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DOCKET
06-AFC-6
DATE APR 0 3 2007
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April 3, 2007

346558

Docket Unit, MS-4
Docket No: 06-AFC-06
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Eastshore Energy Center (06-AFC-06)
Data Responses, Set 3

On behalf of Eastshore Energy LLC, enclosed are an original and 12 copies of the Eastshore Energy Center (06-AFC-06) Data Responses, Set 3 dated April 3, 2007. An electronic copy of the document has also been sent directly to Mr. Lorne Prescot, Project Manager and other parties on the attached Proof of Service List. Please direct any questions regarding this material to either me at 510.587.7787or Jennifer Scholl at 805.568.0650.

Sincerely,

David A. Stein, PE
Vice President

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA

APPLICATION FOR CERTIFICATION
FOR THE EASTSHORE ENERGY CENTER
BY EASTSHORE ENERGY, LLC

Docket No. 06-AFC-6
PROOF OF SERVICE
(Revised 1/3/07)

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DECLARATION OF SERVICE

I, Jeannette Harris, declare that on April 3, 2007, I deposited copies of the attached____ Eastshore Energy Center (06-AFC-06) Data Responses, Set 3__ in the United States mail at _____Sacramento, CA _____with first-class postage thereon fully prepaid and addressed to those identified on the Proof of Service list above.

OR

Transmission via electronic mail was consistent with the requirements of the California Code of Regulations, title 20, sections 1209, 1209.5, and 1210. All electronic copies were sent to all those identified on the Proof of Service list above.

I declare under penalty of perjury that the foregoing is true and correct.

Jeannette Harris

[signature]

Eastshore Energy Center (06-AFC-06)

Data Responses, Set 3

Submitted by:

Eastshore Energy, LLC

April 3, 2007

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155 Grand Avenue, Suite 1000
Oakland, California 94612

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Attachment ALT-68: Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes
Attachment TT-71: FAA Form 7460-1
Attachment WM-75: Phase 1 Report Signature Page

Section 1.0 Data Responses

The Applicant is providing data responses in reply to the data request received by CEC Staff on March 1, 2007. The data responses are in the same order as the data requests provided by the CEC.

Technical Area: Alternatives
Author: Lorne Prescott

BACKGROUND

The Eastshore project site is approximately 1-1/2 miles southwest of the Hayward Executive Airport and would be within the Airport Approach Zoning Plan boundaries. These boundaries extend approximately two (2) miles out from the landing area of the airport. The project's stacks and resulting hot air exhaust plume would introduce the potential for impacts to aircraft flying over the site. Pursuant to the Hayward Municipal Code (HMC) §10-6.35, "…no use may be made of land within any airport approach zone, airport turning zone, or airport transition zone in such a manner as to…endanger the landing, take off, or maneuvering of aircraft."

The Eastshore Energy Center Application for Certification page 9-5, Table 9-3.1 provides a brief description for the proposed project site and six alternative sites.

DATA REQUEST

68. Please compare the proposed site to the identified alternative sites that are within the 2-mile airport approach zone with regard to aviation safety and consistency with uses within the Hayward Airport Approach Zoning Plan (HMC §10-6.35).

    Response:

    The proposed Eastshore Energy Center site and the six alternative sites are not expected to cause a hazard to air navigation as discussed below. As shown in Table ALT-68-1 and on Figures ALT-68-1 and ALT-68-2, the Eastshore Energy Center site and the six alternative sites are located more than 1-mile from the closest runway at the Hayward Executive Airport and several of the sites are located 2 or more miles from the Airport.

    The City of Hayward's Airport Master Plan for Hayward Executive Airport (City of Hayward 2002) defines the airport's Traffic Pattern Zone, which extends about one mile from the airport runways and is the zone within which aircraft fly when circling the airport (See Hayward Executive Airport Master Plan, Exhibit 5B, Figure DR55-1). This zone is shown on Figure ALT-68-1.

    The Hayward Airport Master Plan also mandates certain flight pathways for aircraft to follow for residential zone noise abatement. Aircraft taking off from the airport must follow certain clearly defined patterns to avoid flying over residential areas at low altitude. The Airport paths, Preferred Departure Paths, Touch-n-go Traffic Pattern, and Helicopter Operations (Hayward Executive Airport Master Plan, Exhibit 1C, Figure DR55-2). These paths and the relation of the Eastshore site and the six alternative sites are shown on Figure ALT-68-2.

    As shown on Figure DR-68-1 all of the sites are outside of the traffic pattern zone for the Airport. As shown on Figures ALT-68-1 and ALT-68-2, the Eastshore Energy Center site is located adjacent to the most southerly traffic pattern zone as well as the preferred departure path. The six alternative sites are located

outside of the traffic pattern zone and none of the other sites are close to the preferred departure path. All of the sites are outside of the inner turning zone.

TABLE ALT-68-1
Distances from Hayward Executive Airport

SITE #	Runway	Inner Turning Zone
1	1.27	0.78
2	2.11	1.28
3	1.68	1.51
4	1.58	1.27
5	2.26	1.35
6	1.96	1.04
7	1.68	1.34

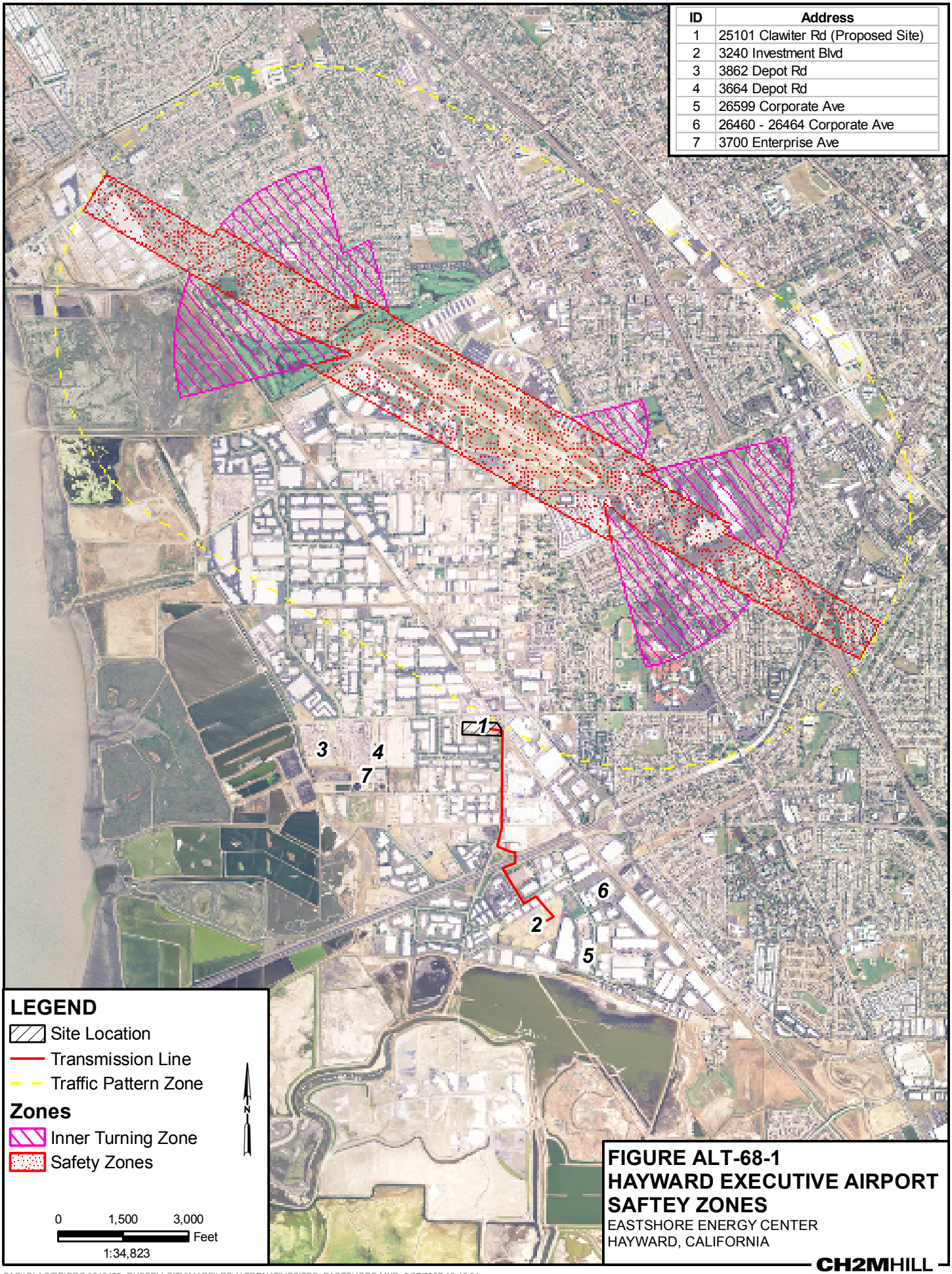
In addition to the distances from Airport features noted in Table ALT-68-1 and Figures ALT-68-1 and ALT-68-2, the proposed Eastshore Energy Center structures would not penetrate any of the Federal Aviation Administration's (FAA's) "imaginary surfaces" that define the protected airspace near a public airport, including the approach surface, transitional surface, or horizontal surface.

In addition, the Pattern Altitude (the altitude at which aircraft are required to fly when circling the runway for landing approach) is 600 feet for Runway 28L-10R and 800 feet for Runway 28R-10L. The tallest Eastshore structure (Engine stacks) would be 70 feet high.

Regarding the hot air exhaust plumes from the Eastshore Energy Center's, these plumes are not expected to cause a hazard to air navigation. The FAA recently conducted a study to assess the risk of aircraft flying over industrial exhaust plumes (FAA 2006), included here as Attachment DR-68-1 and titled "Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes." This study examined the available databases of pilot reports and accident/incident reports over a thirty-year period. This study included more than 670,000 pilot reports and more than 150,000 accident/incident records. The study's authors determined that there were no accidents due to or involving industrial exhaust plumes and only one, unconfirmed, incident during this time. The study determined that the risk of accident would be one in a billion, two orders of magnitude below the FAA's safety standard of one in 10 million. The report concluded that the risk would be "extremely low" and that "the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation (italics added)." The report also states:

> "Current regulations and advisories as well as the present Notice to Airmen (NOTAM) Temporary Flight Restrictions should preclude prudent pilots from flying through or near plumes, thereby making the aviation risk essentially zero (FAA 2006, p. 16, Conclusion 2)."

Thermal plumes are discussed further in this document in responses to Data Request 70.



ID	Address
1	25101 Clawiter Rd (Proposed Site)
2	3240 Investment Blvd
3	3862 Depot Rd
4	3664 Depot Rd
5	26599 Corporate Ave
6	26460 - 26464 Corporate Ave
7	3700 Enterprise Ave

FIGURE ALT-68-1
HAYWARD EXECUTIVE AIRPORT
SAFTEY ZONES
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA

CH2MHILL

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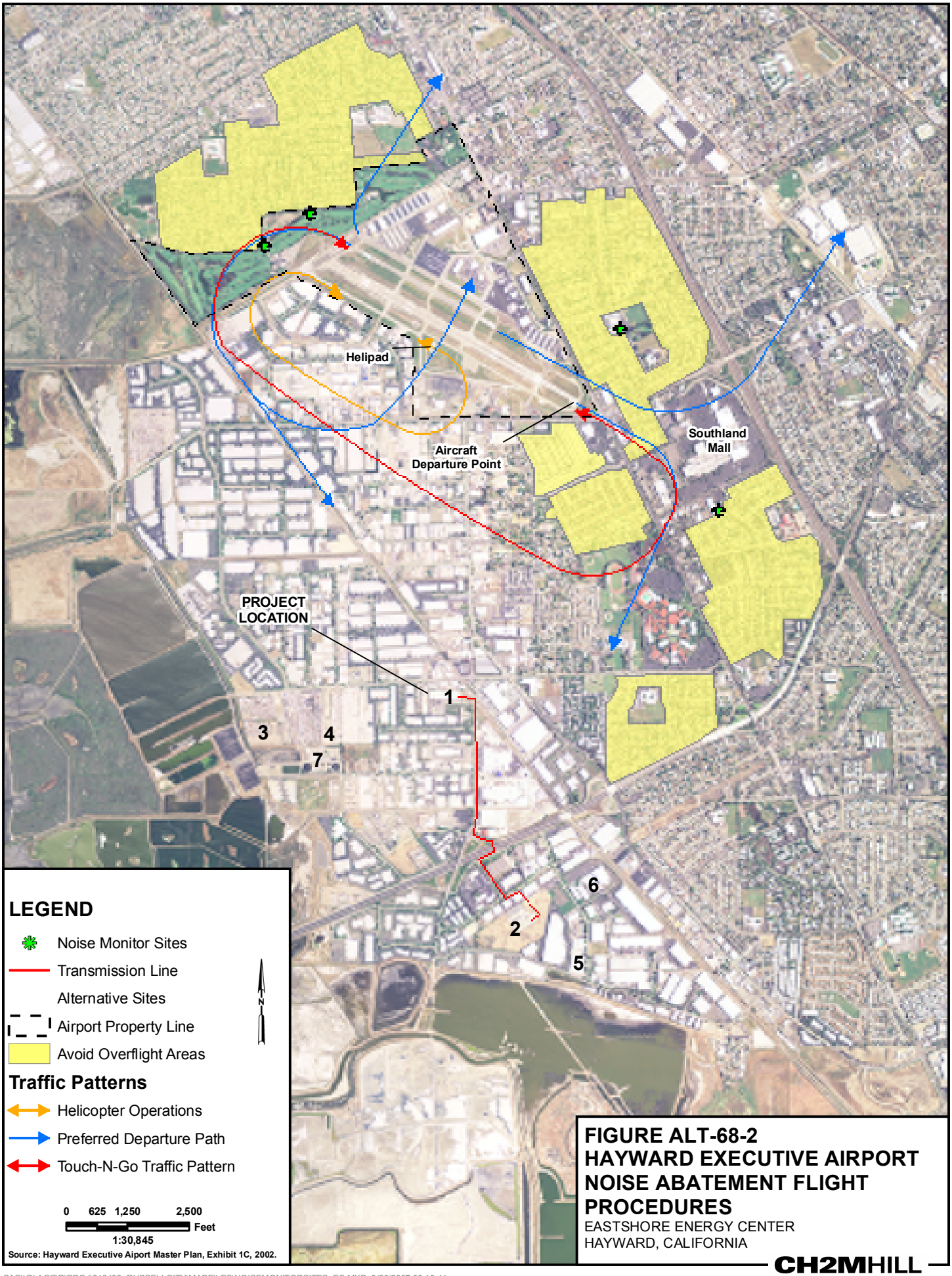

