow of terrorist-controlled ship penetrates outer hull, inner hull, and cargo tank wall of LNG tank ship*	

SECTION 3
DEVELOPMENT OF INCIDENT PROBABILITIES

3.1 Accidental Releases of LNG, Natural Gas, or Other Hydrocarbon Fluids in the LNG Terminal

The probability of occurrence of an accident that results in the release of LNG, natural gas, or hydrocarbon fluids is typically based on the historical record of occurrence of such accidents, or similar accidents involving similar equipment and materials. This commonly used technique is valid for accidents (unintentional events) because they are random events.

The likelihood of a particular accident occurring within some specific time period can be expressed in different ways. One way is to state the statistical probability that the accident will occur during a one-year period. This annual probability of occurrence can be derived from failure frequency data bases of similar accidents that have occurred with similar systems or components in the past.

Most data bases (e.g., CCPS [1989b], OREDA [1984]) that are used in this type of analysis contain failure frequency data (e.g., on the average, there has been one failure of this type of equipment for 347,000 hours of service). By using the following equation, the annual probability of occurrence of an event can be calculated if the frequency of occurrence of the event is known.

$$p = 1 - e^{(-\lambda \cdot t)}$$

where: p = annual probability of occurrence (dimensionless)

λ = annual failure frequency (failures per year)

t = time period (one year)

If an event has occurred once in 347,000 hours of use, its annual failure frequency is computed as follows.

$$\lambda = \frac{1 \text{ event}}{347{,}000 \text{ hours}} \cdot \frac{8{,}760 \text{ hours}}{\text{year}} = 0.0252 \text{ events/year}$$

The annual probability of occurrence of the event is then calculated as follows.

$$p = 1 - e^{(-0.0252 \cdot 1)} = 0.0249$$

Note that the frequency of occurrence and the probability of occurrence are nearly identical. (This is always true when the frequency is low.) An annual probability of occurrence of 0.0249 is approximately the same as saying there will probably be one event per forty years of use.

Due to the scarcity of accident frequency data bases, it is not always possible to derive an exact probability of occurrence for a particular accident. Also, variations from one system to another (e.g., differences in design, construction, operation, maintenance, or mitigation measures) can alter the probability of occurrence for a specific system. Therefore, variations in accident probabilities are usually not significant unless the variation approaches one order of magnitude (i.e., the two values differ by a factor of ten).

In developing the accidental probabilities for the largest accidental releases of LNG, natural gas, and other hydrocarbons identified in Section 2, the references in Appendix A were used.

3.1.1 Example – Development of Event Tree for an Accidental Release from LNG Process Equipment

A release of LNG into the atmosphere may create one or more hazardous conditions, depending on events that occur subsequent to the release. For a fluid such as LNG that is flammable but not toxic, the possibilities are:

(a) No ignition. If a flammable vapor cloud forms but never ignites, the cloud dissipates.
(b) Immediate ignition. If ignition occurs nearly simultaneously with the beginning of the release, the hazard may be thermal radiation from a torch fire (pressurized release) or pool fire (nonpressurized release), or both in some instances.
(c) Delayed ignition with no significant overpressure generated. If there is a time delay between the start of the release and ignition of the release, a flammable vapor cloud will form. After ignition, there will be a vapor cloud fire (flash fire), possibly followed by a pool fire or torch fire.
(d) Delayed ignition with explosion. This situation is just like the previous case but, subsequent to ignition, the vapor cloud explodes rather than burns. The strength of the overpressure developed during the explosion will be dependent on the degree of congestion in the area. Congestion is defined by the amount of void space (open air) in the volume occupied by the equipment, etc., in the area. As rule of thumb, low congestion would be defined as 90% void space (10% equipment) and high congestion would be defined as less than 40% void space.

Each of these four possibilities has some probability of occurring, once a release has occurred. The sum of these four probabilities must equal one. The ignition/explosion probabilities employed in this study are taken from an Institution of Chemical Engineers report [Cox, Lees, and Ang, 1990]. The probabilities are a function of the size of the release.

Consequences of the hazardous events that may occur after release of LNG are proportional to the size of the release. Therefore, when calculating the final outcome probability, it is necessary to estimate the distribution of releases of various sizes. This is typically done by applying a hole size distribution. Information on hole size distributions is included in the data bases listed in Appendix A.

The calculations made for hole size and ignition probability are best illustrated by event trees. One of the event trees prepared for this study is presented in Figure 3-1. It begins with the release of LNG from process piping. Moving from left to right, the tree first branches into three release sizes, each being defined by the diameter (d) of the hole through which the fluid is being released. Each of these three branches divides into three branches based on ignition timing and probability. Each delayed ignition branch divides again into two branches: flash fire and vapor cloud explosion (VCE). At the far right of the event tree are the twelve "outcomes" that have some probability of occurring if the initiating release occurs.

To arrive at the probability of a specific outcome, the probability of failure of the process equipment is modified by the probability at each applicable branch of the event tree. The estimated annual probability of occurrence of each possible outcome, per foot of pipe, is listed on the event tree. For example, the probability of an immediate torch fire following a rupture of the piping leading to piece of process equipment can be found by starting with the probability of a failure per foot of pipe per year ($4.5\ (10)^{-8}$ ft/yr and multiplying it by the percent of time the failure would be a rupture (5.6%), then multiplying it by the percent of time the release is immediately ignited (10%). This is calculated as:

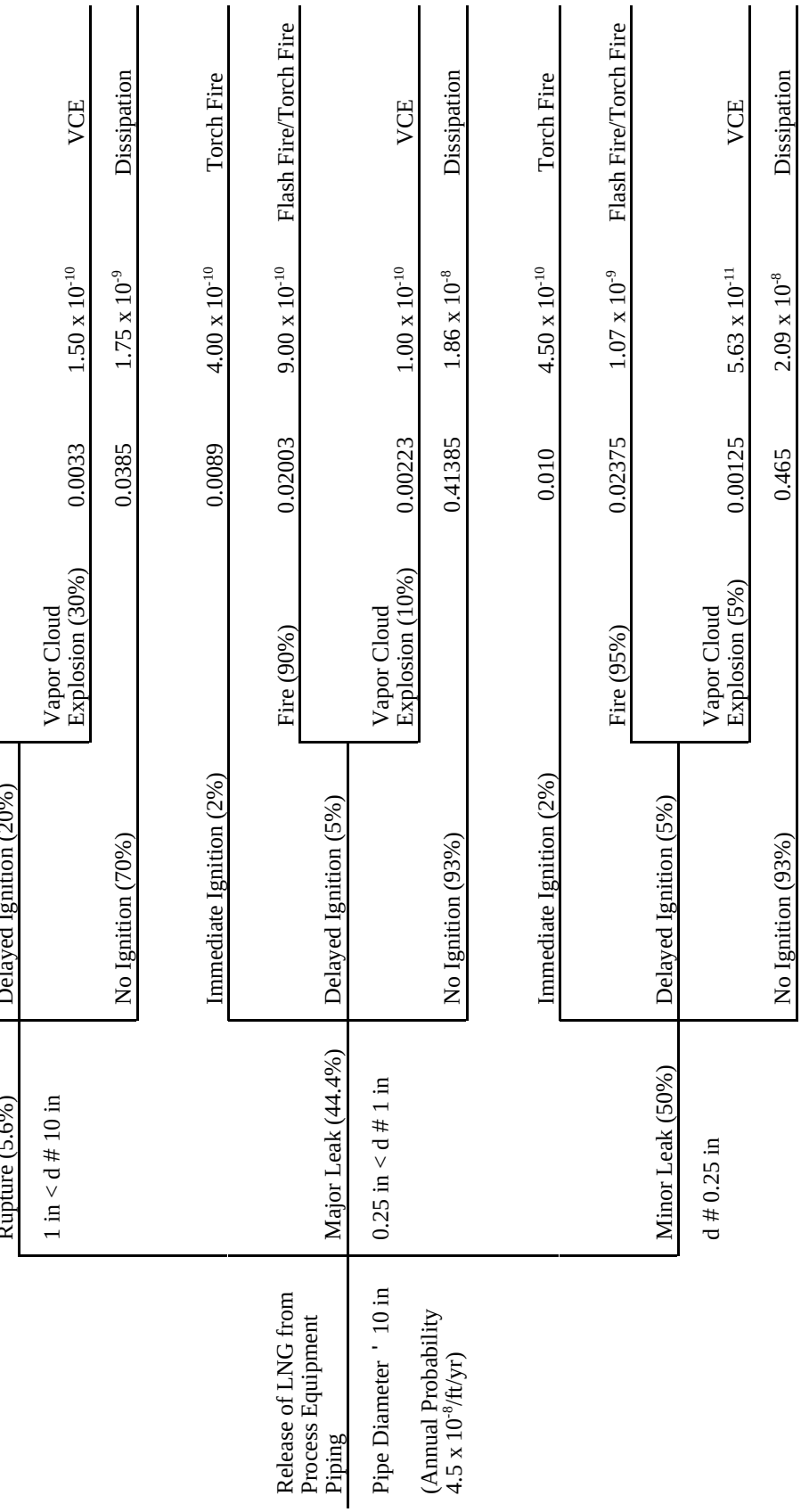


Figure 3-1
Example Event Tree for a Release of LNG from Process Equipment Piping

$$4.5\left(10^{-8}\right)/\text{ft/yr} \cdot 0.056 \cdot 0.10 = 2.5\left(10^{-10}\right)/\text{ft/yr}$$

This value is then multiplied by the amount of piping (x feet) in order to arrive at the total probability of a rupture in the piping associated with the piece of process equipment that results in an immediate torch fire.

In general, small releases are the most likely to occur, the least likely to be ignited (small probability of reaching an ignition source), and least likely to result in vapor cloud explosions (insufficient mass of gas in the flammable gas cloud). The largest releases are the least likely to occur, the most likely to be ignited (highest probability of reaching an ignition source), the most likely to be ignited immediately (the force needed to cause a large release may also be capable of igniting the release), and the most likely to result in a vapor cloud explosion (highest probability of being partially confined by obstructions).

Since the conditional probabilities for ignition and explosion in the event tree are not derived from an historical data base, it could be argued that these probabilities should be increased or decreased. However, even large changes (50%) in the individual probabilities will not make a significant change in the overall analysis since increasing the probability of one event results in a decrease in the probability of some other event.

Similar event trees were constructed for all the accidental LNG, natural gas, and other hydrocarbon releases listed in Table 2-2 (with the exception of the LNG storage tanks failing as the result of an earthquake, which is discussed in Section 3.2). The final outcome probabilities of the largest releases (e.g., full ruptures) identified are presented in Table 3-1.

Table 3-1
Accidental Release and Final Outcome Probabilities

Release Description	Probability of Rupture	Outcome	Outcome Probability	Once In
Rupture of process equipment - location A *	9.45×10^{-7} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	9.45×10^{-8} / yr 1.32×10^{-7} / yr 1.32×10^{-7} / yr 5.67×10^{-8} / yr 6.61×10^{-7} / yr	10,660,000 yr 7,570,000 yr 7,570,000 yr 17,600,000 yr 1,510,000 yr
Rupture of process equipment - location B *	6.69×10^{-5} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	6.69×10^{-6} / yr 9.36×10^{-6} / yr 9.36×10^{-6} / yr 4.01×10^{-6} / yr 4.68×10^{-5} / yr	149,000 yr 107,000 yr 107,000 yr 249,000 yr 21,400 yr
Rupture of process equipment - location C *	6.60×10^{-5} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	6.60×10^{-6} / yr 9.24×10^{-6} / yr 9.24×10^{-6} / yr 3.96×10^{-6} / yr 4.62×10^{-5} / yr	151,000 yr 108,000 yr 108,000 yr 252,000 yr 21,600 yr
Rupture of process equipment - location D *	5.28×10^{-5} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	5.28×10^{-6} / yr 9.40×10^{-6} / yr 9.40×10^{-6} / yr 3.17×10^{-6} / yr 3.70×10^{-5} / yr	189,000 yr 106,000 yr 106,000 yr 315,000 yr 27,000 yr

Table 3-1
Accidental Release and Final Outcome Probabilities
(Continued)

Release Description	Probability of Rupture	Outcome	Outcome Probability	Once In
Rupture of process equipment - location E *	4.05×10^{-6} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	4.05×10^{-7} / yr 7.29×10^{-7} / yr 7.29×10^{-7} / yr 8.10×10^{-8} / yr 2.83×10^{-6} / yr	2,470,000 yr 1,370,000 yr 1,370,000 yr 12,300,000 yr 353,000 yr
Release from process equipment - location F *	3.80×10^{-6} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	3.80×10^{-7} / yr 5.32×10^{-7} / yr 5.32×10^{-7} / yr 2.28×10^{-7} / yr 2.66×10^{-6} / yr	2,630,000 yr 1,880,000 yr 1,880,000 yr 4,390,000 yr 376,000 yr
Release from process equipment - location G *	4.79×10^{-6} / yr	Immediate Torch/Pool Fire Delayed Torch/Pool Fire Flash Fire Vapor Cloud Explosion Dissipation	4.79×10^{-7} / yr 6.71×10^{-7} / yr 6.71×10^{-7} / yr 2.88×10^{-7} / yr 3.35×10^{-6} / yr	2,090,000 yr 1,490,000 yr 1,490,000 yr 3,470,000 yr 298,000 yr

* Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC

3.2 Accidental Releases of LNG from LNG Storage Tanks and Tank Ships

3.2.1 Earthquake-induced Failure of Both LNG Storage Tanks

Like all structures built from metal and concrete, LNG storage tanks can be damaged by a seismic event (earthquake) if the earthquake is strong enough to produce ground accelerations that exceed the limits of the structure. A research and consulting agency established by the government of the Netherlands (Netherlands Organization for Applied Scientific Research, commonly referred to as TNO) has estimated the probability of an accidental instantaneous release of the contents of a full-containment storage tank to be 1×10^{-8} per year [TNO, 1999]. In the absence of historical data for earthquake-induced failures of full-containment storage tanks (i.e., no such failure has ever been recorded for an LNG storage tank), 1×10^{-8} is often referenced within a study to represent the annual probability that a full containment LNG tank could fail.

Site-specific studies [ARUP, 2005, KBR, 2005, and URS/KBR, 2005] for the proposed LNG import terminal in the POLB found three faults within seven km of the proposed terminal. An analysis of the structural design of the LNG tanks found that a peak ground acceleration greater than 1.14 g would be required at the LNG tank location before the forces on the tank might initiate a failure. In order for the Palos Verdes fault (four km away) to produce a peak ground acceleration of 1.14 g or higher, an earthquake exceeding 9 on the Richter scale would be required. This fault is considered "unrealistic" in the seismic assessment [KBR, 2005] that determined that the frequency of such an earthquake would be once in 20,000 years (5×10^{-5} per year). The two remaining faults in the area; Newport-Inglewood and THUMBS-HB were determined to not be capable of producing an earthquake that would produce the peak ground accelerations at the site that may cause tank failure.

Using the site-specific analysis performed for the proposed POLB full containment tanks, the failure of one or both tanks due to an earthquake has been defined as *credible* for this work (i.e., the failure frequency is greater than $1x(10)^{-6}$ per year). Using the LNG-specific EN1473 frequency definitions (see Table 2-3), the failure of one or both LNG tanks due to an earthquake would fall in Range 3, a *Rare Event*. The State of California's Risk Management Program (RMP) requires the evaluation of hazardous material releases that are defined as *probable*. In applying the RMP definitions to hazardous material releases, the Los Angeles County Fire Department's guidelines (LACFD, 1991) define the following categories of probability of occurrence of a hazardous material release.

Frequent = More than once a year (> $1x(10)^{0}$ per year).

Periodic = Once every 1 to 10 years ($1x(10)^{0}$ to $1x(10)^{-1}$ per year). At least once each decade.

Occasional = Once every 10 to 100 years ($1x(10)^{-1}$ to $1x(10)^{-2}$ per year). Probably during the life of the project..

Possible = Once every 100 to 10,000 years ($1x(10)^{-2}$ to $1x(10)^{-4}$ per year). Not expected, but could occur.

Improbable = Not for 10,000 or more years (< $1x(10)^{-4}$ per year). Not expected or likely to occur at all.

The consequences associated with an earthquake-induced failure of one or both LNG storage tanks will be included in the following worst-case consequence analysis because they are *credible*. However, the failure of one or both tanks due to an earthquake is defined as *improbable* per the State of California RMP guidelines and would not be included in an RMP consequence evaluation.

3.2.2 Release of LNG from Ship's Cargo Tank as a Result of Colliding with the Breakwater

If an LNG tank ship were to strike a massive fixed object at sufficient speed, there is a possibility that the impact could result in a release of LNG from a cargo tank (most likely the tank nearest the bow). A study of the mechanics of LNG ship collisions [Greuner and Böckenhauer, 1980] concluded that if a 125,000 m^3 LNG tank ship were to strike a jetty, a "dangerous situation" would occur only if the ship was moving at a speed of more than 10 knots at the time it hit the jetty. It is expected that LNG tank ships will be moving at speeds lower than 10 knots when in the vicinity of the breakwater in the POLB.

According to the Los Angeles/Long Beach Harbor Safety Plan [POLB, 2004], the vessel speed limits in the precautionary zone (outside the breakwater but inside the Sierra and Whiskey buoys) is 12 knots. The vessel speed limit in the Main Channel is 10 knots and the vessel speed limit everywhere else in the Port is 6 knots.

According to industry records [GIIGNL, 2003], there have been approximately 40,000 loaded voyages of LNG tank ships since the commercial marine transport of LNG began in 1959. Since split cargoes (i.e., unloading part of the cargo at one terminal and the rest of it at another terminal) are rare in the LNG trade, it can be assumed that 40,000 ballast voyages (i.e., voyages with the cargo tanks being nearly empty) have also been completed by LNG tank ships. Combining loaded voyages and ballast voyages, and assigning one port call for each voyage (either to be loaded or to be unloaded), results in approximately 80,000 port calls. Thus, there have been about 80,000 chances for an LNG ship to strike a fixed object while in or near a port. Two such incidents have been reported [*Hazardous Cargo Bulletin*, January, 1998 and April, 1996.]. The integrity of the cargo tanks was not compromised in either of these two incidents.

In the absence of sufficient historical data, one way of estimating the frequency of occurrence of an event in which LNG would be released from a cargo tank due to damage caused by the ship striking a fixed object (such as the breakwater) is to assume that such an event occurs tomorrow. The assumed frequency of such an event would then be once in 80,000 port calls, or 1.25×10^{-5} per port call.

3.2.3 Release of LNG from Ship's Cargo Tank(s) as a Result of Colliding with Another Ship

A collision between an LNG tank ship and another ship could result in a release of LNG from a cargo tank on the LNG ship, if the momentum (i.e., mass and speed) of the other ship is great enough to cause the failure of the LNG ship's outer hull, inner hull, and cargo tank wall. The resistance of LNG ships to this type of event has been the subject of several studies, as reported in various publications [e.g., Greuner and Böckenhauer, 1980; FERC, 1996; and Eagle Lyon Pope, 2001]. These analyses predicted the minimum speed at which the non-LNG ship would need to be moving at the time of the collision in order to inflict sufficient damage to the LNG tank ship. This critical speed was shown to depend on the momentum of the non-LNG ship; the angle at which that ship strikes the LNG ship; the separation distance between the outer and inner hulls of the LNG ship; and whether the LNG ship is moored or not at the time of the collision.

For a given size and type of non-LNG ship, the critical speed is lowest when that ship is moving in a direction perpendicular to the LNG ship at the time of the collision. As an example, consider a 64,000 dwt bulk carrier or an 82,000 dwt oil tanker striking a membrane tank LNG ship at an angle of 90 degrees. If the LNG tank ship is moored, the critical speed of the striking ship is 3.0 knots [Eagle Lyon Pope, 2001; FERC, 1996].

As discussed in section 3.2.2, there have been about 80,000 chances for an LNG ship to be struck by another ship while in or near a port. Eight such incidents have been reported [Davis, 1979; Thomas and Lakey, 1993; and LNG OneWorld website], but none of these eight incidents resulted in any release of cargo.

Since there is no historical record of a collision in which LNG was released, the method described in sections 3.2.2 and 3.2.3 was used to make an estimate of the frequency of occurrence of an event in which LNG would be released from a cargo tank as a result of a collision between and LNG ship and another ship (i.e., assume that such an event occurs tomorrow. The assumed frequency of such an event would then be once in 80,000 port calls, or 1.25×10^{-5} per port call.

This assumed frequency applies only to collisions that occur outside the POLB breakwater, where there is room to maneuver a large non-LNG ship at a speed of 3 knots or more, or a small ship (3,000 dwt) at a speed of 12.8 knots or more [Eagle Lyon Pope, 2001]. Outside the breakwater, there is a Precautionary Zone (shown in Figure 3-2) in which the speed limit is 12 knots. Ships approaching the POLB must be within the Main Channel, which is outside the breakwater, in order to enter the Outer Harbor. Ships in the Main Channel are restricted to a maximum speed of 10 knots. Inside the breakwater, all ships are restricted to a maximum speed of 6 knots. If an LNG tank ship were to be struck by a small ship (e.g., 3,000 dwt) moving at a speed of 6 knots, the small ship would not have sufficient momentum to penetrate the inner and outer hulls of the LNG tank ship. Thus, once inside the breakwater, a ship collision could result in a spill of LNG only if the non-LNG ship involved in the collision is a large ship, and only if the non-LNG ship is moving in a direction nearly perpendicular to the LNG ship when the collision occurs. The limited dimensions of the port in the area near the proposed terminal would make it very difficult for a large non-LNG ship to make the maneuvers necessary for it to strike the side of an LNG ship while moving at a speed at or above the critical speed. Therefore, this accident is assumed to occur outside the breakwater.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 3-8
Figure 3-2

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

3.3 Terrorist-Induced Releases of LNG, Natural Gas, or Other Hydrocarbon Fluids in the LNG Terminal

A portion of the qualitative risk analysis of the proposed LNG import terminal in the POLB is centered on estimating the likelihood of a successful terrorist attack on the terminal or shipping operations. Once calculated, this likelihood, or probability can be compared to the probability of the largest worst-case accidental releases.

Unlike events that are accidental in nature, it is impossible to predict the probability of occurrence of specific intentional events (such as those perpetrated by vandals or terrorists). Only the perpetrators of such events know when and where an event will occur. However, within the United States, it is clear that such events are rare or else the historical record of major hazardous events would be skewed as a result of intentional acts. (This has occurred in some countries. For example, in Colombia, the acts of terrorists, rebels, guerrillas, etc., are a major cause of pipeline failures).

There is some indication that flammable fuel facilities in the United States are not an attractive target for sophisticated terrorist attacks. In a March, 2003, United States General Accounting Office report to Congressional Requesters [GAO, 2003], the GAO places focus of potential terrorist attacks on chemical facilities (though it does mention a late-1990s plot to attack a large propane storage facility in California). This can be seen in the following excerpt from the report.

> *Experts agree that chemical facilities present an attractive target for terrorists intent on causing massive damage because many facilities house toxic chemicals that could become airborne and drift to surrounding areas if released. Alternatively, terrorists could steal chemicals, which could be used to create a weapon capable of causing harm. [The Department of] Justice has been warning of the terrorist threat to chemical facilities for a number of years and has concluded that the risk of an attempt in the foreseeable future to cause an industrial chemical release is both real and credible. In fact, according to Justice, domestic terrorists plotted to use a destructive device against a U.S. facility that housed millions of gallons of propane in the late 1990s. In testimony on February 6, 2002, the Director of the Central Intelligence Agency warned of the potential for an attack by al Qaeda on chemical facilities.*
>
> *Some chemical facilities may be at higher risk of a terrorist attack than others when they contain large amounts of toxic chemicals and are located near population centers assuming that the objective is a catastrophic release. Attacks on such facilities could harm a large number of people, with health effects ranging from mild irritation to death, cause large-scale evacuations, and disrupt the local or regional economy. No specific data are available on what the actual effects of successful terrorist attacks on chemical facilities would be. However, facilities subject to the RMP provisions submit to EPA estimates of the potential consequences to surrounding communities of hypothetical accidental "worst-case" chemical releases from their plants. These estimates include the residential population located within the range of a toxic gas cloud produced by a "worst-case"chemical release, called the "vulnerable zone." According to EPA, 123 chemical facilities located throughout the nation have toxic "worst-case" scenarios where more than one million people would be in the "vulnerable zone" and could be at risk of exposure to a cloud of toxic gas. About 600 facilities could each potentially threaten between 100,000 and a million people, and about 2,300 facilities could each potentially threaten between 10,000 and 100,000 people within these facilities' "vulnerable zones."*

A second comment in the report reinforces the conclusion that anti-terrorism activities should be centered on chemical facilities, not flammable facilities.

> *Flammable chemicals affect fewer people because the distance the flammable substance travels tends to be significantly shorter.*

The report goes on to describe the findings of the U.S. Army related to estimating the impacts from chemical releases. Flammable facilities were not included in the Army analysis.

> *The Army has also estimated high potential damage to the population from a toxic chemical release. During a 2001 informal meeting with a number of agencies, the Army Office of the Surgeon General proposed, based on generic estimates, that it was conceivable that as many as 2.4 million people could request medical treatment if a terrorist caused a release of a toxic chemical [U.S. Army, 2001]. According to officials from that office, these estimates include anyone who seeks medical attention as a result of the release—including people with minor irritations or concerns. Finally, a 2002 Brookings Institution report ranks an attack on toxic chemical plants behind only biological and atomic attacks in terms of possible fatalities [Brookings Institution, 2002].* [GAO, 2003]

Experts in consequence and risk assessment would agree with these findings simply based on the ability of a release to inflict injuries. For example, a derailment of a chlorine railcar, accidental or intentional, that resulted in a large leak from a puncture, could result in a toxic vulnerability zone extending approximately three miles from the railcar [Software Program: RMP*Comp]. People inside this vulnerability zone could be exposed to 20 ppm of chlorine for a significant amount of time. 20 ppm of chlorine is the Emergency Response Planning Guideline-3 (ERPG-3) value, which is defined as;

> *The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.*

The U.S. EPA uses the ERPG-2 concentration level in its Risk Management Plan (RMP) program. The ERPG-2 concentration level for chlorine is 3 ppm. ERPG-2 is defined as;

> *The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.*

The chlorine railcar release could create an ERPG-2 vulnerability zone approximately eight miles in radius [Software Program: RMP*Comp].

This example is presented to show that toxic chemicals are a more effective terrorist target than flammable fuel facilities. As will be shown in Section 4, no release from the LNG terminal, accidental or intentional, can produce as large an impact on Long Beach as that from a single railcar of chlorine.

Using the EPA data [GAO, 2003; Belke, 2000], it is possible to define the number of facilities that would have impacts on the surrounding residential population and subdivide these facilities based on the magnitude of the impact following a worst-case event. For instance, for the facilities storing or using toxic chemicals, the following data are available as a result of the EPA Risk Management Plan (RMP).

Table 3-2
EPA RMP Data for Facilities with Toxic Chemicals

Number of U.S. Facilities with Threshold Amounts of Listed Toxic Materials	Affecting this Number of People
123	More than 1,000,000
586	100,000 to 1,000,000
2,306	10,000 to 100,000
4,713	1,000 to 10,000
3,973	100 to 1,000
1,430	10 to 100
855	1 to 10

The following note accompanies the list presented in Table 3-2. This table "includes only those facilities with toxic chemicals that could lead to a "worst-case" scenario. Facilities that only have flammable chemical "worst-case" scenarios are not included. Flammable chemicals affect fewer people because the distance the flammable substance travels tends to be significantly shorter." This statement is borne out by the flammable fuels data reported to the EPA as part of the RMP program [Belke, 2000].

Table 3-3
EPA RMP Data for Facilities with Flammable Chemicals

Number of U.S. Facilities with Threshold Amounts of Listed Flammable Materials	Affecting this Number of People
0	More than 1,000,000
0	100,000 to 1,000,000
40	10,000 to 100,000
250	1,000 to 10,000
720	100 to 1,000
650	10 to 100
1,515	1 to 10

A comparison of Tables 3-2 and 3-3 clearly shows why terrorists might target a facility that stores or uses toxic chemicals in preference to a facility that stores or uses flammable chemicals.

Combining the toxic and flammable fuels facilities into one overall list produces Table 3-4.

Table 3-4
EPA RMP Data for all Facilities

Number of U.S. Facilities with Threshold Amounts of Listed Toxic or Flammable Materials	Affecting this Number of Pe0ple
123	More than 1,000,000
586	100,000 to 1,000,000
2,346	10,000 to 100,000
4,963	1,000 to 10,000
4,693	100 to 1,000
2,080	10 to 100
2,370	1 to 10

Using the EPA's RMP*Comp model [Software Program: RMP*Comp], a worst-case calculation can be made in order to place the proposed LNG terminal in the proper impact category in Tables 3-3 and 3-4. The RMP*Comp program calculates a 0.8 mile vulnerability zone for the proposed LNG terminal. A review of the 2000 US Census data using the program LandView®6 [Software Program: LandView®6] shows there are no residential members of the public within 0.8 miles of the LNG terminal. The Port of Long Beach has estimated that a maximum of 900 workers might be within the 0.8 mile radius circle at any one point in time [S. Crouch, POLB]. Using this data, it is possible to place the proposed LNG terminal in the category that represents the range of 100 to 1000 people within the project's vulnerability zone.

The EPA data base provides a consistent way to review the potential worst-case hazards from over 17,000 facilities in the U.S. For the purposes of this study, only facilities that can produce worst-case impacts in the range of the proposed LNG terminal (100 to 1000 affected people) or greater will be considered. Thus, facilities that have the potential to affect 1 to 10 and 10 to 100 people are removed. This results in 12,711 facilities that have the potential to affect 100 people or more (from 100 to over 1,000,000).

The EPA RMP data provide a numerical accounting of the number of U.S. facilities that might be considered a terrorist target and the potential worst-case impacts following a release from the facilities. The next step in developing a potential "terrorist act" frequency for these facilities is to define a time period of review.

Several high profile terrorist acts have involved U.S. citizens over the past twenty years. A list of such events would include,

June 24, 1985	Highjacking of TWA 847 (Beirut, Lebanon)
October 7, 1985	Highjacking of Achille Lauro (off the coast of Egypt)
December 21, 1988	Bombing of Pan Am 103 (Lockerbie, Scotland)
February 26, 1993	Bombing of World Trade Center (New York, New York)
April 19, 1995	Bombing of Oklahoma City Federal Building (Oklahoma City, Oklahoma)
September 11, 2001	Highjacking of four domestic flights and resultant crashes into the World Trade Center (New York, New York), Pentagon (Arlington, Virginia), and a Pennsylvania field.

From this list, terrorist acts on U.S. soil started no later than February of 1993, with the first bombing of the World Trade Center. It should also be noted that we know of no successful terrorist-initiated act having ever occurred in the facilities covered by Table 3-3 or 3-3. If it is assumed that a successful terrorist event happened tomorrow in any one of the 12,711 facilities, then the frequency of a successful terrorist act could be derived as follows.

$$\frac{1\,event}{11\,years \cdot 12{,}711\,facilities} \text{ or } \frac{1\,event}{139{,}821\,facility\text{-}years}$$

$$= 7.15 \times 10^{-6}\,\frac{successful\ terrorist\ events}{year}$$

This can be thought of as approximately seven chances in a million per year that a successful terrorist-induced failure would occur in any one of the 12,711 facilities that could have impacts of the same magnitude, or larger than, the impact associated with the proposed LNG import terminal in the Port of Long Beach.

3.4 Security of the LNG Import Terminal

The proposed LNG import terminal will work with local and federal agencies in regard to the physical security of the terminal. For obvious reasons, security plans, actions, and responsibilities will not be described in this report. Those descriptions are not necessary since the potential impacts associated with any intentionally-induced release from the facility is simply defined as possible or impossible. Within the framework of the possible/impossible definition of a successful terrorist event, it has been assumed that it may be possible to overcome all possible layers of security. This does not mean that a terrorist-induced release from the LNG import terminal or shipping activities is likely, credible, or incredible. It simply means that under very specific circumstances, a terrorist-induced release may be possible.

In general, the agencies that would have the most visible local security impact in reference to the LNG terminal operation and LNG tank ship movement security are those listed below.

City of Long Beach

Port of Long Beach

Project security for the import terminal

United States Coast Guard

The majority of the 12,711 facilities referenced in Section 3.3 that have as large or larger potential impacts on the public than the proposed LNG import terminal, have some level of security associated with their operations. The multi-tiered security systems that will be in place in the POLB LNG import terminal exceed the security measures in most of the referenced flammable fuel facilities.

Assuming $7.15 \times (10)^{-6}$ / year is the historical record of a successful terrorist event in a flammable fuel facility as a starting point, it can be argued that the probability of a successful event at the LNG terminal in the POLB is less since there are additional levels of security associated with the terminal that are not present in all the flammable fuels facilities in the data base.

QUEST

SECTION 4
CONSEQUENCE ANALYSIS

Significant portions of Section 4 describing the calculations made to determine the size and location of possible releases have been removed due to FERC CEII concerns.

4.1 Development of Release Sizes for Accidental Events

For each of the accidental and intentional releases described in Section 2, the final step in developing the information necessary to perform the consequence modeling is the definition of the events that result in a release of LNG, natural gas, or hydrocarbons from the separation plant.

4.1.1 Size of Release Area Following Accidental Failure of Process Equipment

Definitions of the release areas for accidental failures of process equipment are drawn from equipment reviews. For equipment failures, such as pipe ruptures, the highest initial release rate is defined by a full rupture of the associated piping.

4.1.2 Size of Release Area Following Failure of LNG Storage Tanks Due to an Earthquake

Full containment tanks are constructed to standards that preclude some types of failures that might occur in other tank designs. For example, if the inner tank is overfilled, the concrete outer tank will not fail. The concrete outer tank is designed to withstand specific earthquake loads as defined in 49 CFR 193 without loss of product.

As described in Section 3.2.1, an earthquake of a magnitude exceeding the design standards could conceivably cause a failure of the inner tank and outer concrete tank, resulting in a release of LNG. For the purposes of this study, which is to define worst case events, we will assume one or more large cracks develop in the concrete containment wall (as well as the inner tank) with a resultant release area sufficiently large to effect a rapid release of the tank's contents. A large hole in the tank is designed to be representative of an instantaneous catastrophic failure. A catastrophic tank failure scenario is defined as a credible but extremely unlikely event by TNO [TNO, 1999] and the POLB site-specific analysis [KBR, 2005)].

An earthquake of the magnitude necessary to fail a full containment tank would be capable of toppling the security wall surrounding the two LNG tanks. The toppled wall would eventually allow the LNG to overflow the base of the security wall.

4.1.3 Size of Release Area in LNG Tank Ship Following Collision with Breakwater

One possible consequence of an LNG tank ship colliding with the breakwater while entering the Port is a failure of one of the membrane cargo tanks. A second scenario that was evaluated is based on the assumption that the large rate of loss of LNG from one cargo tank compromises the integrity of the inner hull and, over time, leads to sequential releases from the remaining LNG cargo tanks. The failures in the subsequent tanks were assumed to be caused by cracking of portions of the inner hull, followed by tears in the membrane tanks. The initial tank failure was assumed to occur in the cargo tank nearest the bow of the ship (the point of collision with the breakwater). The failures progressed toward the stern of the ship. Each tank was assumed

to fail five minutes after the previous tank failure. Thus, for a membrane tank ship with five cargo tanks, this assumption results in all five tanks releasing cargo within 20 minutes of a collision with the breakwater.