FIGURE ALT-68-2
HAYWARD EXECUTIVE AIRPORT NOISE ABATEMENT FLIGHT PROCEDURES
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA

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Attachment ALT-68

Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes

Admin Notice 12

Safety Study Report
DOT-FAA-AFS-420-06-1

Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes

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January 2006

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Flight Procedures Standards Branch
Flight Technologies and Procedures Division
Flight Standards Service

Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes

Reviewed By:

1-6-06

Donald P. Pate **Date**
Manager, Flight Procedures Standards Branch, AFS-420

Released by:

1/20/06

John McGraw **Date**
Manager, Flight Technologies and Procedures Division, AFS-400

January 2006

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4. Title and Subtitle Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes		5. Report Date January 2006
6. Author(s) Gary L. Powell, Mark A. Reisweber, Dr James Yates, Alan B. Jones, Paul McCarver, John Holman		7. Performing Organization Code
8. Performing Organization Name and Address Flight Procedure Standards Branch, AFS-420 6425 S. Denning, Room 104 Oklahoma City, Oklahoma 73169		9. Type of Report and Period Covered Safety Study
10. Sponsoring Agency Name and Address Federal Aviation Administration Mike Monroney Aeronautical Center P.O. Box 25082, Oklahoma City, OK 73125		
11. Supplementary Notes		

12. Abstract

The Flight Procedures Standards Branch (AFS-420), Flight Technologies and Procedures Division (AFS-400), was tasked by the Director of Flight Standards Service (AFS-1) of the Federal Aviation Administration (FAA) to perform a risk analysis of overflights of vertical plumes. These thermal *"plumes,"* visible or invisible, are generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems which could have the ability to release large amounts of pressurized or otherwise unstable air. AFS-420 organized and led a safety risk analysis team consisting of FAA subject matter experts (SME) and civilian contract personnel. The SME from various disciplines including: aviation safety, risk analysis/assessment, human factors, aeronautical engineering, air traffic control (ATC), statistical analysis, military/civil and commercial aviation each provided a high level of experience and expertise to examine the issue. Team members are identified in Appendix A. The team determined that the FAA Safety Risk Management (SRM) methodology contained in the FAA Safety Management System (SMS) Manual would be an appropriate vehicle to perform their analysis. The underlying presumption is that high efflux temperature or velocity from industrial facilities may cause air disturbances via exhaust plumes. Two hazards were identified during brainstorming sessions by members of the safety risk analysis team. The first hazard recognized turbulence that may be associated with plumes that could result in possible airframe damage and/or negative affects on aircraft stability in flight. The second hazard discussed was the possible adverse effects of high levels of water vapor, engine/aircraft contaminants, icing, and restricted visibilities produced by these plumes. These hazards taken individually or cumulatively, could possibly result in the loss of the aircraft or fatal injury to the crew, as well as substantial damage to ground facilities. The SME team considered these situations to be most critical for general aviation (GA) aircraft flying at low altitudes during the takeoff and/or landing phase when an aircraft is in close proximity to an airport. The safety risk analysis team performed their analysis of the predictive risks associated with the plumes and determined the effects of the hazards as low, or in the green section of the risk matrix. As a result of this assessment, the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation. However, to further lower the already acceptable risk associated with the overflight of vertical plumes, the team recommended the continuance of training and awareness programs that have been successful with similar hazards of acceptable risk levels.

13. Key Words	14. Distribution Statement
Plumes, Smoke Stacks , Aircraft overflight of industrial exhaust plumes, Powerplants, Power generating facilities	Controlled by AFS-420
15. Security Classification of This Report Unclassified	16. Security Classification of This Page Unclassified

Executive Summary

The Flight Procedures Standards Branch (AFS-420), Flight Technologies and Procedures Division (AFS-400), was tasked by the Director of Flight Standards Service (AFS-1) of the Federal Aviation Administration (FAA) to perform a risk analysis of overflights of vertical exhaust plumes. These thermal "*plumes,*" visible or invisible, are generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems which could have the ability to release large amounts of pressurized or otherwise unstable air.

AFS-420 organized and led a safety risk analysis team consisting of FAA subject matter experts (SME) and civilian contract personnel. The SME from various disciplines including: aviation safety, risk analysis/assessment, human factors, aeronautical engineering, air traffic control (ATC), statistical analysis, and military/civil and commercial aviation, each provided a high level of experience and expertise to examine the issue. Team members are identified in Appendix A. The team determined that the FAA Safety Risk Management (SRM) methodology contained in the FAA Safety Management System (SMS) Manual would be an appropriate vehicle to perform their analysis.

The underlying presumption is that high efflux temperature or velocity from industrial facilities may cause air disturbances via exhaust plumes. Two hazards were identified by members of the safety risk analysis team. The first hazard recognized turbulence that may be associated with plumes that could result in possible airframe damage and/or negative effects on aircraft stability in flight. The second hazard discussed was the possible adverse effects of high levels of water vapor, engine/aircraft contaminants, icing, and restricted visibilities produced by these plumes. These hazards, taken individually or cumulatively, could possibly result in the loss of the aircraft or fatal injury to the crew, as well as substantial damage to ground facilities. The SME team considered these situations to be most critical for general aviation (GA) aircraft flying at low altitudes during the takeoff and/or landing phase when an aircraft is in close proximity to an airport.

The tools and analysis techniques that were used to review the hazards were the "What if" Technique and Preliminary Hazard Analysis (PHA). These tools are described in-depth in the *SMS Manual*. The SRM methodology used by the team to assess and identify safety hazards was to apply SME knowledge, experience, and expertise across the various disciplines during formal and informal review sessions.

The data sources which the team used to assess risks associated with the plume issue included: Aviation Safety Reporting System (ASRS), National Aviation Safety Data Analysis Center (NASDAC), Accident/Incident Data System (AIDS), National Transportation Safety Board (NTSB), Aviation Database & Synopses, and the

Australian Government Civil Aviation Safety Authority Advisory Circular (AC) 139-05(0) Guidelines for Conducting Plume Rise Assessments dated June 2004.

The analysis also included a review of a broad spectrum of the available safety data, regulations, and professional literature. The SME team also considered input from private citizens who had previously expressed concern with regard to the issue.

Historical statistical data analysis concluded that the accident/incident rate for overflights of exhaust plumes to be of the order of 10^{-9} or less. Since the target level of safety (TLS) for GA activities was determined to be 1×10^{-7}, the probability of an accident or incident from overflight of an exhaust plume is considerably less than the required TLS. Since the TLS is satisfied, the likelihood of an accident or incident caused by overflight of an exhaust plume is acceptably small.

The safety risk analysis team performed their analysis of the predictive risks associated with the plumes and determined the effects of the hazards as low, or in the green section of the risk matrix. As a result of this assessment, the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation.

However, to further lower the already acceptable risk associated with the overflight of vertical plumes, the team recommended the continuance of training and awareness programs that have been successful with similar hazards of acceptable risk levels. The safety risk assessment team recommended the following:

- Amend the Aeronautical Information Manual (AIM) Chapter 7, Section 5 with wording to the effect that overflight at less than 1,000 feet vertically above plume generating industrial sites should be avoided.

- Publish (as appropriate) the position and nature of the present power plants located near public airports in the Airport/Facility Directory (A/FD) and issue a Notice to Airmen (NOTAM) when operationally necessary.

- Where operationally feasible, make the temporary fight restriction (TFR) that includes the overflight of power plants a permanent flight restriction.

- Amend FAA Order 7400.2 to consider a plume generating facility as a hazard to navigation when expected flight paths pass less than 1,000 feet above the top of the object. Flight Standards Service will be required to provide comment for any facility not meeting this criterion.

- Amend Advisory Circular 70/7460-2K Proposed Construction of Objects that May Affect the Navigable Airspace - Change Instructions for Completing FAA Form 7460-1 – Notice of Proposed Construction or Alteration Item # 21, add:

> *"For structures such as power plants or any industrial facility where exhaust plume discharge could reasonably be expected and reportable under the provisions of Part 77, thoroughly explain the nature of the discharge."*

These actions will serve to further enhance aviation safety within the National Airspace System.

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1.0. Introduction

The Flight Procedures Standards Branch (AFS-420), Flight Technologies and Procedures Division (AFS-400), was tasked by the Director of Flight Standards Service (AFS-1) of the Federal Aviation Administration (FAA) to perform a risk analysis of overflights of vertical plumes. AFS-420 organized and led a safety risk analysis team (hereafter referred to as the "team") consisting of FAA subject matter experts (SME). Please see Appendix A for a list of SME team participants. The SME from various disciplines including aviation safety, risk analysis/assessment, human factors, aeronautical engineering, air traffic control (ATC), statistical analysis, and military/civil and commercial aviation provided a high level of experience and expertise to examine the issue. The team determined that the FAA Safety Risk Management (SRM) methodology contained in the FAA Safety Management System (SMS) Manual would be an appropriate vehicle to perform their analysis. This methodology includes the following:

- Description of the presumed safety issue
- Identification of potential hazards
- Risk Analysis
- Risk Assessment
- Treatment (mitigation) of the risk, if required

Note: The SRM process is usually applied for risk analysis/assessment of changes to baseline (current) facilities or procedures within the (NAS). However, AFS-420 personnel determined the SRM procedural process provided the greatest flexibility and broadest analysis for determining aviation risk for the issue at hand.

<u>Section 1</u> - Description of the Presumed Safety Issue

The underlying presumption is that high efflux temperature or velocity from industrial facilities may cause air disturbances via exhaust plumes that would have the potential to cause airframe damage and/or negatively affect the stability of aircraft in flight. Associated hazards could include: high levels of water vapor, icing, restricted visibilities, engine/aircraft contaminants. These hazards taken individually or cumulatively, could possibly result in the loss of the aircraft or fatal injury to the crew, as well as substantial damage to ground facilities. The team considered these situations to be most critical for general aviation (GA) aircraft flying at low altitudes during the takeoff and/or landing phase when an aircraft is in close proximity to an airport. These thermal *"plumes,"* visible or invisible, are generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems which could have the ability to release large amounts of pressurized or otherwise unstable air. Research has been accomplished by the Australian Government Civil Aviation Safety Authority (CASA) on plume rise velocities versus aircraft upset. The United States Environmental Protection Agency (EPA) plume rise models are, for the most part, models of plume dispersion and heat/velocity measures that do not provide any analysis on the effect of aircraft overflight.

Section 2 - Review of Safety Data/Literature and Identification of Potential Hazards

The review of safety data and associated literature obtained from various sources included the following:

- National Aeronautics and Space Administration (NASA), Aviation Safety Reporting System (ASRS)
- Federal Aviation Administration (FAA), National Aviation Safety Data Analysis Center (NASDAC), Accident/Incident Data System (AIDS)
- National Transportation Safety Board (NTSB) Aviation Database & Synopses
- Aeronautical Information Manual (AIM), Change 3, August 4, 2005
- Title 14 Code of Federal Regulations (CFR) with specific attention to: Part(s) 77 - *Objects Affecting the Navigable Airspace,* Part 91.13 - *Careless or Reckless Operation,* and Part 91.119 - *Minimum Safe Altitudes: General*
- Federal Aviation Administration Safety Management System Manual, Version 1.1, May 21, 2004
- Australian Government Civil Aviation Safety Authority Advisory Circular (AC) 139-05(0, Guidelines for Conducting Plume Rise Assessments dated June 2004 was reviewed. (Note: this information was used as professional reference material as the FAA does not necessarily agree or disagree with the guidance contained in the AC)

2.0. Discussion

The salient points discussed during the SMS brainstorming sessions at AFS-420 in Oklahoma City, Oklahoma, by the risk analysis team included, but were not limited to:

(1) Aviation Database Queries Regarding Overflight of Vertical Plumes

A database search of NASA ASRS records using various key words such as: *plumes, power plants, smoke stacks, nuclear, industrial power plants, power plant - aircraft – turbulence, smokestack(s), updrafts, downdrafts* and similar combinations was conducted and reviewed. The results of over 671,006 NASA ASRS pilot reports gathered over 30 a year period indicated zero pilot-reported overflight incidents with exhaust plumes from facilities such as power plants.

A similar search of the NASDAC AIDS (FAA) accident/incident database records search (approximately 150,000 records) indicated no accidents and one possible, yet not confirmed, helicopter incident in 1979. Additionally, there was one incident where a flight instructor claimed that outflow from a nearby power plant smoke stack may have contributed to an accident on May 19, 2000 at the Space Coast Regional Airport in Titusville, Florida. The NTSB concluded to the contrary, citing…"*failure of the PIC (pilot-in command) to maintain control of the aircraft...*" was the probable cause.

**Note: The aforementioned databases are open to the public and similar search requests may be accessed/queried via the Internet at: http://asrs.arc.nasa.gov and http://www.nasdac.faa.gov.

(2) FAA Regulations, Orders /Notices, and Guidelines

Additionally, the FAA has knowledge of two undocumented instances where pilots of aircraft *intentionally* flew through plumes of an electrical generating power plant and experienced predicable turbulence issues, where intensity varied directly with altitude. Since the pilots were not trained in methods of data collection and the aircraft were not equipped for data collection, no creditable data were collected. Therefore, these intentional incidents were not given further consideration and deemed irrelevant to the analysis.

The team felt it significant to note that the present Notice to Airmen (NOTAM) Temporary Flight Restrictions (TFR), active at the time of the above incidents, should have precluded prudent pilots from flying through or near plumes. Primarily issued for national security reasons, the TFR is listed as follows:

> **FDC 4/0811 FDC ...SPECIAL NOTICE... THIS IS A RESTATEMENT OF A PREVIOUSLY ISSUED ADVISORY NOTICE. IN THE INTEREST OF NATIONAL SECURITY AND TO THE EXTENT PRACTICABLE, PILOTS ARE STRONGLY ADVISED TO AVOID THE AIRSPACE ABOVE, OR IN PROXIMITY TO SUCH SITES AS POWER PLANTS (NUCLEAR, HYDRO-ELECTRIC, OR COAL), DAMS, REFINERIES, INDUSTRIAL COMPLEXES, MILITARY FACILITIES, AND OTHER SIMILAR FACILITIES. PILOTS SHOULD NOT CIRCLE AS TO LOITER IN THE VICINITY OVER THESE TYPES OF FACILITIES.**

The Aeronautical Information Manual (AIM) Chapter 7, addresses Potential Flight Hazards. Section 7-5-1, which discusses the 10 most frequent cause factors for General Aviation that involve the pilot-in-command, include the following:

5. Failure to see and avoid objects or obstructions, and

7. Improper in-flight decisions or planning.

We reviewed this section for information and methods for assessment and mitigation of similar flight hazards within the NAS that are addressed later in this study.

AIM Section 7-5-3 states:

Obstructions To Flight

a. General. Many structures exist that could significantly affect the safety of your flight when operating below 500 feet AGL, and particularly below

200 feet AGL. While 14 CFR Part 91.119 allows flight below 500 AGL when over sparsely populated areas or open water, such operations are very dangerous.

At and below 200 feet AGL there are numerous power lines, antenna towers, etc., that are not marked and lighted as obstructions, and therefore may not be seen in time to avoid a collision. Notices to Airmen (NOTAMs) are issued on those lighted structures experiencing temporary light outages. However, some time may pass before the FAA is notified of these outages, and the NOTAM issued, thus pilot vigilance is imperative.

b. Antenna Towers. Extreme caution should be exercised when flying less than 2,000 feet AGL because of numerous skeletal structures, such as radio and television antenna towers, that exceed 1,000 feet AGL, with some extending higher than 2,000 feet AGL. Most skeletal structures are supported by guy wires that are very difficult to see in good weather and can be invisible at dusk or during periods of reduced visibility. These wires can extend about 1,500 feet horizontally from a structure; therefore, all skeletal structures should be avoided horizontally by at least 2,000 feet. Additionally, new towers may not be depicted in a current aeronautical chart because the information was not received prior to the printing of the chart.

c. Overhead Wires. Overhead transmission and utility lines often span approaches to runways, natural flyways such as lakes, rivers, gorges, and canyons, and cross other landmarks pilots frequently follow such as highways, railroad tracks, etc. As with antenna towers, these high voltage/power lines or the supporting structures of these lines may not always be readily visible and the wires may be virtually impossible to see under certain conditions. In some locations, the supporting structures of overhead transmission lines are equipped with unique sequence flashing white strobe light systems to indicate that there are wires between the structures.

However, many power lines do not require notice to the FAA and, therefore, are not marked and/or lighted. Many of those that do require notice do not exceed 200 feet AGL or meet the Obstruction Standard of 14 CFR Part 77 and, therefore, are not marked and/or lighted. All pilots are cautioned to remain extremely vigilant for these power lines or their supporting structures when following natural flyways or during the approach and landing phase. This is particularly important for seaplane and/or float equipped aircraft when landing on, or departing from, unfamiliar lakes or rivers.

d. Other Objects/Structures. There are other objects or structures that could adversely affect your flight such as construction cranes near an airport, newly constructed buildings, new towers, etc. Many of these structures do not meet charting requirements or may not be charted because of the charting cycle.

Some structures do not require obstruction marking and/or lighting and some may not be marked and lighted even though the FAA recommended it.

Title 14 Code of Federal Regulations (CFR) Part 91 provides the following guidance for minimum safe flight altitudes and defines careless or reckless operation. We mention these two sections, as they will become significant to the scope of our investigation.

These rules apply to all aircraft operated under 14 CFR Parts 91, 121, 135 or 137.

Sec. 91.119

Minimum safe altitudes: General

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) *Anywhere.* An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) *Over congested areas.* Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) *Over other than congested areas.* An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

(d) *Helicopters.* Helicopters may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section if the operation is conducted without hazard to persons or property on the surface. In addition, each person operating a helicopter shall comply with any routes or altitudes specifically prescribed for helicopters by the Administrator.

Sec. 91.13

Careless or reckless operation.

(a) *Aircraft operations for the purpose of air navigation.* No person may operate an aircraft in a careless or reckless manner as to endanger the life or property of another.

(b) *Aircraft operations other than for the purpose of air navigation.* No person may operate an aircraft, other than for the purpose of air navigation, on any part of the surface of an airport used by aircraft for air commerce (including areas used by those aircraft for receiving or discharging persons or cargo), in a careless or reckless manner as to endanger the life or property of another.

(3) Other Related Material

The Australian Government Civil Aviation Safety Authority (CASA) Advisory Circular (AC) 139-05(0), Guidelines for Conducting Plume Rise Assessments of June 2004, was reviewed as guidance to illustrate a means, but not necessarily the only means of assessing ... *"the potential hazard from plume rise to aircraft operations."* The AC further finds...

- "*Aviation authorities have established that an exhaust plume with a vertical gust in excess of 4.3 meters/second (m/s) may cause damage to an aircraft airframe, or upset an aircraft when flying at low levels.*"

- "CASA requires the proponent of a *facility with an exhaust plume, which has a vertical velocity exceeding the limiting value (4.3 m/s at the aerodrome Obstacle Limitation Surface (OLS) or at 110 meters above the ground level anywhere else) to be assessed for potential hazard to aircraft operation.*"

The FAA does not necessarily approve/disapprove or warrant the data contained in the CASA AC 139-05. The team accepts the information and data contained in AC 139-05 as a valid representation of hazardous exhaust velocities. Lacking other professional data to the contrary, the team used the CASA AC information during the risk assessment and analysis process by stipulating the measures of efflux velocities and altitudes are plausible/representative aviation community data.

However, many narrative sections of AC 139-05 do not apply as Australian laws and regulations regarding land use, hazard assessments, and procedures regarding objects affecting the navigable airspace are far different from those of the United States. A prime example of this is in paragraph 6.2 of the AC where CASA states an obstacle "*...can include the gaseous efflux, which is capable of physical definition or measurement.*" In the United States, 14 CFR Part 77 only considers the height of the structure. For these and similar reasons only quantifiable metrics of plume data will be referenced.

Statement on scope of analysis:

The tools and analysis techniques that were used to analyze the hazards were the "What if" Technique and Preliminary Hazard Analysis (PHA). These tools are described in-depth in the *SMS Manual*. The SRM methodology used by the team to assess and identify safety hazards applied SME knowledge, experience, and expertise across the various disciplines during formal and informal "brainstorming" sessions. The risk analysis team determined the greatest risk of overflight of vertical plumes to aircraft would be in the takeoff and approach/landing phase of flight. Therefore, the analysis would concentrate on these low low-level flying activities (below 1,000 feet AGL). Here, the aircraft would be in close proximity to the ground, and smoke stack/plumes and any resultant turbulence or associated risk would be of greatest consequence.

Therefore, the 4.3 m/s velocity and/or the 110 meters (approximately 360.89 feet) height above the stack CASA criteria for assessment would be most critical during the takeoff/landing phase of flight as the aircraft would be at higher altitudes during other phases, i.e., climb, enroute, and arrival.

The risk analysis team identified the following hazards:

Hazard H1 was identified by association of plumes with other convective activity such as: updrafts, downdrafts, forest fires, and/or weather related activity, and under AIM guidance Obstructions to Flight – Other Objects/Structures.

H1: High efflux temperature or velocity from industrial facilities (power plant exhaust plumes) may cause air disturbances that would have the potential to cause airframe damage and/or negatively affect the stability of aircraft in-flight.

These situations would be most critical at low altitude during the takeoff and/or landing phase when an aircraft is in close proximity to an airport and could possibly result in loss of both aircraft and crew as well as damage to ground facilities.

Hazard H2 was identified by correspondence of concerned citizens and discussion with pilots and ATC personnel.

H2: Exhaust plumes from industrial facilities (power plant, gas or coal fired furnaces, etc.) could result in restricted visibilities with high levels of water vapor, icing, and engine/aircraft contaminants that would have a detrimental effect on aircraft/aircrew performance. These individually or cumulatively could possibly result in substantial aircraft damage, and/or loss of both aircraft and crew as well as damage to ground facilities. These situations would be most critical at low altitude during the takeoff and/or landing phase when an aircraft is in close proximity to an airport.

Section 3 - Risk Analysis and Risk Assessment

Statistical Analysis of Data

In attempting to derive a target level of safety for overflight of exhaust plumes, one difficulty (although most welcome) is that accidents and incidents have been non-existent, so the basis of historical data is limited. The procedure adopted here is to derive target levels of safety for an accident and for a fatal accident due to all causes, and then to estimate what proportion of that risk to allocate to overflight of exhaust plumes. To assess the overall risk, two separate stages are involved as follows:

a) The choice of a unit for the measurement of risk.

b) The choice of a target level for the total risk due to all causes.

A target level of safety for civil aviation may be specified in a number of ways. The most common unit is the fatal accident per departure. In the case of scheduled air carrier operations, the number of departures is recorded annually and the determination of fatal accidents per departure is straightforward. In the case of general aviation, the flights are unscheduled and unrecorded making any estimate of the number of departures extremely inaccurate. However, the FAA conducts an annual survey of general aviation pilots to determine an estimate of the number of hours flown by general aviation pilots during the year in question. Since the survey is scientifically constructed and conducted, the data should be reasonably accurate. Therefore, the decision was made to use incidents per flight hour and fatal accidents per flight hour as the units in the development of the target level of safety.

Table 1 lists the number of accidents, fatal accidents, estimated hours flown, and accident rates for the years 1975 through 2004.

Table 1 - Accidents, Fatalities, Flight Hours, and Rates, 1975 through 2004, U.S. General Aviation

	Accidents		Fatalities			Accidents per 100,000 Flight Hours	
Year	**All**	**Fatal**	**Total**	**Aboard**	**Flight Hours**	**All**	**Fatal**
1975	3995	633	1252	1231	28,799,000	13.87	2.19
1976	4018	658	1216	1203	30,476,000	13.17	2.16
1977	4079	661	1276	1265	31,578,000	12.91	2.09
1978	4216	719	1556	1398	34,887,000	12.08	2.06
1979	3818	631	1221	1203	38,641,000	9.88	1.63
1980	3590	618	1239	1230	36,402,000	9.86	1.69
1981	3500	654	1282	1261	36,803,000	9.51	1.78
1982	3,233	591	1187	1171	29,640,000	10.82	1.96
1983	3,075	555	1,068	1,061	28,673,000	10.67	1.92
1984	3,017	545	1,042	1,021	29,099,000	10.28	1.84
1985	2,739	498	956	945	28,322,000	9.63	1.74
1986	2,581	474	967	879	27,073,000	9.49	1.73
1987	2,495	446	837	822	26,972,000	9.18	1.63
1988	2,388	460	797	792	27,446,000	8.65	1.66
1989	2,242	432	769	766	27,920,000	7.97	1.52
1990	2,242	444	770	765	28,510,000	7.85	1.55
1991	2,197	439	800	786	27,678,000	7.91	1.57
1992	2,111	451	867	865	24,780,000	8.51	1.82
1993	2,064	401	744	740	22,796,000	9.03	1.74
1994	2,022	404	730	723	22,235,000	9.08	1.81
1995	2,056	413	735	728	24,906,000	8.21	1.63
1996	1,908	361	636	619	24,881,000	7.65	1.45
1997	1,844	350	631	625	25,591,000	7.19	1.36
1998	1,905	365	625	619	25,518,000	7.44	1.41
1999	1,905	340	619	615	29,246,000	6.5	1.16
2000	1,837	345	596	585	27,838,000	6.57	1.21
2001	1,727	325	562	558	25,431,000	6.78	1.27
2002	1,715	345	581	575	25,545,000	6.69	1.33
2003	1,741	352	632	629	25,705,000	6.77	1.37
2004	1,614	312	556	556	25,900,000	6.22	1.2
Totals	77,874	14,222	26,749	26,236	849,291,000		
Means	2595.8	474.0667	891.6333	874.5333	28,309,700	9.012333	1.649333

From Table 1, we see that the accident rate trend has been downward. This is illustrated in Figure 1.