4.1.4 Size of Release Area in LNG Tank Ship Following Collision with Another Ship

If an LNG tank ship were to be hit by another ship of sufficient size and speed such that LNG were to be released from one of the membrane tanks [Pitblado, et al., 2004], the sequence of events would be similar to those following a collision of an LNG tank ship with the breakwater.

A second scenario that was evaluated is based on the assumption that the rate of loss of LNG from one cargo tank compromised the integrity of the inner hull and, over time, led to sequential releases from the remaining LNG cargo tanks. The failures in the subsequent tanks were assumed to be caused by cracking of portions of the inner hull, followed by tears in the membrane tanks. The subsequent failures were assumed to occur in five minute intervals. For a membrane tank ship with five cargo tanks, this assumption results in all five tanks releasing cargo within 20 minutes of a collision with another ship.

A summary of the LNG storage tank and LNG tank ship accidental failures is presented in Table 4-1.

Table 4-1
Accidental Releases from LNG Storage Tanks and LNG Tank Ships

Release From
Release from LNG storage tanks following earthquake
Release from LNG tank ship following collision with the breakwater - 1 tank fails
Release from LNG tank ship following collision with the breakwater - 5 tanks fail
Release from LNG tank ship following collision (outside breakwater) with another ship of sufficient size and speed - 1 tank fails
Release from LNG tank ship following collision (outside breakwater) with another ship of sufficient size and speed - 5 tanks fail

4.2 Development of Release Sizes for Intentionally-Induced Events

4.2.1 Size of Release Area Following Intentionally-Induced Failures in Process Equipment

The mechanism defined as that used to cause an intentional failure among the process equipment in the LNG terminal is an explosive charge (e.g., satchel charge). Whether a process pipe or vessel ruptures due to an explosive device or an accidental failure, the release area is assumed to be the same – the area of a ruptured line attached to the vessel.

4.2.2 Size of Release Area Following Commercial Airplane Crash into LNG Storage Tank

Table 2-5 presented a sequence of events that could lead to an intentional crash of a commercial jet airplane into an LNG storage tank. Table 4-2 defines the sequence of events that could result in a release of LNG from the full containment storage tanks following the plane's impact.

Table 4-2
Terrorist-Hijacked Airplane Crashing Into One or Both LNG Tanks

Consequence	Notes
Jet engine hits tank wall at near perpendicular angle.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
Engine penetrates LNG storage tank concrete shell.	
Engine penetrates LNG storage tank insulation and inner nickel steel tank.	
LNG will be released from a hole in the inner (nickel steel) and outer (concrete) shell.	
Vapors evolving off LNG will immediately be ignited.	
LNG will spread over the area surrounding the LNG tanks.	
LNG will escape the area enclosed by the security wall.	
LNG flows over land and onto the water surface.	

4.2.3 Release From an LNG Storage Tank Following a Truck Bomb

Table 2-6 presented a sequence of events that could lead to an explosion of a truck bomb beside an LNG storage tank. Table 4-3 defines the sequence of events that could result in a release of LNG from a full containment storage tank following detonation of a truck bomb.

Table 4-3
Terrorist Detonates Truck Bomb Near an LNG Tank

Consequence	Notes
Explosives detonate, resulting in hole in LNG tank and surrounding security wall.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
LNG will be released from the storage tank.	
Vapors evolving off LNG will immediately be ignited.	
LNG will spread over the area surrounding the LNG tanks.	
LNG will escape the area enclosed by the security wall.	
LNG flows over land and onto the water surface.	

4.2.4 Release From an LNG Storage Tank Following the Impact of a Rocket-propelled Grenade

Table 2-7 presented a sequence of events that could lead to one of the LNG storage tanks being hit by an RPG. Table 4-4 defines the sequence of events that could result in a release of LNG from a full containment storage tank following the impact of an RPG.

Table 4-4
Terrorist Fires Rocket-propelled Grenade (RPG) Into One or Both LNG Tanks

Consequence	Notes
RPG hits tank at near perpendicular angle.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
RPG warhead penetrates storage tank.	
LNG will be released from a single hole.	

4.2.5 Release From LNG Tank Ship Following Crash of Commercial Airplane

Table 2-9 presented a sequence of events that could lead to an intentional crash of a commercial jet airplane into an LNG tank ship docked at the terminal. Table 4-5 defines the sequence of events that could result in a release of LNG from the LNG tank ship following the plane's impact.

Table 4-5
Terrorist-Hijacked Airplane Crashing Into an LNG Tank Ship

Consequence	Notes
Jet aircraft hits tank ship.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
Engine penetrates LNG tank ship outer and inner hulls.	
Engine penetrates LNG insulation and membrane cargo tank.	
LNG will be released from holes in two adjacent membrane cargo tanks.	
Vapors evolving off LNG will immediately be ignited.	
LNG flows out of the cargo tanks and onto the water surface.	

4.2.6 Release From an LNG Tank Ship Following a Boat Bomb

Table 2-10 presented a sequence of events that could lead to an explosion of a boat bomb beside an LNG tank ship docked at the terminal. Table 4-6 defines the sequence of events that could result in a release of LNG from the tank ship following detonation of a boat bomb.

Table 4-6
Terrorists Place Boat Bomb Beside an LNG Tank Ship

Consequence	Notes
Explosives detonate, resulting in hole in LNG tank ship outer hull, inner hull, insulation, and LNG membrane tank.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
LNG will be released from a membrane cargo tank.	
Vapors evolving off LNG will immediately be ignited.	
LNG will spread over the water surface beside the LNG tank ship.	

4.2.7 Release From an LNG Tank Ship Following the Impact of a Rocket-propelled Grenade

Table 2-11 presented a sequence of events that could lead to a LNG tank ship being hit by an RPG while docked at the terminal. Table 4-7 defines the sequence of events that could result in a release of LNG from an LNG tank ship following the impact of an RPG.

Table 4-7
Terrorist Fires Rocket-propelled Grenade (RPG) Into LNG Tank Ship

Consequence	Notes
RPG hits tank ship at near perpendicular angle and penetrates outer and inner hull.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
RPG warhead penetrates storage tank.	
LNG will be released from a single hole.	

4.2.8 Release From an LNG Tank Ship Following a Collision with Another Ship

Table 2-12 presented a sequence of events that could lead to an LNG tank ship being involved in an intentional collision with another ship. Table 4-8 defines the sequence of events that could result in a release of

LNG from an LNG tank ship following a collision with another ship. Note that the release from this event would be identical to that which would occur if the collision was accidental in nature.

Table 4-8
Terrorist-Controlled Ship Collides with an LNG Tank Ship

Consequence	Notes
Collision results in puncture of one LNG cargo tank.	All supporting calculations, documentation, and references in regard to calculating the size and location of potential release area(s) for this scenario have been removed due to FERC CEII concerns.
LNG flows out of one cargo tank and onto the water surface.	
Loss of LNG from one cargo tank leads to failures of other cargo tanks.	
LNG flows out of all cargo tanks and onto the water surface.	

4.2.9 Summary of Release Sizes Due to Intentional Events

A summary of the releases from LNG storage tanks and LNG tank ships due to intentional events is presented in Table 4-9

Table 4-9
Intentionally Caused Releases
from LNG Storage Tanks and LNG Tank Ships

Release From
Release from LNG storage tank after plane crash
Release from LNG storage tank after truck bomb
Release from LNG storage tank after RPG
Release from LNG tank ship after plane crash - 2 tanks fail
Release from LNG tank ship after plane crash - 5 tanks fail
Release from LNG tank ship after boat bomb - 1 tank fails
Release from LNG tank ship after boat bomb - 5 tanks fail
Release from LNG tank ship after RPG
Release from LNG tank ship afer collision with another ship - 1 tank fails
Release from LNG tank ship afer collision with another ship - 5 tanks fail

4.3 Consequence Analysis Models

Each selected release scenario was evaluated to determine the extent and location of a hazard, or hazards, associated with the release. When performing site-specific consequence analysis studies, the ability to accurately model the phenomena associated with a particular hazard is important if an accurate assessment of the potential exposure is to be attained. For this study, one or more models were used to quantify the hazard, or hazards, of each release. All models have built-in assumptions and limitations. The models used in this study are briefly described below, along with their restrictions for use.

4.3.1 FERC Model for LNG Spills onto Water

In the report titled *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers* [FERC, 2004], FERC presents a coupled set of models to determine the release and spread of LNG onto a water surface. The spreading LNG can be assumed to be ignited, or unignited, during the release. If ignited, a solid flame pool fire model defines the radiant impact zone. If unignited, the model produces a time-varying vaporization profile appropriate for input into the DEGADIS dispersion model. The FERC model was developed for use under the following conditions.

- Releases from LNG tank ships
- Releases from a single source of LNG
- Releases onto quiescent water
- Releases onto water without obstructions (e.g., docks, quays, or shoreline)

The model has limitations and cannot be used for the following;

- Releases onto any surface other than a large open body of water
- Releases from an elevation above water level
- Releases of pressurized LNG
- Releases onto rough or non-quiescent water
- Releases into bounded or obstructed areas (e.g., water surfaces bounded by docks)
- Releases of materials other than LNG

4.3.2 DEGADIS

The DEGADIS [GRI, 1990a] suite of models was developed to simulate the dispersion of denser-than-air vapor clouds. DEGADIS is cited in 49 CFR 193 as one of the models appropriate for use in evaluating the flammable cloud dispersion distances following a spill of LNG. It is appropriate to use the DEGADIS models for some, but not all, of the vapor dispersion calculations required in this work. There are two primary sub-models in the DEGADIS suite of models; one for clouds evolving from a liquid pool, and one for vertical momentum jets of vapor. The models were developed for use under the following conditions.

- Vapors evolving from a pool of LNG on water or land
- Vertical releases of gases (e.g., discharge from a relief valve)

The DEGADIS dispersion models have limitations and cannot be used to actually model the following;

- Releases of pressurized or superheated liquids
- Releases of pressurized gases at any angle other than vertical

The DEGADIS suite of models does not calculate a release rate, liquid spreading rate, or associated transient vaporization rate. This information must be supplied by one or more outside models.

4.3.3 LNGFIRE3

The LNGFIRE3 model developed by GRI [GRI, 1990b] is a pool fire model developed to predict the thermal radiation hazards present when the vapors emanating from a pool of LNG are ignited. The model is recommended for use in 49 CFR 193, and is capable of simulating circular and rectangular pools, as well as trenches carrying LNG. There is limited capability for modifying the properties of LNG used in the model. LNGFIRE3 was developed for the following specific conditions.

- Pool fires over fixed-sized pools of LNG
- Pool fires on land

LNGFIRE3 cannot be used for the following;

- LNG pool fires on water
- Pool fires for materials other than LNG
- Jet/torch fires

In addition, LNGFIRE3 does not calculate the spreading or size of an unconfined LNG pool. This information must be supplied to the model.

4.3.4 CANARY by Quest

CANARY by Quest contains a set of complex models that calculate multicomponent thermodynamic properties, release rates and phases, initial dilution of the vapor (dependent upon the release characteristics), and the subsequent dispersion of the vapor introduced into the atmosphere. The models contain algorithms that account for thermodynamics, mixture behavior, transient release rates, gas cloud density relative to air, initial velocity of the released gas, and heat transfer effects from the surrounding atmosphere and the substrate.

CANARY also contains models for pool fire and torch fire radiation. These models account for impoundment configuration, material composition, target height relative to the flame, target distance from the flame, atmospheric attenuation (includes humidity), wind speed, and atmospheric temperature.

For vapor cloud overpressure calculations, CANARY employs the Baker-Strehlow method. It accounts for the reactivity of the fuel in the vapor cloud, the size of the flammable vapor cloud, and the degree to which the vapor cloud is obstructed or confined. The model is based on experimental and historical observations of vapor cloud explosions and deflagrations, with relation to the amount of confinement and obstruction present in the volume occupied by the vapor cloud.

All of the hazard models in CANARY are based on information in the public domain (published literature) and have been validated with experimental data. Technical descriptions of the CANARY models used in this study are presented in Appendix B.

4.3.5 Application of Consequence Models

All accidental and intentional releases were evaluated with one or more of the models listed above. In rare instances, when no model was capable of evaluating a phenomenon (e.g., sequential leakage from multiple tanks), additional calculations were made. In other instances, a model was modified slightly in order to accept an input it could handle, but was not designed for. An example of this was the modification of the FERC model to accept a time-varying, non-monotonically-decreasing mass release rate. This modification was necessary in order to use the FERC spreading model for the multi-tank LNG ship failure scenarios.

A list of the release scenarios identified in this analysis is given in Table 4-10. For each release identified, several potential hazardous outcomes might be possible. The models employed for each calculation are identified in Table 4-10.

4.4 Release Rate Calculations

The FERC and CANARY models have the ability to calculate the transient rate of release of a fluid. The FERC model is limited in that it can only be used for LNG releases from static atmospheric pressure tanks. Thus, the FERC model cannot be used for any of the process area releases since they are non-static systems and are under pressure. As shown in Table 4-10, the FERC model (or a slight variation thereof) was used only for LNG releases from the tank ships.

Table 4-10
Consequence Models Used in Analysis
Facility = LNG Import Terminal at Port of Long Beach, California

Cause of Release (A) = Accidental (I) = Intentional	Thermo-dynamics	Release Rate	Liquid Spreading and Vaporization	Vapor Dispersion From a Pool	Vapor Dispersion From a Jet	Vapor Cloud Explosion	Pool Fire	Torch Fire
(A) (I) Rupture of process equipment - location A *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) (I) Rupture of process equipment - location B *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) (I) Rupture of process equipment - location C *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) (I) Rupture of process equipment - location D *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) (I) Rupture of process equipment - location E *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) (I) Release from process equipment - location F *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) (I) Release from process equipment - location G *	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(A) Release from LNG storage tanks following earthquake	CANARY	CANARY	CANARY FERC(1)	DEGADIS		CANARY	LNGFIRE3 FERC(1)	
(A) (I) Release from LNG tank ship following collision (outside breakwater) - 1 tank fails		FERC	FERC	DEGADIS			FERC	

FERC(1) = FERC model modified to accept external transient release rate data
FERC(2) = FERC model modified to combine transient outflow from multiple sources
* = Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC

Table 4-10
Consequence Models Used in Analysis
Facility = LNG Import Terminal at Port of Long Beach, California
(Continued)

Cause of Release (A) = Accidental (I) = Intentional		Thermo-dynamics	Release Rate	Liquid Spreading and Vaporization	Vapor Dispersion From a Pool	Vapor Dispersion From a Jet	Vapor Cloud Explosion	Pool Fire	Torch Fire
(A) (I)	Release from LNG tank ship following collision (outside breakwater) - 5 tanks fail	CANARY	FERC(2)	FERC(1)	DEGADIS		CANARY	FERC(1)	
(I)	Release from LNG storage tank after plane crash	CANARY	CANARY	CANARY FERC(1)				LNGFIRE3 FERC(1)	
(I)	Release from LNG storage tank after truck bomb	CANARY	CANARY	CANARY FERC(1)				LNGFIRE3 FERC(1)	
(I)	Release from LNG storage tank after RPG	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY	CANARY
(I)	Release from LNG tank ship after plane crash - 2 tanks fail		FERC(2)	FERC(1)				FERC(1)	
(I)	Release from LNG tank ship after plane crash - 5 tanks fail		FERC(2)	FERC(1)				FERC(1)	
(I)	Release from LNG tank ship after boat bomb - 1 tank fails		FERC	FERC				FERC(1)	
(I)	Release from LNG tank ship after boat bomb - 5 tanks fail		FERC(2)	FERC(1)				FERC(1)	
(I)	Release from LNG tank ship after RPG	CANARY	FERC	FERC	CANARY	CANARY	CANARY	CANARY	CANARY

FERC(1) = FERC model modified to accept external transient release rate data
FERC(2) = FERC model modified to combine transient outflow from multiple sources

4.4.1 Release Rate Calculations for Process Equipment Releases

An example of the transient release rate from output provided by the CANARY model is presented in Figure 4-1. The release is caused by the rupture of process equipment F. As can be seen in Figure 4-1, the fluid (released under 580 psig pressure) forms an aerosol composed of vapor and suspended liquid droplets. Virtually none of the liquid reaches the ground. The mass rate of release decays until the inventory is exhausted (about 30 seconds). This aerosol flow rate is input to the torch fire radiation model or the momentum jet dispersion model, dependent on the hazard being evaluated.

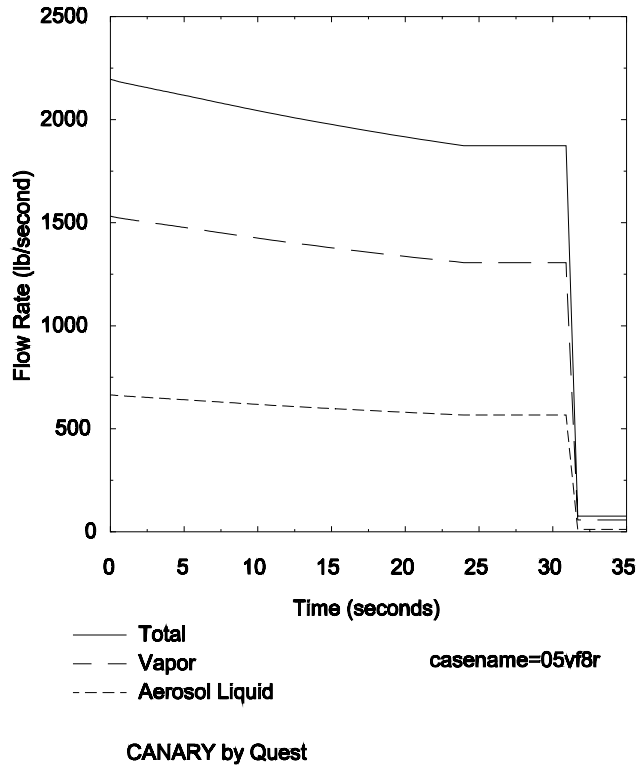


Figure 4-1
Release Rate from Process Equipment F

Calculations for all the process equipment failures (accidental or intentional) were made in a similar manner using the CANARY model.

4.4.2 Release Rate Calculations for Storage Tank Failures Due to an Earthquake

The maximum inventory in the LNG storage tanks would occur just after an LNG tank ship finishes unloading its cargo. This is represented by one full (160,000 m^3) tank and one half-full tank. (One tank is assumed to be only half full since LNG would be withdrawn from this tank while the other tank is being filled.) The release rate calculations were performed with CANARY. The release rate from the full tank is presented in Figure 4-2 and the release rate from the half-full tank is presented in Figure 4-3.

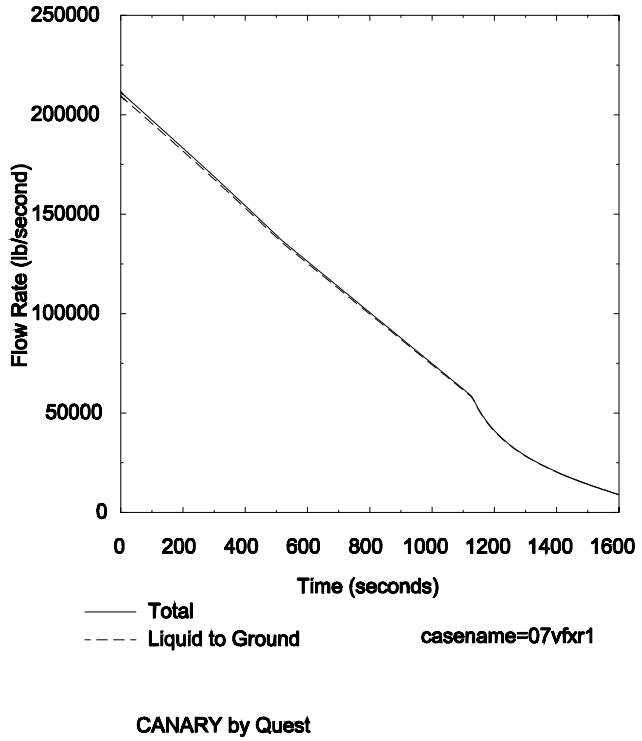


Figure 4-2
Release Rate from Failure of Full LNG Storage Tank Following an Earthquake

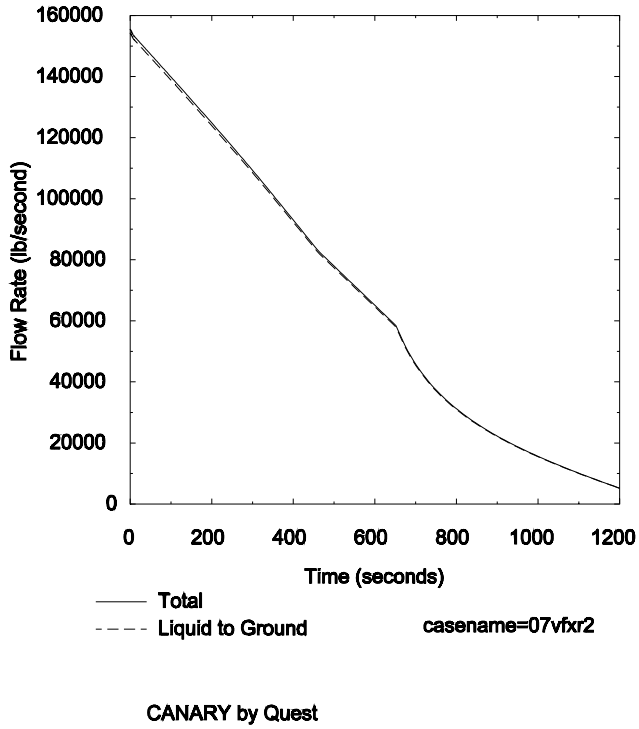


Figure 4-3
Release Rate from Failure of a Half-Full LNG Storage Tank Following an Earthquake

4.4.3 Release Rate Calculations from an LNG Tank Ship Following Collision with the Breakwater

As described in Section 4.1.3, a collision of an inbound LNG tank ship with the breakwater could release LNG from one membrane tank or result in the sequential failure of all five membrane tanks. The release rate results for the single tank failure were made with the FERC model and are presented in Figure 4-4. The FERC model was modified to accept multiple release sources, such as that required for the sequential tank failure scenario. The release rate results for the sequential tank failure scenario are also presented in Figure 4-4.

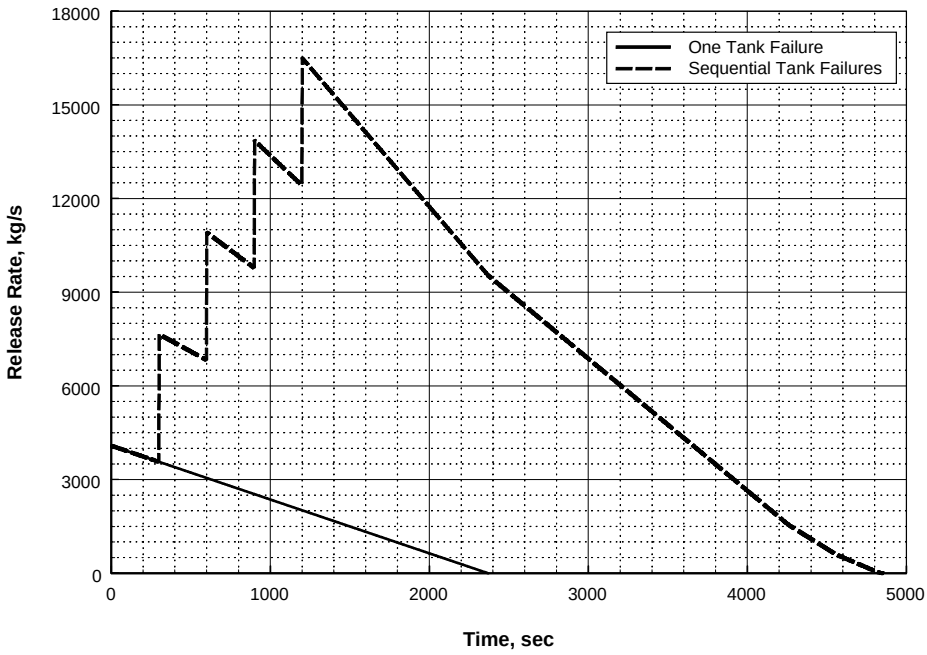


Figure 4-4
Release Rate from Failure of One Membrane Tank
and from Sequential Failure of Five Membrane Tanks
on an LNG Tank Ship Following Collision with the Breakwater

4.4.4 Release Rates Summary

These three scenarios (pressurized process area release, LNG storage tank release, and LNG tank ship release) cover the range of fluid releases from aerosol jets (no liquid to the ground), to single point (one tank) failures, to sequential failures of multiple tanks. The three accidental scenarios presented were run under non-fire conditions. This condition maximizes the LNG liquid pool diameter (when applicable).

These three scenarios represent the range of release rate calculations made for both the accidental and intentional releases.

4.5 Liquid Spreading and Vaporization Calculations

4.5.1 Liquid Spreading Calculations for Process Equipment Releases

Many of the process area releases result in high velocity, flashing fluid aerosol jets that produce very little liquid on the ground. In these cases, the inputs to the fire radiation and vapor dispersion models are dominated by the momentum jet. An example of this was provided in Section 4.4.1 for the release from process equipment F.

4.5.2 Liquid Spreading Calculations for Storage Tank Failures Due to an Earthquake

For the cases where LNG is released onto the ground inside the security fence surrounding the LNG storage tanks, the CANARY model calculates the spreading and vaporization of the liquid on land. As an example, for the case where an earthquake causes the storage tanks to fail, the vaporization history of the LNG spilled on the land surface is presented in Figure 4-5.

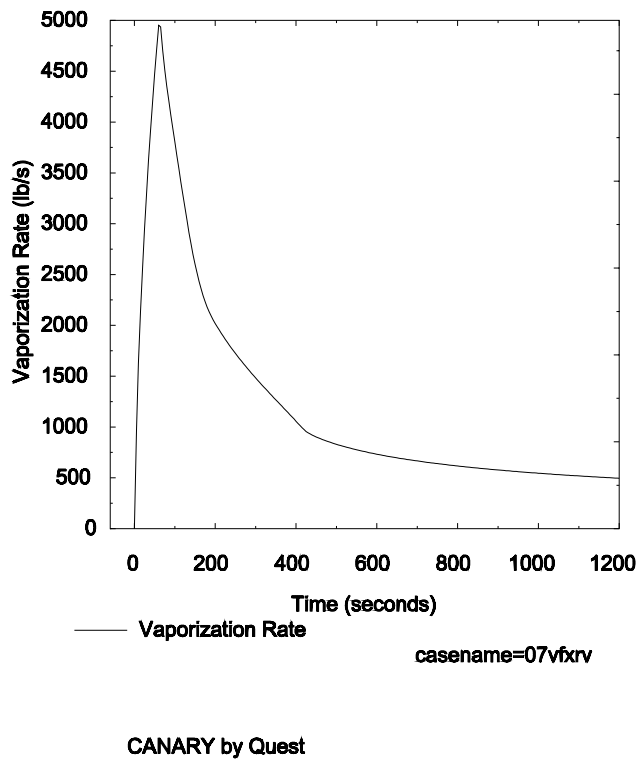


Figure 4-5
LNG Vaporization Rate for Land-Based Pool
Following Tank Failure Due to an Earthquake

In the earthquake case, the bulk of the LNG released from the storage tanks ends up flowing through the collapsed security wall and out onto the water surrounding the facility. Modifying the FERC spreading and vaporization program to accept the LNG outflow released from the two storage tanks and overflowing the security wall and onto the surrounding water results in the transient vaporization profile presented in Figure 4-6. The FERC model predicts the maximum radius of the semicircle formed by the LNG on water to be 2,700 feet (non-burning case).

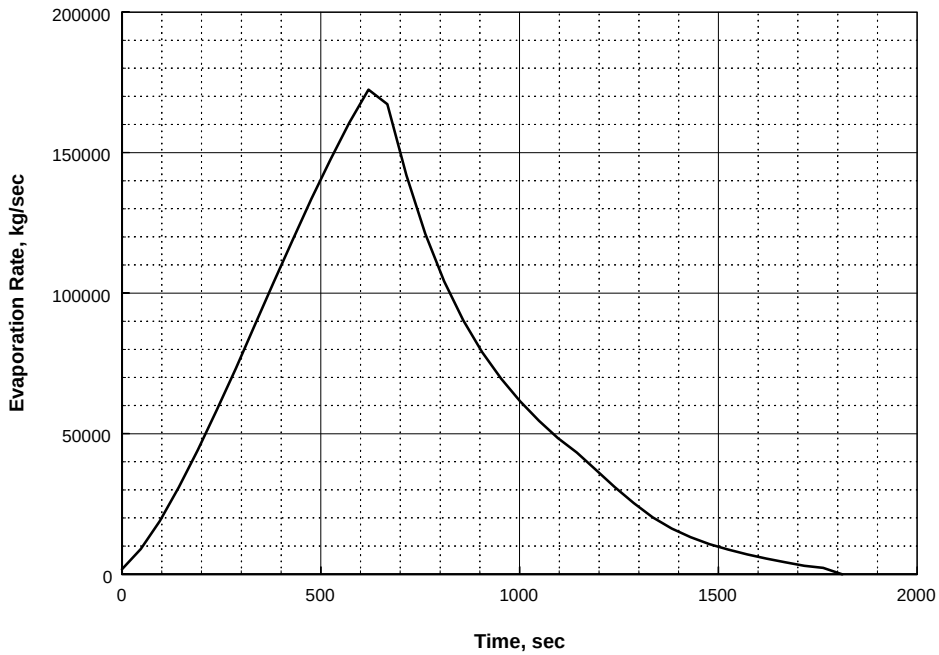


Figure 4-6
Vaporization Rate History from LNG Reaching Water Surface Following Failure of LNG Storage Tanks After an Earthquake (Modified FERC Model - Non-Burning Case)

4.5.3 Liquid Spreading Calculations from LNG Tank Ship Following Collision with the Breakwater

As described in Section 4.1.3, the collision of an inbound LNG tank ship with the breakwater could release LNG from one membrane tank or result in the sequential failure of all five membrane tanks. The FERC model was modified to accept multiple release sources so it could be used to model the sequential tank failure scenario. The transient vaporization results for both the single tank failure and sequential tank failure scenarios are presented in Figure 4-7. These spreading results are for the case where the LNG pool is not on fire. The maximum radius of the FERC-defined semicircle is 450 ft for the single tank failure and 820 ft for the multiple tank failure.

Similar release rate, pool spreading, and vaporization history calculations were made for all accidental and intentional release cases listed in Tables 4-2 through 4-8. Table 4-10 identifies the model used (CANARY, FERC, or modified FERC) for each calculation.

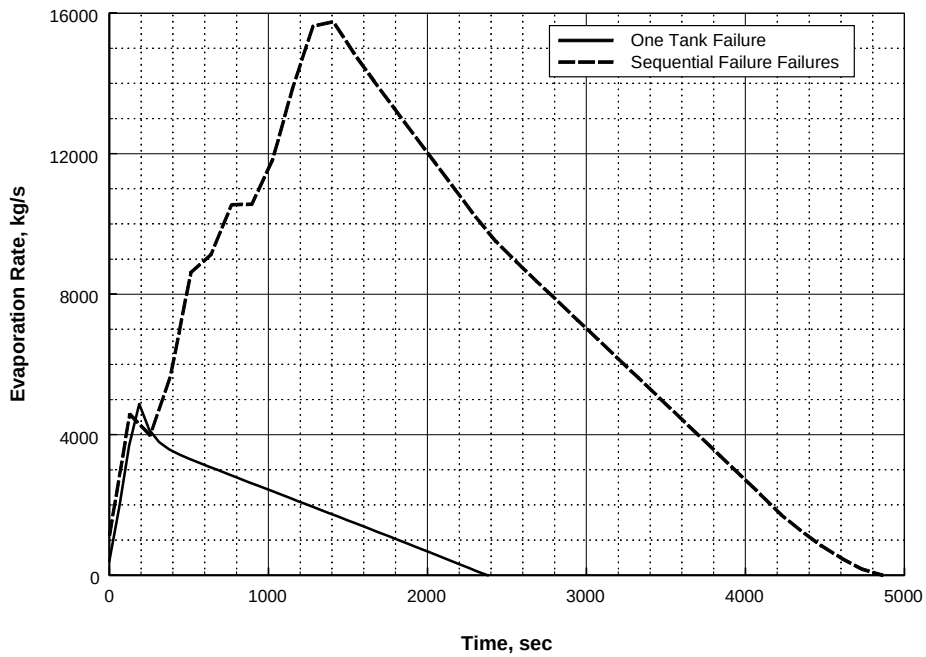


Figure 4-7
Vaporization Rate History from Failure of One Full Membrane Tank and from Sequential Failure of Five Full Membrane Tanks on an LNG Storage Tank Ship Following Collision with the Breakwater
(Modified FERC Model - Non-Burning Case)

4.6 Fire Radiation Calculations

In each accidental and intentional release identified, there is a possibility that the vapor released (either directly, such as a natural gas release, or indirectly, such as vapors evolving off a liquid pool) will be ignited. The ignition source may be accidental in nature or intentional (as in the case of explosive devices). The resultant fire may be in the form of jet fire, pool fire, or both, dependent on the nature of the release.

4.6.1 Hazard Footprints and Vulnerability Zones

When conducting consequence analysis calculations, it may be necessary to determine the impact of each possible combination of:

- hole size,
- release orientation,
- release outcome,
- atmospheric stability,
- wind speed, and
- wind direction

for each potential release included in the study. For each potential release, each unique combination of these factors results in a "unique accident." In this study, the focus is on determining the worst-case impacts. Thus, the hole size, release orientation, wind speed, and atmospheric stability have been defined. What is not known is the wind direction. Depending on which way the wind is blowing, a different area around the release point (or the point defined as the center of the hazard) may be exposed to a hazardous condition. It is important to distinguish between the largest area potentially exposed to a radiant impact from a single accident and the total area that could be exposed to any possible radiant impact from a single accident.

A hazard footprint can be defined as the area over which a given unique accident is capable of producing some level of undesirable consequences (e.g., radiant flux of at least 1,600 Btu/(hr•ft^2)). A vulnerability zone is defined as the area within the circle created by rotating a hazard footprint around its point of origin. Any point within that circle could, under some set of circumstances, be exposed to a hazard level that equals or exceeds the endpoint used to define the hazard footprint. However, except for accidents that produce circular hazard zones (e.g., Boiling Liquid Expanding Vapor Explosions (BLEVEs)), only a portion of the area within the vulnerability zone can be affected by a unique accident. This is illustrated in Figure 4-8 by the 1,600 Btu/(hr•ft^2) radiant flux footprint generated by immediate ignition of the flashing fluid release from process equipment F. The hazard footprint (cross-hatched area) and its vulnerability zone (the circle) are both presented.