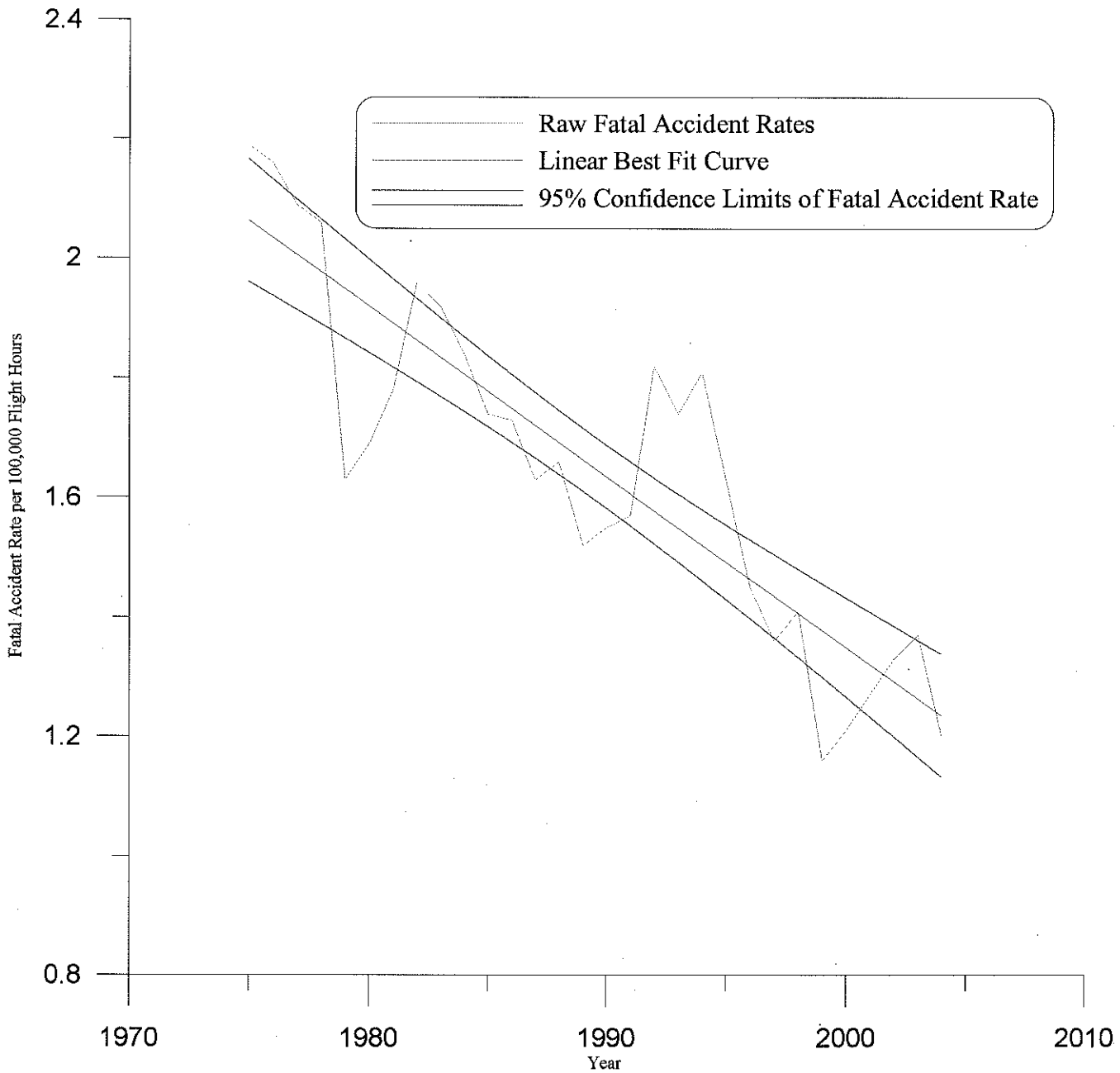


Figure 1. U.S. General Aviation Fatal Accident Rates (all causes) in Fatal Accidents per 100,000 Hours.

The confidence bands depicted in Figure 1 give an indication of the range of values the actual accident rate may fall within with a probability of 0.95. The lower confidence band in Figure 1 intersects the year 2005 at about 1.0. This indicates that a conservative estimate of the current fatal accident rate is 1 in 100,000 hours or 1×10^{-5} per flight hour.

Since the fatal accident rate is lower than the overall accident rate, we may conservatively choose 1×10^{-5} per flight hour as the overall target level of safety for flights of general aviation aircraft. An overflight of an exhaust plume is just one of many factors that could cause an accident or incident. When the number of factors that could cause a failure or accident is essentially unknown, standard engineering practice is applied.

Standard engineering practice assumes there are 100 possible causes and apportions the probability equally between the assumed factors. Therefore, since the overall target level of safety is 1×10^{-5} per flight hour, the target level of safety for overflight of an exhaust plume would be $1 \times 10^{-5}/ 10^{2} = 1 \times 10^{-7}$ per flight hour.

From Table 1 we see that there were approximately 849,291,000 flight hours by general aviation aircraft during the time period 1975 to 2004. During this time period a careful search of the available aviation databases revealed that zero accidents or incidents related to overflight of a plume have been reported. This implies that the probability of an accident or incident caused by overflight of a plume is very small. If there were just one reported accident or incident, the estimated rate would be 1/849,241,000 or 1.2×10^{-9}. If there were two reported accidents or incidents, the estimated rate would be 2/849,241,000 or 2.4×10^{-9}. Therefore, it is safe to conclude that the accident/incident rate for overflights of exhaust plumes is of the order of 10^{-9} or less. Since the target level of safety was determined to be 1×10^{-7}, the probability of an accident or incident from overflight of an exhaust plume is less than the target level of safety. Since the target level of safety is met, the likelihood of an accident or incident caused by overflight of an exhaust plume is acceptably small.

Human Factors Assessment

Power plant exhaust plumes do not present an immediate or critical increase in human mental or physical workload, resulting in any commensurate decrease in performance. However, like any phenomenon in the NAS, pilots need to be properly armed with the knowledge that it exists. This prior knowledge allows for proper flight planning of routes and avoidance strategies, thus eliminating inadvertent visual or physical contact with a plume. As in any operation in the NAS, pilot comfort levels directly impact anxiety that subsequently may cause an increase in self-induced levels of stress and mental/physical workload. The more knowledge pilots have access to regarding any respective flight, the more comfortable he/she is. It is strongly advised that the existence of plumes in a flying area be published and disseminated to pilots for the reasons mentioned above. Pilots should be prepared to see and avoid power plant exhaust plumes just as they would be prepared to see and avoid any obstacle in their flight path, expected or unexpected. We would expect that any plume encounter would be a relatively benign event. The pilot's mental and/or physical resources would not be so task-overloaded as to preclude a safe maneuver out of, and away from the condition.

Preliminary Risk Assessment

A preliminary risk assessment of the two identified hazards was completed during brainstorming sessions by the technical team consisting of the previously mentioned FAA SME. The risk associated with a hazard is the composite of predicted severity (Table 2) and likelihood (Table 3) of the potential effect or outcome of the hazard in the worst credible system state. The following SMS Manual matrixes were used to develop the risk matrix for overflight of vertical plumes. The "Flying Public" row of the "Effect On" column was utilized for Severity and the "Qualitative ATC Service/NAS Level System" column was used for Likelihood.

Table 2 - Severity definitions

Effect On: ↓	Hazard Severity Classification				
	No Safety Effect **5**	**Minor** **4**	**Major** **3**	**Hazardous** **2**	**Catastrophic** **1**
Air Traffic Control	Slight increase in ATC workload	Slight reduction in ATC capability or significant increase in ATC workload	Reduction in separation as defined by a low/moderate severity operational error (as defined in FAA Order 7210.56) or significant reduction in ATC capability	Reduction in separation as defined by a high severity operational error (as defined in FAA Order 7210.56) or a total loss of ATC Capability (ATC Zero)	Collision with other aircraft, obstacles or terrain
Flying Public	- No effect on flight crew - Has no effect on safety - Inconvenience	- Slight increase in flight crew workload - Slight reduction in safety margin or functional capabilities - Physical discomfort of occupants	- Significant increase in flight crew workload - Significant reduction in safety margin or functional capability - Physical distress possibly including injuries	- Large reduction in safety margin or functional capabilities - Serious or fatal injury to small number of occupants or cabin crew - Physical distress/ excessive workload	Outcome would result in: - Hull loss - Multiple fatalities

Table 3 - Likelihood Definitions

	NAS System			Flight Procedures	Operational	
		Qualitative				
	Quantitative[1]	Individual Item/System	ATC Service/ NAS Level System[2]		Per Facility[3]	NAS-wide[4]
Frequent A	Probability of occurrence per operation/operational hour is equal to or greater than $1x10^{-3}$	Expected to occur frequently for an item	Continuously experienced in the system	Probability of occurrence per operation/ operational hour is equal to or greater than $1x10^{-5}$	Expected to occur more than once per week	Expected to occur every 1-2 days
Probable B	Probability of occurrence per operation/operational hour is less than $1x10^{-3}$, but equal to or greater than $1x10^{-5}$	Expected to occur several times in the life of an item	Expected to occur frequently in the system		Expected to occur about once every month	Expected to occur several times per month
Remote C	Probability of occurrence per operation/operational hour is less than $1x10^{-5}$ but equal to or greater than $1x10^{-7}$	Expected to occur sometime in the life cycle of an item	Expected to occur several times in system life cycle	Probability of occurrence per operation/ operational hour is less than $1x10^{-5}$ but equal to or greater than $1x10^{-7}$	Expected to occur about once every 1 -10 years	Expected to occur about once every few months
Extremely Remote D	Probability of occurrence per operation/operational hour is less than $1x10^{-7}$ but equal to or greater than $1x10^{-9}$	Unlikely but possible to occur in an item's life cycle	Unlikely but can reasonably be expected to occur in the system life cycle	Probability of occurrence per operation/ operational hour is less than $1x10^{-7}$ but equal to or greater than $1x10^{-9}$	Expected to occur about once every 10-100 years	Expected to occur about once every 3 years
Extremely Improbable E	Probability of occurrence per operation/operational hour is less than $1x10^{-9}$	So unlikely, it can be assumed that it will not occur in an item's life cycle	Unlikely to occur, but possible in system life cycle	Probability of occurrence per operation/ operational hour is less than $1x10^{-9}$	Expected to occur less than once every 100 years	Expected to occur less than once every 30 years

Preliminary Risk

Figure 2 reflects the definition of risk being the composite of severity and likelihood. This matrix classifies risk into three levels: High, Medium, and Low. The risk levels used in the matrix are defined as:

- **High risk** – unacceptable risk.

- **Medium risk** – acceptable risk; minimum acceptable safety objective; proposal may be implemented, but tracking and management are required.
- **Low risk** – acceptable without restriction or limitation; hazards are not required to be actively managed, but are to be documented.

The safety risk team preliminary risk assessment matrix in Figure 2 indicates where the initial hazards (H1/H2) identified by overflight of vertical plumes (in the takeoff/landing phase 1,000 feet AGL and below) would be situated on the risk matrix without considering or implementing any of the mitigations previously discussed. The team performed their analysis of the predictive risks associated with the plumes and determined the effects of both H1 and H2 hazards as low, or in the green section of the risk matrix. As a result of this assessment, the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation.

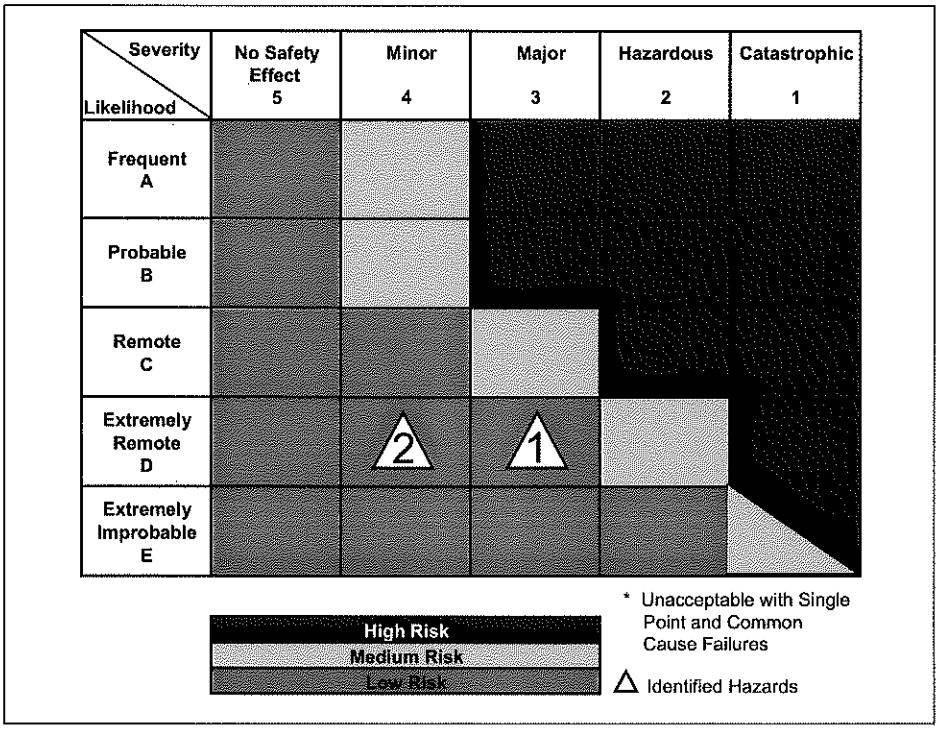


Figure 2 – Preliminary Risk Matrix Without Mitigation (current Risk)

Section 4 - Summary of Risk Analysis Team Deliberations

The review of the material in Section 2, the statistical analysis of data and the in-depth professional discussion, experience, and knowledge of SMEs on the team, led to the following preliminary observations:

- Given the virtually non-existent accident/incident safety data by either GA or commercial aviation pilots, the team was extremely confident in drawing the preliminary inference that hazard(s) associated with plume overflight represent an extremely low risk to aviation and the flying public.
- However, and in light of supporting data to the contrary, the team agreed that intentional and/or inadvertent overflight of industrial plumes at low altitudes (less than 1,000 feet above) during high velocity operation of the facility could possibly result in aircraft upset and a resultant incident or accident.
- The team determined that low, close-in operations at small to medium size airports by general aviation (GA) aircraft, particularly aircraft under 12,500 lbs. and those in the Light Sport Aircraft (LSA) category, would be of greatest potential concern.
- The SME team considered and discussed their belief that safety data which indicated few, if any accidents/incidents attributable to the issue may be a reflection of the cumulative actions over many years of prudent aviators and ATC personnel. This includes knowledge of and training in established "see-and avoid" techniques and/or mitigating operational procedures. The situation with plumes was deemed similar to many hazards present in the NAS today (see AIM Chapter 7 for further examples). Moreover, rules and regulations restricting the altitude for overflight of power plant facilities coupled with pilot training, alerting, and the common sense aviator aptitude were determined to be the major factors in the scarcity of associated data and resultant low risk factor.
- At airports where power plants could not be optimally avoided by current approach procedures or when weather resulted in plume footprints that could adversely affect airport operations, ATC past and present operational procedures were deemed more than adequate to maintain established acceptable levels of risk.
- Plume effects (H2) on aircraft, engine component function, and/or corrosion were deemed inconsequential by the SME team.
- The team noted the CASA flight restriction of 4.3m/s above OLS or 110 (meters) AGL as less restrictive than the 14 CFR Part 91 restrictions previously mentioned.

Section 5 – Conclusions, Recommendations, and Residual Risk

Safety is freedom from unacceptable risk. Everyday in the NAS aircraft and airmen operate with hazards that constantly present various levels of risk. From bird strikes, to engine failures, to runway incursions, these situations present vastly different scenarios for the pilot, crew, and ATC personnel to consider. However, these hazards all have one characteristic in common – they represent ***acceptable risk*** that is considered and mitigated as necessary to allow flight operations to proceed to a safe conclusion in the vast majority of cases.

Many of these risks represent far greater concern and thereby require a more complicated Risk Control Strategy or mitigation effort than the issue addressed by this study.

Our interpretation of available data is not so much that plumes are not hazards or present zero risk, but that pilots and controllers operating within the NAS have been and will continue to apply prudence and common sense skills to constantly "see and avoid" any potential hazard. These mitigating techniques are employed everyday throughout NAS through timely communication, training, and procedures for operating near hazardous weather, forest fires, large sporting events, volcanic ash, migratory bird activity, antenna towers, and overhead wires.

The risk assessment team offers the following conclusions and recommendations with regard to "overflight of plumes" and associated hazards:

Conclusions:

1. Given the considerably large pool of safety data available, it is safe to conclude that the accident/incident rate for overflights of exhaust plumes is of the order of 1×10^{-9} or less. Since the target level of safety was determined to be 1×10^{-7}, the probability of an accident or incident from overflight of an exhaust plume is less than the target level of safety. Since the target level of safety is met, the current likelihood of an accident or incident caused by an overflight of an exhaust plume is acceptably small.

2. Current regulations and advisories as well as the present Notice to Airmen (NOTAM) Temporary Flight Restrictions should preclude prudent pilots from flying through or near plumes, thereby making the aviation risk essentially zero.

3. Safety data and TLS notwithstanding, the FAA believes that flight over or around plume generating facilities should be avoided as there is the *potential* (however low) for aircraft upset at close proximity to high velocity plumes.

Recommendations:

Given the extremely low risk these plumes present, further mitigation is not required. However, the risk assessment team would offer that the FAA continue to enhance awareness programs that have been successful with similar hazards of acceptable risk levels. These programs include pilot and ATC personnel professional education, communication, advisement and avoidance strategies, and operational techniques. Accordingly, the safety risk assessment team recommends the FAA:

(a) Amend the Aeronautical Information Manual (AIM) Chapter 7, Section 5 with wording to the effect that overflight at less than 1,000 feet vertically of plume generating industrial sites should be avoided.

(b) Publish (as appropriate) the position and nature of the present power plants located near public airports in the Airport/Facility Directory (A/FD), and issue a Notice to Airmen (NOTAM) when operationally necessary.

(c) Make the Temporary Flight Restriction (TFR) that includes the overflight of power plants (which was issued primarily for national security purposes) - a permanent flight restriction where operationally feasible.

(d) Amend FAA Order 7400.2 to consider a plume generating facility as a hazard to navigation when expected flight paths pass less than 1,000 feet above the top of the object.

(e) Advisory Circular 70/7460-2K Proposed Construction of Objects That May Affect the Navigable Airspace - Change Instructions for Completing FAA Form 7460-1 – Notice of Proposed Construction or Alteration, Item # 21, to add:

> "For structures such as power plants or any industrial facility where exhaust plume discharge could reasonably be expected and reportable under the provisions of Part 77, thoroughly explain nature of the discharge."
>
> Amend the AC as necessary to explain this change.

Residual Risk

A risk matrix, as shown in Figure 3, indicates where the residual risk of the hazards identified with the overflight of vertical plumes are situated with the implementation of the recommendations described above.

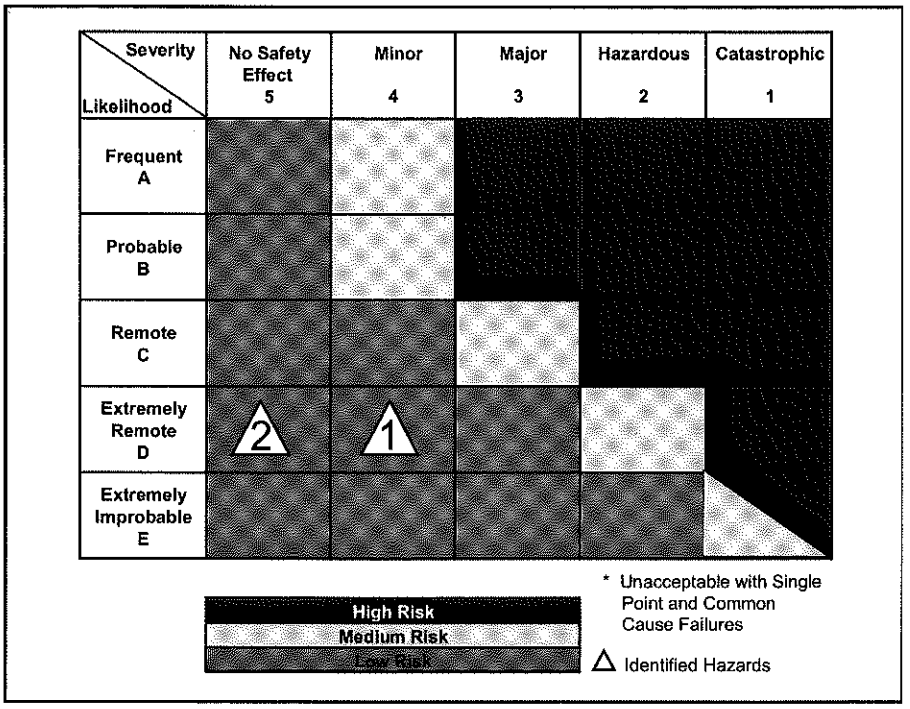


Figure 3 – Risk Matrix with Mitigation* (Residual Risk)
* Not required

Glossary of Terms

Aviation Safety Reporting System (ASRS) and Aviation Safety Reporting Program (ASRP). ASRS and ASRP are voluntary programs designed to encourage the identification and reporting of deficiencies and discrepancies in the airspace system. The National Aeronautics and Space Administration (NASA) accomplishes receipt, processing, and analysis of raw data rather than the FAA, which ensures the anonymity of the reporter and of all parties involved in a reported occurrence or incident and, consequently, increase the flow of information necessary for the effective evaluation of the safety and efficiency of the system. [Advisory Circular 00-46, *Aviation Safety Reporting Program]*

Accident. An event associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and until all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.

Accident/Incident Reporting Data System (AIDS). The FAA AIDS database contains accident and incident data records for all categories of civil aviation.

Assessment. An estimation of the size/scope of risk or quality of a system or procedure.

Effect. The effect is a description of the potential outcome or harm of the hazard if it occurs in the defined system state.

14 CFR Part 91 (General Aviation). Prescribes the operation of aircraft (other than moored balloons, manned rockets, and unmanned free balloons, which are governed by CFR Part 101, and ultralight vehicles operated in accordance with CFR Part 103) within the United States, including the waters within three nautical miles of the U.S. coast. Flights operating for recreation and training are generally carried out under CFR Part 91. Although general aviation usually involves small aircraft, the definition depends on the nature of the operation rather than the size of the aircraft.

14 CFR Part 121 (Air Carrier). Refers to scheduled domestic airlines and cargo carriers that fly large transport category aircraft.

14 CFR Part 135 (Air Taxi and Commuter). Refers to either scheduled (commuter operations) or nonscheduled (air taxi operations) flights. Scheduled CFR Part 135 operations apply to smaller aircraft carrying nine or fewer passengers on regularly scheduled routes. Nonscheduled CFR Part 135 operations apply to smaller aircraft carrying nine or fewer passengers with schedules that are arranged between the passengers and the operator. The nonscheduled operations also include cargo planes with payload capacities of 7,500 pounds or less.

14 CFR Part 137 (Agricultural). Refers to agricultural aircraft operations. Agricultural aircraft operation means the operation of an aircraft for the purpose of (1) dispensing any

economic poison; (2) dispensing any other substance intended for plant nourishment, soil treatment, propagation of plant life, or pest control; or (3) engaging in dispensing activities directly affecting agricultural, horticultural, or forest preservation, but not including the dispensing of live insects.

Fatal Injury. The NTSB defines a fatal injury as any event that results in death within 30 days of the event.

Hazard. Any real or potential condition that can result in injury, illness, or death to people; damage to, or loss of a system (hardware or software), equipment or property; and/or damage to the operating environment. A hazard is a prerequisite to an accident or incident.

Hazard Tracking. Hazard tracking is a closed-loop means of ensuring that the requirements and mitigations associated with each hazard that has associated medium and/or high risk are implemented. Hazard tracking is the process of defining safety requirements, verifying implementation, and reassessing the risk to make sure the hazard meets its risk level requirement before being accepted.

Incident. The NTSB defines an incident as an event, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations.

Likelihood. Likelihood is an expression of how often an event is expected to occur. Severity must be considered in the determination of likelihood. Likelihood is determined by how often the resulting harm can be expected to occur at the worst credible severity, which will usually occur in the worst credible system state.

Mitigation. An action taken to reduce the risk of a hazard.

National Airspace System (NAS). An integrated set of constituent pieces that are combined in an operational or support environment to accomplish a defined objective. These pieces include people, operational environment, usage, equipment, information, procedures, facilities, services, and other support services.

National Aviation Safety Data Analysis Center (NASDAC). The NASDAC system enables users to perform queries across multiple databases and display queries in useful formats. The NASDAC is a data warehouse and integrated database system.

Plume. Thermal updrafts generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems, which could have the ability to release large amounts of pressurized or otherwise unstable air. Can be visible or invisible in the air and disperse at various velocities/rates and directions for a given facility output and atmospheric conditions.

Preliminary Hazard Analysis (PHA). A risk analysis tool used in the hazard identification process for nearly all risk management applications except the most time-critical.

The broad scope of this tool provides a guide to the identification of issues. The PHA considers all of the hazards inherent to each aspect of an operation, without regard to risk. The PHA helps overcome the tendency to focus immediately on risk in one aspect of an operation, sometimes at the expense of overlooking more serious issues elsewhere in the operation.

Process. An organized group of related activities that work together to produce a desirable condition.

Qualitative Data. Subjective data is expressed as a measure of quality; nominal data.

Quantitative Data. Objective data expressed as a quantity, number or amount that allows for more rational analysis and substantiation of findings.

Risk. The risk associated with a hazard is the composite of predicted severity and likelihood of the potential effect or outcome of the hazard in the worst credible system state. The two types of risk addressed in this study are, (1) current, (2) residual:

> **Current.** Current risk is the predicted severity and likelihood of an effect associated with a hazard at the current time.
>
> **Residual.** Residual risk is the remaining risk that exists after all control/mitigating techniques have been implemented or exhausted.

Risk Assumption Strategy. To accept the likelihood, probability, and consequences associated with the risk.

Risk Avoidance Strategy. To select a different approach or to not participate in the operation, procedure, or system development to avert the potential of occurrence and/or consequence.

Risk Control Strategy. To develop options and alternatives and/or take actions to minimize or eliminate the risk.

Safety. Freedom from unacceptable risk.

Safety Management System (SMS). An integrated collection of processes, procedures, policies, and programs that are used to assess, define, and manage the safety risk in the provision of air traffic control (ATC) and navigation services.

Safety Risk Management (SRM). A formalized, proactive approach to system safety. SRM is a methodology usually applied to all (NAS) changes that ensures all risks are identified and mitigated prior to the change being made. For the purposes of this study, SRM provides a flexible "closed-loop" safety analysis framework well-suited to the analysis of presumed hazards.

Severity. Severity is the measure of how bad the results of an event are predicted to be. Severity is determined by the worst credible potential outcome.

Substantial Damage – The NTSB defines substantial damage as failure that adversely affects the structural strength, performance, or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component. Engine failure or damage limited to the engine if only one engine fails or is damaged, bent fairings or cowlings, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, engine accessories, brakes, or wingtips are not considered "substantial damage."

Target Level of Safety (TLS). The target level of safety is the maximum allowable probability of a hazardous event. The target level of safety is usually determined from historical data for various operations, but is sometimes developed through analysis.

"What - if" Technique. Is a brainstorming method designed to add discipline and structure to the experiential and intuitive expertise of operational personnel.

Worst Credible System State. In this definition, "*worst*" is the most unfavorable conditions expected (e.g., extremely high levels of efflux material and velocity, extreme weather disruption, etc.); "*credible*" implies that it is reasonable to expect the assumed combination of extreme conditions will occur within the NAS.