Vulnerability zones can be used to define the size and shape of the area around a release within which there is a finite probability of exposure to the defined hazard level. Persons located outside this area would not be at risk to the hazard level defined. Thus, for the process equipment F, persons outside the vulnerability zone presented in Figure 4-8 would not be affected by a 1,600 Btu/(hr•ft^2) radiant hazard under any condition.

The 1,600 Btu/(hr•ft^2) vulnerability zone presented in Figure 4-8 for the process equipment F fire scenario was generated with the CANARY software. The generation of a hazard footprint requires three-dimensional radiant flux maps be calculated. The LNGFIRE3 and FERC fire models do not calculate the radiant flux data to this level of detail. Thus, when the LNGFIRE3 and FERC radiation models are used, only the vulnerability zone (a circle) can be calculated. Used incorrectly, this information can lead to an overestimation of the possible radiant impact of a fire.

4.6.2 Fire Radiation Calculations for Storage Tank Failures Due to an Earthquake

As described in Section 4.1.2, an earthquake of a magnitude sufficient to cause a failure of one or both of the LNG storage tanks would also cause the failure of the security wall. With the failure of the security wall, there is the potential to have a pool of LNG on shore, generally confined by the remnants of the security wall, and as an expanding pool on the water surface. It is almost certain that an earthquake of the magnitude necessary to fail one or both LNG storage tanks would also create multiple ignition sources in the immediate area, thus igniting the natural gas/air mixture formed during the release.

In order to model this scenario, two individual calculations were run. The first employed LNGFIRE3 to calculate the 1,600 Btu/(hr•ft^2) radiant impact zone due to the land-based pool fire. The second employed the FERC model to calculate the water-based pool fire. The 1,600 Btu/(hr•ft^2) vulnerability zone from the LNGFIRE3 model is presented in Figure 4-9 (the smaller circle). The 1,600 Btu/(hr•ft^2) vulnerability zone from the FERC model is also presented in Figure 4-9 (the larger circle).

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-19
Figure 4-8

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-20
Figure 4-9

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

A comparison of the two vulnerability zones shows that the water-based fire clearly defines the size of the vulnerability zone. Even if the wind is blowing from the east-southeast (from the water toward the storage tank area) the extent of the vulnerability zone created by the water-based pool fire dominates the result and serves to define the 1,600 Btu/(hr•ft^2) vulnerability zone for this scenario.

4.6.3 Fire Radiation Calculations for an LNG Tank Ship Collision with the Breakwater

The water-based pool fire calculations for the scenarios in which the LNG tank ship collides with the breakwater were made with the FERC model. The scenario that involves one tank failure is directly modeled with the FERC pool fire model. The 1,600 Btu/(hr•ft^2) vulnerability zone calculated by the FERC model is presented in Figure 4-10. The sequential tank failure scenario requires modification of the FERC model to accept a transient, non-monotonically-decreasing liquid outflow. With this modification, the FERC model calculates the 1,600 Btu/(hr•ft^2) vulnerability zone for the five tank sequential failure and is presented in Figure 4-11.

Although immediate ignition of the evolving natural gas vapors from the spilled LNG is less likely in this scenario than in the LNG storage tank failures due to an earthquake, the ignition of the spill results in the worst case pool fire impacts.

4.6.4 Summary of Fire Radiation Calculations

Fire radiation calculations were made using the models defined in Table 4-10 for each accidental and intentional release scenario. Maximum distances to the 1,600 Btu/(hr•ft^2) radiant hazard endpoint are presented in Table 4-11. Since several of the potential releases involve LNG pools that may move away from the release point before they are ignited, or while they are ignited, the center of each fire is also identified in Table 4-11. When defining the extent of the 1,600 Btu/(hr•ft^2) vulnerability zone for each release, the center of the fire should be used as the reference point.

Plots of the 1,600 Btu/(hr•ft^2) vulnerability zones for several of the scenarios are presented in Figures 4-12 through 4-17. These plots are listed in Table 4-11.

4.7 Flammable Vapor Cloud Dispersion Calculations

The ability of a release of LNG, natural gas, or other hydrocarbons to develop into a drifting cloud is dependent on the mechanism that caused the release. When analyzing the possible progression of events following accidental failures (see Section 3.1.1), there are often four possible outcomes.

- Immediate ignition followed by a fire (pool or torch)
- Delayed ignition producing a flash fire (and possible pool or torch fire)
- Delayed ignition producing a flash fire and some amount of overpressure
- No ignition; dissipation of hydrocarbon vapors below flammable limits

As described in Section 3, the probability of each outcome is dependent on a number of factors. In many cases, the probability of immediate ignition of an accidental release is not 100%. Thus, there is a possibility of the formation of a drifting cloud of flammable gas followed by the eventual ignition of the cloud that creates a flash fire. In some instances, the flash fire may lead to overpressures above some minimal level.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-22
Figure 4-10

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-23
Figure 4-11

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Table 4-11
Consequence Analysis Results
Facility = LNG Import Terminal at Port of Long Beach, California

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to 1,600 Btu/(hr ft^2) Radiant Flux Level	Measured From	Figure	Distance (ft) to 1 psig Overpressure	Distance (ft) to LFL
(A) (I)	Rupture of process equipment - location A*	280	Release Point	—	NA	1,705
(A) (I)	Rupture of process equipment - location B*	270	Release Point	—	320	585
(A) (I)	Rupture of process equipment - location C*	530	Release Point	—	190	995
(A) (I)	Rupture of process equipment - location D*	240	Release Point	—	190	545
(A) (I)	Rupture of process equipment - location E*	490	Release Point	—	NA	400
(A) (I)	Release from process equipment - location F*	830	Release Point	Figure 4-8	320	990
(A) (I)	Release from process equipment - location G*	360	Release Point	—	320	700
(A)	Release from LNG storage tanks following earthquake	8,610	Center of LNG Pool on Water	Figure 4-9	NA	36,400
(A)	Release from LNG tank ship following collision with breakwater - 1 tank fails	2,200	Center of LNG Pool by Tank Ship	Figure 4-10	NA	9,260
(A)	Release from LNG tank ship following collision with breakwater - 5 tanks fail	3,345	Center of LNG Pool by Tank Ship	Figure 4-11	NA	19,330

NA = Explosion overpressure level not achieved
DNA = Does not apply – vapor cloud formation is not possible following initiating event
* = Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC

Table 4-11
Consequence Analysis Results
Facility = LNG Import Terminal at Port of Long Beach, California
(Continued)

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to 1,600 Btu/(hr ft^2) Radiant Flux Level	Measured From	Figure	Distance (ft) to 1 psig Overpressure	Distance (ft) to LFL
(A) (I)	Release from LNG tank ship following collision (outside breakwater) - 1 tank fails	2,980	Center of LNG Pool on Water	—	NA	16,510
(A) (I)	Release from LNG tank ship following collision (outside breakwater) - 5 tanks fail	3,370	Center of LNG Pool on Water	—	NA	21,200
(I)	Release from LNG storage tank after plane crash	2,835	Center of LNG Pool on Water	Figure 4-12	DNA	DNA
(I)	Release from LNG storage tank after truck bomb	7,020	Center of LNG Pool on Water	Figure 4-13	DNA	DNA
(I)	Release from LNG storage tank after RPG	230	LNG Pool by Tank	—	NA	130
(I)	Release from LNG tank ship after plane crash - 2 tanks fail	3,635	Center of LNG Pool by Tank Ship	Figure 4-14	DNA	DNA
(I)	Release from LNG tank ship after plane crash - 5 tanks fail	3,635	Center of LNG Pool by Tank Ship	Figure 4-15	DNA	DNA
(I)	Release from LNG tank ship after boat bomb - 1 tank fails	3,115	Center of LNG Pool by Tank Ship	Figure 4-16	DNA	DNA
(I)	Release from LNG tank ship after boat bomb - 5 tanks fail	3,320	Center of LNG Pool by Tank Ship	Figure 4-17	DNA	DNA
(I)	Release from LNG tank ship after RPG	115	Center of LNG Pool by Tank Ship	—		460

NA = Explosion overpressure level not achieved
DNA = Does not apply – vapor cloud formation is not possible following initiating event

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-26
Figure 4-12

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-27
Figure 4-13

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-28
Figure 4-14

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-29
Figure 4-15

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-30
Figure 4-16

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-31
Figure 4-17

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

When considering intentional releases, the device that is used to effect the release of LNG, natural gas, or other hydrocarbons often involves an explosive or is itself a significant ignition source. In many of these cases, there is no opportunity for an evolving vapor/air flammable mixture to avoid the immediate and sustained ignition source. Thus, these releases will follow the immediate ignition path and result in a pool fire, torch fire, or both.

Table 4-12 presents a summary of the accidental and intentional events that have the potential to develop a flammable cloud following a release of LNG, natural gas, or other hydrocarbons. These cases require dispersion calculations to determine the maximum extent of a drifting flammable cloud under worst case conditions.

Table 4-12
Ability of Release Events to Allow Vapor Cloud Development

Release	Development of Flammable Cloud Following Accidental Release?	Development of Flammable Cloud Following Intentional Release?
Rupture of process equipment - location A*	Yes	No
Rupture of process equipment - location B*	Yes	No
Rupture of process equipment - location C*	Yes	No
Rupture of process equipment - location D*	Yes	No
Rupture of process equipment - location E*	Yes	No
Release from process equipment - location F*	Yes	No
Release from process equipment - location G*	Yes	No
Release from LNG storage tanks following earthquake	Yes	NA
Release from LNG tank ship following collision with the breakwater - 1 tank fails	Yes	Yes
Release from LNG tank ship following collision with the breakwater - 5 tanks fails	Yes	Yes
Release from LNG tank ship following collision (outside breakwater) with another ship of sufficient size and speed - 1 tank fails	Yes	Yes
Release from LNG tank ship following collision (outside breakwater) with another ship of sufficient size and speed - 5 tanks fail	Yes	Yes
Release from LNG storage tank after plane crash	NA	No
Release from LNG storage tank after truck bomb	NA	No

* Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC

NA - Not Applicable

Table 4-12
Ability of Release Events to Allow Vapor Cloud Development
(Continued)

Release	Development of Flammable Cloud Following Accidental Release?	Development of Flammable Cloud Following Intentional Release?
Release from LNG storage tank after RPG	NA	Yes
Release from LNG tank ship after plane crash - 2 tanks fail	NA	No
Release from LNG tank ship after plane crash - 5 tanks fail	NA	No
Release from LNG tank ship after RPG	NA	Yes

NA - Not Applicable

4.7.1 Flammable Vapor Cloud Dispersion Calculations for Process Equipment Releases

The release caused by an accidental rupture of the process equipment F could result from an equipment failure that did not result in immediate ignition. If the failure had been intentionally caused by an explosive device (e.g., satchel charge), the release would be ignited and a torch fire would result.

The fluid from the process equipment F would be released under pressure and forms an aerosol composed of vapor and suspended liquid droplets. As described in Section 4.4.1, virtually none of the liquid reaches the ground. The aerosol flow rate is input to the momentum jet dispersion model contained in the CANARY software since DEGADIS cannot model this release.

The hazard footprint and vulnerability zone for the flammable vapor cloud following the accidental release from the process equipment F are presented in Figure 4-18.

Flammable cloud dispersion calculations for all process equipment releases listed in Table 4-11 were made using the CANARY software.

4.7.2 Flammable Vapor Cloud Dispersion Calculations for Storage Tank Failures Due to an Earthquake

It is extremely unlikely that an earthquake of the magnitude necessary to cause the failure of both LNG tanks would not create multiple immediate ignition sources for the ignition of any of the flammable vapors released in the terminal. If immediate ignition does not occur, it is not possible to know how far the cloud would drift before being ignited.

In the extreme case where all worst case conditions are combined;

low wind speed (2 m/s),
stable atmosphere (Pasquill-Gifford F), and
no immediate ignition sources,

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 4-34
Figure 4-18

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

the flammable cloud only has one choice – it must drift over the open water in order to achieve it's maximum extent. Any travel inland would result in shorter travel distances due to ignition sources created by the earthquake event.

The vapor generation rate history calculated in Section 4.5.2 is used as input to the DEGADIS model. The DEGADIS model calculates the maximum flammable cloud travel distance over water to be 36,400 ft (6.9 miles). The cloud would require a little over three hours to travel this distance.

There are no credible arguments that would allow for a flammable cloud of this size to exist in the immediate neighborhood of multiple ignition sources caused by such a massive earthquake. However, in the context of this worst-case analysis study, the flammable vapor cloud travel defined by this case – over water without any portion of the cloud traveling inland – may be defined as possible but it certainly is not credible.

4.7.3 Flammable Vapor Dispersion Calculations from LNG Tank Ship Following Collision with the Breakwater

The evolution of a flammable cloud without ignition following a release from an LNG cargo tank following collision with the breakwater is a far more credible scenario than the generation of a large flammable cloud following an earthquake near the terminal. The generation of flammable vapor over the open water, with immediate ignition sources limited to the LNG tank ship itself, results in a scenario where the cloud might drift some distance before encountering an ignition source.

The vapor generation histories for the single LNG cargo tank and sequential LNG cargo tank failures described in Section 4.5.3 were input to the DEGADIS program. Under the worst case conditions defined for this work, the following flammable cloud travel distances and times (over water) were calculated.

LNG Tank Ship Collision with Breakwater Scenarios	Maximum Distance to Lower Flammable Limit	Cloud Travel Time (minutes) to Maximum Travel Distance
One tank failure	9,260 ft (1.75 miles)	45
Sequential failure of five tanks	19,330 ft (3.66 miles)	90

Flammable vapor cloud dispersion calculations were made for the cases identified in Table 4-11 under worst case atmospheric conditions. The flammable cloud travel distances achieved by the larger releases should be viewed with caution due to the number of factors that would prevent the development of such large clouds. Therefore, it would be incorrect to develop flammable vapor cloud vulnerability zones (circles) for the following releases:

- Earthquake caused failures of one or both LNG storage tanks
- Collision of LNG tank ship with breakwater (one or all cargo tanks fail)
- Collision of LNG tank ship with another ship near the harbor entrance (one or all cargo tanks fail)

The generation of vulnerability zones for these releases, as they pertain to the onshore or inland travel of a flammable vapor cloud, is defined by the site-specific characteristics of existing ignition sources, or those created due the initial failure mechanism. The evaluation of such an ignition source map and the construction of ignition probabilities as a function of cloud size and travel time is beyond the scope of this work. However, under no circumstances should the maximum cloud travel distances presented in Table 4-11 be applied as the inland or onshore travel distances of the eight scenarios listed above.

4.8 Vapor Cloud Explosion Overpressure Calculations

In an industrial environment such as the POLB, common ignition sources would be motor vehicles, diesel generators, electric switch boxes, arc welders, fired heaters, electric motors, or any electrical equipment not classified for use in a flammable environment. In situations when the drifting flammable cloud encounters an ignition source and begins to burn back, or flash back, towards the source of the release, overpressure will be generated by the burning process. In this analysis, the Baker-Strehlow model was used to calculate the magnitude of the overpressure . This model is based on the premise that the strength of the blast wave generated by a vapor cloud explosion (VCE) is dependent on the reactivity of the flammable gas involved; the presence (or absence) of structures such as walls that partially confine the vapor cloud; and the spatial density of obstructions within the flammable cloud [Baker, et al., 1994; 1998]. This model reflects the results of several international research programs on vapor cloud explosions, which show that the strength of the blast wave generated by a VCE increases as the degree of confinement and/or obstruction of the cloud increases. The following quotations are directly applicable to natural gas releases and natural gas vapors evolving from pools of LNG.

> *"On the evidence of the trials performed at Maplin Sands, the deflagration [explosion] of truly unconfined flat clouds of natural gas or propane does not constitute a blast hazard."* [Hirst and Eyre, 1982] (Tests conducted by Shell Research Ltd., in the United Kingdom.)

> *"Both in two- and three-dimensional geometries, a continuous accelerating flame was observed in the presence of repeated obstacles. A positive feedback mechanism between the flame front and a disturbed flow field generated by the flame is responsible for this. The disturbances in the flow field mainly concern flow velocity gradients. Without repeated obstacles, the flame front velocities reached are low both in two-dimensional and three-dimensional geometry."* [van Wingerdan and Zeeuwen, 1983] (Tests conducted by TNO in the Netherlands.)

> *"The current understanding of vapor cloud explosions involving natural gas is that combustion only of that part of the cloud which engulfs a severely congested region, formed by repeated obstacles, will contribute to the generation of pressure."* [Johnson, Sutton, and Wickens, 1991] (Tests conducted by British Gas in the United Kingdom.)

Researchers who have studied case histories of accidental vapor cloud explosions have reached similar conclusions.

> *"It is a necessary condition that obstacles or other forms of semi-confinement are present within the explosive region at the moment of ignition in order to generate an explosion."* [Wiekema, 1984]

> *"A common feature of vapor cloud explosions is that they have all involved ignition of vapor clouds, at least part of which, have engulfed regions of repeated obstacles."* [Harris and Wickens, 1989]

A review of the release scenarios that have the potential to develop drifting flammable vapor clouds finds that accidental releases in the process area of the terminal have the potential to be located in amongst the process piping and equipment and are afforded some degree of obstruction. The Baker-Strehlow model contained in CANARY was used to calculate the distances to the 1 psig overpressure level.

The ability of the larger flammable vapor clouds to reach a confined or congested area without ignition is governed by the same obstacles as presented in Section 4.7. If the leading edge of a large flammable cloud were to encounter a congested area, fill it with flammable vapor, and then find an ignition source inside or outside the congested area, the overpressure generated would be a function of the volume of the congested area. Flammable vapors outside the congested area would not significantly contribute to the overpressure generated.

Without the site-specific knowledge of each and every possible congested or obstructed area along the shoreline that could be reached by a drifting vapor cloud, it is impossible to calculate site-specific effects. However, the Baker-Strehlow model does provide information on the maximum overpressure levels that could be achieved by natural gas explosions under a variety of conditions.

For flammable natural gas mixtures in outdoor residential or commercial areas that have some degree of obstruction (e.g., parked cars) the maximum overpressure generated in the cloud would be approximately 1.09 psig. This would be the localized overpressure and cannot be applied to the body of the flammable cloud as the overpressure level will drop exponentially with distance from the obstructed area.

Using this information as a guide, the footprint of any overpressure map onto the shoreline near the LNG terminal will extend no further than the existing or created ignition sources. The exact mapping of such is beyond the scope of this work.

QUEST

SECTION 5
POTENTIAL IMPACTS TO NEIGHBORING FACILITIES

5.1 Neighboring Facilities

The proposed LNG import terminal is located on the west side and south end of Pier T in the Port of Long Beach. One task defined for this work was to calculate the potential impacts to neighboring industrial facilities, both current and proposed. These impacts were to be calculated for the worst-case events, both accidental and intentional, identified in Section 2.

Two facilities of particular interest are the existing oil berth at T-121 and the proposed oil berth at T-124. These two facilities are identified on Figure 5-1.

5.2 Impact Levels on Industrial Equipment

The potential impact on people from exposure to radiant flux levels from a fire, as well as overpressure levels following the ignition of a flammable cloud, were quantified in Section 4. Evaluating the impact of radiant and overpressure hazards on industrial equipment located near the LNG terminal requires the use of a different set of hazard endpoints (i.e., radiant flux and explosion overpressure levels) than those used to determine impacts on people.

5.2.1 Vulnerability of Structures and Plant Equipment to Radiant Energy

Structures composed of noncombustible materials (e.g., metal storage tanks) can be weakened, resulting in damage or complete destruction, if the radiant heat flux is high enough and persists long enough to heat the structure to its damage point.

Part 193 of Title 49 of the Code of Federal Regulations (commonly referred to as 49 CFR 193), is the United States Department of Transportation (U.S. DOT) federal standard for LNG facilities in the U.S. [DOT]. Through reference to an industry standard, NFPA 59A – *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 49 CFR 193 sets 10,000 Btu/(hr⋅ft^2) (30 kW/m^2) as the limiting heat flux at the demarcation line between land area controlled by the LNG facility and land areas controlled by other parties. The intent is to ensure that the heat flux from code-specified design spill fires will not cause failures of steel-framed buildings and similar industrial-type structures outside the LNG facility. Therefore, when analyzing the effects of worst-case fires that can be much larger than the design spill fires, it is reasonable to use 10,000 Btu/(hr⋅ft^2) as the lower limit for radiant heat flux calculations in an industrial area. Non-combustible structures outside the 10,000 Btu/(hr⋅ft^2) isopleth should not be heavily damaged by the fire, and those within the 10,000 Btu/(hr⋅ft^2) isopleth will withstand several minutes of exposure to the radiant heat before failing.

5.2.1.1 Radiant Flux Endpoint Criteria

As shown in Section 4, the large scale fires evaluated under worst-case atmospheric conditions have the potential to affect people in areas outside the LNG terminal fence line. When evaluating a person's possible exposure to a radiant flux level that would cause skin burns after a short period of time, the use of

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-2
Figure 5-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

vulnerability zones was employed. Vulnerability zones identify the total area in which, under some circumstances, people could be exposed to a radiant level greater than or equal to that necessary to cause skin burns (e.g., 1,600 Btu/(hr⋅ft^2) for 30 seconds).

The same type of approach can be used to identify the potential radiant impact to the industrial areas neighboring the LNG terminal. For the purposes of this study, the radiant endpoint selected for evaluation is 10,000 Btu/(hr⋅ft^2). This level of radiant heat will have the following effect on materials in an industrial area.

- Exposure to 10,000 Btu/(hr⋅ft^2) for 15 to 20 minutes will cause wooden buildings to ignite. [HUD, 24 CFR 51]
- Exposure to 10,000 Btu/(hr⋅ft^2) for several minutes will damage steel structures. [HUD, 24 CFR 51]

5.2.1.2 Radiant Energy Vulnerability Zones – Industrial Equipment Impact

Using the same pool fire and torch fire models as defined in Section 4 for the selected accidental and intentional events, the distance to the 10,000 Btu/(hr⋅ft^2) radiant flux level was calculated. The results for these calculations (the radii of the vulnerability zones) are presented in Table 5-1. Equipment within the vulnerability zones identified in Table 5-1 have the possibility, under certain weather conditions (e.g., the wind blowing toward the equipment), to be exposed to radiant impacts that would cause their structural failure.

As can be seen from Table 5-1 and Figure 5-1, several of the larger events have the potential to impact the existing oil berth (T-121, 1,300 ft from a point centered between the two LNG storage tanks) and the proposed berth (T-124, 750 ft from a point centered between the two LNG storage tanks). Several of the radiant vulnerability zones are presented in Figures 5-2 through 5-11.

From a review of these vulnerability zones it can be concluded that if one of the LNG release events were to occur and a fire ensue, that significant damage to areas within T-124 and T-121 is possible. All the large releases involving LNG have the potential to last from tens of minutes to several hours, depending on the size of the hole through which the LNG is being released. In all cases, the duration of the fire is closely linked to the duration of the release. The reason for this is that LNG liquid spread is unrestricted in most cases and the FERC spreading model allows the LNG to spread to very thin pool thickness. Thus, once the source of LNG is exhausted (there is no more LNG to release), the fire consumes the remaining LNG in a very short time.

5.2.2 Vulnerability of Structures and Plant Equipment to Overpressure

Gas-phase explosions are the result of very rapid combustion of flammable vapor clouds. One characteristic of all explosions is the sudden (nearly instantaneous) release of energy. In gas-phase explosions, a portion of the released energy manifests itself as a pressure wave.

Pressure waves created by explosions can travel through any solid, liquid, or gas, including the earth, water, and air. For the purposes of this study, pressure waves in air are of most interest since vapor cloud explosions occur in the air.

Table 5-2 lists the approximate overpressures required to produce specific levels and types of damage to equipment, buildings, and other structures commonly found in industrial areas. For example, a peak side-on overpressure of 20.7 kPa (3 psi) will cause typical oil storage tanks to fail.

Table 5-1
Consequence Analysis Results – Equipment Impact
Facility = LNG Import Terminal at Port of Long Beach, California

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to 10,000 Btu/(hr•ft^2) Radiant Flux Level	Measured From	Figure	Maximum Overpressure Achieved	Distance (ft) to 2.3 psig
(A) (I)	Rupture of process equipment - location A*	140	Release Point	—	1.09	NA
(A) (I)	Rupture of process equipment - location B*	160	Release Point	—	3.06	130
(A) (I)	Rupture of process equipment - location C*	360	Release Point	—	1.86	NA
(A) (I)	Rupture of process equipment - location D*	160	Release Point	—	1.86	NA
(A) (I)	Rupture of process equipment - location E*	400	Release Point	—	1.09	NA
(A) (I)	Release from process equipment - location F*	600	Release Point	Figure 5-2 Figure 5-12	3.06	130
(A) (I)	Release from process equipment - location G*	260	Release Point	—	3.06	130
(A)	Release from LNG storage tanks following earthquake	3,780	Center of LNG Pool on Water	Figure 5-3	1.09	NA
(A)	Release from LNG tank ship following collision with breakwater - 1 tank fails	990	Center of LNG Pool by Tank Ship	Figure 5-4	1.09	NA
(A)	Release from LNG tank ship following collision with breakwater - 5 tanks fail	1,480	Center of LNG Pool by Tank Ship	Figure 5-5	1.09	NA

NA = Explosion overpressure level not achieved
DNA = Does not apply – vapor cloud formation is not possible following initiating event
* = Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC

Table 5-1
Consequence Analysis Results – Equipment Impact
Facility = LNG Import Terminal at Port of Long Beach, California
(Continued)

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to 10,000 Btu/(hr-ft^2) Radiant Flux Level	Measured From	Figure	Maximum Overpressure Achieved	Distance (ft) to 2.3 psig
(A) (I)	Release from LNG tank ship following collision (outside breakwater) - 1 tank fails	1,325	Center of LNG Pool on Water	—	1.09	NA
(A) (I)	Release from LNG tank ship following collision (outside breakwater) - 5 tanks fail	1,495	Center of LNG Pool on Water	—	1.09	NA
(I)	Release from LNG storage tank after plane crash	1,265	Center of LNG Pool on Water	Figure 5-6	DNA	DNA
(I)	Release from LNG storage tank after truck bomb	3,090	Center of LNG Pool on Water	Figure 5-7	DNA	DNA
(I)	Release from LNG storage tank after RPG	80	LNG Pool by Tank	—	1.09	NA
(I)	Release from LNG tank ship after plane crash - 2 tanks fail	1,610	Center of LNG Pool by Tank Ship	Figure 5-8	DNA	DNA
(I)	Release from LNG tank ship after plane crash - 5 tanks fail	1,650	Center of LNG Pool by Tank Ship	Figure 5-9	DNA	DNA
(I)	Release from LNG tank ship after boat bomb - 1 tank fails	1,385	Center of LNG Pool by Tank Ship	Figure 5-10	DNA	DNA
(I)	Release from LNG tank ship after boat bomb - 5 tanks fail	1,635	Center of LNG Pool by Tank Ship	Figure 5-11	DNA	DNA
(I)	Release from LNG tank ship after RPG	65	Center of LNG Pool by Tank Ship	—	1.09	NA

NA = Explosion overpressure level not achieved
DNA = Does not apply – vapor cloud formation is not possible following initiating event

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-6
Figure 5-2

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-7
Figure 5-3

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-8
Figure 5-4

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-9
Figure 5-5

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-10
Figure 5-6

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-11
Figure 5-7

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-12
Figure 5-8

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-13
Figure 5-9

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-14
Figure 5-10

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-15
Figure 5-11

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Table 5-2
Damage Produced by Blast [Clancey, 1972]

Overpressure (psig)	Damage
0.02	Annoying noise (137 dB if of low frequency 10-15 Hz)
0.03	Occasional breaking of large glass windows already under strain
0.04	Loud noise (143 dB), sonic boom glass failure
0.1	Breakage of small windows under strain
0.15	Typical pressure for glass breakage
0.3	"Safe distance" (probability 0.95 no serious damage beyond this value); projectile limit; some damage to house ceilings; 10% window glass broken
0.4	Limited minor structural damage
0.5 - 1.0	Large and small windows usually shattered; occasional damage to window frames
0.7	Minor damage to house structures
1.0	Partial demolition of houses, made uninhabitable
1 - 2	Corrugated asbestos shattered; corrugated steel or aluminum panels, fastenings fail, followed by buckling; wood panels (standard housing) fastenings fail, panels blown in
1.3	Steel frame of clad building slightly distorted
2	Partial collapse of walls and roofs of houses
2 - 3	Concrete or cinder block walls, not reinforced, shattered
2.3	Lower limit of serious structural damage
2.5	50% destruction of brickwork of houses
3	Heavy machines (3,000 lb) in industrial building suffered little damage; steel frame building distorted and pulled away from foundations
3 - 4	Frameless, self-framing steel panel building demolished; rupture of oil storage tanks
4	Cladding of light industrial buildings ruptured
5	Wooden utility poles snapped; tall hydraulic press (40,000 lb) in building slightly damaged
5 - 7	Nearly complete destruction of houses
7	Loaded train wagons overturned
7 - 8	Brick panels, 8-12 inches thick, not reinforced, fail by shearing or flexure
9	Loaded train boxcars completely demolished
10	Probable total destruction of buildings; heavy machine tools (7,000 lb) moved and badly damaged, very heavy machine tools (12,000 lb) survived
300	Limit of crater lip

5.2.2.1 Explosion Overpressure Endpoint Criteria

As shown in Section 4, the vapor cloud explosion overpressures have little potential to adversely affect people in areas outside the immediate LNG terminal. This is primarily due to the inability of the drifting cloud to penetrate the nearby shoreline without finding an ignition source.

For purposes of this study, 2.3 psi overpressure was selected as the lower limit for evaluating the possible overpressure impacts on the neighboring industrial sites. Overpressures lower than 2.3 psig would not be expected to produce significant damage to industrial equipment.

5.2.2.2 Explosion Overpressure Vulnerability Zones – Industrial Equipment Impact

As noted in Section 4, the maximum overpressure generated by a flammable cloud of natural gas that drifted into a moderately obstructed area, such as a parking lot, was 1.09 psig. Thus, if this type of event were to occur, the overpressure levels would be below those required to produce significant structural damage in industrial areas.

Using the same explosion overpressure methodology as defined in Section 4 for the selected accidental and intentional events, the distance to the 2.3 psig overpressure level was calculated. The results for these calculations (the radius of each vulnerability zone) are presented in Table 5-1. It should be noted in Table 5-1 that several of the releases in the gas processing area have the potential to generate maximum overpressures in the range of 3 psig. This is a result of a more reactive fluid mixture (ethane, propane, etc.) being released in obstructed areas within the process area (e.g., congested areas with pipe racks, etc.). The majority of the large releases identified in this work resulted in vapor clouds composed primarily of methane, defined as a low reactivity material. The 2.3 psig overpressure vulnerability zone for a release from process equipment F is presented in Figure 5-12 as an example of a more reactive material.

None of the vapor cloud explosion events evaluated resulted in overpressures high enough to fail the oil storage tanks proposed for T-124. According to Clancey [Clancey, 1972], an overpressure in excess of 3 psig would be necessary in order to rupture oil storage tanks.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 5-18
Figure 5-12

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

SECTION 6
WORST-CASE HAZARDS ASSOCIATED WITH OTHER FLAMMABLE FUEL FACILITIES

6.1 Flammable Fuel Facilities

The potential worst-case impacts associated with the proposed LNG import terminal in the Port of Long Beach can be compared to the potential worst-case impacts of other flammable fuel facilities. Previously completed studies on three flammable fuel facilities were used for this comparison. It should be noted that terrorist-induced failures were explicitly considered in only one of the three previous studies. However, as was the case when evaluating several of the events in the LNG import terminal, several of the events evaluated in the other flammable fuel facilities would have the same impact whether the initial release was accidental or intentional in nature.

The three flammable fuel facilities can be briefly described as follows.

Facility #1 The largest refrigerated propane terminal in northen California. This terminal has refrigerated propane storage tanks, pressurized ambient temperature storage tanks (bullets), and both railcar and tank truck loading.

Facility #2 Several petroleum product tank farms, located in southern California, with large capacity storage tanks containing a variety of petroleum products.

Facility #3 10 million tons per annum (10 mtpa) LNG import terminal in Mexico. This terminal will have a peak natural gas generation capacity of 2.4 billion cubic feet per day (2.4 bcfd).

None of the three facilities stores or processes any significant amount of toxic materials. Thus, the comparison of potential hazards between the three facilities and the LNG import terminal is based solely on the flammable nature of the hydrocarbons processed and stored in each.

In addition to the three facilities described above, the flammable hazards associated with a range of LPG storage vessels that are located throughout the Long Beach area were calculated. The LPG vessel sizes ranged from a common 5 gallon backyard grill propane bottle to a 12,500 barrel LPG storage sphere that located in refinery.

6.2 Propane Storage Terminal, Elk Grove, California

6.2.1 Description of the Major Components in the Propane Terminal

The Suburban Propane Elk Grove facility [COEG, 2000] receives pressurized ambient temperature liquid propane from tank trucks and railcars, stores both ambient temperature and refrigerated liquid propane, and loads ambient temperature propane for off-site transport. On average, approximately 120,000 gallons of propane are handled at the facility each day by tank truck and railcar.

The major equipment at the facility consists of four 60,000-gallon pressurized, ambient temperature propane storage vessels (bullets); two 12,000,000-gallon refrigerated, low pressure storage tanks; tank truck and rail-

car loading/unloading stations; and a propane refrigeration system. The propane storage bullets are nominally 12 feet in diameter and 91 feet long, placed horizontally on concrete supports about 5 feet above the ground. The large refrigerated propane storage tanks are approximately 146 feet in diameter and 122 feet tall.

Propane is received at the facility as pressurized, ambient temperature liquid carried in tank trucks or railcars. The tank trucks have a typical capacity of 10,000 gallons and the railcars a typical capacity of 33,000 gallons. The large refrigerated storage tanks serve as storage reservoirs that can absorb the seasonal swings in propane demand. Liquid propane can be moved from the refrigerated storage tanks to the pressurized bullets using centrifugal pumps.

6.2.2 Potential Hazards Associated with the Propane Terminal

For flammable fuel facilities that process and store refrigerated and pressurized flammable fluids, the common hazards are:

- Torch fires (gas and liquefied gas releases)
- Flash fires (liquefied gas releases)
- Pool fires (liquefied gas releases)
- Vapor cloud explosions (gas and liquefied gas releases)
- BLEVEs (major failures of tank trucks, railcars, or aboveground pressurized storage tanks)

With the exception of the BLEVE, all the potential hazards associated with the propane terminal are present in the proposed LNG import terminal. The BLEVE event has the potential to occur in the propane terminal due to the storage of propane in pressure vessels (bullets, railcars, and tank trucks). It should be noted that BLEVE's are not possible in the proposed LNG import terminal as none of the flammable materials are stored under pressure, thus there are no pressurized storage vessels.

6.2.3 Potential Release Events Associated with the Propane Terminal

The propane terminal was the subject of a foiled sabotage effort by two US citizens in 1999. Due to concern about the consequences of such possible events, both accidental and intentional releases of propane were evaluated. The worst-case consequence results from this study are presented in Table 6-1. Whether the release was caused by accidental or intentional means, once the release occurs, the methodologies used to calculate the extents of the potential impacts were the same. For example, whether a pipe fails due to a bad weld or due to detonation of an explosive charge placed beside it, the resulting fires would be identical. In Table 6-1, the events and the consequence analysis results associated with that event are identified as being produced by an accidental (A) or an intentional (I) event.

In general, the largest potential hazards in the propane facility are associated with pool fires following a significant release from the refrigerated propane storage tanks or a BLEVE of one of the pressurized storage bullets. However, the largest potential hazard is the flash fire associated with a large release from both refrigerated propane tanks. If an earthquake of sufficient magnitude to fail the tanks were to occur, the flammable vapor cloud travel distances reported should not be considered credible due to the inability to avoid the numerous ignition sources generated by the earthquake. In other words, it would be expected that any one of the many available ignition sources (e.g., downed power lines) in the immediate area would ignite the flammable vapors. Once ignited, a pool fire would result. If this were to occur, the flammable cloud distances listed in Table 6-1 could not be achieved as the cloud would be ignited before it reached the listed distances. It is unlikely that the cloud would extend any significant distance past the facility fence line.

Table 6-1
Consequence Analysis Results
Facility = Propane Terminal Near Sacramento, California

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to Radiant Flux Level 1,600 Btu/(hr ft^2)		Measured From	Distance (ft) to 1 psig Overpressure		Distance (ft) to LFL	
(A)	Release from two 12,000,000 gallon refrigerated propane storage tanks following earthquake	(A)	1,320	Center of diked area for both tanks	(A)	525	(A)	26,750
(A) (I)	Rupture of bottom connection on 12,000,000 gallon refrigerated propane storage tank	(A) (I)	1,230	Center of dike	(A) (I)	525	(A)	700
(A) (I)	Rupture of bottom connection on 60,000 gallon propane bullet	(A) (I)	230	Release point	(A) (I)	525	(A)	650
(A) (I)	BLEVE of 60,000 gallon propane bullet	(A) (I)	1,900	Release point		—		—
(A) (I)	BLEVE of 33,000 gallon propane railcar	(A) (I)	1,550	Release point		—		—

Comparison of the worst-case hazards for the propane facility and the proposed LNG import terminal finds that the pool fire radiant impact distances and the flash fire impact distances to be similar for the land-based releases. This is primarily due to the fact that the propane is stored in a cryogenic state similar to the LNG in the proposed import terminal. The behavior of propane vapor clouds evolving off a liquid pool is similar to the behavior of natural gas evolving off a pool of LNG.

The biggest difference between the two terminals has to do with the method of shipping the propane or LNG into or out of the terminals. The propane facility employs pressurized railcars and tank trucks while the LNG terminal will use insulated tank ships and tank trucks. The differences manifest themselves not only in the size of a potential hazard due to transportation inventory (LNG is larger) but also with the frequency of the possible events (propane shipping is far more frequent).

6.3 Petroleum Product Bulk Storage Terminals, Southern California

6.3.1 Description of the Terminals

The subjects of this study were several bulk storage facilities associated with Equilon's Wilmington Refinery CARB Phase 3 Project [SCAQMD, 2001]. The majority of the bulk terminal changes involved changing the products that the storage tanks contained. These modifications involved atmospheric storage tanks.

The four bulk terminals selected for evaluation are all located in southern California. The products stored at the sites include crude oil, jet fuel, kerosene, gasoline, and ethanol. The products are stored in tanks with a range of capacities, several as large as 100,000 barrels.

The common hazards associated with the storage of ambient temperature flammable hydrocarbons in atmospheric storage tanks are:

- Flash fires (vapors evolving off liquid pools)
- Pool fires

6.3.2 Potential Release Events Associated with the Bulk Terminals

Several of the worst-case consequence results from the analysis of the bulk terminals are presented in Table 6-2. Intentional acts were not considered in the original analysis. However, if they had been, the resulting consequences would be no larger than the consequences associated with the accidental events considered in Table 6-2.

The largest potential hazards are associated with pool fires in the impounding area following a significant release from one or more storage tanks. Unlike the propane terminal, vapors evolving off the hydrocarbon fluids in the terminal (crude oil, jet fuel) do not form large vapor clouds. Often the extent of the flammable vapors will only be slightly outside the confined pool. Thus, if an ignition source is found, a pool fire is the result. There will be no significant overpressure generated by the ignition of the petroleum products in the tank farm environment.

The potential fire impacts from any one storage tank in any of the bulk terminals is smaller than the fire impacts due to either one of the proposed LNG tanks. This is primarily due to inventory and site layout. The physical properties of the materials stored in the bulk terminals (jet fuel, gasoline, etc.) have lower burning rates and produce "smokier" flames. These two characteristics result in shorter fires that radiate less thermal energy.

Table 6-2
Consequence Analysis Results
Facility = Flammable Fuel Depots, Southern California

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to Radiant Flux Level 1,600 Btu/(hr)(ft^2)		Measured From	Distance (ft) to 1 psig Overpressure	Distance (ft) to LFL
(A)	Morman Island Terminal - Jet Fuel - Tank top fire	(A)	215	Center of tank	—	—
(A) (I)	Morman Island Terminal - Jet Fuel - Dike fire	(A) (I)	350	Center of dike	—	—
(A)	Signal Hill Terminal - Gasoline - Tank top fire	(A)	175	Center of tank	—	—
(A) (I)	Signal Hill Terminal - Gasoline - Dike fire	(A) (I)	595	Center of dike	—	—
(A)	Colton Terminal - Gasoline - Tank top fire	(A)	140	Center of tank	—	—
(A) (I)	Colton Terminal - Gasoline - Dike fire	(A) (I)	485	Center of dike	—	—
(A)	Rialto Terminal - Diesel - Tank top fire	(A)	95	Center of tank	—	—
(A) (I)	Rialto Terminal - Diesel - Dike fire	(A) (I)	315	Center of dike	—	—

6.4 LNG Import Terminal, Mexico

6.4.1 Description of the Major Components in the LNG Import Terminal

The Altamira LNG Import Terminal has been proposed for the eastern coast of Mexico. The project has undergone regulatory review in Mexico during which time a number or safety, consequence, and risk analysis studies were completed [Shell and El Paso Consortium, 2001]. The LNG import terminal will receive LNG from tank ships, store the LNG in large insulated storage tanks, and regasify the LNG using open rack vaporizers. In the final phase of the project, the terminal will have a nominal throughput of 10 million tonnes[1] per annum (mpta).

The facility is comprised of several main components.

- LNG tanker berthing facility and unloading arms.
- Large capacity atmospheric LNG storage tanks.
- In-tank and external LNG pumps.
- Open rack vaporizers.
- Vapor handling equipment.

6.4.2 Potential Hazards Associated with the LNG Import Terminal

The potential hazards associated with the LNG import terminal are identical to those identified in Section 4 for the proposed SES LNG terminal in the Port of Long Beach.

- Torch fires (gas and liquefied gas releases)
- Flash fires (gas and liquefied gas releases)
- Pool fires (liquefied gas releases)
- Vapor cloud explosions (gas and liquefied gas releases)

6.4.3 Potential Release Events Associated with the LNG Terminal

The consequence and risk analysis studies completed for the LNG terminal were focused on accidental releases of LNG and natural gas from the onshore terminal. Thus, release events involving the transport of LNG by tank ship were not included in this study. Similarly, intentional acts, due to sabotage or terrorism were not included in this study.

A summary of the largest worst-case consequences following the largest release events evaluated in the study is presented in Table 6-3. The maximum flammable cloud travel distance listed in Table 6-3 is associated with an earthquake-induced failure of an LNG storage tank. As described in the evaluation of the SES LNG import terminal and the propane terminal in Section 5.2, this should not be considered a credible event since multiple ignition sources would exist in the immediate area. These ignition sources would prevent any significant travel of the vapor cloud prior to ignition.

[1] 1 tonne = 1000 kilograms = 2204 lb = 1.102 tons

Table 6-3
Consequence Analysis Results
Facility = LNG Import Terminal, Altamira, Mexico

Cause of Release (A) = Accidental (I) = Intentional	Distance (ft) to Radiant Flux Level 1,600 Btu/(hr-ft^2)	Measured From	Distance (ft) to 1 psig Overpressure	Distance (ft) to LFL
(A) Rupture of process equipment - location W*	(A) 600	Release point	—	(A) 3,770
(A) Rupture of process equipment - location X*	(A) 300	Release point	(A) 200	(A) 570
(A) Rupture of process equipment - location Y*	(A) 140	Release point	(A) 200	(A) 620
(A) Rupture of process equipment - location Z*	(A) 420	Release point	—	(A) 375
(A) Release from LNG storage tank following earthquake	(A) 1,240	Center of tank	(A) 200	(A) 21,200

* Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC

6.5 Comparison of Flammable Fuels Facilities Potential for Off-site Impacts

Each of the three flammable fuels facilities evaluated has the potential to generate offsite impacts if a significant release of one or more of the fuels stored or processed in the facility were to occur. In each facility where a intentional release was evaluated, the impacts resulting from an intentional release were no larger than the impacts associated with one or more releases that could occur accidentally.

Table 6-4
Comparison of Worst-Case Impacts from Four Flammable Fuel Facilities

Facility	Offsite Impacts and Maximum Hazard Impact Distance		
	Radiant (1,600 Btu/(hr•ft^2))	Flash Fire (LFL)	Overpressure (1 psig)
LNG Import Terminal, Long Beach, California	Yes max. distance = 8,610 ft	Yes max. distance = 34,600 ft	Yes max. distance = 320 ft
Propane Terminal, Northern California	Yes max. distance = 1,900 ft	Yes max. distance = 26,750 ft	Yes max. distance = 525 ft
Bulk Storage Terminals, Southern California	Yes max. distance = 595 ft	Yes max. distance = 675 ft	No
LNG Import Terminal, East Coast of Mexico	Yes max. distance = 1,240 ft	Yes max. distance = 21,200 ft	Yes max. distance = 200 ft

As can be seen from a review of Table 6-4, all four facilities have the potential to produce off-site impacts. The common misconception that explosions in flammable fuel facilities produce significant off-site explosion impacts is not supported by the modeling performed in this study, nor the historical record [Mahoney, 1997].

As described in Section 4.8, the inability of an evolving flammable vapor cloud to travel significant distances before finding an ignition source reduces the significance of the flammable vapor cloud travel distances in industrial or populated areas. Therefore, the flammable vapor cloud travel distances listed in Table 6-4 should be thought of as theoretical maximums rather than realistic assessments.

This leaves the comparison of fire radiation impacts (pool fires and torch fires) as the best method for comparing the impacts among the facilities. When this comparison is made, the maximum radiant impacts from the four facilities range from 595 to 8,610 feet from the fire source. In all four facilities, these worst-case radiant impacts have the potential to extend past the facility property line.

In the specific case of the proposed LNG import terminal in the Port of Long Beach, only two of the events evaluated have the potential to produce radiant impacts past the industrial area defined by the POLB boundary line. The largest radiant impact distance, 8,610 ft to 1,600 Btu/(hr•ft^2) [second degree skin burns], results from an earthquake of sufficient magnitude to fail both LNG storage tanks and the security wall surrounding the tanks. This failure allows a significant portion of the LNG to reach the water. Following ignition, the fire column (as defined by the FERC fire model) can produce 1,600 Btu/(hr•ft^2) slightly past the eastern POLB boundary line. When reviewing this scenario, four things should be kept in mind.

1. An earthquake of the magnitude necessary to fail the full containment LNG storage tank, would be more than sufficient to level every structure in the Port of Long Beach as well as the City of Long Beach.

2. In addition to an earthquake of sufficient magnitude occurring that fails both LNG tanks, a high wind would have to be blowing in order for the fire to impact any area outside the POLB boundary.

3. The FERC fire model employed to make this calculation does not have an ability to account for the lack of oxygen available to the core of such a large fire. The model is believed [FERC, 2004; Raj, 2004] to significantly overestimate the height and surface flux of the flame, thus overestimating the potential impacts.

4. This accidental event, although defined as possible, would be considered incredible when performing risk assessments and would not be used as a benchmark for siting calculations.

The second fire event that has the ability to produce 1,600 Btu/(hr⋅ft^2) [second degree skin burns] impacts past the POLB boundary is from a fire following a truck bomb that fails one of the LNG storage tanks as well as the security wall. This event, although intentional in nature, results in a fire similar to, but smaller than, the fire associated with the earthquake. In this case, the 1,600 Btu/(hr⋅ft^2) impact zone does not extend as far as the earthquake-induced failure since the LNG inventory is less (only one tank fails). However, issues 2 and 3 listed above would also apply to this scenario.

All the remaining LNG fire events evaluated for this study (those associated with terminal operations, storage, and LNG tank ship movements and operations) have no fire radiation impacts (second degree skin burns) that extend past the POLB boundary. This is true whether the initiating event is accidental or intentional.

6.6 Fire Hazards Associated With Storage of LPG in the Long Beach Area

Many residents of the Long Beach are aware of the use, transportation, and storage of LPG. LPG (liquid petroleum gas) is stored and used in vessels as small as 5 gallons. The 5 gallon tanks are commonly used within backyard bar-b-que grills. Residents in Long Beach can exchange the 5 gallon tanks at local distribution centers (often the neighborhood gas station).

Similar to the 5 gallon bar-b-que tank, many mobile homes and travel trailers have 35 gallon LPG tanks incorporated into their design. These tanks are attached to the exterior of the truck or trailer and travel the local roadways without restriction.

LPG is commonly transported over the local highways in tanks that include:

- Converted-fuel vehicles (LPG for fuel instead of gasoline or diesel), 80 gallon tank capacity
- LPG delivery truck (bobtail design), 4,000 gallon tank
- LPG transport truck (semi-trailer design), 10,000 gallon tank

Another type of LPG storage vessel that is more common in rural areas is a 1,000 gallon storage tank that is used for cooking, water heating, and home heating fuel. These tanks are often located beside the residence.

In refineries and gas plants it is not uncommon to find LPG storage vessels ranging in size from 30,000 to 60,000 gallon. Cylindrical vessels are often used to store inventories in this range. When larger quantities

of LPG are stored, spherical vessels are often used. The capacities of these spherical vessels will range up to 12,500 barrels (528,000 gallons).

Although LPG is a flammable fuel like natural gas, the fact that it is stored as a liquid under pressure (as opposed to refrigerated like LNG), poses additional hazards that are not possible with the storage and use of LNG and natural gas. The largest and most dramatic of these is a Boiling Liquid Expanding Vapor Explosion (BLEVE). ...

A BLEVE (Boiling Liquid Expanding Vapor Explosion) is defined as the catastrophic failure of a pressure vessel, occurring at a time when the temperature of the liquid in the vessel is well above its boiling temperature at normal atmospheric pressure (i.e., the liquid is superheated). Most BLEVEs are caused by the vessel becoming overheated and weakening as a result of being in contact with the flames from an external fire. If parts of the vessel become too hot and too weak, the vessel will fail catastrophically. When this occurs, some portion of the superheated liquid will flash to vapor. The vapor will expand and shatter most of the remaining liquid into drops, and propel them away from the vessel. In most cases, the resulting mixture of air, vapor, and liquid drops will be ignited by the external fire, resulting in a fireball. The fireball will exist for a brief time, typically from 2 to 30 seconds, depending on the amount of liquid that was in the vessel. During its brief existence, the fireball will emit a large amount of radiant energy. This thermal radiation is the primary hazard created by a BLEVE.

When a BLEVE occurs, the distance from the failed vessel to a point where second-degree skin burns would be experienced by an exposed person can be calculated. For the purposes of comparison, a BLEVE calculation was performed for each of the LPG vessels described above. The results are presented in Table 6-5.

Table 6-5
Radiant Impact Distances for
Common LPG Storage and Transport Vessels

Propane Tank Description	Capacity (gallons)	Distance to 2nd Degree Skin Burns (feet)
Backyard bar-b-que grill tank	5	21
Mobile home propane tank	35	55
Pickup truck propane tank (automobile fuel conversion)	80	77
Farm house propane tank (heat and hot water)	1,000	252
Bobtail propane delivery truck	4.000	450
Semi-trailer propane tank	10,000	657
Railroad propane tankcar	33,000	1,069
LPG bullet storage (refinery, gas plant)	60,000	1,360
LPG sphere storage (refinery)	528,000	3,223

A review of the BLEVE results in Table 6-5 shows that BLEVEs of the larger LPG vessel result in radiant impact distances similar in size as many of the radiant zones evaluated for the LNG terminal. It should be kept in mind that BLEVEs are not influenced by the wind and their hazard zones are round whereas a radiant zone formed by an LNG pool fire is influenced by the wind and is only round under calm conditions (not the worst case). Thus, a BLEVE impact zone with a smaller radius will affect the same total area an LNG pool fire with a larger downwind distance reach.

6.7 Comparison of Risk

To put this type of evaluation in perspective, it is instructive to look at the types of risks people are ordinarily exposed to during day-to-day life. Table 6-6 lists the risks a citizen of Long Beach might be exposed to each and every day. As can be seen in the table, there voluntary risks (driving a car) and involuntary risks (dying from influenza) that are higher than the risk of injury that may result from living near the proposed LNG import terminal in the POLB.

In reviewing the results in Table 6-6, two issues should be kept in mind. The statistics from the National Safety Council are for fatalities and the risks outside the POLB property line are for injury. Thus, the risk levels for the LNG terminal are overstated when viewed in this context. Secondly, the development of the successful terrorist probability is based upon a successful terrorist event occurring in any of the 12,711 facilities in the US EPA data base, not just the POLB facility. Thus, if the probability of a successful terrorist attack was weighted toward a “good target” (as defined by the US EPA data), the probability values associated terrorist-induced events in the proposed LNG terminal in the POLB would be less.

Table 6-6
Individual Risk of Early Fatality by Various Causes
[National Safety Council, 1997]

Hazard	Approximate Individual Risk of Early Fatality	
	Probability/Year	One Chance in
Heart disease	2.76×10^{-3}	360
Cancer	2.01×10^{-3}	495
Stroke	5.77×10^{-4}	1,730
All accidents	3.52×10^{-4}	2,840
Pneumonia and influenza	3.07×10^{-4}	3,260
Motor vehicle	1.63×10^{-4}	6,125
Homicide	9.25×10^{-5}	10,800
Falls	5.31×10^{-5}	18,820
Poisoning by solids and liquids	3.69×10^{-5}	27,075
Pedestrian death by motor vehicle	2.30×10^{-5}	43,500
Drowning	1.50×10^{-5}	68,035
Fires and burns	1.21×10^{-5}	82,920
Suffocation by ingesting food or object	1.13×10^{-5}	88,450
Firearms	5.28×10^{-6}	189,530
Poisoning by gas or vapor	2.26×10^{-6}	442,235
Electric current	2.11×10^{-6}	473,000
Rail travel	1.45×10^{-6}	687,400
Scheduled air travel	5.99×10^{-7}	1,668,810
Cataclysmic storms and floods resulting from storms	4.03×10^{-7}	2,479,800
Lightning	3.16×10^{-7}	3,158,800
Bee strings and snake bites	2.37×10^{-7}	4,211,750
Cataclysmic earth movements and ruptures	1.73×10^{-7}	5,768,300
Accidental release of LNG from proposed LNG terminal, which produces second degree burns outside of POLB boundary	*1.00×10^{-7}*	*10,000,000*
Intentional release of LNG from proposed LNG terminal, which produces second degree burns outside of POLB boundary	*1.44×10^{-8}*	*69,600,000*

SECTION 7
CONCLUSIONS

7.1 Limitations of Study

The overall scope and execution of the study is limited by two restrictions. First, the study is not a full quantitative risk analysis since it was defined to evaluate only the worst-case releases. Thus, not all possible events are identified, quantified, and incorporated into the study. The events evaluated in this study cover a range of the largest accidental and intentionally-induced releases that could occur in the LNG import terminal and LNG tank ship operations. The study is not designed to be all inclusive, rather it is targeted at defining a set of representative worst-case impacts.

Secondly, all the data used to develop the releases, resultant consequences, and associated probabilities are drawn from publicly available resources. No use of proprietary, confidential, or not-to-be-publicly disclosed information was used in this study.

7.2 Development of Flammable Fuel Release Sequences and Probabilities

The identification of terminal components that may fail due to an accidental failure was made using a formal review process coupled with historical data and Quest's experience in the LNG industry. Many of the largest accidental releases identified have never occurred in the industry, but they are still considered credible.

Identifying the largest releases that could be effected by intentional acts required a less structured approach than that used for the accidental releases. Several potential terrorist-executed acts that came out of public hearings and comment letters were described that, if successful, would result in a release of LNG, natural gas, or other flammable fluid from the terminal or tank ship operations. Each event sequence was described, including a number of the obstacles that would have to be overcome in order for a release to occur.

The specific question of whether an LNG import terminal is an attractive target for terrorists is beyond the scope of this study. A discussion of that issue would focus on whether a large-scale release of flammable fluid would satisfy one or more of the following criteria.

- Does the LNG import terminal serve as an iconic symbol, worthy of political impact?
- Does damage to the LNG import terminal result in a significant economic impact?
- Do the hazards associated with large releases from the LNG import terminal result in large loss of life or injuries to the public?

This study was designed to answer the third question.

Following the development of the LNG, natural gas, and other flammable fuel release sequences, the probability or frequency of each event was calculated. For the accidental releases, historical data from published sources containing LNG-specific or similar industry data were used when available. In the absence of such failure rate data, data from standard hydrocarbon operations were used.

The data for LNG tank ships show that there has never been a significant release of LNG from the LNG cargo tanks due to a collision with another ship or collision with a fixed object (such as a breakwater). Using the available data on LNG ship transits and assuming that the next collision with a fixed object or large ship

results in a large release of LNG from one or more LNG cargo tanks, a release frequency of $1.25 \times (10)^{-5}$ per port call can be estimated. This results in a frequency of once in 80,000 port calls.

An evaluation of the probability of a successful terrorist-induced event in a flammable fuel or toxic chemical facility that would have similar or larger impacts than those associated with the proposed LNG terminal developed three critical points:

- Following the terrorist events of September 11, 2001, the United States General Accounting Office released a report stating that flammable fuels facilities do not present an attractive terrorist target compared to facilities that contain toxic materials. This is a direct result of the potential impacts of flammable fuels facilities being smaller than those associated with toxic chemical facilities.

- Data from the United States Environmental Protection Agency's Risk Management Plan Program show that 12,711 toxic and flammable fuel facilities in the United States have a potential public impact as large or larger than the proposed LNG terminal in the POLB. Using the first World Trade Center bombing (February, 1993) as a starting point for successful terrorist acts in the United States, provides an eleven-year period for developing a frequency. Recognizing that no successful terrorist event has been carried out against any of the 12,711 toxic or flammable fuel facilities in the United States, means that if one were to occur tomorrow, the frequency of such an event would be $7.15(10)^{-5}$/yr , or once in 140,000 years.

- The multi-layer security systems designed for the proposed LNG terminal operations are expected to hinder access to the Port of Long Beach, LNG terminal grounds, and Long Beach Harbor. These security systems would not and can not make the probability of an intentional act zero, but they can be assumed to reduce the potential success of such an act.

7.3 Consequence Analysis for Worst-Case Releases

The largest releases due to accidental causes were defined in a straight-forward manner, and only two required assumptions.

- The earthquake failure scenario is assumed to result in a catastrophic failure of one or both LNG storage tanks. The actual size of the hole is not critical to the analysis as long as it is large enough that the liquid can be released in a reasonably short period of time.

- A collision between an LNG tank ship and another ship of sufficient size and speed was assumed to result in a hole in outer hull, inner hull and one membrane cargo tank. If the release caused the subsequent failure of one or more membrane tanks, the release area in each subsequently affected tank was assumed to be represented by a similar sized hole.

The largest releases due to terrorist-induced failures were evaluated based on an analysis of a range of possible initiating events. Although an exact assessment of each event cannot be realized in a body of work such as this (e.g., exactly where would the truck bomb be parked?), the events evaluated represent a reasonable range of possible scenarios and impacts. The results of the analysis identifies the following events as those producing the largest releases from the LNG terminal and LNG tank ship operations.

LNG terminal land-based releases

- Truck bomb beside LNG storage tank resulting in hole in one LNG storage tank.
- Boeing 767 crashing into LNG storage tank resulting in hole in one LNG storage tank.

LNG tank ship releases

- Boeing 767 crashing into LNG tank ship resulting in holes in two LNG membrane cargo tanks.
- Boat bomb beside LNG tank ship resulting in a hole in one LNG membrane cargo tank.

Several consequence models were used to determine the size of the radiant energy and explosive overpressure hazard zones following the release and ignition of a flammable fluid from the LNG terminal or LNG tank ships described in this work. In some cases, a model was modified to perform in an alternate manner than it was originally designed for. The models used in the analysis are:

FERC's LNG spill onto water model
LNGFIRE3
DEGADIS
CANARY by Quest

The maximum distances to hazard levels defined for this work for the seven largest releases described above are presented in Table 7-1.

When considering intentional releases, the device that is used to effect the release of LNG, natural gas, or other hydrocarbons often involves an explosive or is itself a significant ignition source. In many of these cases, there is no opportunity for an evolving vapor/air flammable mixture to avoid an immediate and sustained ignition source. Thus, many of these releases always result in a pool fire, torch fire, or both. This is represented by the DNA (does not apply) notations in Table 7-1.

7.3.1 Flammable Cloud Travel Distances

Only three of the seven largest release scenarios have the potential to generate a drifting flammable vapor cloud following the release of LNG.

- The failure of both LNG storage tanks due to an earthquake.
- The release from an LNG tank ship following a collision with another ship.
- The release from an LNG tank ship following a collision with the breakwater.

Of these three, only the release from an LNG tank ship following a collision with another ship might be developed as a terrorist-induced event, provided the terrorists are able to commandeer a ship of sufficient size to ram an LNG tank ship hard enough to rupture one or more cargo tanks.

Table 7-1
Largest Consequence Analysis Results
Facility = LNG Import Terminal at Port of Long Beach, California

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to 1,600 Btu/(hr•ft^2) Radiant Flux Level	Measured From	Distance (ft) to 1 psig Overpressure	Distance (ft) to LFL
(A)	Release from LNG storage tanks following earthquake	8,610	Center of LNG Pool on Water	NA	36,400
(A) (I)	Release from LNG tank ship following collision (outside breakwater) - 5 tanks fail	3,370	Center of LNG Pool on Water	NA	21,200
(A)	Release from LNG tank ship following collision with breakwater - 5 tanks fail	3,345	Center of LNG Pool by Tank Ship	NA	19,330
(I)	Release from LNG storage tank after truck bomb	7,020	Center of LNG Pool on Water	DNA	DNA
(I)	Release from LNG storage tank after plane crash	2,835	Center of LNG Pool on Water	DNA	DNA
(I)	Release from LNG tank ship after plane crash - 5 tanks fail	3,635	Center of LNG Pool by Tank Ship	DNA	DNA
(I)	Release from LNG tank ship after boat bomb - 5 tanks fail	3,320	Center of LNG Pool by Tank Ship	DNA	DNA

NA = Explosion overpressure level not achieved
DNA = Does not apply – vapor cloud formation is not possible following initiating event

QUEST

It is extremely unlikely that an earthquake of the magnitude necessary to cause the failure of both LNG tanks would not create multiple immediate ignition sources for the ignition of any of the flammable vapors released in the terminal. There are no credible arguments that would allow for a flammable cloud of this size to exist in the immediate neighborhood of multiple ignition sources caused by such a massive earthquake. However, in the context of this worst-case analysis study, the flammable vapor cloud travel defined by this case – over water without any portion of the cloud traveling inland – may be defined as possible although it certainly is not credible.

Following an LNG tank ship collision with a breakwater or another ship, there is a reasonable chance that a release of LNG may result in a drifting cloud. The generation of a flammable cloud over an open water surface, void of immediate ignition sources, results in scenarios where the flammable portion of the cloud could drift some distance before encountering an ignition source. The most likely location of such an available ignition source would be near the shoreline.

Under the worst-case conditions defined for this work, the following cloud travel distances (and times) were calculated.

LNG Tank Ship Collision with Breakwater Scenarios	Maximum Distance to Lower Flammable Limit	Cloud Travel Time to Maximum Travel Distance
One cargo tank failure	9,260 ft (1.75 miles)	45 minutes
Sequential failure of five cargo tanks	19,330 ft (3.66 miles)	90 minutes

It should be kept in mind that these cloud travel distances can only be achieved it the drifting cloud remains over water. Once the cloud begins to travel inland, it is bound to encounter any one of many possible ignition sources. Once ignited, the flame will burn back toward the source and the ability of the cloud to drift further will have been halted. Therefore, it would be incorrect to develop flammable vapor cloud vulnerability zones (circles) for the following releases.

- Earthquake caused failures of both LNG storage tanks
- Collision of LNG tank ship with breakwater
- Collision of LNG tank ship with another ship

The areas along the shoreline that could be affected by a flash fire following the development of drifting flammable cloud are those areas without potential ignition sources (e.g., open beaches, parks, etc.). Once one or more ignition sources are encountered, the ingress of the cloud will be stopped.

7.3.2 Vapor Cloud Explosion Hazard Distances

Within an industrial area, large flammable vapor clouds are likely to be ignited before they reach a confined or congested area. If the leading edge of a large flammable cloud were to encounter a congested area, fill it with flammable vapor, and then find an ignition source, the overpressure impact would be a function of the volume of the congested area.

Without site-specific knowledge of each possible congested or obstructed area along the shoreline that could be reached by a drifting vapor cloud, it is impossible to calculate site-specific effects. However, the Baker-

Strehlow model does provide information on the maximum overpressure levels that could be achieved by natural gas explosions under a variety of conditions.

For flammable natural gas mixtures in outdoor residential or commercial areas that have some degree of obstruction (e.g., parked cars), the maximum overpressure generated in the cloud would be approximately 1.09 psig. This would be the localized overpressure in the congested area and the magnitude of the overpressure will drop dramatically as distance from the congested area increases.

Using this information as a guide, the footprint of any overpressure map onto the shoreline near the LNG terminal will extend no further than the existing or created ignition sources nearest to the shoreline.

7.3.3 LNG Pool Fire Radiant Hazard Distances

For each accidental and intentional release listed in Table 7-1, there is a strong possibility that the vapor released (either directly, such as a natural gas release, or indirectly, such as vapors evolving off a liquid pool) will be ignited at the time of the release or shortly thereafter. The ignition source may be accidental in nature or intentional (as in the case of explosive devices). For the releases listed in Table 7-1 the dominant fire is due to fire above an expanding pool of LNG.

Since several of the potential releases involve LNG pools that may move away from the release point before they are ignited, or while they are ignited, the center of each fire is also identified in Table 7-1. When defining the extent of the 1,600 Btu/(hr•ft^2) vulnerability zone [second degree skin burns] for each release, the center of the fire should be used as the reference point.

7.4 <u>Potential Impact to Neighboring Facilities</u>

The proposed LNG import terminal is located on the west side and south end of Pier T in the Port of Long Beach. One task defined for this work was to calculate the potential impacts to neighboring industrial facilities, both current and proposed. These impacts were calculated for the worst-case events, both accidental and intentional.

As shown in Section 4, the large scale fires evaluated under worst-case atmospheric conditions have the potential to affect people in areas outside the LNG terminal fence line. When evaluating a person's possible exposure to a 1,600 Btu/(hr•ft^2) [second degree skin burns] radiant flux level, the use of vulnerability zones was employed to identify the total area that, under some circumstances, could be exposed to a radiant level greater than or equal to 1,600 Btu/(hr•ft^2). The same type of approach can be used to identify the potential radiant impact to the industrial areas neighboring the LNG terminal. For the purposes of this study, the radiant endpoint selected for evaluation was 10,000 Btu/(hr•ft^2), a level that would cause damage to structural steel.

As can be seen from Table 7-2, all of the largest events that occur at the terminal or the dock have the potential to impact the existing oil berth (T-121, which is 1,300 ft from a point centered between the two LNG storage tanks) and the proposed berth (T-124, which will be 750 ft from a point centered between the two LNG storage tanks). Several of the largest events have the potential to expose portions of T-124 and T-121 to radiant flux levels in excess of 10,000 Btu/(hr•ft^2). If this were to occur, flammable structures on T-124 and T-121 would be expected to ignite and ordinary storage tanks might incur a roof failure due to metal fatigue. Following a roof failure, the contents in the tank may ignite, resulting in a separate independent fire

Table 7-2
Largest Consequence Analysis Results – Equipment Impact
Facility = LNG Import Terminal at Port of Long Beach, California

Cause of Release (A) = Accidental (I) = Intentional		Distance (ft) to 10,000 Btu/(hr)(ft^2) Radiant Flux Level	Measured From	Maximum Overpressure Achieved	Distance (ft) to 2.3 psig
(A)	Release from LNG storage tanks following earthquake	3,780	Center of LNG Pool on Water	1.09	NA
(I)	Release from LNG storage tank after truck bomb	3,090	Center of LNG Pool on Water	DNA	DNA
(I)	Release from LNG storage tank after plane crash	1,265	Center of LNG Pool on Water	DNA	DNA
(I)	Release from LNG tank ship after plane crash - 5 tanks fail	1,650	Center of LNG Pool by Tank Ship	DNA	DNA
(I)	Release from LNG tank ship after boat bomb - 5 tanks fail	1,635	Center of LNG Pool by Tank Ship	DNA	DNA

NA = Explosion overpressure level not achieved
DNA = Does not apply – vapor cloud formation is not possible following initiating event

source. The storage tanks on T-124 and T-121 are small in comparison to the size of the LNG fire being evaluated. The storage tanks would burn for a longer duration than the LNG fires, but would have significantly smaller impact on the surroundings.

The largest 10,000 Btu/(hr•ft^2) radiant vulnerability zone follows an earthquake-induced failure of both LNG storage tanks. The vulnerability zone for this pool fire is presented in Figure 7-1. A review of Figure 7-1 shows that this event can affect both T-121 and T-124, as well as portions of the POLB, but the 10,000 Btu/(hr•ft^2) vulnerability zone does not extend past the POLB boundary in any direction.

7.5 Comparison to Other Flammable Fuels Facilities

The potential worst-case impacts associated with the proposed LNG import terminal in the Port of Long Beach were compared to the potential worst-case impacts of three flammable fuel facilities. It should be noted that terrorist-induced failures were explicitly considered in only one of the three previous studies. However, as was the case when evaluating several of the events in the LNG import terminal, several of the events evaluated in the other flammable fuel facilities would have the same impact whether the initial release was accidental or intentional in nature.

The three flammable fuel facilities can be briefly described as follows.

Facility #1 The largest refrigerated propane terminal in northen California. This terminal has refrigerated propane storage tanks, pressurized ambient temperature storage tanks (bullets), and both railcar and tank truck loading.

Facility #2 Several petroleum product tank farms, located in southern California, with large capacity storage tanks containing a variety of petroleum products.

Facility #3 10 million tons per annum (10 mtpa) LNG import terminal in Mexico. This terminal will have a peak natural gas generation capacity of 2.4 billion cubic feet per day (2.4 bcfd).