Appendix A – Risk Assessment Team Members

Name	Organization/Position
Alan Jones	AFS-420/Operations Research Analyst
Dr. James Yates	AFS-420/FAA Contractor-ISI, Senior Engineer & Pilot
Dean Alexander	AFS-440/ Test Director & Airspace System Inspection Pilot
Rick Dunham	AFS-440/ Test Director & Airspace System Inspection Pilot
Lt. Col Paul McCarver	AFS-420/USAF Pilot & Military Liaison
Michael Werner	AFS-420/Pilot & Aviation Safety Inspector (Operations)
Gary Powell	AFS-420/Pilot & Aviation Safety Inspector (Operations)
Larry Ramirez	AFS-440/Air Traffic Control Liaison
James Nixon	AFS-420/FAA Contractor-ISI, Pilot & Approach Procedure Specialist
Mark Reisweber	AFS-440/Engineering Psychologist (Human Factors) & Pilot
John Holman	AFS-420/FAA Contractor-ISI, Pilot & Approach Procedure Specialist

Technical Area: Land Use
Author: James Adams

BACKGROUND

The Eastshore project site is approximately 1 1/2 miles southwest of the Hayward Executive Airport and would be within the Airport Approach Zoning Plan boundaries. These boundaries extend approximately two (2) miles out from the landing area of the airport. The project's stacks and resulting hot air exhaust plume would introduce the potential for impacts to aircraft flying over the site. Pursuant to the Hayward Municipal Code (HMC) §10-6.35, "…no use may be made of land within any airport approach zone, airport turning zone, or airport transition zone in such a manner as to…endanger the landing, take off, or maneuvering of aircraft."

DATA REQUEST

69. As it relates to potential aviation hazards, please discuss the suitability of the proposed project site and its consistency with uses within the Hayward Airport Approach Zoning Plan (HMC §10-6.35).

    Response:

    Please refer to Data Response 68.

Technical Area: Traffic and Transportation
Author: Shaelyn Strattan

BACKGROUND

The Eastshore project site is approximately 1-1/2 miles southwest of the Hayward Executive Airport and would be within the Airport Approach Zoning Plan boundaries. These boundaries extend approximately two (2) miles out from the landing area of the airport. The project's stacks and resulting hot air exhaust plumes would introduce the potential for impacts to aviation safety and the safe maneuvering of aircraft within this area. Per the Hayward Municipal Code (HMC) §10-6.35, "…no use may be made of land within any airport approach zone, airport turning zone, or airport transition zone in such a manner as to…endanger the landing, take off, or maneuvering of aircraft."

Staff has been advised by the Hayward Airport Acting Manager, the Federal Aviation Administration (FAA), and Alameda Airport Land Use Commission staff that aircraft traverse the area at altitudes as low as 400 feet above ground level (agl) and regularly fly over the area at altitudes below 1000 feet agl. The Hayward Executive Airport averages approximately 400 airport operations per day. Smaller single and two-engine aircraft, rotor craft (such as helicopters), and ultra-light or experimental aircraft are particularly susceptible to low level turbulence. The AFC provides no discussion of potential plume impacts or analysis of plume velocity, heat dispersal, or other plume characteristics that might contribute to low altitude turbulence in AFC §8.10 (Traffic & Transportation). Analyses of the velocity, shape, and dispersal of the exhaust plumes are necessary for staff to determine the potential impact of plumes generated by the Eastshore facility on aircraft flying in the immediate vicinity of the project.

DATA REQUEST

70. Please provide a detailed plume analysis for the thermal plumes generated by the Eastshore facility's exhaust stacks, including:

    a) Frequency of plume generation, velocity, shape, continuity, and dispersal of plume(s), up to and including 2000 feet agl.

    b) Meteorological impacts on plume formation and behavior. Provide the name of the computer model used and its inputs and outputs.

    c) Potential impacts to air mass stability and aircraft operations in the area affected by the plumes. Please consider elements such as aircraft type, speed, and altitude; low visibility; cool temperatures; and calm winds when evaluating potential aviation impacts.

    Response:

    The Applicant has conducted a modeling study of the exhaust plumes that the Eastshore stacks would be likely to generate. This modeling study follows an Australian methodology, called the Spillane Method, for describing industrial plumes that was developed in Australia (Best et al. 2003). This is the only

available published thermal plume analysis methodology of its type applicable to aviation safety analysis known to the Applicant.

In addition, the Applicant has also examined the Commission's documents relating to the Blythe Energy Power Plant (98-AFC-8C) compliance case and the Blythe Energy Project Phase II (02-AFC-01). In the Blythe compliance case, the power plant's cooling tower was in alignment with the Blythe Airport runway centerline approximately one mile from the runway and airplanes would pass directly over the Blythe power plant at an elevation of approximately 300-500 feet above the ground or less when landing (Blythe Energy Project Phase II Commission Decision, page 176). In the Blythe Phase II case, small aircraft also making an approach to the runway would, similarly, pass directly over the Blythe II cooling tower at low altitude before making a right-angle turn to land. The Commission Staff used a variety of methodologies to evaluate potential plume heights and cooling tower alternatives for the Blythe plumes. For this Eastshore analysis, the applicant selected one conservative approach available as noted above and described in detail later (Best et al. 2003) for assessing Eastshore plumes under the Australian requirements, which are described next.

In the Blythe II siting case, the Staff also invoked a standard of 4.3 meters per second (m/s) at 110 meters in height as a benchmark velocity/altitude for initial screening of plume velocities in calm conditions. This is the standard used by the Australian Civil Aviation Safety Authority as a screening threshold (CASA 2004). Industrial sources located near airports in Australia meeting or exceeding this standard then conduct additional modeling using meteorological conditions to determine what percentage of time a plume of this velocity would occur at 110 meters. Windy conditions will bend thermal plumes to lower maximum elevations and cause more rapid mixing with ambient air than would take place under calm conditions. Unfortunately, the Australian government documents do not present any data or cite any studies in support of this standard.

The FAA's "Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes" industrial plumes safety study (2006) acknowledges the Australian standard of AC 139-05 (the Australian Government's Advisory Circular), but neither supports this standard for American airspace nor refutes it, saying

> The FAA does not necessarily approve/disapprove or warrant the data contained in the CASA AC 139-05…. However, many narrative sections of AC 139-05 do not apply as Australian laws and regulations regarding land use, hazard assessments, and procedures regarding objects affecting the navigable airspace are far different from those of the United States (FAA 2006: page 6).

Although the Australian standard of 4.3 m/s (9.6 miles per hour) has not been accepted for use in the United States by the FAA and although there is no available documentation to support it, it is the only available standard of reference and Staff has cited it in the Blythe case.

As will be discussed further, plume heights and vertical velocities were shown in the Australian study (Best et al. 2003) to be significantly less under light wind speeds than the calm conditions assessed here. The procedures presented in the Best paper and used here are based on one of the analytical solutions under the Spillane methodology for calm conditions.

For this analysis, three different stack conditions were assessed for Eastshore stacks using the Spillane methodology: plumes from a single engine stack and merging of plumes from the fourteen engine stacks. The Spillane methodology is based on the following procedure based on calm conditions:

1. Determine the height and vertical velocity of the initial momentum-dominated plume rise phase (jet phase).
2. Calculate virtual source height parameters to approximate the jet phase results for use in subsequent calculations of the buoyancy-dominated plume rise phase.
3. Determine the plume top-hat diameters as a function of plume height (a linear relationship under calm conditions) for various heights and then determine plume-averaged vertical velocities at this height assuming conservation of momentum.
4. For multiple plumes (used for merging engine stacks), determine the beginning and ending heights in the transition from single plumes to merged plumes and then calculate the resulting plume parameters including plume top-hat diameters and plume-averaged vertical velocities. These parameters are increased by factors of $N^{0.25}$ under merged plume conditions (where N equals the number of merged plumes).

Eastshore engine stack characteristics are shown in the following table:

TABLE TT-70-1
Eastshore Stack Characteristics

Stack Parameter	Engine Stacks (Each stack)
Stack Height h_s (meters)	21.336
Stack Diameter D (meters)	1.208
Stack Velocity V_{exit} (m/sec)	22.27
Volumetric Flowrate (m^3/sec)	26
Stack Potential Temp θ_s (Kelvins)	641.48
Buoyancy Flux F_o (m^4/s^3)	43
Number of Stacks N	14
Stack Separation d (meters)	5.4

Notes: Buoyancy flux calculated for ambient temperature θ_a of 293 Kelvins based on $F_o = gV_{exit}D^2(1-\theta_a/\theta_s)/4$ and assuming neutral conditions ($d\theta_a/dz=0$).

As discussed above, plume rise is initially dominated by momentum. At a height of 6.25 diameters (D) above the stack release height, the plume diameter is expected to be approximately twice the original stack diameter, with a Gaussian distribution of vertical velocities across the plume diameter (plume center vertical velocity of V_{exit} and plume edge velocity near zero). Based on conservation of momentum, this would give a plume-averaged vertical velocity of $V_{exit}/2$. After the initial jet phase, plume rise is dominated by buoyancy. Under calm conditions, the plume closure conditions can be solved analytically and one solution presented in the Australian study under the Spillane Methodology assumes that the plume diameter 2a at a height of z (in meters above the stack release height) is equal to 2(0.16)(z-zv) with a virtual source height zv equal to 6.25D[1-(θe/θs)1/2] where θe was assumed to be equal to θ_a. Assuming a Gaussian distribution of vertical velocities from the plume center to the plume edge and conservation of buoyancy gives plume-averaged vertical velocities V_{plume} (in m/s) equal to $V_{exit}D/2a$, which can be solved for any height above the jet phase (or above the height of total merging for multiple stacks). The height above the stack release height where the plume-averaged vertical velocity equals the Australian CASA critical velocity of 4.3 m/s can also be solved and is included in the table below. All of these calculations are based on the conservative assumption of calm conditions.

The Australian study shows that, in the case of N multiple, equally-spaced identical sources (used for the fourteen engine stacks), the plume diameters and plume-averaged vertical velocities under merged conditions increase by a factor of $N^{0.25}$, as stated above. Plume merging begins at a height where the plume diameter for a single engine stack equals the stack separation and is complete (for a perpendicular flow) at a height where the plume diameter for a single engine stack equals twice the stack separation. These heights are included in the table below.

TABLE TT-70-2
Eastshore Plume Modeling Results Using Spillane Methodology for Calm Conditions

Plume Characteristic	Single Engine Stack	Merged Engine Stacks
Jet Phase Top (meters above stack release):	7.55	Same as single stack
Plume Diameter (meters)	2.42	
Vertical Velocity (m/s)	11.14	
Merged Plume Transition		
(meters above stack release)	N/A	
Beginning of Merging		19.32
Total Merging		36.20
Virtual Height (meters above stack release):	2.45	Same as single stack
Plume-averaged vertical velocity (m/s) at 110 meters (~361 feet) above ground	0.98	1.89
Height (meters above ground) where plume- averaged vertical velocities=4.3 m/s	43.33	61.60

Plume-averaged vertical velocities at 110 meters (~361 feet) above ground level are greatest for the merged engine stack plume and are equal to 1.89 m/s. Since this is less than the Australian CASA screening threshold of 4.3 m/s at a height of 110 meters above ground, no further analyses are warranted (to determine frequency of occurrence of various vertical velocities based on site-specific wind speeds at typical aircraft operations heights). Similarly, the height above which plume-averaged vertical velocities are less than 4.3 m/s is greatest for the merged engine stack plume and equal to 61.6 meters above ground level. Therefore, even assuming calm conditions and merged plumes that allow for maximum plume rise and plume-averaged vertical velocities, it is clear that industrial exhaust plumes from the Eastshore engines stacks would not exceed the Australian CASA screening threshold. Eastshore operations should therefore not pose a significant hazard to aircraft operations in the project vicinity.

The calculations presented here are based on worst-case atmospheric conditions of calm conditions. The Best, et al. (2003) technical paper shows that, for an illustrative example (buoyancy flux of 3200 m^4/s^3), uniform light wind speeds of 1.5 m/s and 3.0 m/s result in decreases in plume-averaged vertical velocities at a height of 200 meters from 7.8 m/s under calm conditions to 5.5 and 3.6 m/s, respectively. Therefore, the use of calm conditions is a conservative approach for plumes from Eastshore operations.

The FAA's "Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes" (2006) safety risk analysis of industrial exhaust plumes in relation to civil aviation has found that the risk of an aviation accident resulting from an

industrial exhaust plume is extremely low. The FAA study concluded, "the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation (FAA 2006, Abstract)." In addition, there are currently no procedures by which project proponents are required to notify the FAA regarding the locations or characteristics of exhaust plumes that their projects would be likely to generate. The FAA study has concluded that, as part of the "continuance of training and awareness programs that have been successful with similar hazards of acceptable risk levels" the instructions for notifying the FAA regarding potential hazards to air navigation be modified to include descriptions of thermal plumes from power plants and other industrial sources. However, the FAA has not acted on this recommendation and may or may not do so.

Notwithstanding this demonstrated lack of hazard to air navigation with regard to industrial exhaust plumes and the lack of a regulatory law, ordinance, regulation, or standard requiring the disclosure of industrial exhaust plumes and their characteristics, the analysis presented above demonstrates that the exhaust plumes from operations at the Eastshore will not pose a significant hazard to aircraft landings, take offs, or aircraft maneuvering.