None of the three facilities stores or processes any significant amount of toxic material. Thus, the comparison of potential hazards between the three facilities and the LNG import terminal is based solely on the flammable nature of the hydrocarbons processed and stored in each.

Each of the three flammable fuels fatalities evaluated has the potential to generate offsite impacts if a significant release of one or more of the fuels stored or processed in the facility were to be released. In each facility where an intentional release was evaluated, the impacts resulting from an intentional release were no larger than the impacts associated with one or more releases that could occur accidentally.

As can be seen from a review of Table 7-3, all four facilities have the potential to produce off-site impacts. The common misconception that explosions in flammable fuel facilities produce significant off-site explosion impacts is not supported by the modeling performed in this study, nor the historical record.

Additional hazard calculations were made for a range of LPG storage and transport vessels commonly found in the Long Beach areas. LPG vessels as small as 5 gallon (bar-b-que bottles) to refinery LPG storage spheres (12,500 barrels) were evaluated. Boiling Liquid Expanding Vapor Explosion (BLEVE) calculations were performed for the range of vessels identified, and the distances from the failed vessel to where second-degree skin burns might occur were defined. These distances ranged from 20 feet (for the bar-b-que bottle) to over 3,000 feet for the refinery storage sphere. The analysis was performed to provide easily recognizable examples of potential flammable fuel hazards in the Long Beach area.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 7-9
Figure 7-1

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Table 7-3
Comparison of Worst-Case Impacts from Four Flammable Fuel Facilities

Facility	Offsite Impacts and Maximum Hazard Impact Distance		
	Radiant Heat (1,600 Btu/(hr•ft^2))	Flash Fire (LFL)	Overpressure (1 psig)
LNG Import Terminal, Long Beach, California	Yes max. distance = 8,610 ft	Yes max. distance = 34,600 ft	Yes max. distance = 320 ft
Propane Terminal, Northern California	Yes max. distance = 1,900 ft	Yes max. distance = 26,750 ft	Yes max. distance = 525 ft
Bulk Storage Terminals, Southern California	Yes max. distance = 595 ft	Yes max. distance = 675 ft	No
LNG Import Terminal, East Coast of Mexico	Yes max. distance = 1,240 ft	Yes max. distance = 21,200 ft	Yes max. distance = 200 ft

7.6 Summary

This study evaluated the extent of fire radiation and explosion overpressure hazards for a range of worst-case releases that included both accidental and intentional releases of flammable fluid from SES's proposed LNG terminal and tank ship operations in the POLB. The hazards associated with the proposed LNG import terminal and LNG tank ship operations are common to most flammable fuel facilities world-wide.

The historical record shows that successful intentional releases of flammable fuel from US facilities events have not occurred. This finding is supported by Federal reports addressing this topic that were written after the terrorist events of September 11, 2001. The Federal reports do not identify flammable fuel facilities as those that could affect large numbers of the public.

A full range of accidental and intentional releases of LNG, natural gas, and other flammable fluids were evaluated in order to quantify the potential impact if such releases were to occur. The accidental releases covered a range of credible events that could occur in an LNG terminal. The intentional releases covered a range of possible terrorist-induced releases ranging from localized damage to equipment as a result of a small explosive charge to more sophisticated and logistically challenging operations involving hijacked aircraft or ships.

The evaluation of the accidental and intentional release scenarios found that the most likely hazard to result from any of the releases is exposure to radiant heat from a pool fire or torch fire. The potential for any of the releases to produce damaging overpressures was found to be small and localized. The potential for drifting flammable vapor clouds to travel a significant distance before being ignited was small, with the possible exception of those releases that may occur outside of the Long Beach Harbor breakwater.

A review of the accidental and intentional events evaluated in this study finds that the events can be divided into four classes. These classes are defined by the event's historical record, or in the case of an earthquake capable of failing the LNG tanks, the predicted frequency of a such an earthquake. The four classes are presented in Table 7-4. In general, the historical record of the LNG import/export industry identifies significant failures within the process area to be the most likely event of those evaluated in this work. The second class involves an accidental release from an LNG tank ship. Although the historical record for LNG

Table 7-4
Comparison of Classes of LNG Release Events

Release Event	Estimate of Frequency of Event	Chance of Event
Rupture of process equipment within LNG terminal (accidental). – Rupture of process equipment - location A * – Rupture of process equipment - location B * – Rupture of process equipment - location C * – Rupture of process equipment - location D * – Rupture of process equipment - location E * – Release from process equipment - location F * – Release from process equipment - location G *	~$3(10)^{-3}$ per year [Historical record of all export and import LNG terminals worldwide.]	3 chances in 1000 per year [Note: all releases were in export terminals.]
LNG ship collision with another ship or breakwater within POLB or harbor entrance (accidental). – Release from LNG tank ship following collision with the breakwater - 1 tank fails – Release from LNG tank ship following collision with the breakwater - 5 tanks fail – Release from LNG tank ship following collision (outside breakwater) with another ship of sufficient size and speed - 1 tank fails – Release from LNG tank ship following collision (outside breakwater) with another ship of sufficient size and speed - 5 tanks fail	~ $1(10)^{-5}$ per port call [Historical record for LNG shipping. No loss of LNG has occurred.]	1 chance in 1000 per year [Assumes 100 LNG ship deliveries per year.]

* Details have been removed because this is considered to be Critical Energy Infrastructure Information (CEII) by the FERC.

Table 7-4
Comparison of Classes of LNG Release Events
(Continued)

Release Event	Estimate of Frequency of Event	Chance of Event
Earthquake-induced failure of LNG tank (accidental).	~$5(10)^{-5}$ per year [Project evaluation of tank design and local conditions.]	5 chances in 100,000 per year.
Release of LNG from terminal or ship due to intentional causes. – Terrorist-hijacked airplane crashing into one or both LNG tanks – Terrorist detonates truck bomb near an LNG tank – Terrorist fires rocket-propelled grenade (RPG) into one or both LNG tanks – Terrorist-hijacked airplane crashing into an LNG tank ship – Terrorist place boat bomb beside an LNG tank ship – Terrorist fires rocket-propelled grenade (RPG) into LNG tank ship – Terrorist-controlled ship collides with an LNG tank ship	~$7(10)^{-6}$ per year [Historical record of terrorist activities in US.]	7 chances in 1,000,000 per year. [Assumes LNG terminal is as valid a “target” as previous terrorist targets.]

tank ships does contain collisions, there has not been a release of LNG during or following a collision. Thus, the probability listed in Table 7-4 assumes that the next shipment of LNG ends in a collision and loss of cargo. As LNG shipments continue without incident, this frequency only gets smaller.

As described in the project documents, an earthquake capable of failing the full containment LNG tank designed for the site is "completely unrealistic." However, according to the analysis, it is not impossible. The frequency of such an earthquake is identified in Table 7-4. As described earlier, it should be kept in mind that an earthquake of sufficient magnitude to fail the LNG tanks would level the Long Beach area.

The last class of release events are those associated with intentional acts against the LNG terminal or LNG tank ship. These event frequencies are based on the historical record of terrorist events in the United States and are not specific to LNG terminals. This historical record of terrorist-induced events in the United States produces a frequency that is lower than the other event frequencies identified in this work.

The potential impact to neighboring POLB facilities was evaluated for the worst-case releases identified in this study. As would be expected in any analysis of this type, the industrial neighbors of the proposed LNG import terminal could be exposed to radiant hazards following events of the magnitude evaluated in this study. For the largest release studied, both accidental and intentional, there is the potential for the 10,000 Btu/(hr•ft^2) radiant flux level to extend 3,780 ft from the terminal. The areas within the POLB that could be affected by this release can be identified in Figure 7-1. It should be noted that the 10,000 Btu/(hr•ft^2) [structural steel damage] radiant level does not extend outside the POLB boundary for any scenario evaluated.

The potential hazards associated with accidental and intentional releases from the proposed LNG import terminal were compared to three other large flammable fuel facilities. Fire radiation impacts (pool fires and torch fires) provided the best method for comparing the impacts among the facilities. When this comparison is made, the maximum radiant impacts from the four facilities range from 595 to 8,610 feet from the fire source. In all four facilities, these worst-case radiant impacts, as defined by 1,600 Btu/(hr•ft^2) radiant heat flux [second degree burns], have the potential to extend past the facility property line.

Additional calculations for a range of LPG storage and transportation vessels in common use in the Long Beach area were made. The radiant zones were found to range from 20 to over 3,000 feet, dependent on the capacity of the vessel. These potential hazards exist in Long Beach on a day-to-day basis.

In the specific case of the proposed LNG import terminal in the Port of Long Beach, only two of the events evaluated have the potential to produce radiant impacts that could affect the public outside of the industrial area defined by the POLB boundary line. The largest radiant impact (as defined by 1,600 Btu/(hr•ft^2)) distance, was 8,610 ft, which would result from an earthquake of sufficient magnitude to fail both LNG storage tanks and the security wall surrounding the tanks. This failure allows a significant portion of the LNG to reach the water. Following ignition, the fire column (as defined by the FERC fire model) can produce 1,600 Btu/(hr•ft^2) slightly past the eastern POLB boundary line. The vulnerability zone for this scenario is presented in Figure 7-2 When reviewing this scenario, four things should be kept in mind.

1. An earthquake of the magnitude necessary to fail one or both tanks has been defined as "unrealistic" following a site-specific study. Thus, a catastrophic tank failure due to an earthquake should not be thought of as likely or probable. This accidental event, although defined as credible, would not normally be used as a benchmark for siting calculations.

2. An earthquake of the magnitude necessary to fail the full containment LNG storage tanks would be sufficient to level essentially every structure in the Port of Long Beach, as well as in the City of Long Beach.

3. In addition to the earthquake, a high wind would have to be blowing from the west to the east in order for the fire to impact the area outside the POLB boundary indicated in Figure 7-2.

4. The FERC fire model employed to make this calculation is not able to account for the lack of oxygen available to the core of such a large fire. Thus, the model overestimates the height and surface flux of the flame. This results in overestimating the potential impacts.

The second fire event that has the ability to produce 1,600 Btu/(hr⋅ft^2) impacts past the POLB boundary is a pool fire following a truck bomb that fails one of the LNG storage tanks as well as the security wall. This event, although intentional in nature, results in a fire similar to, but smaller than, the fire associated with the earthquake (Figure 7-3). In this case, the 1,600 Btu/(hr⋅ft^2) impact zone does not extend as far as the earthquake-induced failure since the LNG inventory is less (only one tank fails). However, issues 2 and 3 listed above would also apply to this scenario.

All the remaining LNG fire events evaluated for this study (those associated with terminal operations, storage, and LNG tank ship movements and operations) have no fire radiation impacts that extend past the POLB boundary. This is true whether the initiating event is accidental or intentional.

In conclusion, the results of this study can be summarized by the following points.

- The historical record and the Federal government's evaluation of flammable fuel facilities does not support the contention that the proposed LNG terminal would make an attractive terrorist target.

- If a successful terrorist-induced event occurred tomorrow in <u>any</u> toxic chemical or flammable fuels facility in the United States that could impact as many or more people than the proposed LNG import terminal in the POLB, the historical frequency would then be approximately 7.15 x $(10)^{-6}$/yr.

- The fire radiation hazards from LNG pool fires are the most likely hazards to occur, and they produce the largest hazard zones should they occur. Significant overpressures covering a large area are not possible and the opportunity for drifting flammable vapor clouds to travel any significant distance over land before igniting is not credible.

- None of the accidental or intentional releases from the LNG terminal or LNG tank ship operations have the ability to produce radiant levels (10,000 Btu/(hr⋅ft^2)) capable of damaging industrial equipment outside the POLB boundary.

- Only one accidental release (that caused by an earthquake of sufficient magnitude to fail the LNG tanks) can produce a radiant hazard (1,600 Btu/(hr⋅ft^2); second degree skin burns) to persons outside of the POLB boundary. It should be recognized that an earthquake of this magnitude would, on its own, cause wide-spread destruction in the POLB and Long Beach.

- Only one intentional release, the effective placement of a truck bomb beside one of the LNG storage tanks, can produce a radiant hazard (1,600 Btu/(hr⋅ft^2); second degree skin burns) to persons outside of the POLB boundary, and only under specific atmospheric conditions.

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 7-15
Figure 7-2

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

Non-Internet Public

DRAFT ENVIRONMENTAL IMPACT
STATEMENT/ENVIRONMENTAL IMPACT REPORT
FOR THE
LONG BEACH LNG IMPORT PROJECT

Docket No. CP04-58-000, et al.

Page 7-16
Figure 7-3

Public access for the above information is available only
through the Public Reference Room, or by e-mail at
public.referenceroom@ferc.gov

SECTION 8
REFERENCES

Section 1 References

Glasfeld, Rolf D. (1979), *Some Aspects of LNG Ship Safety and Reliability*. Prepared for Gastech 79 LNG/ LPG Conference & Exhibition, 13-16 November, 1979, Houston, Texas.

Section 2 References

Borrero, Ph.D., J., S. Cho, J.E. Moore II, Ph.D., H.W. Richardson, C. Synolakis, Ph.D. 2005. Could it Happen Here? Civil Engineering. April.

EN 1473 (1997), *Installation and Equipment for Liquefied Natural Gas - Design of Onshore Installations*. European Standard EN 1473; British Standard BS EN 1473; British Standards Board, 1997.

EPA (1996), *Accidental Release Prevention Requirements: Risk Management Programs Under the Clean Air Act, Section 112(r)(7)*. United States Environmental Protection Agency, 40 CFR Part 68, 1996.

McCulloch, D.S. (1985). *Evaluating Tsunami Potential in Evaluating Earthquake Hazards in the Los Angeles Region - An Earth Science Perspective*. United States Geological Survey, Professional Paper 1360, p.375-413. Ziony, J., ed.

NTSB (5); 1985-2003: National Transportation Safety Board, *Table 5. Accidents, Fatalities, and Rates, 1984 through 2003, for U.S. Air Carriers Operating Under 14 CFR 121, Scheduled and Nonscheduled Service (Airlines)*. Internet site www.ntsb.gov/aviation/Table5.htm as of April 2004.

SCAQMD (2001), Final Environmental Impact Report for the Equilon Enterprises, LLC, Los Angeles Refinery, CARB Pahse 3 Proposed Project, Volume III Hazard Analysis, October 2001.

Synolakis, C. 2003. Tsunami and Seiche. Earthquake Engineering Handbook, Chapter 9. CRC Press.

Section 3 References

ARUP (2005), *Tank Failure Assessment*. ARUP & Partners California Ltd., Report to the Port of Long Beach dated April 5, 2005.

Belke, James C. (2000), *Chemical Accident Risks in U.S. Industry - A Preliminary Analysis of Accident Risk Data from U.S. Hazardous Chemical Facilities*. United States Environmental Protection Agency, Washington, D.C. 20460, September 25, 2000.

Brookings Institution (2002), *Protecting the American Homeland; A Preliminary Analysis*. Washington, D.C., 2002.

CCPS (1989b), *Guidelines for Process Equipment Reliability Data, with Data Tables*. Center for Chemical Process Safety of the American Institute of Chemical Engineers, 345 East 47th Street, New York, New York 10017, 1989 (ISBN 0-8169-0422-7).

Cox, A. W., F. P. Lees, and M. L. Ang (1990), *Classification of Hazardous Locations*. The Institution of Chemical Engineers (IChemE), Rugby, Warwickshire, United Kingdom, 1990.

Crouch, Stacey, The Port of Long Beach. "LB LNG Import Terminal HA." E-mail to John B. Cornwell, September 10, 2004.

Davis, L. N. (1979) *Frozen Fire*. Friends of the Earth, San Francisco, California, 1979.

Eagle Lyon Pope (2001), *Elba Island LNG Terminal, Addendum No. 2 Report to Southern LNG, Inc.* Eagle Lyon Pope Port and Marine Consultants, Report No. ELP-55010-0501-57005-Rev02/Add2, August, 2001.

FERC (1996), *EcoEléctrica LNG Import Terminal and Cogeneration Project, Final Environmental Impact Statement*. Federal Energy Regulatory Commission (FERC), Office of Pipeline Regulation, Washington, D.C. 20426, April, 1996.

GAO (2003), *Homeland Security, Voluntary Initiatives are Underway at Chemical Facilities, but the Extent of Security Preparedness is Unknown*. U.S. General Accounting Office, GAO-03-439, March, 2003.

G.I.I.G.N.L. (2003), *The LNG Industry 2003*. International Group of Liquefied Natural Gas Importers, 22, rue Marius Aufan - 92300 Levallois-Perret.

Greuner, H. P. and M Böckenhauer (1980), "Studies of the Resistance of LNG Carriers to Collisions." *Sixth International Conference on Liquefied Natural Gas*, Kyoto, Japan, April 7-10, 1980, Session III, Paper 6.

Hazardous Cargo Bulletin, September, 1982,"LNG by Sea: How Safe is It?" R. J. Lakey. pp. 20-21.

Hazardous Cargo Bulletin, April, 1996.

Hazardous Cargo Bulletin, January, 1998.

KBR (2005), Technical Memorandum from KBR to the Port of Long Beach titled *Summary of Estimated Earthquake Magnitudes based on Design Requirements and for the Failure Case for the LNG Storage Tanks for the SES LNG Terminal Project* (Rev. 1) dated April 29, 2005.

LNG OneWorld website (www.lngoneworld.com), July 5, 2002.

OREDA (1984), *OREDA, Offshore Reliability Data Handbook* (First Edition). OREDA, Post Office Box 370, N-1322 Hovik, Norway, 1984 (ISBN 82-515-0087-7).

POLB, 2004. Los Angeles/Long Beach Harbor Safety Plan, Los Angeles/Long Beach Harbor Safety Committee, June 2004.

SIGTTO, November, 1982, "Save Havens for Disabled Gas Carriers." Society of International Gas Tanker and Terminal Operators Limited, 17, St. Helen's Place London EC3A 6DE.

Software Program: LandView®6 Version 1.0 by United States Environmental Protection Agency, United States Coast Guard, National Oceanic and Atmospheric Administration, and United States Census Bureau, October, 2003.

Software Program: RMP*Comp Version 1.07 by United States Environmental Protection Agency.

Thomas, W. D. and R. J. Lakey (1993), "The LNG/LPG Fleet Safety Record—A Reprise". Paper presented at GASTECH 93, Paris, France, 15-19 February 1993.

TNO (1999), *Guidelines for Quantitative Risk Assessment* (First Edition), the Purple Book. CPR 18E, the Netherlands Organization for Applied Scientific Research, Committee for the Prevention of Disasters, the Hague, Netherlands, 1999.

URS/KBR (2005), Technical Memorandum from C.B. Crouse (URS) to T. Howe (KBR) and M. Lee (KBR) regarding Magnitude of Earthquake Producing the SSE Ground Motion. Project number 33757600, March 21, 2005

U.S. Army (2001), *Draft Medical NBC Hazard Analysis of Chemical-Biological-Radiological-Nuclear High Explosive Threat, Possible Scenarios and Planning Requirements*. Army Office of the Surgeon General, October, 2001.

Section 4 References

Baker, Q. A., M. J. Tang, E. Scheier, and G. J. Silva (1994), "Vapor Cloud Explosion Analysis." *28th Loss Prevention Symposium*, American Institute of Chemical Engineers (AIChE), April 17-21, 1994.

Baker, Q. A., C. M. Doolittle, G. A. Fitzgerald, and M. J. Tang (1998), "Recent Developments in the Baker-Strehlow VCE Analysis Methodology." *Process Safety Progress*, 1998: p. 297.

Eagle Lyon Pope (2001), *Elba Island LNG Terminal, Addendum No. 2 Report to Southern LNG, Inc*. Eagle Lyon Pope Port and Marine Consultants, Report No. ELP-55010-0501-57005-Rev02/Add2, August, 2001.

FERC (1996), *EcoEléctrica LNG Import Terminal and Cogeneration Project, Final Environmental Impact Statement*. Federal Energy Regulatory Commission (FERC), Office of Pipeline Regulation, Washington, D.C. 20426, April, 1996.

FERC (2004), U.S. Federal Energy Regulatory Commission (FERC) report titled *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, published on June 29, 2004.

GRI (1990a), *LNG Vapor Dispersion Prediction with the DEGADIS Dense Gas Dispersion Model*. Gas Research Institute, GRI-89/0242, April 1988-July 1990.

GRI (1990b), *LNGFIRE: A Thermal Radiation Model for LNG Fires*. Gas Research Institute, GRI-89/0176, June 29, 1990.

Greuner, H. P. andM Böckenhauer (1980), "Studies of the Resistance of LNG Carriers to Collisions." *Sixth International Conference on Liquefied Natural Gas*, Kyoto, Japan, April 7-10, 1980, Session III, Paper 6.

Harris, R. J., and M. J, Wickens (1989), "Understanding Vapour Cloud Explosions—An Experimental Study." The Institution of Gas Engineers, Communication No. 1408, 1989.

Hirst, W. J. S., and J. A. Eyre (1982), "Maplin Sands Experiments 1980: Combustion of Large LNG and Refrigerated Liquid Propane Spills on the Sea." *Proceedings of the Second Symposium on Heavy Gases and Risk Assessment*, Frankfurt am Main, May 25-26, 1982: pp. 211-224.

Johnson, D. M., P. Sutton, and M. J. Wickens (1991), "Scaled Experiments to Study Vapour Cloud Explosions." IChemE Symposium Series No. 124, *Hazards XI*, New Directions in Process Safety, Manchester, United Kingdom, April, 1991: pp. 67-85.

KBR (2005), Technical Memorandum from KBR to the Port of Long Beach titled *Summary of Estimated Earthquake Magnitudes based on Design Requirements and for the Failure Case for the LNG Storage Tanks for the SES LNG Terminal Project* (Rev. 1) dated April 29, 2005.

Pitblado, R. M., J. Baik, G. J. Hughes, C. Ferro, and S. J. Shaw (2004). "Consequences of LNG Marine Incidents." *CCPS Annual International Conference and Workshop*, Center for Chemical Process Safety of the American Institute of Chemical Engineers, Orlando, Florida, June 29-July 1, 2004.

TNO (1999), *Guidelines for Quantitative Risk Assessment* (First Edition), the Purple Book. CPR 18E, the Netherlands Organization for Applied Scientific Research, Committee for the Prevention of Disasters, the Hague, Netherlands, 1999.

van Wingerden, C. J. M., and J. P. Zeeuwen (1983), "Flame Propagation in the Presence of Repeated Obstacles: Influence of Gas Reactivity and Degree of Confinement." *Journal of Hazardous Materials*, Vol. 8, 1983: pp. 139-156.

Wiekema, B. J. (1984), "Vapour Cloud Explosions—An Analysis Based on Accident" (Part I). *Journal of Hazardous Materials*, Vol. 8, 1984: pp. 285-311.

Wiekema, B. J. (1984), "Vapour Cloud Explosions – An Analysis Based on Accident" (Part II). *Journal of Hazardous Materials*, Vol. 8, 1984: pp. 313-329.

Section 5 References

Clancey, V. J. (1972), "Diagnostic Features of Explosion Damage." *6th International Meeting on Forensic Sciences*, Edinburgh, Scotland, 1972.

DOT (May 2000), *Liquefied Natural Gas Facilities: Federal Safety Standards* (49 CFR 193). U.S. Department of Transportation, Research and Special Programs Administration, Washington, D.C., 2000.

HUD, 24 CFR 51, *Environmental Criteria and Standards; Siting of HUD-Assisted Projects Near Hazardous Operations Handling Petroleum Products or Chemicals of an Explosive or Flammable Nature.* Department of Housing and Urban Development (HUD), Final Rule, FEDERAL REGISTER Vol. 49, No. 29, February 10, 1984, Docket No. R-84-709; FR-935.

NFPA 59A (2001), *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*. National Fire Protection Association, Boston, Massachusetts, 2001.

Section 6 References

COEG (2000), Lent Ranch Marketplace Draft Environmental Impact Report for the City of Elk Grove, Appendix 4.5 Hazards, October, 2000.

FERC (2004). U.S. Federal Energy Regulatory Commission (FERC) Office of Pipeline Regulation report titled *Comments of The International LNG Alliance and The International Gas Union on Final Report*, published May 28, 2004 FERC Docket No. AD04-6-000.

Mahoney, David G., Editor (1997), *Large Property Damage Losses in the Hydrocarbon-Chemical Industries; A Thirty-year Review* (Seventeenth Edition). J&H Marsh & McLennan, M&M Protection Consultants, New York, New York, 1997.

National Safety Council (1997), *Accident Facts, 1997 Edition*. Library of Congress Catalog Card Number 91-60648, ISBN 0-87912-196-3, 1997.

Raj, Phani K. (2004), Letter from Dr. Phani K. Raj to Federal Energy Regulatory Commission regarding Technical Comments on the report *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*, May 27, 2004. FERC Docket No. AD04-6-000.

SCAQMD (2001), Final Environmental Impact Report for the Equilon Enterprises, LLC, Los Angeles Refinery, CARB Phase 3 Proposed Project, Volume III Hazard Analysis, October 2001.

Shell and El Paso Consortium (2001), Terminal de Regasificación de Gas Natural Licuado Altamira Estudio Cuantitativo de Riesgos, Terminal de LNG de Altamira, S. de R.L. de C.V., Diciembre 2001.

Appendix A References

Bush, S. H. (1975), "Pressure Vessel Reliability." *Journal of Pressure Vessel Technology*, No. 97, Series J, February, 1975: pp. 54-70.

CCPS (1989b), *Guidelines for Process Equipment Reliability Data, with Data Tables*. Center for Chemical Process Safety of the American Institute of Chemical Engineers, 345 East 47th Street, New York, New York, 1989.

Fearnehough, G. D. (1985), *The Control of Risk in Gas Transmission Pipelines*. British Gas Research and Development, D.473, January, 1985.

Green, A. E., and A. J. Bourne (1972), *Reliability Technology*. John Wiley and Sons, Ltd., New York, New York, 1972.

HSE (1991), *Major Hazard Aspects of the Transport of Dangerous Substances*. Health and Safety Executive, Advisory Committee on Dangerous Substances, London, United Kingdom, 1991.

Lees, F. P. (1996), *Loss Prevention in the Process Industries* (Second Edition), Volumes I, II, and III. Butterworth-Heinemann (Publishers), Oxford, United Kingdom, 1996.

OREDA (1984), *OREDA, Offshore Reliability Data Handbook* (First Edition). OREDA, Post Office Box 370, N-1322 Hovik, Norway, 1984.

Smith, T. A., and R. G. Warwick (1981), *A Survey of Defects in Pressure Vessels in the United Kingdom for the Period 1962-1978 and Its Relevance to Nuclear Primary Circuits*. Safety and Reliability Directorate, SRD R-203, United Kingdom Atomic Energy Authority, December, 1981.

Sooby, W., and J. M. Tolchard (1993), "Estimation of Cold Failure Frequency of LPG Tanks in Europe." Paper presented at the Conference on Risk and Safety Management in the Gas Industry, Hong Kong, October, 1993.

TNO (1983), *LPG, A Study*. The Netherlands Organization for Applied Scientific Research, Apeldoorn, the Netherlands, May, 1983.

TNO (1999), *Guidelines for Quantitative Risk Assessment* (First Edition), the Purple Book. CPR 18E, the Netherlands Organization for Applied Scientific Research, Committee for the Prevention of Disasters, the Hague, Netherlands, 1999.

USCB (1999), *1997 Economic Census, Transportation, 1997 Commodity Flow Survey*. U.S. Department of Transportation (Bureau of Transportation Statistics), U.S. Department of Commerce (Economics and Statistics Administration), and U.S. Census Bureau, EC97TCF-US(HM), December, 1999.

USNRC (1975), *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*. WASH 1400, U.S. Nuclear Regulatory Commission, Washington, D.C., October, 1975.

APPENDIX A
FAILURE RATE DATA REFERENCES

Failure Rate Data References

Equipment	Failure Rate Data Bases
Piping	*Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants* [USNRC, 1975] *Guidelines for Process Equipment Reliability Data, with Data Tables* [CCPS, 1989b] *The Control of Risk in Gas Transmission Pipelines* [Fearnehough, 1985]
Gaskets	*Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*. [USNRC, 1975] *Reliability Technology* [Green and Bourne, 1972]
Valves	*Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*. [USNRC, 1975] *Guidelines for Process Equipment Reliability Data, with Data Tables* [CCPS, 1989b]
Pressure Vessels	*Guidelines for Process Equipment Reliability Data, with Data Tables* [CCPS, 1989b] "Pressure Vessel Reliability." *Journal of Pressure Vessel Technology* [Bush, 1975] *A Survey of Defects in Pressure Vessels in the United Kingdom for the Period 1962-1978 and Its Relevance to Nuclear Primary Circuits* [Smith and Warwick, 1981] *1997 Economic Census, Transportation, 1997 Commodity Flow Survey* [USCB, 1999] *Major Hazard Aspects of the Transport of Dangerous Substances* [HSE, 1991] *LPG, A Study* [TNO, 1983] "Estimation of Cold Failure Frequency of LPG Tanks in Europe" [Sooby and Tolchard, 1993]
Pumps	*Reliability Technology* [Green and Bourne, 1972] *OREDA, Offshore Reliability Data Handbook* (First Edition) [OREDA, 1984] *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*. [USNRC, 1975] *Guidelines for Process Equipment Reliability Data, with Data Tables* [CCPS, 1989b]
Transfer Hoses	*Reliability Technology* [Green and Bourne, 1972] *Accident Facts, 1997 Edition* [Lees, 1996] *Guidelines for Process Equipment Reliability Data, with Data Tables* [CCPS, 1989b]
Storage Tanks	*Guidelines for Quantitative Risk Assessment* (First Edition) [TNO, 1999]

QUEST

APPENDIX B
CANARY BY QUEST® MODEL DESCRIPTIONS

The following model descriptions are taken from the CANARY by Quest User Manual.

Section A	Engineering Properties
Section B	Pool Fire Radiation Model
Section C	Torch Fire and Flare Radiation Model
Section D	Fireball Model
Section E	Fluid Release Model
Section F	Momentum Jet Dispersion Model
Section G	Heavy Gas Dispersion Model
Section I	Vapor Cloud Explosion Model

QUEST

Engineering Properties

Purpose

The purpose of this model is to provide an accurate means of computing physical and thermodynamic properties of a wide range of chemical mixtures and pure components using a minimum of initial information.

Required Data

(a) Fluid composition
(b) Temperature and pressure of the fluid prior to release

Methodology

Basic thermodynamic properties are computed using the Peng-Robinson equation of state [Peng and Robinson, 1976]. The necessary physical and thermodynamic properties are calculated in the following manner.

Step 1: The temperature and pressure of the fluid at storage conditions and the identity and mole fraction of each component of the fluid are obtained. Mixture parameters are determined using data from the extensive properties data base within CANARY.

Step 2: Each calculation begins with the computation of the vapor and liquid fluid composition. For cases where the temperature and pressure result in only one phase being present, the vapor or liquid composition will be the same as the initial feed composition. The composition calculation is an iterative procedure using a modification of the techniques described by Starling [1973].

Step 3: Once the vapor and liquid compositions are known, the vapor and liquid densities, enthalpies, entropies, and heat capacities can be computed directly. Other physical properties (viscosity, thermal conductivity, surface tension, etc.) are computed using correlations developed in Reid, Prausnitz, and Poling [1987].

Step 4: A matrix of properties is computed over a range of temperatures and pressures. Physical and thermodynamics properties required by other models within CANARY are then interpolated from this table.

Basic Thermodynamic Equations

$$Z^3 - (1 - B) \cdot Z^2 + \left(A - 3 \cdot B^2 - 2 \cdot B\right) \cdot Z - \left(A \cdot B - B^2 - B^3\right) = 0 \tag{1}$$

where: Z = fluid compressibility factor, $\frac{P \cdot V}{R \cdot T}$, dimensionless

P = system pressure, kPa

V = fluid specific volume, m^3/kmol

R = gas constant, 8.314 $m^3 \cdot kPa/(kmol \cdot K)$

T = absolute temperature, K

$$A = \frac{a \cdot P}{R^2 \cdot T^2}$$

$$a = 0.45724 \cdot \frac{R^2 \cdot T^2}{P_c} \cdot \alpha$$

$$\alpha = \left[1 + m \cdot \left(1 - T_r^{0.5}\right)^2\right]$$

$$m = 0.37464 + 1.54226 \cdot \omega - 0.26992 \cdot \omega^2$$

ω = acentric factor

$$T_r = \frac{T}{T_c}$$

T_c = pseudo-critical temperature, K

P_c = pseudo-critical pressure, kPa

$$B = \frac{b \cdot P}{R \cdot T}$$

$$b = 0.0778 \cdot R \cdot \frac{T_c}{P_c}$$

$$H = H^o + \frac{P}{\rho} - R \cdot T + \int_0^{\rho} \left[P - T \cdot \left(\frac{\partial P}{\partial T}\right)_{\rho}\right] \cdot \left(\frac{d\rho}{\rho^2}\right) \tag{2}$$

where: H = enthalpy of fluid at system conditions, kJ/kg

H^o = enthalpy of ideal gas at system temperature, kJ/kg

$$S = S^o - R \cdot \ln\left(\rho \cdot R \cdot T\right) + \int_0^{\rho} \left[\rho \cdot R - \left(\frac{\partial P}{\partial T}\right)_{\rho}\right] \cdot \left(\frac{d\rho}{\rho^2}\right) \tag{3}$$

where: S = entropy of fluid at system conditions, kJ/(kg•K)

S^o = entropy of ideal gas at system temperature, kJ/(kg•K)

$$R \cdot T \cdot \ln\left(\frac{f_i}{f_i^o}\right) = \left[\left(H_i - H_i^o\right) - T \cdot \left(S_i - S_i^o\right)\right] \tag{4}$$

where: f_i = fugacity of component i, kPa

f_i^o = standard state reference fugacity, kPa

References

Peng, D., and D. B. Robinson, "New Two-Constant Equation of State." *Industrial Engineering Chemistry Fundamentals*, Vol. 15, No. 59, 1976.

Reid, R. C., J. M. Prausnitz, and B. E. Poling, *The Properties of Gases and Liquids* (Fourth Edition). McGraw-Hill Book Company, New York, New York, 1987.

Starling, K. E., *Fluid Thermodynamic Properties for Light Petroleum Systems*. Gulf Publishing Company, Houston, Texas, 1973.

Pool Fire Radiation Model

Purpose

The purpose of this model is to predict the impact of fire radiation emitted by flames that are fueled by vapors emanating from liquid pools. Specifically, the model predicts the maximum radiant heat flux incident upon a target as a function of distance between the target and the flame.

Required Data

(a) Composition of the liquid in the pool
(b) Temperature of the liquid in the pool
(c) Wind speed
(d) Air temperature
(e) Relative humidity
(f) Elevation of the target (relative to grade)
(g) Elevation of the pool (relative to grade)
(h) Dimensions of the free surface of the pool
(i) Orientation of the pool (relative to the wind direction)
(j) Spill surface (land or water)

Methodology

Step 1: The geometric shape of the flame is defined. The flame column above a circular pool, square pool, or rectangular pool is modeled as an elliptical cylinder.