BACKGROUND

As noted in AFC §2.1.1, the Eastshore project includes construction of fourteen (14) exhaust stacks, 70 feet in height, that would emit an accelerated heat plume at a temperature of up to 700°F. The stacks are all aligned, which could create the potential for individual plumes to merge, increasing the plume's breadth and intensity. Title 14, Part 77 of the Code of Federal regulations (14 CFR 77), "Objects Affecting Navigable Airspace", requires that the FAA be notified of proposed construction that may affect aviation safety and navigable airspace, in compliance with 49 USC §44718. This allows the FAA the opportunity to identify and minimize potentially adverse effects on aviation. Although the stacks proposed for the Eastshore project do not physically exceed the maximum height limits for structures within affected airspace, the thermal plumes may extend into navigable airspace and create a recurring impact that could result in low altitude, clear air turbulence (CAT). Energy Commission staff's discussions with FAA personnel resulted in a request from the FAA for the Applicant to file FAA Form 7460-1 and include the applicable plume information. FAA staff also recommends that the applicant include a cover letter with the application requesting the project be specifically reviewed by the FAA's Air Traffic Division, in addition to the normal routing and review process. In support of this request, it should be noted that an aviation safety report entitled "Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes" was completed in January 2006 and is currently under review by the FAA Aviation Safety staff. In that document, it is recommended that instructions for FAA Form 7460-1 (Notice of Proposed Construction or Alteration) be amended to require a thorough explanation of the nature of any exhaust plume discharge.

DATA REQUEST

71. Complete and electronically file FAA Form 7460-1 (Notice of Proposed Construction or Alteration). Prior to filing, please submit a copy of the draft project description section of Form 7460-1 to Energy Commission staff for review and comments. The project description should thoroughly explain the nature of the exhaust plume discharge, including the data generated in response to Data Request #70.

    Response:

    Eastshore Energy, LLC has prepared and submitted the attached FAA Form 7460-1 to the FAA, the Hayward Airport Land Use Commission and Mr. Lorne Prescott at the California Energy Commission. As noted in the cover letter, the contents of the form were reviewed with Mr. Joe Rodriguez, Supervisor, Environmental and Planning Compliance Section of the the FAA's Burlingame office. Mr. Rodriguez indicated his belief that the content of the form would be sufficient for the FAA to complete its own independent safety analysis. Since Mr. Rodriguez was unaware that the FAA had completed its own Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes in January 2006 (see attachment to data request 68), a copy of this FAA report was also provided to Mr. Rodriguez via email for his records.

    As noted in data response 68, the FAA's Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes) states that there are standing regulations and advisories that preclude prudent pilots from flying through or near plumes, reducing the aviation risk to essentially zero. The attached Form 7460-1 notification affords the FAA with sufficient information to allow the publication of the location of the Eastshore Energy Center and its associated transmission line in the Airport/Facility Directory (See Attachment TT-71).

    In addition, since CEC staff have expressed concern about the possibility that Eastshore exhaust might cause unexpected localized thermal instability under certain atmospheric conditions, the form also recommends that the FAA provide appropriate notification to pilots using the Hayward Executive Airport. Although the thermal plumes associated with Eastshore will not be directly visible, the facility will be visible to pilots in the area. This, in combination with appropriate FAA notification, will allow pilots to avoid flying over Eastshore Energy Center.

72. Please provide a copy of the final filed FAA Form 7460-1 to Energy Commission staff and the Alameda Airport Land Use Commission.

    Response:

    As previously stated in data response 71, a copy of Form 7460-1 has been submitted to both the FAA and the Hayward Airport Land Use Commission (See Attachment TT-71).

BACKGROUND

Energy Commission staff is uncertain about the potential for the air cooled condenser to create thermal plumes that would extend into navigable airspace. Additional information is needed to determine if any plumes created would present a hazard to aviation.

DATA REQUEST

73. Please provide the following information for the two air cooled condensers:

    a) total design heat rejection load (MW or MMBtu/hr),

    b) the number of stack(s)/openings,

    c) a description of whether the stacks/openings are round or rectangular,

    d) the diameter or cross section area of each stack/opening,

    e) the stack opening exhaust velocity,

    f) the ACC total exhaust mass flow rate, and

    g) the exhaust release height.

Response:

Eastshore does not plan to use any "air cooled condensers". Each of the fourteen (14) Wartsila 20V34SG gas fired reciprocating engines will be cooled by three (3) forced draft radiator assemblies. Each radiator assembly will contain twelve (12) variable-speed, electric motor-driven, 3-foot diameter fans with a maximum rotational speed of about 680 rpm. The fans are mounted above the radiator coils in the fan assembly. As such, each fan will vent warm air that has passed over the coils directly to atmosphere through a fan collar. There are no radiator fan exhaust "stacks". There will be a total of 504 fan openings.

The final selection of the radiators has not occurred. This selection will be made during final project design. In general, each radiator assembly will be a rectangular structure with dimensions of approximately 38 ft long by 8 ft wide. Answers to each of the lettered subrequests are provided below for the radiator operating at a worst-case (maximum) design heat rejection point representing a 100 °F operating day.

a. Radiator heat rejection (per radiator ie, total for all 12 fans) = 15.525. MMBtu/hr

b. There will be a total of 504 fan openings discharging to the atmosphere

c. Each fan opening is round

d. Fan opening diameter (approximate) =3 feet

e. Radiator exhaust velocity (fan collar outlet) = 33 ft/sec.

f. Total radiator air flow (per radiator ie. total for 12 fans): = 1,620,000 lb/hr

g. Expected radiator exhaust release height above grade (approximate) = 20 feet

Attachment TT-71

FAA Form 7460-1 Notice of Construction

CH2M HILL
155 Grand Avenue, Suite 1000
Oakland, CA 94612
Tel 510.587.7787
Fax 510.622.9122

March 28, 2007

346558

FAA
Southwest Regional Office
Air Traffic Division, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Subject: Eastshore Energy Center (06-AFC-06)
FAA Form 7460-1 Notice of Construction

To Whom It May Concern:

On behalf of Eastshore Energy, LLC I am attaching a copy of the completed FAA Form 7460-1 for the proposed Eastshore Energy Center project to be located in Hayward, CA. The same form has also been electronically submitted to the FAA. The content of the form was reviewed with Mr. Joe Rodriguez, Supervisor, Environmental Planning and Compliance Section of the FAA Burlingame office on March 21, 2007 and deemed to provide sufficient detail (with a very minor modification we did incorporate) to allow the FAA to perform the required safety analysis. We are also submitting hard copies of the form directly to the California Energy Commission and the Hayward Airport Land Use Commission under separate cover.

Sincerely,

David A. Stein, PE
Vice President

cc: Joe Rodriguez, FAA (Burlingame, CA)
Lorne Prescott, CEC
Hayward Airport Land Use Commission

Notice of Proposed Construction or Alteration (7460-1)

Project Name: EASTS-000062793-07 **Sponsor:** Eastshore Energy LLC c/o Tierra Energy

Details for Case : Eastshore Energy Center Exhaust Stacks

Show Project Summary

Case Status

ASN: 2007-AWP-1614-OE

Status: Accepted

Date Accepted: 03/28/2007

Date Determined:

Letters: None

Construction / Alteration Information

Notice Of: Construction

Duration: Permanent

if Temporary **:** Months: Days:

Work Schedule - Start: 10/01/2007

Work Schedule - End: 06/30/2009

State Filing: Not filed with State

Structure Summary

Structure Name: Eastshore Energy Center Exhaust Stacks

Structure Type: Other w/o Antenna

Other **:** Power Plant Exhaust and T-Line

FCC Number:

Prior ASN:

Structure Details

Latitude: 37° 38' 15" N

Longitude: 122° 7' 12" W

Horizontal Datum: NAD83

Site Elevation (SE): 25 (nearest foot)

Structure Height (AGL): 70 (nearest foot)

Marking/Lighting: Other

Other **:** Neutral color, no lighting

Nearest City: Hayward

Nearest State: California

Traverseway: No Traverseway

Description of Location: The site is located between Depot Rd and Diablo Rd on the west side of Clawiter Rd in Hayward. The address is 25101 Clawiter Rd Hayward CA 94545. The site is approx 6.2 acres and located in the NW portion of Section 30 Township 3S Range 4E Rancho Arroyo de la Alameda, Alameda County, APN 439075180.

Description of Proposal: The Eastshore Energy Center will consist of 14 natural gas-fired reciprocating engine generators designed to generate up to 115.5 MW net of electricity for sale to PG&E. Please see additional details in Attachment A provided separately.

Common Frequency Bands

Low Freq	High Freq	Freq Unit	ERP	ERP Unit

Specific Frequencies

ATTACHMENT A

Eastshore Energy Center Project Description

The Eastshore Energy Center will consist of fourteen (14) natural gas-fired reciprocating engine generators designed to generate up to 115.5 megawatts (MW) net of electricity for sale to PG&E. The engine generators will be housed inside a 36 ft tall x 418 ft long x 71 ft wide main engine building. Each generator will be equipped with a dedicated air pollution control system and 70 ft tall x 4 ft diameter exhaust stack (fourteen stacks total). The existing site is occupied largely by an existing 35-ft tall warehouse structure that is both longer and wider than the proposed engine building. This existing structure will be demolished and replaced with the new building and equipment. The facility will export electricity to PG&E via a new 1.1 mile transmission line interconnecting to the PG&E Eastshore substation located south of State Route (SR) 92. Construction of the transmission line will include the placement of approximately 10 - 12 new 90-ft tall transmission poles along the eastern shoulder of Clawiter, as well as Investment Blvd and Production Blvd in the business park located south of SR 92. Although the specific locations of the transmission poles are not known at this time, the location of the entire transmission line route is shown on the general location drawing. PG&E is expected to complete the final design of the transmission line in July 2007. At that time, the specific locations of the new poles will be known and Eastshore would be pleased to provide their specific locations at that time should the FAA deem that this specific information is necessary.

The exhaust gases associated with each 70-ft x 4 ft diameter stack will be released to the atmosphere at approximately 74 feet/sec and 700 degrees Farenheit. Since the California Energy Commission staff have expressed concern about the possibility that the exhaust gases may cause unexpected localized thermal instability under certain atmospheric conditions, we recommend that the FAA include an appropriate notification to pilots using the Hayward Executive Airport. Since the transmission line will be suspended from the new poles along the entire route, we recommend that the FAA provide appropriate notification to pilots for the entire transmission line.

In addition to the general location drawing (7.5 min topo), also attached are plan and elevation views of the proposed facility as well as an artistic rendering:

- Figure 1.2-1, Project Location
- Figure 1.2-3, Site General Arrangement
- Figure 1.2-4a, Site Elevation Drawing – View Looking North
- Figure 1.2-4b, Site Elevation Drawing – View Looking West
- Figure 1.2-2b, Artist Rendering of Eastshore Energy Center

LEGEND

Site Location

Transmission Line Route

N

0 1,000 2,000 4,000 Feet

SCALE IS APPROXIMATE

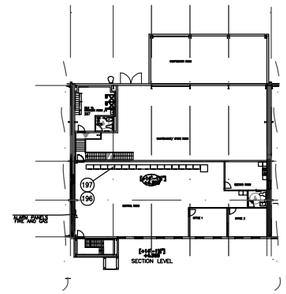
FIGURE 1.2-1
PROJECT LOCATION
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA

CH2MHILL

BAO \\ZINFANDEL\GIS\PROJECTS\EASTSHORE\MAPFILES\FIG_1_2_SITELOCATION.MXD FIG_1_2_SITELOCATION.PDF 8/24/2006 14:35:10

N

0' 25' 50' 75'



BUILDING SECOND FLOOR PLAN

ENGINE HALL & UTILITY BLOCK

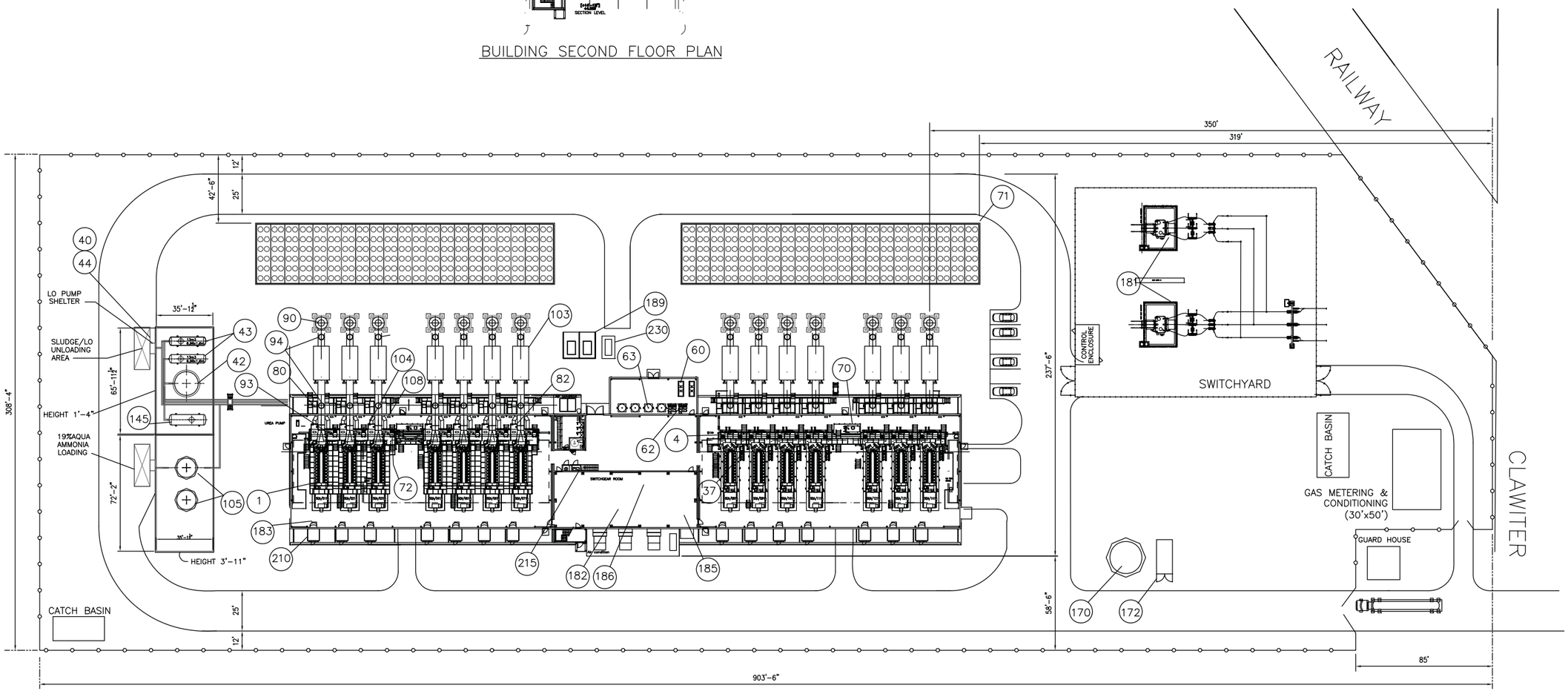
ITEM NO	PCS.	CODE (FIRST)	DESCRIPTION	WEIGHT INCL. LIQUIDS KG	LB	MOUNTING LEVEL MILLIM.	(FLR LEVEL) INCH.
1	14	SQA	ENGINE GENERATOR SET	134700	296952	+0.000	0'– 0"
4	14	QEA	AUXILIARY MODULE	4200	9259	+0.000	0'– 0"
37	14	ZBB	GAS REGULATING UNIT	200	440	+0.000	0'– 0"
60	2	TCA	WORKING AIR UNIT	670	1477	+0.000	0'– 0"
62	2	TSA	STARTING AIR UNIT	710	1565	+0.000	0'– 0"
63	4	TSB	STARTING AIR BOTTLE 9.4M3/2500 GAL	4335	9555	+0.000	0'– 0"
70	2	VBA	MAINTENANCE WATER TANK 4M3/1060GAL	4940	10890	+0.000	0'– 0"
72	14	VEA	EXPANSION VESSEL 600L/160GAL	775	1708	+4.940	16'– 2"
80	14	NGA	CHARGE AIR FILTER	960	2116	+3.100	10'– 2"
82	14	–	CHARGE AIR & EXHAUST GAS MODULE	3000	6613	+3.240	11'– 2"
93	14	NHA	EXHAUST GAS VENTILATION UNIT	55	121	+4.940	16'– 2"
104	14	SEN	DOSING BOX	–	–	+0.000	0'– 0"
108	14	SNC	NOX CONTROLLER	–	–	+0.000	0'– 0"
182	18	–	MV SWITCHGEAR	–	–	+0.000	0'– 0"
183	14	BAN	NEUTRAL GROUNDING RESISTOR	–	–	+0.000	0'– 0"
185	–	BEY	DC–SYSTEM	–	–	+0.000	0'– 0"
186	–	BFA	LV SWITCHGEAR	–	–	+0.000	0'– 0"
189	2	BFB	STATION SERVICE TRANSFORMER	–	–	+0.000	0'– 0"
196	4	CFA	CONTROL PANEL, COMMON	–	–	+0.000	0'– 0"
197	14	CFC	CONTROL PANEL, ENGINE WISE	–	–	+0.000	0'– 0"
210	14	–	VENTILATION UNIT (ENGINEHALL)	2000	4409	–	–
215	14	–	FREQUENCY CONVERTER	–	–	–	–
230			225 KW BLACK START GEN.SET				

MECHANICAL UTILITY AREA

ITEM NO	PCS.	CODE (FIRST)	DESCRIPTION	WEIGHT INCL. LIQUIDS KG	LBS	MOUNTING LEVEL MILLIM.	INCH.
71	42	–	RADIATORS LOW–LOW NOISE RADIATORS	–	–	–	–
90	14	NHA	EXHAUST GAS SILENCER	5200	11454	+5.560	+22'– 5"
94	34	NGA	RUPTURE DISC	–	–	–	–
103	14	–	DENOX (SCR)	14000	30864	+5.560	+22'– 5"
170	1	–	RAW WATER TANK 35,000 GAL	–	–	–	–
172	1	–	FIRE FIGHTING CONTAINER	–	–	–	–
181	2	AET	STEP–UP TRANSFORMER	–	–	–	–
				–	–	–	–

DAY / STORAGE TANK / UNLOADING AREA

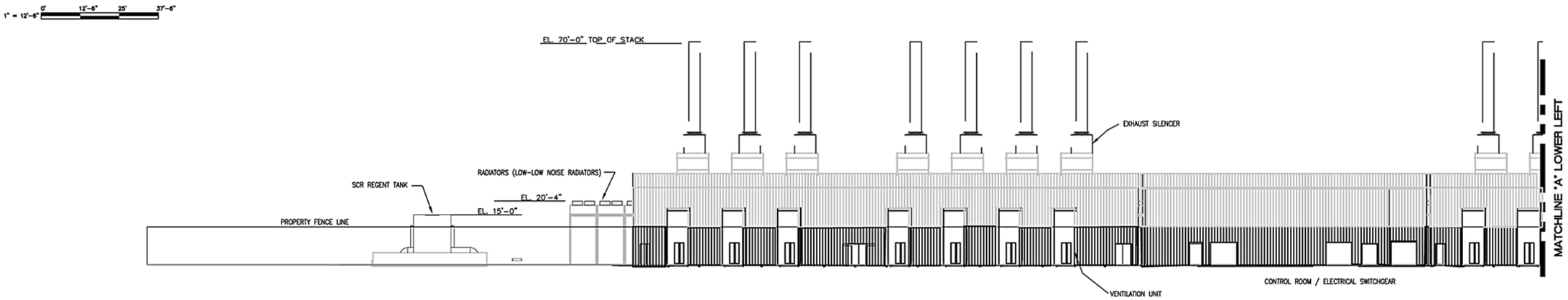
ITEM NO	PCS.	CODE (FIRST)	DESCRIPTION	WEIGHT INCL. LIQUIDS KG	LBS	MOUNTING LEVEL MILLIM.	INCH.
40	1	QAA	LO UNLOADING PUMP UNIT (CLEAN)	–	–	–	–
42	1	QAC	CLEAN LO TANK 55M3/14531GAL	–	–	–	–
43	2	QAD	USED/SERVICE LO TANK 13M3/3434GAL	–	–	–	–
44	2	QAE	LO TRANSFER PUMP UNIT	–	–	–	–
105	2	–	SCR REGENT TANK 10,000 GAL	–	–	–	–
145	1	DDB	DIRTY WATER HOLDING TANK 20M3/5284 GAL	–	–	–	–



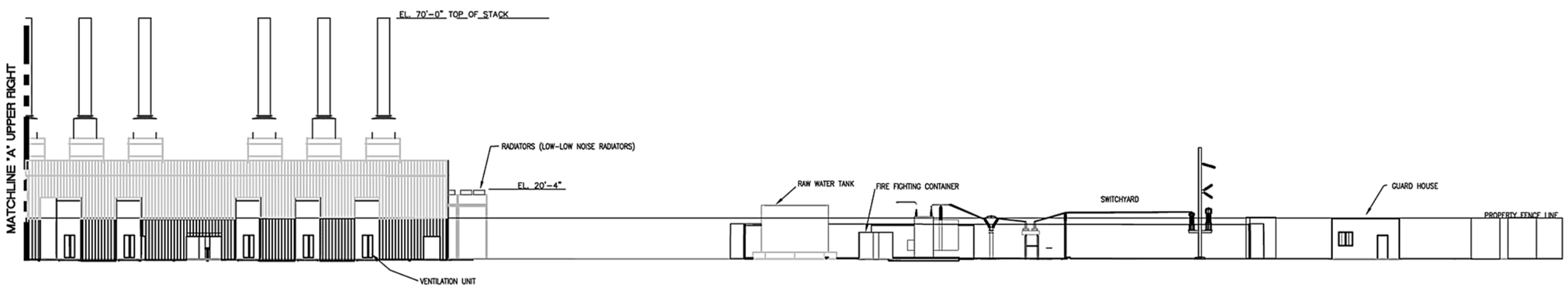
Stantec

FIGURE 1.2-3
SITE GENERAL ARRANGEMENT
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA
ALAMEDA COUNTY

CH2MHILL



PLANT ELEVATION LOOKING NORTH



PLANT ELEVATION LOOKING NORTH - CONTINUE

FIGURE 1.2-4A
SITE ELEVATION DRAWING - VIEW LOOKING NORTH
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA
ALAMEDA COUNTY

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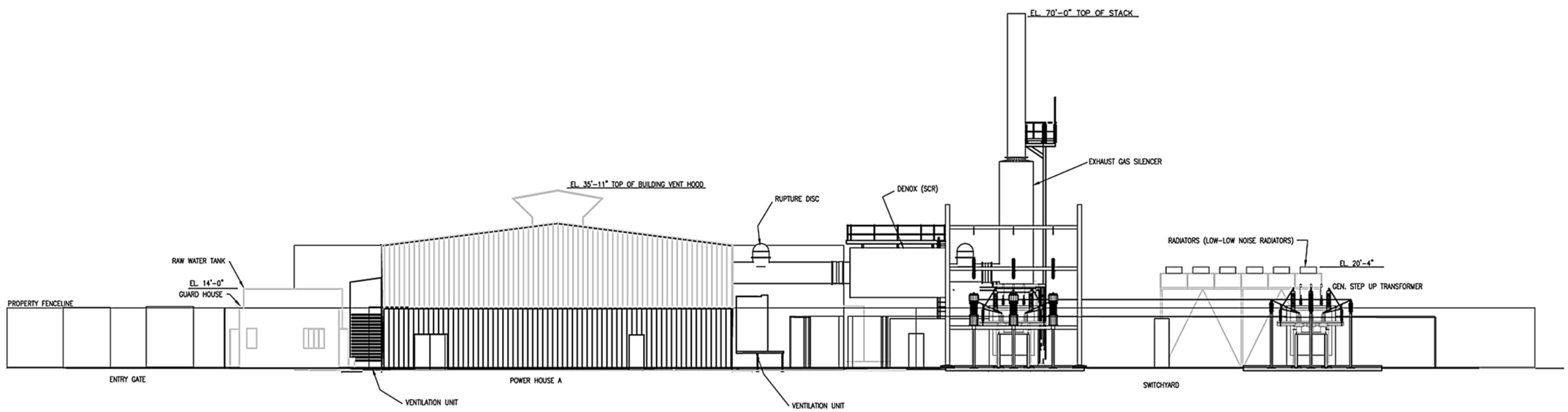
CH2MHILL

ES072006008BAO_Fig 1.2-4a Site Elevation Drawing 08-25-06 dash



PLANT ELEVATION LOOKING WEST

FIGURE 1.2-4B
SITE ELEVATION DRAWING - VIEW LOOKING WEST
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA
ALAMEDA COUNTY

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ES072006008BAO_Fig 1.2-4b Site Elevation Drawing West 08-25-06 dash

FIGURE 1.2-2B
ARTIST RENDERING OF EASTSHORE ENERGY CENTER
EASTSHORE ENERGY CENTER
HAYWARD, CALIFORNIA

CH2MHILL

ES072006008BAO_Eastshore_AFC Fig 1.2-2b rendering.ai 09-07-06 dash

Technical Area: Waste Management
Author: Suzanne Phinney

BACKGROUND

AFC page 8.13-3 states that the primary waste generated during operation of the Eastshore facility will be non-hazardous solid waste. Although Section 8.13.4.2 states that "the types of waste and their estimated quantities are discussed below," the immediately following discussion on non-hazardous solid waste describes only landfill disposal options. No discussion of type or quantity of non-hazardous waste is provided.

DATA REQUEST

74. Please describe and quantify (in both tons and cubic yards) the non-hazardous solid waste that will be generated during project operations.

    Response:

    Eastshore will produce facility wastes, typical of power generation facility operations and maintenance activities. These will include rags, broken and rusted metal and machine parts, defective or broken electrical materials, empty containers, the typical refuse generated by workers and small office operations, and other miscellaneous solid wastes. The quantity generated is estimated to be approximately 100 cubic yards per year (a 2 cubic yard dumpster emptied once/week). Assuming a conversion factor of 1.5 tons per 1 cubic yard, the facility would generate approximately 150 tons per year. Some metal parts will be recycled, as required.

BACKGROUND

Written communication from the City of Hayward (October 20, 2006 and January 12, 2007) notes that the Phase I Environmental Site Assessment does not bear the stamp of a registered professional. American Society of Testing and Materials (ASTM) E1527-05, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process", states in Section12.12: "Signature-The environmental professional(s) responsible for the Phase I Environmental Site Assessment shall sign the report." Additionally, both ASTME1527-00 and U.S. EPA have identified qualifications for environmental professionals assessing site conditions. EPA's All Appropriate Inquiries Rule became effective in November 2006 and provides more specificity than the ASTM standard. At a minimum, an environmental professional must have:

- A state or tribal issued certification or license and three years of relevant full-time work experience; or
- A Baccalaureate degree or higher in science or engineering and five years of relevant full-time work experience; or
- Ten years of relevant full-time experience.
- An environmental professional may also qualify through certification or license requirements, including:

- A current Professional Engineer's (P.E.) License;
- A current Professional Geologist's (P.G.) License;

DATA REQUEST

75. Please provide documentation, including a copy of the Phase I ESA page stamped by the registered professional, that the Phase I ESA meets all professional requirements.

Response:

Page 1 of the Phase I report states that the report was completed in conformance with that applicable ASTM standard. Attached is a revised copy of the signature page bearing the professional engineer stamp for the responsible author (See Attachment WM-75).

Attachment WM-75

Phase 1 Report Signature Page

PHASE I ENVIRONMENTAL SITE ASSESSMENT

October 20, 2005

Former Trend Technologies Metal Finishing Facility
25101 Clawiter Road
Hayward, California

TRC Project No. 25-1477-03

Prepared For:

Black Hills Energy, Inc.
Golden, Colorado

Prepared by:

Mark Trevor
Project Geologist

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