Step 2: The dimensions of the flame column are determined. The dimensions of the base of the flame are defined by the pool dimensions. An empirical correlation developed by Thomas [1965] is used to calculate the length (height) of the flame.

$$L = 42 \cdot D_h \cdot \left(\frac{\dot{m}}{\rho_a \cdot \left(g \cdot D_h \right)^{0.5}} \right)^{0.61}$$

where: L = length (height) of the flame, m
D_h = hydraulic diameter of the liquid pool, m
$\dot{m}$ = mass burning flux, kg/(m^2•s)
ρ_a = density of air, kg/m^3
g = gravitational acceleration, 9.8 m/s^2

Notes: Mass burning fluxes used in the Thomas equation are the steady-state rates for pools on land (soil, concrete, etc.) or water, whichever is specified by the user.

For pool fires with hydraulic diameters greater than 100 m, the flare length, L, is set equal to the length calculated for $D_h = 100$ m.

Step 3: The angle (Φ) to which the flame is bent from vertical by the wind is calculated using an empirical correlation developed by Welker and Sliepcevich [1970].

$$\frac{\tan(\Phi)}{\cos(\Phi)} = 3.2 \cdot \left(\frac{D_h \cdot u \cdot \rho_a}{\mu_a}\right)^{0.07} \cdot \left(\frac{u^2}{g \cdot D_h}\right)^{0.7} \cdot \left(\frac{\rho_v}{\rho_a}\right)^{-0.6}$$

where: Φ = angle the flame tilts from vertical, degrees
u = wind speed, m/s
μ_a = viscosity of air, kg/(m·s)
ρ_v = density of fuel vapor, kg/m^3

Step 4: The increase in the downwind dimension of the base of the flame (flame drag) is calculated using a generalized form of the empirical correlation Moorhouse [1982] developed for large circular pool fires.

$$D_w = 1.5 \cdot D_x \cdot \left(\frac{u^2}{g \cdot D_x}\right)^{0.069}$$

where: D_w = downwind dimension of base of tilted flame, m
D_x = downwind dimension of the pool, m

Step 5: The flame is divided into two zones: a clear zone in which the flame is not obscured by smoke; and a smoky zone in which a fraction of the flame surface is obscured by smoke. The length of the clear zone is calculated by the following equation, which is based on an empirical correlation developed by Pritchard and Binding [1992].

$$L_c = 55.05 \cdot D_h^{-0.6} \cdot \left(\frac{\dot{m}}{\rho_a}\right)^{1.13} \cdot (u+1)^{0.179} \cdot \left(\frac{C}{H}\right)^{-2.49}$$

where: L_c = length of the clear zone, m
$\frac{C}{H}$ = carbon/hydrogen ratio of fuel, dimensionless

Step 6: The surface flux of the clear zone is calculated using the following equation.

$$q_{cz} = q_{sm} \cdot \left(1 - e^{-b \cdot D_h}\right)$$

where: q_{cz} = surface flux of the clear zone, kW/m^2
q_{sm} = maximum surface flux, kW/m^2
b = extinction coefficient, m^{-1}

Average surface flux of the smoky zone, q_{cz}, is then calculated, based on the following assumptions.

- The smoky zone consists of clean-burning areas and areas in which the flame is obscured by smoke.
- Within the smoky zone, the fraction of the flame surface that is obscured by smoke is a function of the fuel properties and pool diameter.
- Smoky areas within the smoky zone have a surface flux of 20 kW/m^2 [Hagglund and Persson,1976].
- Clean-burning areas of the smoky zone have the same surface flux as the clean-burning zone.
- The average surface flux of the smoky zone is the area-weighted average of the surface fluxes for the smoky areas and the clean-burning areas within the smoky zone.

(This two-zone concept is based on the Health and Safety Executive POOLFIRE6 model, as described by Rew and Hulbert [1996].)

Step 7: The surface of the flame is divided into numerous differential areas. The following equation is then used to calculate the view factor from a differential target, at a specific location outside the flame, to each differential area on the surface of the flame.

$$F_{dA_t \to dA_f} = \frac{\cos(\beta_t) \cdot \cos(\beta_f)}{\pi \cdot r^2} \cdot dA_f \qquad \text{for } [\ \beta_t\ ] \text{ and } [\ \beta_f\ ] < 90^\circ$$

where: $F_{dA_t \to dA_f}$ = view factor from a differential area on the target to a differential area on the surface of the flame, dimensionless
dA_f = differential area on the flame surface, m^2
dA_t = differential area on the target surface, m^2
r = distance between differential areas dA_t and dA_f, m
β_t = angle between normal to dA_t and the line from dA_t to dA_f, degrees
β_f = angle between normal to dA_f and the line from dA_t to dA_f, degrees

Step 8: The radiant heat flux incident upon the target is computed by multiplying the view factor for each differential area on the flame by the appropriate surface flux (q_{cz} or q_{sz}) and by the appropriate atmospheric transmittance, then summing these values over the surface of the flame.

$$q_{ai} = \sum_{A_f} q_{sf} \cdot F_{dA_t \to dA_f} \cdot \tau$$

where: q_{ai} = attenuated radiant heat flux incident upon the target due to radiant heat emitted by the flame, kW/m^2
A_f = area of the surface of the flame
q_{sf} = radiant heat flux emitted by the surface of the flame, kW/m^2 (q_{sf} equals either q_{cz} or q_{sz}, as appropriate)
τ = atmospheric transmittance, dimensionless

Atmospheric transmittance, τ, is a function of absolute humidity and r, the path length between differential areas on the flame and target [Wayne, 1991].

Step 9: Steps 7 and 8 are repeated for numerous target locations.

Validation

Several of the equations used in the Pool Fire Radiation Model are empirical relationships based on data from medium- to large-scale experiments, which ensures reasonably good agreement between model predictions and experimental data for variables such as flame length and tilt angle. Comparisons of experimental data and model predictions for incident heat flux at specific locations are more meaningful and of greater interest. Unfortunately, few reports on medium- or large-scale experiments contain the level of detail required to make such comparisons.

One source of detailed test data is a report by Welker and Cavin [1982]. It contains data from sixty-one pool fire tests involving commercial propane. Variables that were examined during these tests include pool size (2.7 to 152 m^2) and wind speed. Figure B-1 compares the predicted values of incident heat flux with experimental data from the sixty-one pool fire tests.

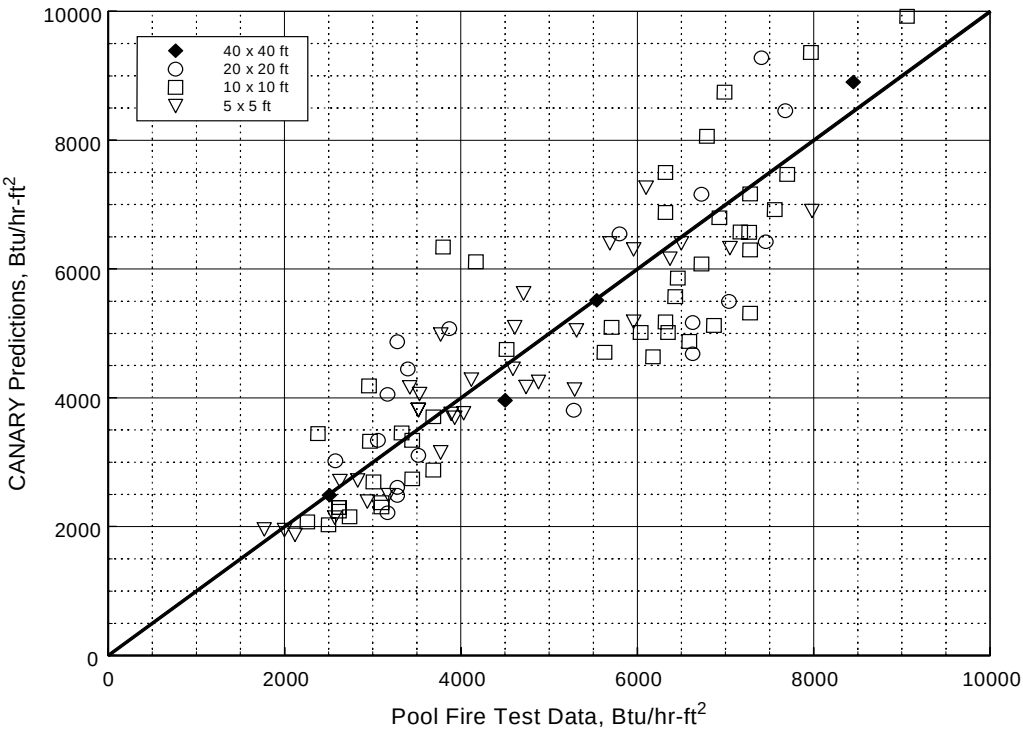


Figure B-1

In another series of tests, fire radiation measurements were taken for large liquefied natural gas (LNG) pool fires. The Montoir tests are the largest tests of LNG fires, involving pools up to 35 meters in diameter [Nédelka, Moorhouse, and Tucker, 1989]. Figure B-2 compares the radiation isopleths predicted by CANARY with the actual measurements taken in Test 2 of the Montoir series.

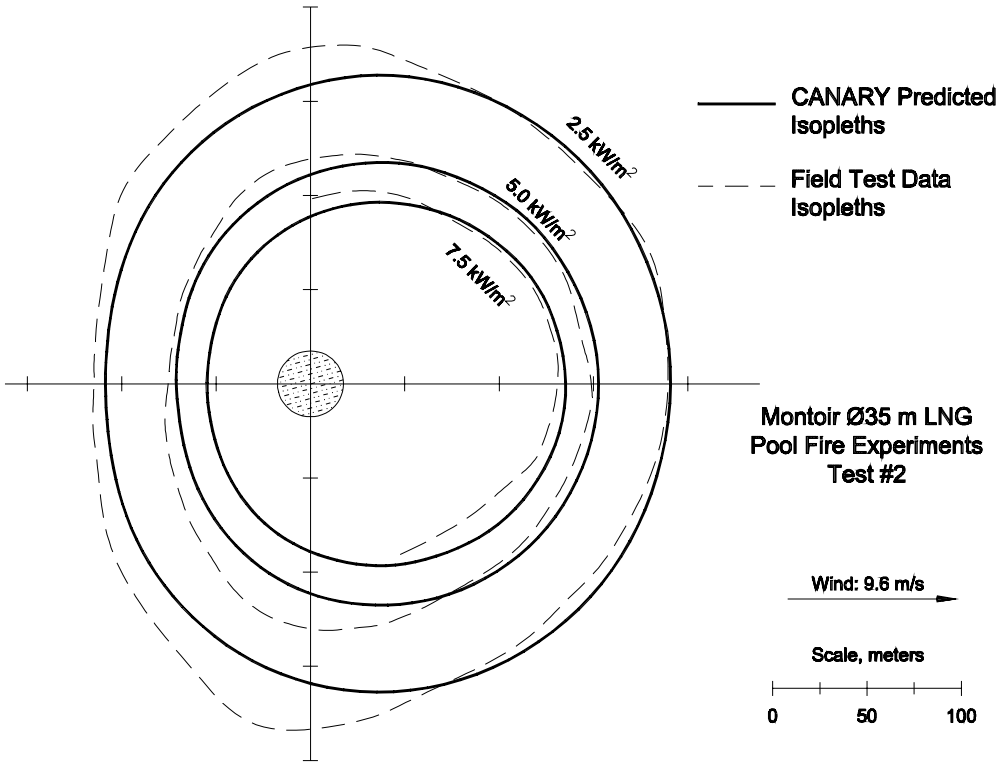


Figure B-2

References

Hagglund B., and L. Persson, *The Heat Radiation from Petroleum Fires*. FOA Rapport, Forsvarets Forskningsanstalt, Stockholm, Sweden, 1976.

Moorhouse, J., "Scaling Criteria for Pool Fires Derived from Large-Scale Experiments." *The Assessment of Major Hazards*, Symposium Series No. 71, The Institution of Chemical Engineers, Pergamon Press Ltd., Oxford, United Kingdom, 1982: pp. 165-179.

Nédelka, D., J. Moorhouse, and R. F. Tucker, "The Montoir 24 m Diameter LNG Pool Fire Experiments." *Ninth International Conference on Liquefied Natural Gas* (Volume 2), Nice, France, Institute of Gas Technology, Chicago, Illinois, 1989.

Pritchard, M. J., and T. M. Binding, "FIRE2: A New Approach for Predicting Thermal Radiation Levels from Hydrocarbon Pool Fires." *IChemE Symposium Series*, No. 130, 1992: pp. 491-505.

Rew, P. J., and W. G. Hulbert, *Development of Pool Fire Thermal Radiation Model*. HSE Contract Research Report No. 96/1996.

Thomas, P. H., *F.R. Note 600*, Fire Research Station, Borehamwood, England, 1965.

Wayne, F. D., "An Economical Formula for Calculating Atmospheric Infrared Transmissivities." *Journal of Loss Prevention in the Process Industries*, Vol. 4, January, 1991: pp. 86-92.

Welker, J. R., and W. D. Cavin, *Vaporization, Dispersion, and Radiant Fluxes from LPG Spills*. Final Report No. DOE-EP-0042, Department of Energy Contract No. DOE-AC05-78EV-06020-1, May, 1982 (NTIS No. DOE-EV-06020-1).

Welker, J. R., and C. M. Sliepcevich, *Susceptibility of Potential Target Components to Defeat by Thermal Action*. University of Oklahoma Research Institute, Report No. OURI-1578-FR, Norman, Oklahoma, 1970.

Torch Fire and Flare Radiation Model

Purpose

The purpose of this model is to predict the impact of fire radiation emitted by burning jets of vapor. Specifically, the model predicts the maximum radiant heat flux incident upon a target as a function of distance between the target and the point of release.

Required Data

(a) Composition of the released material
(b) Temperature and pressure of the material before release
(c) Mass flow rate of the material being released
(d) Diameter of the exit hole
(e) Wind speed
(f) Air temperature
(g) Relative humidity
(h) Elevation of the target (relative to grade)
(i) Elevation of the point of release (relative to grade)
(j) Angle of the release (relative to horizontal)

Methodology

Step 1: A correlation based on a Momentum Jet Model is used to determine the length of the flame. This correlation accounts for the effects of:

- composition of the released material,
- diameter of the exit hole,
- release rate,
- release velocity, and
- wind speed.

Step 2: To determine the behavior of the flame, the model uses a momentum-based approach that considers increasing plume buoyancy along the flame and the bending force of the wind. The following equations are used to determine the path of the centerline of the flame [Cook, et al., 1987].

$$\Phi_X = (\rho_{ja})^{0.5} \cdot \bar{u} \cdot \sin(\theta) \cdot \cos(\varphi) + (\rho_\infty)^{0.5} \cdot u_\infty \qquad \text{(downwind)}$$

$$\Phi_Y = (\rho_{ja})^{0.5} \cdot \bar{u} \cdot \sin(\theta) \cdot \sin(\varphi) \qquad \text{(crosswind)}$$

$$\Phi_Z = (\rho_{ja})^{0.5} \cdot \bar{u} \cdot \cos(\theta) + (\rho_\infty)^{0.5} \cdot u_b \cdot \frac{(i+1)}{n} \qquad \text{(vertical)}$$

where: Φ_{XYZ} = momentum flux in X, Y, Z direction
ρ_{ja} = density of the jet fluid at ambient conditions, kg/m^3

$\bar{u}$ = average axial velocity of the flame, m/s
θ = release angle in $X-Z$ plane (relative to horizontal), degrees
φ = release angle in $X-Y$ plane (relative to downwind), degrees
ρ_∞ = density of air, kg/m^3
u_∞ = wind speed, m/s
ρ_b = density of combustion products, kg/m^3
u_b = buoyancy velocity, m/s
n = number of points taken along the flame length

These correlations were developed to predict the path of a torch flame when released at various orientations. The model currently does not allow a release angle in a crosswind direction; the release angle is confined to the downwind/vertical plane (i.e., $\varphi = 0$).

Step 3: The angle of flame tilt is defined as the inclination of a straight line between the point of release and the end point of the flame centerline path (as determined in Step 2).

Step 4: The geometric shape of the flame is defined as a frustum of a cone (as suggested by several flare/fire researchers [e.g., Kalghatgi, 1983, Chamberlain, 1987]), but modified by adding a hemisphere to the large end of the frustum. The small end of the frustum is positioned at the point of release, and the centerline of the frustum is inclined at the angle determined in Step 3.

Step 5: The surface emissive power is determined from the molecular weight and heat of combustion of the burning material, the release rate and velocity, and the surface area of the flame.

Step 6: The surface of the flame is divided into numerous differential areas. The following equation is then used to calculate the view factor from a differential target, at a specific location outside the flame, to each differential area on the surface of the flame.

$$F_{dA_t \to dA_f} = \frac{\cos(\beta_t) \cdot \cos(\beta_f)}{\pi \cdot r^2} \cdot dA_f \qquad \text{for } [\,\beta_t\,] \text{ and } [\,\beta_f\,] < 90$$

where: $F_{dA_t \to dA_f}$ = view factor from a differential area on the target to a differential area on the surface of the flame, dimensionless
dA_f = differential area on the flame surface, m^2
dA_t = differential area on the target surface, m^2
r = distance between differential areas dA_t and dA_f, m
β_t = angle between normal to dA_t and the line from dA_t to dA_f, degrees
β_f = angle between normal to dA_f and the line from dA_t to dA_f, degrees

Step 7: The radiant heat flux incident upon the target is computed by multiplying the view factor for each differential area on the flame by the surface missive power and by the appropriate atmospheric transmittance, then summing these values over the surface of the flame.

$$q_{ai} = \sum_{A_f} q_{sf} \cdot F_{dA_t \to dA_f} \cdot \tau$$

where: q_{ai} = attenuated radiant heat flux incident upon the target due to radiant heat emitted by the flame, kW/m^2

A_f = area of the surface of the flame

q_{sf} = radiant heat flux emitted by the surface of the flame, kW/m^2

τ = atmospheric transmittance, dimensionless

Atmospheric transmittance, τ, is a function of absolute humidity and r, the path length between differential areas on the flame and target [Wayne, 1991].

Step 8: Steps 6 and 7 are repeated for numerous target locations.

Validation

Several of the equations used in the Torch Fire and Flare Radiation Model are empirical relationships based on data from medium- to large-scale experiments, which ensures reasonably good agreement between model predictions and experimental data for variables such as flame tilt angle. Comparisons of experimental data and model predictions for incident heat flux at specific locations are more meaningful and of greater interest. Unfortunately, few reports on medium- or large-scale experiments contain the level of detail required to make such comparisons.

One reasonable source of test data is a report by Chamberlain [1987]. It contains data from seven flare tests involving natural gas releases from industrial flares, with several data points being reported for each test. Variables that were examined during these tests include release diameter (0.203 and 1.07 m), release rate and velocity, and wind speed. Figure C-1 compares the predicted values of incident heat flux with experimental data from the seven flare tests.

References

Chamberlain, G. A., "Developments in Design Methods for Predicting Thermal Radiation from Flares." *Chemical Engineering Research and Design*, Vol. 65, July, 1987.

Cook, D. K., M. Fairweather, G. Hankinson, and K. O'Brien, "Flaring of Natural Gas from Inclined Vent Stacks." *IChemE Symposium Series #102*, Pergamon Press, 1987.

Kalghatgi, G. T., "The Visible Shape and Size of a Turbulent Hydrocarbon Jet Diffusion Flame in a Cross Wind." *Combustion and Flame*, Vol. 52, 1983: pp. 91-106.

Wayne, F. D., "An Economical Formula for Calculating Atmospheric Infrared Transmissivities." *Journal of Loss Prevention in the Process Industries*, Vol. 4, January, 1991: pp. 86-92.

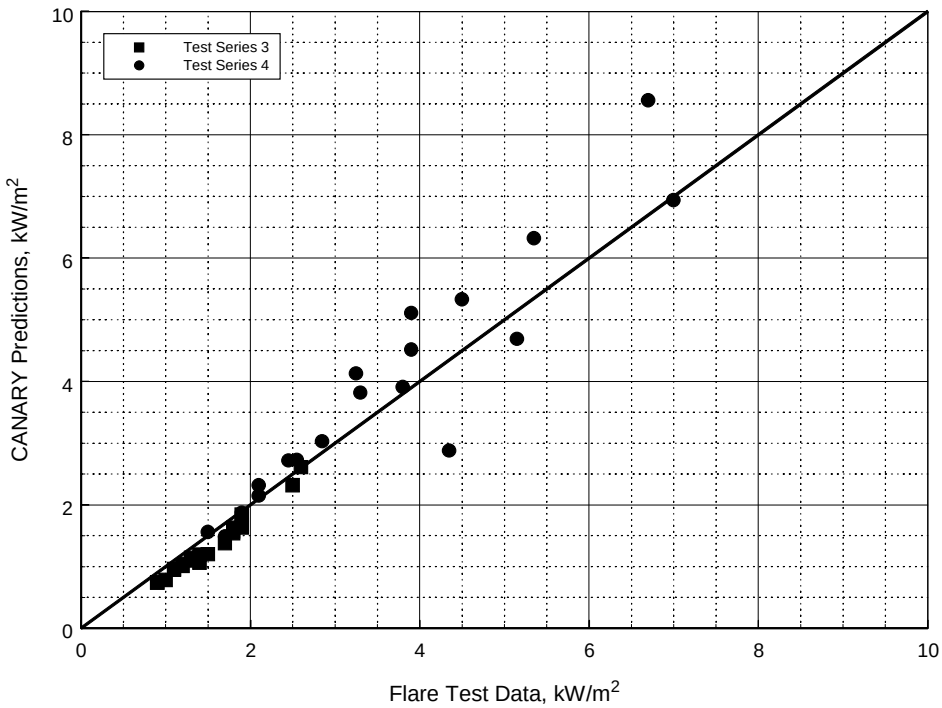

Test Series 3
Test Series 4
CANARY Predictions, kW/m2
Flare Test Data, kW/m2
0
2
4
6
8
10

Figure C-1

Fireball Model

Purpose

The purpose of the Fireball Model is to predict the impact of thermal radiation emitted by fireballs that result from catastrophic failures of pressure vessels containing superheated liquids. Specifically, the model predicts the average radiant heat flux incident upon a grade-level target as a function of the horizontal distance between the target and the center of the fireball.

Required Data

(a) Composition of flammable liquid within the pressure vessel
(b) Mass of flammable liquid within the pressure vessel
(c) Pressure within vessel just prior to rupture
(d) Temperature of the liquid within the vessel just prior to rupture
(e) Air temperature
(f) Relative humidity

Methodology

Step 1: Calculate the mass of fuel consumed in the fireball. The mass of fuel in the fireball is equal to the smaller of the mass of fuel in the vessel (as specified by the user), or three times the mass of fuel that flashes to vapor when it is released to the atmosphere [Hasegawa and Sato, 1977].

Step 2: Calculate the maximum diameter of the fireball using the empirical correlation from Roberts [1981/82].

$$D_{\max} = 5.8 \cdot M_f^{1/3}$$

where: $D_{\max}$ = maximum diameter of the fireball, m
M_f = mass of fuel in the fireball, kg

Step 3: Calculate fireball duration using the following empirical correlation [Martinsen and Marx, 1999].

$$t_d = 0.9 \cdot M_f^{1/4}$$

where: t_d = fireball duration, s
M_f = mass of fuel in the fireball, kg

Step 4: Calculate the size of the fireball and its location, as a function of time. The fireball is assumed to grow at a rate that is proportional to the cube root of time, reaching its maximum diameter, $D_{\max}$, at the time of liftoff, $t_d / 3$. During its growth phase, the fireball remains tangent to grade. After liftoff, it rises at a constant rate [Shield, 1994].

Step 5: Estimate the surface flux of the fireball. The fraction of the total available heat energy that is emitted as radiation is calculated using the equation derived by Roberts [1981/82].

$$f = 0.0296 \cdot P^{0.32}$$

where: f = fraction of available heat energy released as radiation, dimensionless
P = pressure in vessel at time of rupture, kPa

The total amount of energy emitted as radiation is then calculated.

$$E_r = f \cdot M_f \cdot \Delta H_c$$

where: E_r = energy emitted as radiation, kJ
ΔH_c = heat of combustion, kJ/kg

The surface flux is estimated by dividing E_r by the average surface area of the fireball and the fireball duration, but it is not allowed to exceed 400 kW/m^2.

Step 6: Calculate the maximum view factor from a differential target (at specific grade level locations outside the fireball) to the fireball, using the simple equation for a spherical radiator [Howell, 1982].

$$F = \frac{R^2}{H^2}$$

where: F = view factor from differential area to the fireball, dimensionless
R = radius of the fireball, m
H = distance between target and the center of the fireball, m

R and H vary with time due to the growth and rise of the fireball. Therefore, the duration of the fireball is divided into time intervals and a view factor is calculated at the end of each interval.

Step 7: Compute the attenuated radiant heat flux at each target location, at the end of each time interval, by multiplying the appropriate view factor by the surface flux of the fireball and by the appropriate atmospheric transmittance. The transmittance of the atmosphere is a function of the absolute humidity and path length from the fireball to the target [Wayne, 1991]. For each target location, calculate the average attenuated heat flux over the duration of the fireball.

Step 8: Calculate the absorbed energy at each target location. For a given location, the energy absorbed during each time interval is computed by multiplying the length of the interval by the average attenuated radiant heat flux for that interval. The absorbed energies for all time intervals are then summed to determine the radiant energy absorbed over the duration of the fireball.

Step 9: Calculate the integrated dosage at each target location. This is computed in the same manner as absorbed energy is computed in Step 8, except that the average attenuated radiant heat flux for each time interval is taken to the 4/3rds power before it is multiplied by the time interval. This allows the dosage to be used in the probit equation for fatalities from thermal radiation [Eisenberg, Lynch, and Breeding, 1975].

$$Pr = -38.4785 + 2.56 \cdot \ln\left(q^{4/3} \cdot t\right)$$

where: Pr = probit
q = radiant heat flux, W/m^2
t = exposure time, s

Validation

Several of the equations used in the Fireball Model are empirical relationships based on data from small- to medium-scale experiments, which ensures reasonably good agreement between model predictions and experimental data for variables such as maximum fireball diameter. Comparisons of experimental data and model predictions for average incident heat flux, absorbed energy, or dosage are more meaningful and of greater interest. Unfortunately, very few reports on small- or medium-scale fireball experiments contain the level of detail required to make such comparisons, and no such data are available for large-scale experiments.

One of the most complete sources of test data for medium-scale fireball tests is a report by Johnson, Pritchard, and Wickens [1990]. It contains data on five BLEVE tests that involved butane and propane, in quantities up to 2,000 kg. Figure D-1 compares the predicted values of absorbed energy with experimental data from those five BLEVE tests.

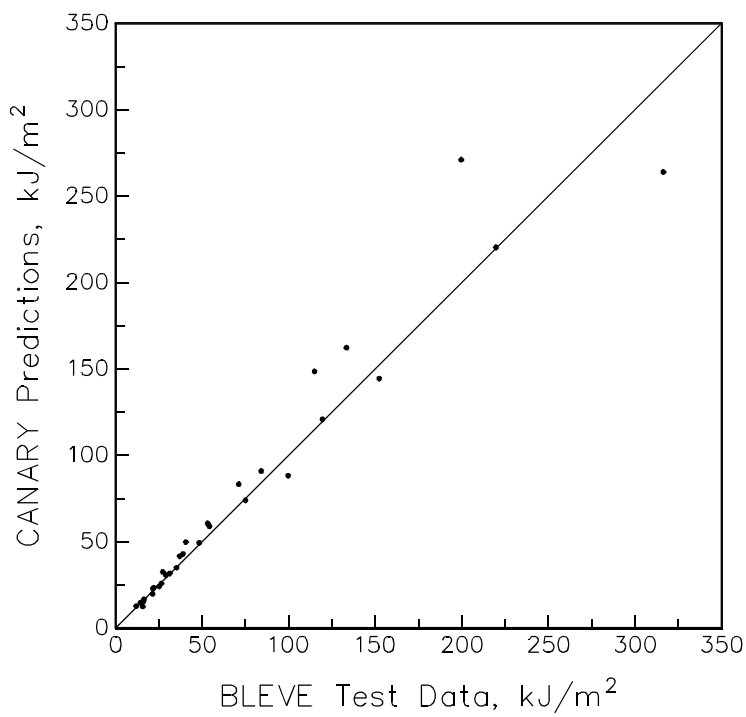


Figure D-1

References

Eisenberg, N. A., C. J. Lynch, and R. J. Breeding, *Vulnerability Model: A Simulation System for Assessing Damage Resulting from Marine Spills*. U.S. Coast Guard, Report CG-D-136-75, June, 1975.

Hasegawa, K., and K. Sato, "Study on the Fireball Following Steam Explosion of *n*-Pentane." *Proceedings of the Second International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, Heidelberg, Germany, September, 1977: pp. 297-304.

Howell, John R., *A Catalog of Radiation Configuration Factors*. McGraw-Hill Book Company, 1982.

Johnson, D. M., M. J. Pritchard, and M. J. Wickens, *Large-Scale Catastrophic Releases of Flammable Liquids*. Commission of European Communities, Report EV4T.0014, 1990.

Martinsen, W. E., and J. D. Marx, "An Improved Model for the Prediction of Radiant Heat from Fireballs." Presented at the 1999 International Conference and Workshop on Modeling Consequences of Accidental Releases of Hazardous Materials, San Francisco, California, September 28 - October 1, 1999.

Roberts, A. F., "Thermal Radiation Hazards from Releases of LPG from Pressurized Storage." *Fire Safety Journal*, Vol. 4, 1981/82: pp. 197-212.

Shield, S. R., *Consequence Modeling for LPG Distribution in Hong Kong*. Thornton Research Centre, Safety and Environment Department, United Kingdom, TNRN 95.7001, December 13, 1994.

Wayne, F. D., "An Economical Formula for Calculating Atmospheric Infrared Transmissivities." *Journal of Loss Prevention in the Process Industries*, Vol. 4, January, 1991: pp. 86-92.

Fluid Release Model

Purpose

The purpose of the Fluid Release Model is to predict the rate of mass release from a breach of containment. Specifically, the model predicts the rate of flow and the physical state (liquid, two-phase, or gas) of the release of a fluid stream as it enters the atmosphere from a circular breach in a pipe or vessel wall. The model also computes the amount of vapor and aerosol produced and the rate at which liquid reaches the ground.

Required Data

(a) Composition of the fluid
(b) Temperature and pressure of the fluid just prior to the time of the breach
(c) Normal flow rate of fluid into the vessel or in the pipe
(d) Size of the pipe and/or vessel
(e) Length of pipe
(f) Area of the breach
(g) Angle of release relative to horizontal
(h) Elevation of release point above grade

Methodology

Step 1: Calculation of Initial Flow Conditions

The initial conditions (before the breach occurs) in the piping and/or vessel are determined from the input data, coupled with a calculation to determine the initial pressure profile in the piping. The pressure profile is computed by dividing the pipe into small incremental lengths and computing the flow conditions stepwise from the vessel to the breach point. As the flow conditions are computed, the time required for a sonic wave to traverse each section is also computed. The flow in any length increment can be all vapor, all liquid, or two-phase (this implies that the sonic velocity within each section may vary). As flow conditions are computed in each length increment, checks are made to determine if the fluid velocity has exceeded the sonic velocity or if the pressure in the flow increment has reached atmospheric. If either condition has been reached, an error code is generated and computations are stopped.

Step 2: Initial Unsteady State Flow Calculations

When a breach occurs in a system with piping, a disturbance in flow and pressure propagates from the breach point at the local sonic velocity of the fluid. During the time required for the disturbance to reach the upstream end of the piping, a period of highly unsteady flow occurs. The portion of the piping that has experienced the passage of the pressure disturbance is in accelerated flow, while the portion upstream of the disturbance is in the same flow regime as before the breach occurred.

To compute the flow rate from the breach during the initial unsteady flow period, a small time increment is selected and the distance that the pressure disturbance has moved in that time increment

is computed using the sonic velocity profile found in the initial pressure profile calculation. The disturbed length is subdivided into small increments for use in an iterative pressure balance calculation. A pressure balance is achieved when a breach pressure is found that balances the flow from the breach and the flow in the disturbed section of piping. Another time increment is added, and the iterative procedure continues. The unsteady period continues until the pressure disturbance reaches the upstream end of the pipe.

Step 3: Long-Term Unsteady State Flow Calculations

The long-term unsteady state flow calculations are characterized by flow in the piping system that is changing more slowly than during the initial unsteady state calculations. The length of accelerated flow in the piping is constant, set by the user input pipe length. The vessel contents are being depleted, resulting in a potential lowering of pressure in the vessel. As with the other flow calculations, the time is incremented and the vessel conditions are computed. The new vessel conditions serve as input for the pressure drop calculations in the pipe. When a breach pressure is computed that balances the breach flow with the flow in the piping, a solution for that time is achieved. The solution continues until the ending time or other ending conditions are reached.

The frictional losses in the piping system are computed using the equation:

$$h = \left(\frac{4 \cdot f \cdot L \cdot U_{ls}^2}{2 \cdot g_c \cdot D_e} \right) \tag{1}$$

where: h = head (pressure) loss, ft of fluid
f = friction factor
L = length of system, ft
U = average flowing velocity, ft/sec
g_c = gravitational constant, 32.2 $lb_m \cdot ft/(lb_f \cdot sec^2)$
D_e = equivalent diameter of duct, ft

The friction factor is computed using the following equation:

$$\frac{1}{\sqrt{f}} = 1.74 - 2.0 \cdot \log_{10} \left[\frac{2 \cdot \varepsilon}{D_e} + \frac{18.7}{Re \cdot \sqrt{f}} \right] \tag{2}$$

where: ε = pipe roughness, ft
Re = Reynolds number, $D_e \cdot U \cdot \rho / \mu$, dimensionless
ρ = fluid density, lb/ft^3
μ = fluid viscosity, lb/(ft•sec)

Equations (1) and (2) are used for liquid, vapor, and two-phase flow regimes. Since the piping is subdivided into small lengths, changes in velocity and physical properties across each segment are assumed to be negligible. At each step in the calculation, a check is made to determine if the fluid velocity has reached or exceeded the computed critical (sonic) velocity for the fluid. If the critical velocity has been exceeded, the velocity is constrained to the critical velocity and the maximum mass flow rate in the piping has been set.

If the fluid in the piping is in two-phase flow, the Lockhart and Martinelli [1949] modification to Equation (1) is used. The Lockhart and Martinelli equation for head loss is shown below:

$$h_{TP} = \Phi^2 \cdot \left(\frac{4 \cdot f \cdot L \cdot U_{ls}^2}{2 \cdot g_c \cdot D_e} \right) \tag{3}$$

where: h_{TP} = head loss for two-phase flow, ft of fluid
Φ = empirical parameter correlating single- and two-phase flow, dimensionless
U_{ls} = superficial liquid velocity (velocity of liquid if liquid filled the pipe), ft/sec

This equation is valid over short distances where the flowing velocity does not change appreciably.

Validation

Validation of fluid flow models is difficult since little data are available for comparison. Fletcher [1983] presented a set of data for flashing CFC-11 flowing through orifices and piping. Figures E-1 through E-4 compare calculations made using the Fluid Release Model with the data presented by Fletcher. Figure E-1 compares fluid fluxes for orifice type releases. These releases had length-to-diameter (L/D) ratios less than 0.88. Figure E-2 compares computed and experimental release fluxes for an L/D ratio of 120 at several levels of storage pressure. Figure E-3 compares similar releases for an L/D of 37.5. Figure E-4 shows predicted and experimental release fluxes at a given pressure for L/D ratios from 1 to 200.

Figures E-5 and E-6 compare computed and experimental gas discharge rates for the complete breach of two pipes. One pipe had an internal diameter of 6.2 inches (0.157 m); the other had a diameter of 12 inches (0.305 m). These pipes were initially pressurized to 1,000 psia with air and then explosively ruptured. The experimental values were reported in a research paper for Alberta Environment, authored by Wilson [1981].

Aerosols and Liquid Droplet Evaporation

Liquids stored at temperatures above their atmospheric pressure boiling point (superheated liquids) will give off vapor when released from storage. If the temperature of storage is sufficiently above the normal boiling point, the energy of the released vapor will break the liquid stream into small droplets. If these droplets are small enough, they will not settle, but remain in the vapor stream as aerosol droplets. The presence of aerosol droplets in the vapor stream changes its apparent density and provides an additional source of vapor. Droplets large enough to fall to the ground will lose mass due to evaporation during their fall.

The prediction of aerosol formation and amount of aerosol formed is based on the theoretical work performed for the Center for Chemical Process Safety (CCPS) by CREARE. CREARE's work has been extended and corrected by Quest. The extension to the model computes the non-aerosol drop evaporation. In Figure E-7, the four experimental data sets available for comparison (chlorine (Cl_2), methylamine (MMA), CFC-11, and cyclohexane) are compared to the values computed by the CANARY Aerosol Model.

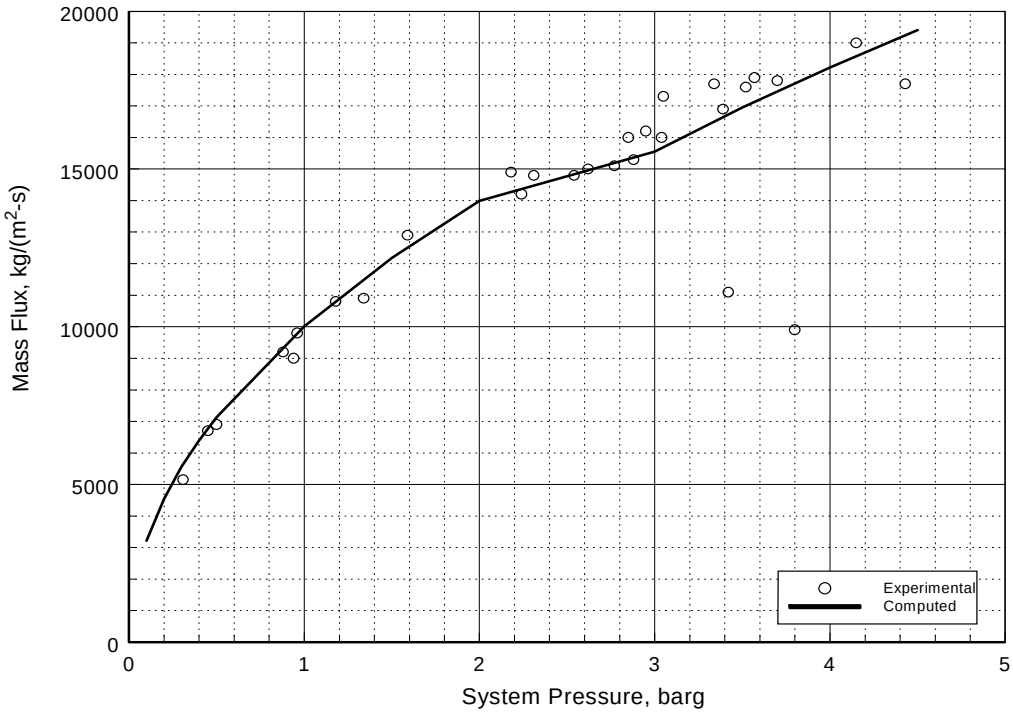


Figure E-1
Comparison of CFC-11 Orifice Releases as a Function of System Pressure

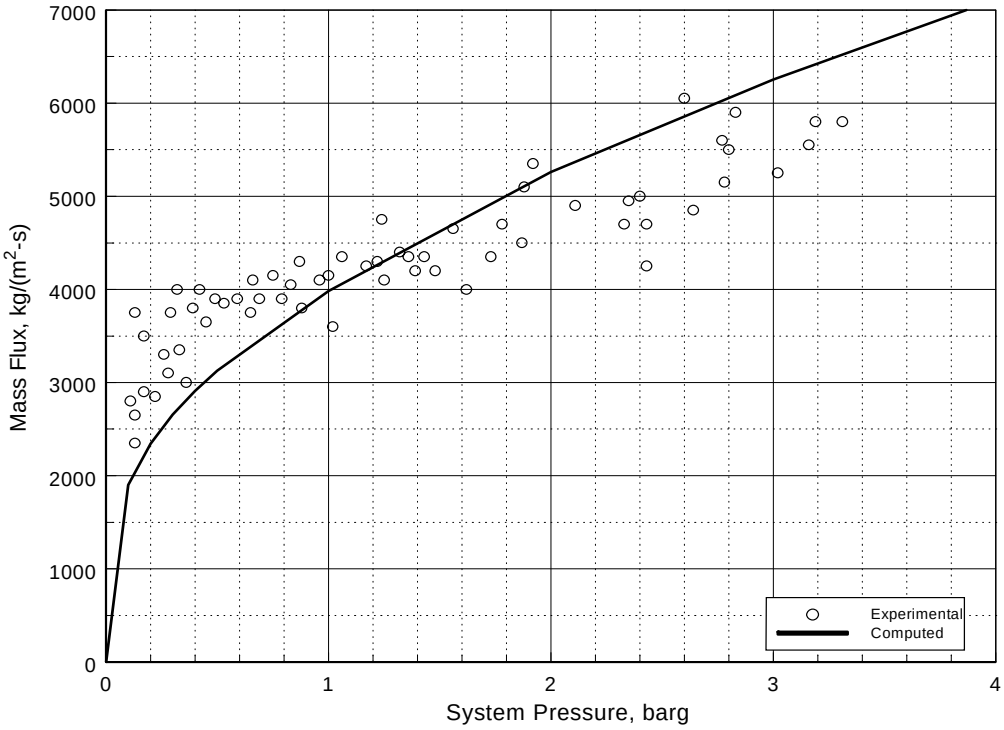


Figure E-2
CFC-11 Release Rate Comparison with L/D of 120

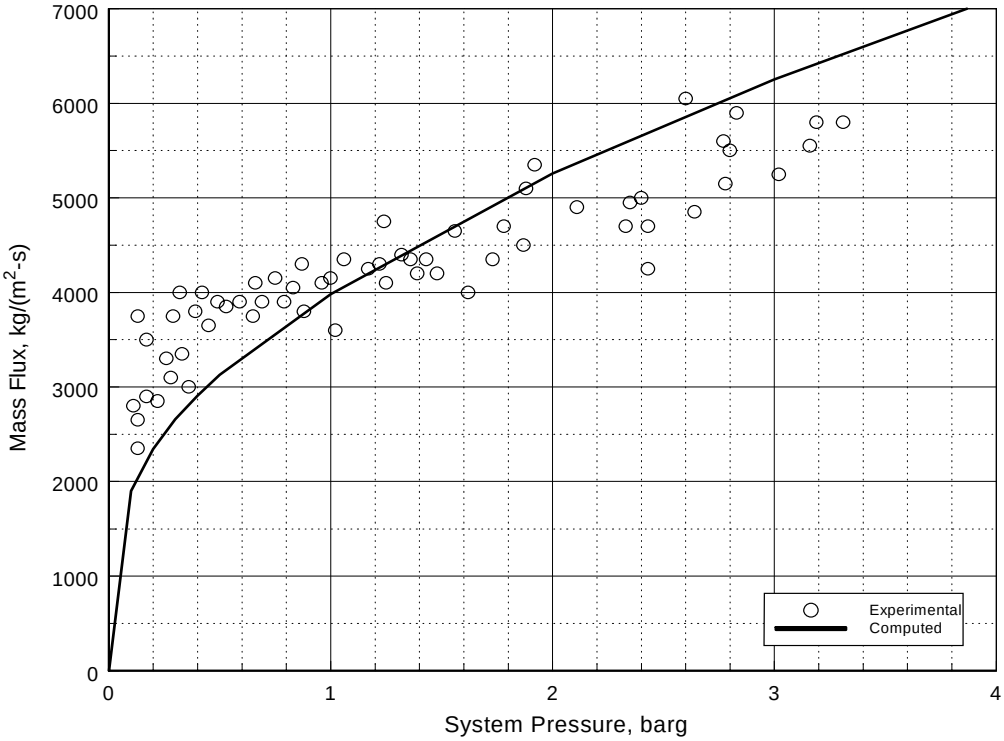


Figure E-3
CFC-11 Release Rate Comparison with L/D of 37.5

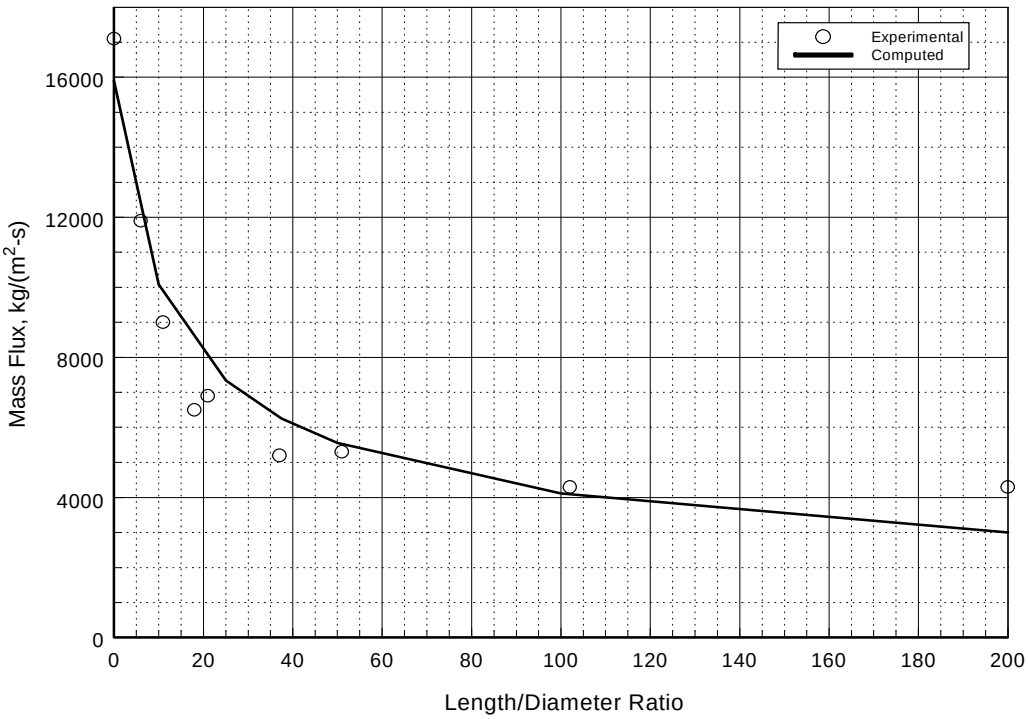


Figure E-4
CFC-11 Release Rate Comparison at Varying L/D Ratios

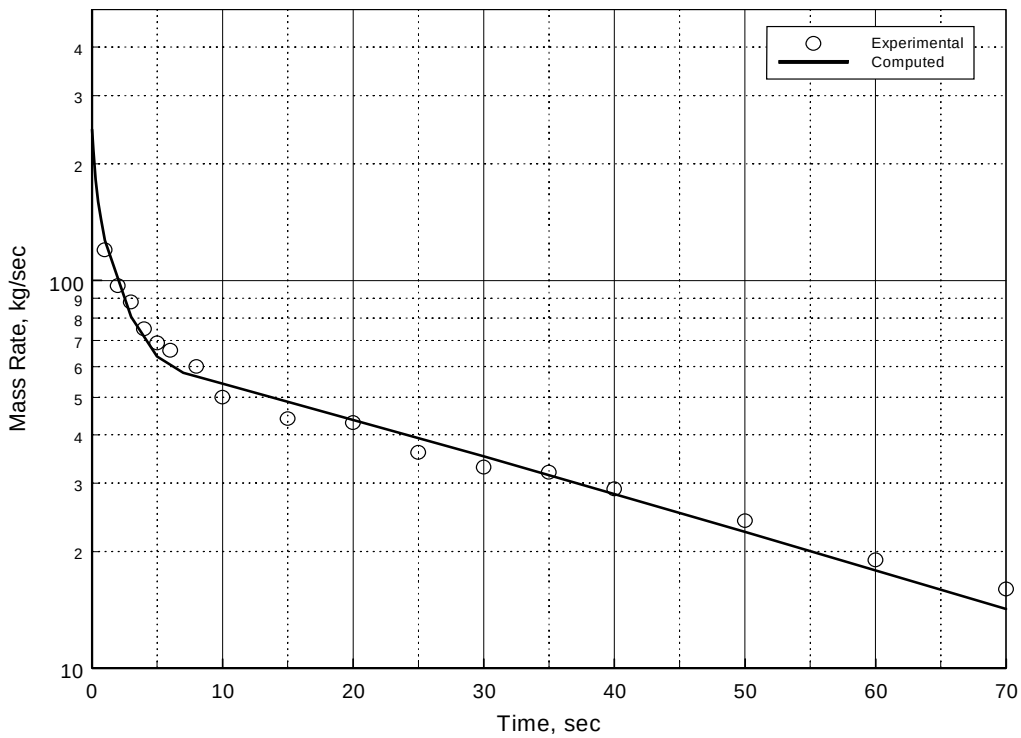


Figure E-5
Air Discharge Rates for 0.157 m Diameter Piping

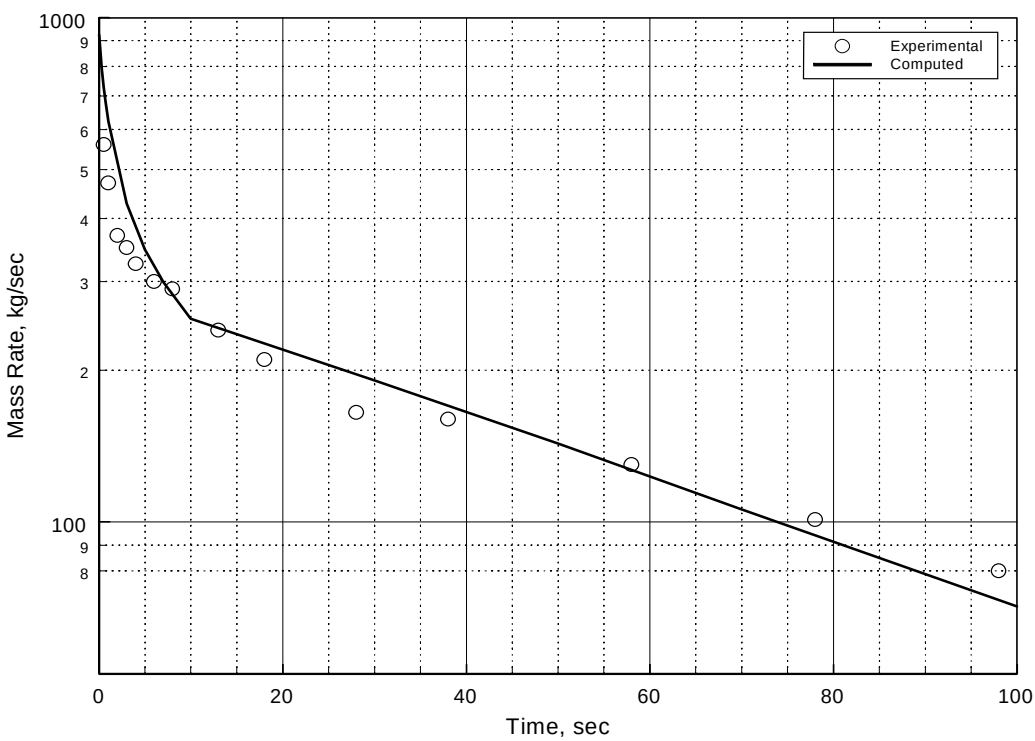


Figure E-6
Air Discharge Rates for 0.305 m Diameter Piping

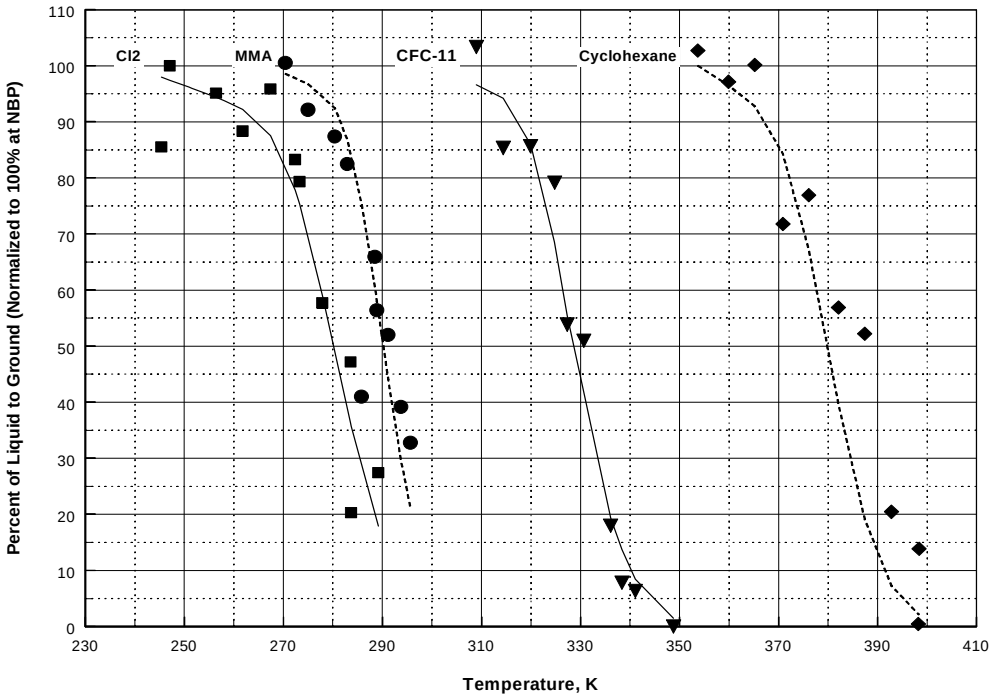


Figure E-7
Aerosol Formation as a Function of Storage Temperature

References

Fletcher, B., "Flashing Flow Through Orifices and Pipes." Paper presented at the AIChE Loss Prevention Symposium, Denver, Colorado, 1983.

Lockhart, R. W., and R. C. Martinelli, "Proposed Correlation of Data for Isothermal Two-Phase, Two-Component Flow in Pipes." Chemical Engineering Progress, Vol. 45, 1949: p. 39.

Wilson, D. J., "Expansion and Plume Rise of Gas Jets from High Pressure Pipeline Ruptures." Research Paper, Pollution Control Division, Alberta Environment, April, 1981.

Momentum Jet Dispersion Model

Purpose

The purpose of this model is to predict the dispersion of a jet release into ambient air. It is used to predict the downwind travel of a flammable or toxic gas or aerosol momentum jet release.

Required Data

(a) Composition and properties of the released material
(b) Temperature of released material
(c) Release rate of material
(d) Vertical release angle relative to wind direction
(e) Height of release
(f) Release area
(g) Ambient wind speed
(h) Ambient Pasquill-Gifford stability class
(i) Ambient temperature
(j) Relative humidity
(k) Surface roughness scale

Methodology

Step 1: An assumption is made that flow perpendicular to the main flow in the plume is negligible, that the velocity and concentration profiles in the jet are similar at all sections of the jet, that molecular transport in the jet is negligible, and that longitudinal turbulent transport is negligible when compared to longitudinal convective transport. The coordinate system is then defined in s and r, where s is the path length of the plume and r is the radial distance from the plume centerline. The angle between the plume axis and horizontal is referred to as θ. Relationships between the downwind coordinate, x, vertical coordinate, y, and plume axis are given simply by:

$$\frac{dx}{ds} = \cos(\theta) \tag{1}$$

and

$$\frac{dy}{ds} = \sin(\theta) \tag{2}$$

Step 2: Velocity, concentration, and density profiles are assumed to be cylindrically symmetric about the plume axis and are assumed to be Gaussian in shape. The three profiles are taken as:

$$u(s,r,\theta) = U_a \cdot \cos(\theta) + u^*(s) \cdot e^{\frac{-r^2}{b^2(s)}} \tag{3}$$

where: u = plume velocity, m/s
U_a = ambient wind speed, m/s
u^* = plume velocity relative to the wind in the downwind direction at the plume axis, m/s
$b(s)$ = characteristic width of the plume at distance s from the release, m

$$\rho(s,r,\theta) = \rho_a + \rho^*(s) \cdot e^{\frac{-r^2}{\lambda^2 \cdot b^2(s)}} \tag{4}$$

where: ρ = plume density, kg/m^3
ρ_a = density of ambient air, kg/m^3
$\rho^*(s)$ = density difference between plume axis and ambient air, kg/m^3
λ^2 = turbulent Schmidt number, 1.35

$$c(s,r,\theta) = c^*(s) \cdot e^{\frac{-r^2}{\lambda^2 \cdot b^2(s)}} \tag{5}$$

where: c = pollutant concentration in the plume, kg/m^3
$c^*(s)$ = pollutant concentration at plume centerline, kg/m^3

Step 3: The equation for air entrainment into the plume and the conservation equations can then be solved. The equation for air entrainment is:

$$\frac{d}{ds}\left(\int_0^{b\sqrt{2}} \rho \cdot u \cdot 2 \cdot \pi \cdot dr\right) = 2 \cdot \pi \cdot b \cdot \rho_a \cdot \left\{\alpha_1 \cdot |u^*(s)| + \alpha_2 \cdot U_a \cdot |\sin(\theta)| \cos(\theta) + \alpha_3 \cdot u'\right\} \tag{6}$$

where: α_1 = entrainment coefficient for a free jet, 0.057
α_2 = entrainment coefficient for a line thermal, 0.5
α_3 = entrainment coefficient due to turbulence, 1.0
u' = turbulent entrainment velocity (root mean square of the wind velocity fluctuation is used for this number), m/s

Step 4: The equations of conservation of mass, momentum, and energy are given as:

$$\frac{d}{ds}\left(\int_0^{b\sqrt{2}} c \cdot u \cdot 2 \cdot \pi \cdot dr\right) = 0 \tag{7}$$

$$\frac{d}{ds}\left(\int_0^{b\sqrt{2}} \left(\rho \cdot u^2 \cdot \cos(\theta) \cdot 2 \cdot \pi \cdot dr\right)\right) = 2 \cdot \pi \cdot b \cdot \rho_a \cdot \left\{\alpha_1 \cdot \left|u^*(s)\right| + \alpha_2 \cdot U_a \cdot \left|\sin(\theta)\right| \cdot \cos(\theta) + \alpha_3 \cdot u'\right\} + C_d \cdot \pi \cdot b \cdot \rho_a \cdot U_a^2 \left|\sin(\theta)\right| \tag{8}$$

$$\frac{d}{ds}\left(\int_0^{b\sqrt{2}} \rho \cdot u^2 \cdot \cos(\theta) \cdot 2 \cdot \pi \cdot dr\right) \tag{9}$$
$$= \int_0^{b\sqrt{2}} g \cdot (\rho_a - \rho)\, \pi \cdot r \cdot dr \pm C_d \cdot \pi \cdot b \cdot \rho_a \cdot U_a^2 \cdot \sin(\theta) \cdot \cos(\theta)$$

$$\frac{d}{ds}\left(\int_0^{b\sqrt{2}} \rho \cdot u \left(\frac{1}{\rho} - \frac{1}{\rho_{a0}}\right) \cdot 2 \cdot \pi \cdot r \cdot dr\right) \tag{10}$$
$$= \rho_a \cdot 2 \cdot \pi \cdot b \left(\frac{1}{\rho_a} - \frac{1}{\rho_{a0}}\right) \cdot \left\{\alpha_1 \cdot |u^*(s)| + \alpha_2 \cdot U_a \ \sin(\theta)| \cdot \cos(\theta) + \alpha_3 \cdot \acute{u}\right\}$$

The subscript 0 refers to conditions at the point of release. These equations are integrated along the path of the plume to yield the concentration profiles as a function of elevation and distance downwind of the release.

Step 5: After the steady-state equations are solved, an along-wind dispersion correction is applied to account for short-duration releases. This is accomplished using the method outlined by Palazzi, et al. [1982].

Step 6: If the plume reaches the ground, it is coupled to the Heavy Gas Dispersion Model (described in Section G) and the dispersion calculations continue.

Validation

The Momentum Jet Dispersion Model used in CANARY was validated by comparing results obtained from the model with experimental data from field tests. Data used for this comparison and the conditions used in the model were taken from an American Petroleum Institute (API) study [Hanna, Strimaitis, and Chang, 1991]. For this model, comparisons were made with the Desert Tortoise, Goldfish, and Prairie Grass series of dispersion tests. Results of these comparisons are shown in Figure F-1.

References

Astleford, W. J., T. B. Morrow, and J. C. Buckingham, *Hazardous Chemical Vapor Handbook for Marine Tank Vessels* (Final Report – Phase II). U.S. Coast Guard Report No. CG-D-12-83, April, 1983.

Hanna, S. R., D. G. Strimaitis, and J. C. Chang, *Hazard Response Modeling Uncertainty (A Quantitative Method), Evaluation of Commonly Used Hazardous Gas Dispersion Models*, Volume II. Study co-sponsored by the Air Force Engineering and Services Center, Tyndall Air Force Base, Florida, and the American Petroleum Institute; performed by Sigma Research Corporation, Westford, Massachusetts, September, 1991.

Havens, J., and T. Spicer, *LNG Vapor Dispersion Prediction with the DEGADIS Dense Gas Dispersion Model*. Gas Research Institute Contract No. 5086-252-1287 with the University of Arkansas, September, 1990: pp. 37-48.

Ooms, G., "A New Method for the Calculation of the Plume Path of Gases Emitted by a Stack." *Atmospheric Environment*, Vol. 6, 1972: pp. 889-909.

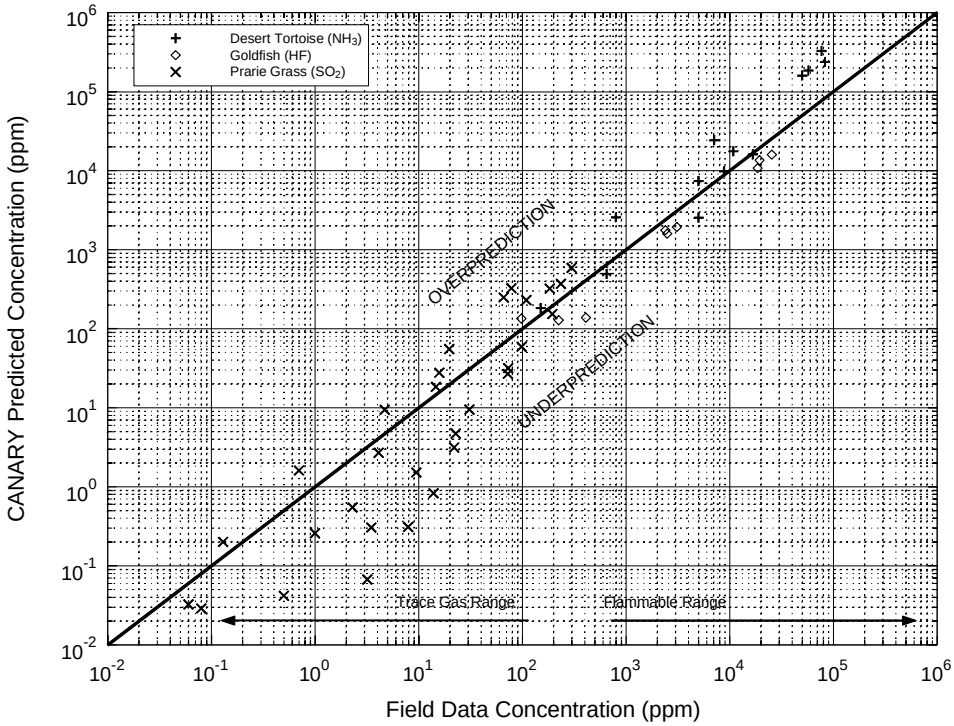


Figure F-1

Ooms, G., A. P. Mahieu, and F. Zelis, "The Plume Path of Vent Gases Heavier than Air." *First International Symposium on Loss Prevention and Safety Promotion in the Process Industries*, C. H. Buschman, Editor, Elsevier Press, 1974.

Palazzi, E., M. De Faveri, G. Fumarola, and G. Ferraiolo, "Diffusion from a Steady Source of Short Duration." *Atmospheric Environment*, Vol. 16, No. 12, 1982: pp. 2785-2790.

Heavy Gas Dispersion Model

Purpose

The purpose of this model is to predict the dispersion and gravity flow of a heavy gas released into the air from liquid pools or instantaneous gas releases. It is used to predict the downwind travel of a flammable or toxic vapor cloud.

Required Data

(a) Composition and properties of the released material
(b) Temperature of released material
(c) Vapor generation rate
(d) Vapor source area
(e) Vapor source duration
(f) Ambient wind speed
(g) Ambient Pasquill-Gifford atmospheric stability class
(h) Ambient temperature
(i) Relative humidity
(j) Surface roughness scale

Methodology

Step 1: For a steady-state plume, released from a stationary source, the Heavy Gas Dispersion Model solves the following equations:

$$\frac{d}{dx}\left(\rho \cdot U \cdot B \cdot h \cdot m\right) = \rho_s \cdot W_s \cdot B_s \tag{1}$$

$$\frac{d}{dx}\left(\rho \cdot U \cdot B \cdot h\right) = \rho_a \cdot \left(V_e \cdot h + W_e \cdot B\right) + \rho_s \cdot W_s \cdot B_s \tag{2}$$

$$\frac{d}{dx}\left(\rho \cdot U \cdot B \cdot h \cdot C_p \cdot T\right) = \rho_a \cdot \left(V_e \cdot h + W_e \cdot B\right) \cdot C_{pa} \cdot T_a + \rho_s \cdot W_s \cdot B_s \cdot C_{ps} \cdot T_s + f_t \tag{3}$$

$$\begin{aligned} &\frac{d}{dx}\left(\rho \cdot U \cdot B \cdot h \cdot U\right) \\ &\quad = -0.5 \cdot \alpha_g \cdot g \cdot \frac{d}{dx}\left[\left(\rho - \rho_a\right) \cdot B \cdot h^2\right] + \rho_a \cdot \left(V_e \cdot h + W_e \cdot B\right) \cdot U_a + f_u \end{aligned} \tag{4}$$

$$\frac{d}{dx}\left(\rho \cdot U \cdot B \cdot h \cdot V_g\right) = g \cdot \left(\rho - \rho_a\right) \cdot h^2 + f_{vg} \tag{5}$$

$$U \cdot \frac{dZ_c}{dx} = -V_g \cdot \frac{Z_c}{B} \tag{6}$$

$$U \cdot \frac{dB}{dx} = \frac{\rho_a}{\rho} \cdot V_e + V_g \tag{7}$$

$$\rho \cdot T = \frac{\rho_a \cdot T_a \cdot M_s}{\left[M_s + \left(M_a - M_s\right) \cdot m\right]} \tag{8}$$

where: x = downwind distance, m
ρ = density, kg/m^3
U = velocity in the direction of the wind, m/s
B = cloud width parameter, m
h = cloud height parameter, m
m = mass fraction of source gas
T = temperature, K
C_p = specific heat, J/(kg $\cdot$ K)
f_t = ground heat flux, J/(m$\cdot$s)
f_u = downwind friction term, kg/s^2
f_v = crosswind friction term, kg/s^2
V_e = horizontal entrainment rate, m/s
V_g = horizontal crosswind gravity flow velocity, m/s
W_e = vertical entrainment rate, m/s
W_s = vertical source gas injection velocity, m/s
M = molecular weight, kg/kmole
s = refers to source properties
a = refers to ambient properties

The first six equations are crosswind-averaged conservation equations. Equation (7) is the width equation, and Equation (8) is the equation of state.

Step 2: All of the gas cloud properties are crosswind averaged. The three-dimensional concentration distribution is calculated from the average mass concentration by assuming the following concentration profile:

$$C(x, y, z) = C(x) \cdot C_1(y) \cdot C_2(z) \tag{9}$$

$$C(x) = \frac{M_a \cdot m(x)}{M_s + \left(M_a - M_s\right) \cdot m(x)} \tag{10}$$

$$C_1(y) = \frac{1}{4 \cdot b} \cdot \left\{ erf\left(\frac{y+b}{2 \cdot \beta}\right) - erf\left(\frac{y-b}{2 \cdot \beta}\right) \right\} \tag{11}$$

$$B^2 = b^2 + 3 \cdot \beta^2 \tag{12}$$

$$C_2(z) = \left(\frac{6}{\pi}\right)^{1/2} \cdot \frac{1}{h} \cdot \exp\left(\frac{-3 \cdot z^2}{2 \cdot h^2}\right) \tag{13}$$

where: $C(x, y, z)$ = concentration in plume at x, y, z, kg/m^3
y = crosswind coordinate, m
z = vertical coordinate, m
b, B, β = half-width parameters, m

Step 3: As there are now two parameters used to define $C_1(y)$, the following equation is needed to calculate b:

$$U \cdot \left(\frac{db}{dx}\right) = V_g \cdot \frac{b}{B} \tag{14}$$

Step 4: The vertical entrainment rate is defined to be:

$$W_e = \frac{\sqrt{3} \cdot a \cdot k \cdot U_* \cdot \delta\left(\frac{h}{H}\right)}{\Phi_h\left(\frac{h}{L}\right)} \tag{15}$$

where: a = constant, 1.5
k = constant, 0.41
U_* = friction velocity, m/s
L = Monin-Obukhov length derived from the atmospheric stability class

Step 5: The profile function δ is used to account for the height of the mixing layer, H, and to restrict the growth of the cloud height to that of the mixing layer. H is a function of stability class and is defined as:

$$\delta\left(\frac{h}{H}\right) = 1 - \frac{h}{H} \tag{16}$$

The Monin-Obukhov function, Φ_h, is defined by:

$$\Phi_h\left(\frac{h}{L}\right) = \begin{cases} 1 + 5 \cdot \frac{h}{L} & L \geq 0 \text{ (stable)} \\ \left[1 - 16 \cdot \frac{h}{L}\right]^{-1/2} & L < 0 \text{ (unstable)} \end{cases} \tag{17}$$

Step 6: After the steady-state equations are solved, an along-wind dispersion correction is applied to account for short-duration releases. This is accomplished using the method outlined by Palazzi, et al. [1982].

Validation

The Heavy Gas Dispersion Model used in CANARY was validated by comparing results obtained from the model with experimental data from field tests. Data used for this comparison and the conditions used in the model were taken from an American Petroleum Institute (API) study [Hanna, Strimaitis, and Chang, 1991]. For this model, comparisons were made with the Burro, Maplin Sands, and Coyote series of dispersion tests. Results of these comparisons are shown in Figure G-1.

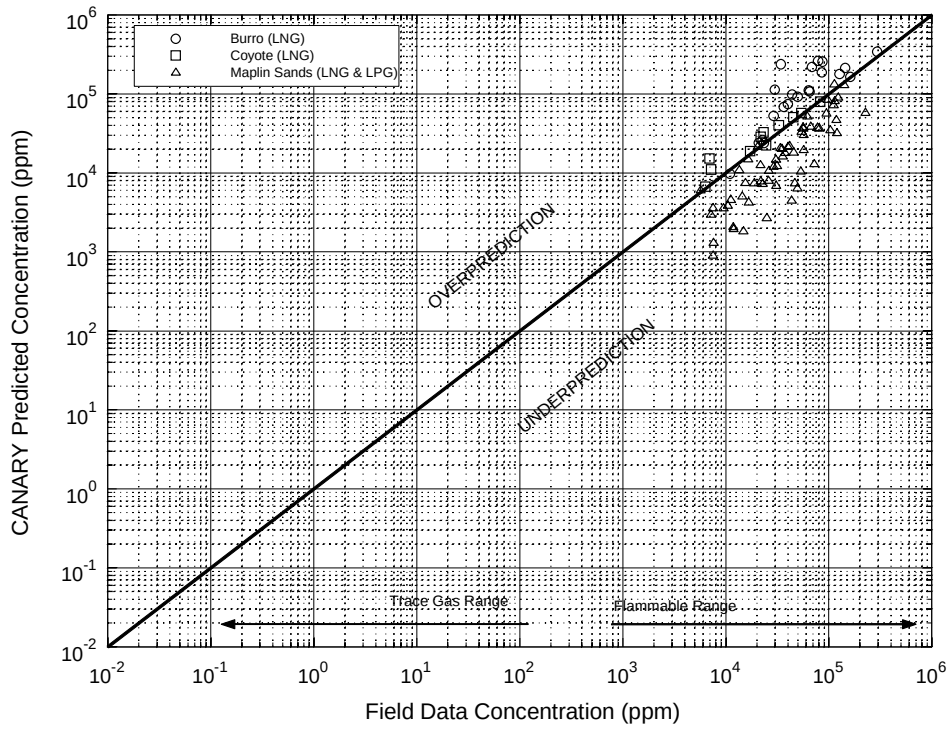


Figure G-1

References

Ermak, D. L., and S. T. Chan, *A Study of Heavy Gas Effects on the Atmospheric Dispersion of Dense Gases*. UCRL-92494, Lawrence Livermore National Laboratory, Livermore, California. Presented at the 15th NATO/CCMS International Technical Meeting on Air Pollution Modeling and Its Applications, St. Louis, Missouri, April 15-19, 1985.

Ermak, D. L., S. T. Chan, D. L. Morgan, Jr., and L. K. Morris, "A Comparison of Dense Gas Dispersion Model Simulations with Burro Series LNG Spill Test Results." *Journal of Hazardous Materials*, Vol. 6, 1982: pp. 129-160.

Ermak, D. L., and S. T. Chan, *Recent Developments on the FEM3 and SLAB Atmospheric Dispersion Models*. UCRL-94071, Lawrence Livermore National Laboratory, Livermore, California. Presented at the IMA Conference on Stably Stratified Flows and Dense Gas Dispersion, Chester, England, April 9-10, 1986.

Hanna, S. R., D. G. Strimaitis, and J. C. Chang, *Hazard Response Modeling Uncertainty (A Quantitative Method), Evaluation of Commonly-Used Hazardous Gas Dispersion Models*, Volume II. Study

cosponsored by the Air Force Engineering and Services Center, Tyndall Air Force Base, Florida, and the American Petroleum Institute; performed by Sigma Research Corporation, Westford, Massachusetts, September, 1991.

Morgan, D. L., L. K. Morris, S. T. Chan, D. L. Ermak, T. G. McRae, R. T. Cederwall, R. P. Kooperman, H. C. Goldwire, Jr., J. W. McClure, and W. J. Hogan, *Phenomenology and Modeling of Liquefied Natural Gas Vapor Dispersion*. UCRL-53581, Lawrence Livermore National Laboratory, Livermore, California, 1982.

Morgan, D. L., Jr., L. K. Morris, and D. L. Ermak, *SLAB: A Time-Dependent Computer Model for the Dispersion of Heavy Gases Released in the Atmosphere*. UCRL-53383, Lawrence Livermore National Laboratory, Livermore, California, 1983.

Palazzi, E., M. De Faveri, G. Fumarola, and G. Ferraiolo, "Diffusion from a Steady Source of Short Duration." *Atmospheric Environment*, Vol. 16, No. 12, 1982: pp. 2785-2790.

Vapor Cloud Explosion Model

Purpose

The purpose of this model is to predict the overpressure field that would be produced by the explosion of a partially confined and/or obstructed fuel-air cloud, based on the Baker-Strehlow methodology. Specifically, the model predicts the magnitude of the peak side-on overpressure and specific impulse as a function of distance from the source of the explosion.

Required Data

(a) Composition of the fuel (flammable fluid) involved in the explosion
(b) Total mass of fuel in the flammable cloud at the time of ignition or the volume of the partially-confined/obstructed area
(c) Fuel reactivity (high, medium, or low)
(d) Obstacle density (high, medium, or low)
(e) Flame expansion (1-D, 2-D, 2½-D, or 3-D)
(f) Reflection factor

Methodology

Step 1: The combustion energy of the cloud is estimated by multiplying its mass by the heat of combustion. If the volume of the flammable cloud is input, the mass is estimated by assuming that a stoichiometric mixture of gas and air exists within that volume.

Step 2: The combustion energy is multiplied by the reflection factor to account for blast reflection from the ground or surrounding objects.

Step 3: Flame speed is determined from the fuel reactivity, obstacle density, and flame expansion parameters, as presented in Baker, et al. [1994, 1998].

Fuel reactivity and obstacle density each have low, medium, and high choices. The flame expansion parameter allows choices of 1-D, 2-D, 2.5-D, and 3-D. The choices for these three parameters create a matrix of 36 possibilities, thus allowing locations that have differing levels of congestion or confinement to produce different overpressures. Each matrix possibility corresponds to a flame speed, and thus a peak (source) overpressure. The meanings of the three parameters and their options are:

Fuel Reactivity (High, Medium, or Low). The fuels considered to have high reactivity are acetylene, ethylene oxide, propylene oxide, and hydrogen. Low reactivity fuels are (pure) methane and carbon monoxide. All other fuels are medium reactivity. If fuels from different reactivity categories are mixed, the model recommends using the higher category unless the amount of higher reactivity fuel is less than 2% of the mixture.

Obstacle Density (High, Medium, or Low). High obstacle density is encountered when objects in the flame's path are closely spaced. This is defined as multiple layers of obstruction resulting in at least a 40% blockage ratio (i.e., 40% of the volume is occupied by obstacles). Low density areas are defined as having a blockage ratio of less than 10%. All other blockage ratios fall into the medium category.

Flame Expansion (1-D, 2-D, 2.5-D, or 3-D). The expansion of the flame front must be characterized with one of these four descriptors. 1-D expansion is likened to an explosion in a pipe or hallway. 2-D expansion can be described as what occurs between flat, parallel surfaces. An unconfined (hemispherical expansion) case is described as 3-D. The additional descriptor of 2.5-D is used for situations that begin as 2-D and quickly transition to 3-D.

Step 4: Based on the calculated flame speed, appropriate blast curves are selected from the figures in Baker, et al., 1994. For flame speeds not shown on the graph, appropriate curves are prepared by interpolation between existing curves.

Step 5: The Sachs scaled distance, $\bar{R}$, is calculated for several distances using the equation:

$$\bar{R} = \frac{R}{\left(\frac{E}{P_0}\right)^{1/3}}$$

where: R = distance from the center of the explosion
E = total energy calculated in step 2, above
P_0 = atmospheric pressure

Step 6: The peak side-on overpressure and specific impulse at each scaled distance are determined from the blast curves in Baker, et al., 1994.

References

Baker, Q. A., M. J. Tang, E. Scheier, and G. J. Silva, "Vapor Cloud Explosion Analysis." *28th Loss Prevention Symposium, AIChE,* 1994.

Baker, Q. A., C. M. Doolittle, G. A. Fitzgerald, and M. J. Tang, "Recent Developments in the Baker-Strehlow VCE Analysis Methodology." *Process Safety Progress,* 1998: p. 297.

APPENDIX C
Base Parameters for Consequence Modeling

Description	Value	Units
Atmospheric Conditions		
Wind speed for dispersion	4.47 [2]	mph [m/s]
Wind speed for fire radiation	12 [5.35]	mph [m/s]
Wind speed measurement height	32.8 [10]	ft [m]
Air temperature	64	F
Relative humidity	66	%
Atmospheric stability (dispersion model only)	F	Pasquill
Spill Surface Conditions		
Surface roughness on land	0.04	m
Surface roughness on water	0.001	m
LNG Parameters		
Evaporation rate on water (FERC Model)	0.1669	kg/m^2-s
Burning rate on water (FERC Model)	0.282	kg/m^2-s
Density of LNG (FERC Model)	422.5	kg/m^3
Surface flux for fire radiation (FERC Model)	265	kW/m^2
LNG Composition		
Nitrogen	0.10	mole %
Methane	86.80	mole %
Ethane	8.10	mole %
Propane	3.40	mole %
Iso-butane	1.60	mole %

APPENDIX G

REFERENCES AND CONTACTS

APPENDIX G

REFERENCES AND CONTACTS

ABSG Consulting Inc. 2004. *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers*. May.

Allen & Kimbell, LLP. 2004. Letter dated March 29 from C.D. Kimbell, Counsel for the Archer Trust to U.S. Coast Guard and C. Oggins, California State Lands Commission. Available online at http://dms.dot.gov (Docket No. USCG-2004-16877-140).

American Bureau of Shipping. 2002. Guidance Notes for Building and Classing Offshore LNG Terminals. May.

American Gas Association. 1986. "An Analysis of Reportable Incidents for Natural Gas Transportation and Gathering Lines 1970 Through June 1984." NG-18 Report No. 158, Pipeline Research Committee of the American Gas Association. D.J. Jones, G.S. Kramer, D.N. Gideon, and R.J. Eiber.

Arthur D. Little, Inc. 1979. *Assessment of Risks and Risk Control Options Associated with Liquefied Natural Gas Trucking Operations from the Distrigas Terminal, Everett, Massachusetts*. June.

ARUP & Partners California Ltd. 2005. Tank Failure Assessment. Report to the Port of Long Beach dated April 5, 2005.

Bakker, et al. 2003. 2003 Integrated Energy Policy Report. California Energy Commission. Docket No: 02-IEP-1. Pub No. 100-03-019. Available online at http://www.energy.ca.gov/2003_energypolicy/.

Belke, J.C. 2000. *Chemical Accident Risks in U.S. Industry – A Preliminary Analysis of Accident Risk Data from U.S. Hazardous Chemical Facilities*. U.S. Environmental Protection Agency. Washington, DC. September.

Borrero, Ph.D., J., S. Cho, J.E. Moore II, Ph.D., H.W. Richardson, C. Synolakis, Ph.D. 2005. Could it Happen Here? *Civil Engineering*. April.

Brookings Institution. 2002. *Protecting the American Homeland; A Preliminary Analysis*. Washington, DC.

California Air Pollution Control Officers Association. 1993. CAPCOA Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines. October.

California Air Resources Board. 2004. Personal communication on January 14 with Paul Hughes and Renee Kamena.

California Coastal Commission. 2003. Program Overview. Available online at http://www.coastal.ca.gov/whoweare.html.

California Drinking Water Source Assessment and Protection Program. 2005. Available online at http://www.dhs.ca.gov/ps/ddwem/dwsap/guidance/index.htm.

California Energy Commission. 2001. California Energy Outlook: Electricity and Natural Gas Trends Report, September 7.

REFERENCES AND CONTACTS

California Energy Commission. 2002. California LNG Transportation Fuel Supply and Demand Assessment. Available online at http://www.energy.ca.gov/reports/2002-02-13_600-02-002F.PDF.

California Energy Commission. 2005a. Environmental Issues and Opportunities in the California-Mexico Border Region. Staff paper prepared in support of the 2005 Integrated Energy Policy Report Proceedings. Available online at http://www.energy.ca.gov/2005publications/CEC-600-2005-022/CEC-600-2005-022.PDF.

California Energy Commission. 2005b. Status of Proposed LNG Projects – California and Baja. Updated: 8/15/05. Available online at http://www.energy.ca.gov/lng/projects.html.

California Energy Commission. 2005c. State of California Energy Action Plan II. Completed in cooperation with the Public Utilities Commission. September.

California State Lands Commission, United States Coast Guard, and Maritime Administration. 2004. Draft Environmental Impact Statement/Environmental Impact Report for the Cabrilllo Port Liquefied Natural Gas Deepwater Port. Federal Docket No. USCG-2004-16877, State Clearinghouse No. 2004021107, and CSLC EIR No. 727.

ChevronTexaco. 2005. Terminal GNL Mar Adentro de Baja California. Available online at http://www.chevrontexaco.com/gnlbaja/default_eng.asp (Accessed April 14, 2005).

City of Long Beach. 2003. Long Beach Major Employers (Top 25). Available online at http://www.ci.long-beach.ca.us/business/top25.htm.

City of Long Beach. 2005. About Long Beach; History of Long Beach. Available online at http://cms.longbeach.gov/aboutlb/timeline.htm.

City of Long Beach Water Department. 2005. Personal communication on April 22, between J. Rieland (Natural Resource Group, Inc.) and L. Oaks (City of Long Beach Water Department).

City of Los Angeles, Department of City Planning. 1999. Wilmington-Harbor City Community Plan.

City of Los Angeles, Department of City Planning. 2002. General Plan of the City of Los Angeles.

City of Los Angeles. 1989. City of Los Angeles Municipal Code.

Clancey, V.J. 1972. "Diagnostic Features of Explosion Damage." 6th International Meeting on Forensic Sciences, Edinburgh, Scotland.

Davis, T.L., and J.S. Namson. 1998. Unpublished United States Geological Survey NEHRP Southern California Cross Section Study. Cross Sections 12, 13, and 15. Available online at www.davisnamson.com.

Department of the Navy. 1997. Final Environmental Impact Statement for the Disposal and Reuse of Naval Station Long Beach, Long Beach, California. Prepared for the Department of the Navy, Southwest Division, Naval Facilities Engineering Command, 1420 Kettner Blvd., Suite 507, San Diego, California 92101.

REFERENCES AND CONTACTS

Department of the Navy/City of Long Beach. 1998. Final Environmental Impact Statement/Environmental Impact Report for the Disposal and Reuse of Long Beach Complex, Long Beach, California, April.

Dibblee, T.W., Jr. 1989. Geologic Map of the Palos Verdes Peninsula and Vicinity, Los Angeles County, California. Dibblee Geologic Foundation Map DF-70, Santa Barbara, California. Scale 1:24,000.

Eagle Lyon Pope. 2004. *Long Beach LNG Import Project Shipping Studies*. Report No. GM-55127-0803-57081 prepared for TRC Companies. January.

Edwards, B.D., D.J. Ponti, K.D. Ehmann, J.C. Tinsley, and E.G. Reicherdt. 2002. Offshore Stratigraphic Controls on Saltwater Intrusion in Los Angeles Area Coastal Aquifers (abs). AGU Fall Meeting, San Francisco, CA. EOS, v. 83, no. 47.

Edwards, B.D., K.D. Ehmann, D.J. Ponti, J.C. Tinsley, and E.G. Reicherdt. 2003 (abs.). Offshore Stratigraphic Controls on Saltwater Intrusion in Los Angeles Area Coastal Aquifers in LA Basin 2003. Original Urban Oil Field Legend Conference Program and Abstracts. American Association of Petroleum Geologists, Pacific Section, Western Region Society of Petroleum Engineers.

Edwards, B.D., R.D. Catchings, T.G. Hildebrand, M.S. Miller, D.J. Ponti, and S.C. Wolfe. 2001. Quaternary Sedimentary Structure of the Southwestern Los Angeles Basin Region. Geologic Society of America Abstracts Program, v. 33, no. 3:A-41.

Energy Information Administration. 2003. Expansion and Change on the U.S. Natural Gas Pipeline Network – 2002. Energy Information Administration, Office of Oil and Gas. May.

Energy Information Administration. 2004. Annual Energy Outlook 2004 with Projections to 2025. Energy Information Administration - Report #:DOE/EIA-0383(2003). January 9.

Energy Information Administration. 2005. Impact of Indian Ocean Tsunami on Energy Markets. January 11, 2005. Available online at http://www.eia.doe.gov/emeu/steo/pub/tsunami.html.

Engine, Fuel, and Emissions Engineering, Incorporated. 1996. Air Pollution Impacts and Revenue Implications of LNG Taxation, Final Report submitted to U.S. Environmental Protection Agency, May 17.

Fancher, J. 2004. Personal communication on March 1, between T. Mattson (Natural Resource Group, Inc.) and J. Fancher (U.S. Fish and Wildlife Service, Carlsbad Ecological Services Field Office (760) 431-9440).

Federal Energy Regulatory Commission. 1996. Eco Eléctrica LNG Import Terminal and Cogeneration Project, Final Environmental Impact Statement. FER/EIS-0099F. PRPB/EIS94-62-1219JPU.

Federal Energy Regulatory Commission and California State Lands Commission. 2000. Final Environmental Impact Statement/Environmental Impact Report and Proposed Land Use Plan Amendment, Vol. I, North Baja Pipeline Project. FERC/EIS-0132; CSLC EIR No. 703; State Clearinghouse No. SCH2001011020; BLM Reference No. CAA-42662.

REFERENCES AND CONTACTS

Federal Energy Regulatory Commission and California State Lands Commission. 2002. Environmental Impact Statement/Environmental Impact Report, Kern River 2003 Expansion Project, Vols. I and II. FERC/EIS-0144D, Docket No. CP01-422-000; CSLC EIR No. 710; State Clearinghouse No. 2001071035; BLM Reference No. CACA-43346.

Glaholt, R.G., M. Nunas, and S. Ong. 2000. An Investigation into the Influence of Marine Pipelines and Cables on Benthic Ecology and Biodiversity. Report prepared for Georgia Strait Crossing Pipeline Limited and filed with the Federal Energy Regulatory Commission in Docket No. CP01-176-000.

Gopal, J., et al. 2003. Natural Gas Market Assessment Staff Report, August. California Energy Commission. 100-03-006. Available online at http://www.energy.ca.gov/reports/2003-08-08_100-03-006.PDF.

Greenspan, A. 2003. The Economic Outlook. Testimony of the Federal Reserve Board Chairman, Alan Greenspan, before the Joint Economic Committee of the U.S. Congress, May 21.

Greuner, H. P. and M Böckenhauer. 1980. "Studies of the Resistance of LNG Carriers to Collisions." Sixth International Conference on Liquefied Natural Gas, Kyoto, Japan, April 7-10, 1980, Session III, Paper 6.

Harbors Environmental Projects. 1976. Environmental Investigations and Analysis Los Angeles-Long Beach Harbors 1973-1976. Marine Studies of San Pedro Bay, California Part 14.D.F. Soule and M. Oguri, eds. The Office of Sea Grant and Allan Hancock Foundation, University of Southern California. Final Report to the U.S. Army Corps of Engineers Los Angeles District.

Houston, C. 2003. Personal communication (on November 20, between C. Houston (Port of Long Beach, Environmental Remediation Specialist) and P. Eckert (Sound Energy Solutions).

Insurance Service Organization. 2003. ISO's Public Protection Classification Program. Available online at http://www.iso.com/studies_analyses/ppc_program/docs/p2.html.

Intergovernmental Panel on Climate Change. 2001. Climate Change 2001: Impacts, Adaptation, and Vulnerabilities. Available online at http://www.ipcc.ch/.

International Council for the Exploration of the Sea. 1995. Underwater Noise of Research Vessels: Review and Recommendations. ICES-Cooperative Research Report No. 209.

Jennings, C.W. 1994. Fault Activity Map of California and Adjacent Areas. California Division of Mines and Geology. Scale 1:750,000.

LNG Express. 2002. ABS Issues Guidance Notes for Construction Classing of Offshore LNG Terminals. LNG Express, June 2002, Volume XII, No. 6.

LNG Express. 2003. Offshore LNG Terminals Become Focus in Wake of Terrorist Threats. LNG Express, July 2003, Volume XIII, No. 7.

LNG Express. 2004. Sinking Feeling: Offshore U.S. Terminal Developers Run into Cost, Environmental Challenges. LNG Express, October 2004, Volume XIV, No. 10.

REFERENCES AND CONTACTS

Los Angeles Basin Contaminated Sediments Task Force. 2003. Management Strategy Support Document - Contaminated Sediments in the Los Angeles Region.

Maloney, N.J. and K. Chan. 1974. Hydrography of Harbors, Lagoons and Sloughs. Ch. 5 in: Dailey, M.D., B. Hill, and N. Lansing (eds.). A summary of knowledge of the southern California coastal zone and offshore areas. Vol. I - Physical environment. Prepared for the Bureau of Land Management.

Marks, Mignon, et al. 2004. LNG and California's Future Natural Gas Needs, Staff Draft. California Energy Commission, March 17.

MBC Applied Environmental Sciences. 2001a. Pier T Wharf Extension Dredge Project, receiving water monitoring, Port of Long Beach. Summary report, September 2001. Prepared for the Port of Long Beach.

MBC Applied Environmental Sciences. 2001b. Pier T Marine Terminal West Basin Dredging Project, receiving water monitoring, Long Beach Harbor. Summary report, May 2001. Prepared for the Port of Long Beach.

McCulloch, D.S. 1985. Evaluating Tsunami Potential in Evaluating Earthquake Hazards in the Los Angeles Region – An Earth Science Perspective. U.S. Geological Survey, Professional Paper 1360, p.375-413. Ziony, J., ed.

MEC Analytical Systems, Inc. 1988. Biological baseline and an ecological evaluation of existing habitats in Los Angeles Harbor and adjacent waters, Volumes 1 through 3. Prepared for the Port of Los Angeles.

MEC Analytical Systems, Inc. 2002. Ports of Long Beach and Los Angeles: Year 2000 Biological Baseline Study of San Pedro Bay. Report submitted to the Port of Long Beach in association with Science Applications International Corporation, Merkel & Associates, Inc., Keane Biological Consulting, and Everest International Consultants.

Mitsubishi Heavy Industries, Ltd. 2005. Summary of Estimated Earthquake Magnitudes based on Design Requirements and for the Failure Cast for the LNG Storage Tanks for the SES LNG Terminal Project.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 1991. Habitat Protection Policy. Adopted June 8, 1978. Revised October 25, 1991. U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 2003. Non-fishing Impacts to Essential Fish Habitat and Recommended Conservation Measures. NOAA Fisheries, Alaska Region-Northwest Region-Southwest Region. Editors: J. Hanson, M. Helvey, and R. Strach.

Natural Gas Intelligence. 2004. North American LNG Import Terminals, December 15.

Office of Environmental Health Hazard Assessment. 2003. The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments, August.

REFERENCES AND CONTACTS

Office of Environmental Health Hazard Assessment/Air Resources Board. 2002. Consolidated Table of OEHHA/ARB-Approved Risk Assessment Health Values. Available online at http://www.arb.ca.gov/toxics/healthval/healthval.htm (accessed October 1, 2003).

Pacific Fishery Management Council. 1998a. Essential Fish Habitat: West Coast Groundfish. Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan. October.

Pacific Fishery Management Council. 1998b. Essential Fish Habitat: Coastal Pelagic Species. Amendment 8 to the Northern Anchovy Fishery Management Plan. December.

Parfomak, P.W. 2003. Liquefied Natural Gas Infrastructure Security: Background and Issues for Congress. Congressional Research Service Report for Congress. September 9.

Port of Long Beach. 1998. Final Report; Baseline Study of Dry Dock #1 Basin Sediment. Contract HD-5951, Job Task 9802.

Port of Long Beach. 2002. Draft Environmental Impact Statement/Environmental Impact Report & Application Summary Report: Port of Long Beach Pier J South Terminal Development. State Clearinghouse No. 2000-061141. December.

Port of Long Beach. 2003a. Pier J South Terminal Development Draft Environmental Impact Statement/Environmental Impact Report. Prepared by URS Corporation. June.

Port of Long Beach. 2003b. The Port of Long Beach. Available online at www.polb.com.

Port of Long Beach. 2004. Los Angeles/Long Beach Harbor Safety Plan, Los Angeles/Long Beach Harbor Safety Committee. June.

Port of Long Beach. 2005. About the Port – History. Available online at http://www.polb.com/html/1_about/history.html.

Port of Long Beach. Undated. Terminal Operations. Voluntary Diesel Emission Reduction Program.

Port of Los Angeles. 2000. Draft Supplemental Environmental Impact Statement/Environmental Impact Report for the Channel Deepening Project.

Ports of Long Beach and Los Angeles. 2001. *Ports of Long Beach/Los Angeles Transportation Study*. June.

Powars, C. and G. Pope. 2002. California LNG Transportation Fuel Supply and Demand Assessment. Final Report for work under Work Authorization 15 – Contract 500-00-002. Prepared for the California Energy Commission. Prepared by Charles Powars, St. Croix Research, Gary Pope, and USA PRO & Associates.

Quest Consultants Inc. 2005. *Hazards Analysis of a Proposed LNG Import Terminal in the Port of Long Beach, California*.

Regional Water Quality Control Board. 1994. Water Quality Control Plan for the Los Angeles River Basin.

REFERENCES AND CONTACTS

Reish, D. J. 1957. The Effect of Pollution on Marine Life. Industrial Wastes. September – October:114-118.

Sandia National Laboratories. 2004. Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water. Sandia National Laobratories, Albuquerque, NM 87185 and Livermore, California 94550. Report for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Sempra Energy Utilities. 2003. May 14 response regarding potential capacity to receive new supplies into the utility systems from Otay Mesa. Included in Appendix 10-1 of Environmental Resource Report 10 of the Sound Energy Solutions, Long Beach LNG Import Project, Federal Energy Regulatory Commission application (see Docket # CP04-58-000).

Sempra Energy. 2005. Energía Costa Azul groundbreaking takes place. Available online at http://www.sempra.com/lng_energiaCostaAzul.htm (Accessed April 14, 2005).

Soule, D. F. 1976. Biomass and recolonization studies in the outer Los Angeles Harbor. In: Soule, D. F., and M. Oguri (Eds.), Potential effects of dredging on the biota of Outer Los Angeles Harbor: toxicity, bioassay, and recolonization studies, Marine Studies of San Pedro, California, Part 11. Harbors Environmental Projects, Allan Hancock Foundation and Office of Sea Grant Programs, University of Southern California.

South Coast Air Quality Management District. 1993. CEQA Air Quality Handbook.

South Coast Air Quality Management District. 1999. Multiple Air Toxics Exposure Study II.

South Coast Air Quality Management District. 2003a. Air Quality Management Plan, August 1.

South Coast Air Quality Management District. 2003b. Personal communication on September 11, between B. Baird (South Coast Air Quality Management District) and D. Jones (Jeffer, Mangels, Butler & Marmaro).

South Coast Air Quality Management District. 2003c. Personal communication on September 29, between S. Lang (Air Quality Specialist) and E. Walther (TRC Environmental Corporation).

South Coast Air Quality Management District. 2003d. Board Agenda No. 3, April 4.

South Coast Air Quality Management District. 2004. Air Quality. Available online at www.aqmd.gov.

Stocker, M. 2001. Fish, mollusks and other sea animals' use of sound, and the impact of anthropogenic noise in the marine acoustic environment. Unpublished paper prepared for the Earth Island Institute. Available online at http://www.msa-design.com/FishEars.html.

Synolakis, C. 2003. Tsunami and Seiche. Earthquake Engineering Handbook, Chapter 9. CRC Press.

Transportation Research Board. 2000. "Highway Capacity Manual, HCM 2000." National Research Council, Washington, D.C.

REFERENCES AND CONTACTS

TRC Environmental Corporation. 2003. Notes from July 14 meeting with representatives of the Port of Long Beach, NOAA Fisheries, Los Angeles Regional Water Quality Control Board, U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Army Corps of Engineers, and Sound Energy Solutions.

U.S. Army. 2001. *Draft Medical NBC Hazard Analysis of Chemical-Biological-Radiological-Nuclear High Explosive Threat, Possible Scenarios and Planning Requirements*. Army Office of the Surgeon General. October.

U.S. Coast Guard. 2005. *Navigation and Vessel Inspection Circular – Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic*. June.

U.S. Coast Guard and the Maritime Administration. 2003. Port Pelican Final Environmental Impact Statement. Docket No. USCG-2002-14134. Available online at http://dms.dot.gov.

U.S. Department of Commerce, Bureau of Census. 1990a. Census of Population and Housing Characteristics. Available online at www.census.gov.

U.S. Department of Commerce, Bureau of Census. 1990b. Labor Force Status and Employment Characteristics. Available online at www.census.gov.

U.S. Department of Commerce, Bureau of Census. 2000a. Census of Population and Housing Characteristics. Available online at www.census.gov.

U.S. Department of Commerce, Bureau of Census. 2000b. Profile of General Demographic Characteristics, Income and Poverty Status in 1989 (1990 data set). Available online at www.census.gov.

U.S. Department of Commerce, Bureau of Census. 2000c. Profile of Selected Economic Characteristics. Available online at www.census.gov.

U.S. Department of Commerce, Bureau of the Census. 2000d. QT-H1 General Housing Characteristics 2000. Available online at www.census.gov.

U.S. Department of Commerce, Bureau of the Census. 2001. LandView Census 2000 Population Estimator. U.S. Census Bureau, Geography Division. Available online at http://www.census.gov/geo/landview/lv5/lv5.html.

U.S. Department of Energy. 2004. Alternative Fuels Data Center. Available online at www.afdc.doe.gov.

U.S. Environmental Protection Agency. 1998. Compilation of Air Pollutant Emission Factors (AP-42), Volume 1 (Stationary Point and Area Sources), Section 1.4 – Natural Gas Combustion, Table 1.4-3 (Emission Factors for Speciated Organic Compounds from Natural Gas Combustion). July.

U.S. Environmental Protection Agency. 2002. Clean Alternative Fuels: Liquefied Natural Gas, EPA 420-F-00-038. March.

REFERENCES AND CONTACTS

U.S. Environmental Protection Agency. 2004. Sole Source Aquifer Protection Program National Summary of Sole Source Aquifer Designations. Available online at http://www.epa.gov/safewater/swp/ssa/reg9.html.

U.S. General Accounting Office. 2003. *Homeland Security, Voluntary Initiatives are Underway at Chemical Facilities, but the Extent of Security Preparedness is Unknown*. GAO-03-439. March.

URS. 2003a. Final Geotechnical Report Proposed LNG Terminal Development Pier Echo, Terminal Island, Port of Long Beach, California. URS Job No. 33756065, November 14.

URS. 2003b. Final Report Seismic Hazard Analysis for LNG Import Terminal, Port of Long Beach, California. URS Job No. 33756066, November 14.

URS. 2004. Addendum to Final Report Seismic Hazard Analysis for LNG Import Terminal, Port of Long Beach, California. URS Job No. 33756066. Addendum date September 15, 2004.

URS. 2005. Technical Memorandum dated March 21, from C.B. Crouse (URS) to T. Howe and M. Lee (KBR).

Walls, C., T.K. Rockwell, K. Mueller, Y. Back, S. Williams, J. Pfanner, J. Dolan, and P. Fang. 1998. Escape Tectonics in the Los Angeles Metropolitan Region and Implications for Seismic Risk. Nature, v. 394.

Ziony, J.I., and L.M. Jones. 1989. Map Showing Late Quaternary Faults and 1978-1984 Seismicity of the Los Angeles Region, California. United States Geological Survey Miscellaneous Field Studies Map MF-1964.

APPENDIX H

LIST OF PREPARERS

APPENDIX H

LIST OF PREPARERS

Federal Energy Regulatory Commission

Boyle, Michael – Project Manager
B.A., Environmental Sciences, 1978, University of Virginia

Boros, Laurie – Cultural Resources
B.A., Anthropology/Archaeology, 1980, Queens College, C.U.N.Y.

Busch, Steven – Reliability and Safety
M.E., Environmental Engineering, 2003, University of Maryland
B.S., Mechanical Engineering, 1999, University of Maryland

Thomas, Hugh V. – Air Quality, Noise, Reliability and Safety
M.E., Mechanical/Environmental Engineering, 1999, University of Maryland
B.S., Mechanical Engineering, 1991, University of Maryland
B.S., Physical Science, 1990, Salisbury State University

Port of Long Beach

Crouch, Stacey – Senior Environmental Specialist
B.A., Biology, 1979, California State University, Long Beach

Steinberg, Ari – Senior Program Manager
B.S., Civil Engineering, 1983, Seattle University

Johnson, Tom – Manager of Environmental Planning
Ph.D., Coastal Oceanography, 1987, State University of New York, Stony Brook
M.S., Marine Sciences, 1983, University of Delaware
B.A., Zoology, 1972, Cornell University

Natural Resource Group, Inc.

Lake, Douglas – Technical Director
M.S., Aquatic Entomology, 1980, University of New Hampshire
B.S., Biology, 1976, Marietta College

Davis, Amy – Project Manager, Introduction, Proposed Action, Reliability and Safety, Recommendations
B.A., English, 1975, University of Maryland

Lee, Jennifer – Deputy Project Manager, Land Use, Socioeconomics, Marine Transportation, Cumulative Impacts, Growth-inducing Impacts, Application Summary Report
B.A., Environmental Studies and Geography, 1995, University of St. Thomas

Braun, Bill – Geology, Soils and Sediments, Groundwater Resources
M.S. Course Work, Geology, 1980 to 1983, South Dakota School of Mines and Technology
B.S., Earth Sciences, 1980, St. Cloud State University

LIST OF PREPARERS

Mason, Mark – Noise
B.S., Geology, 1983, Winona State University
B.S., Biology, 1981, Winona State University

Mattson, Todd – Alternatives, Surface Water Resources, Biological Resources
M.S., Zoology and Physiology, 1994, University of Wyoming
B.A., Biology, 1992, Moorhead State University

Rice, Zeke – Cultural Resources, Cumulative Impacts
B.A., Anthropology/Archaeology and Sociology, 1994, Hamline University

Vann, Scot – Air Quality
M.S., Environmental Engineering, 1996, University of Texas
B.S., Civil Engineering, 1994, Texas A&M University

CH2M Hill

Castleberry, John – Air Quality
B.S., Applied Physics, 1987, University of California, Davis