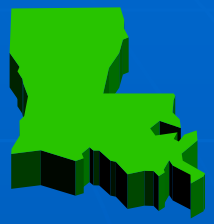


Trunkline LNG Lake Charles Terminal Site Visit May 23rd and 24th, 2007

Hosny Hakim P.E. and Michael Edwards P.E.
California State Lands Commission
Marine Facilities Division

Trunkline LNG Lake Charles Terminal

- Completed 1981
- Located Lake Charles, LA, 9 mi. South Downtown
- ~40 mi. from Gulf of Mexico
- Recent Upgrades incl.
  - New Ship Berth
  - New 140K m^3 Storage tank
  - Added 7 SCVs
- Storage 4 tanks 425K m^3 (2.7 Mbbl)
- Peak Capacity 2.1 Bcf/day

Trunkline LNG Lake Charles Terminal

- 2 Concrete Wharves
- Latest completed 2006
- No Simultaneous Transfer
- Transfer Shutdown During 2nd Vessel Movement
- Vessels 30K – 100K m^3
- Typ. Unloading 12 hours

Trunkline LNG Lake Charles Terminal

- Brackish Water
- 40 feet dredge depth
- No Current
- 1-2 ft tidal variation
- 1400’x1600’ Turning Basin
- Earthquake UBC Zone 1
- 150 mph Design Wind Speed (tanks)

Trunkline LNG Lake Charles Terminal

- 2005 Hurricane Rita Hit Lake Charles
- No Major Structural Damage to Facility
- Flooding at Facility
- Much Debris in Channel
- Resumed Terminal Operations within 10 days

Trunkline LNG Lake Charles Terminal

- Wharf
  - Concrete Deck Supported by Concrete Piles
  - Four Berthing Dolphins at Each Wharf w/Steel Piles
  - Mooring Line Configuration and Required Strength by Optimoor

Trunkline LNG Lake Charles Terminal

- Wharf (cont):
  - Berthing Approach Velocity 0.5 ft/sec, 0° angle
  - Operational Wind Speed - 30 knots sustained for 10 min
  - Survival Wind Speed - 40 knots sustained for 10 min
  - No Tension Monitoring Devices
  - 100 Ton Rated Mooring Hooks

Trunkline LNG Lake Charles Terminal

Berthing and Mooring Dolphins 2006 Berth

Trunkline LNG Lake Charles Terminal

Fender and Berthing Dolphin 2006 Berth

Trunkline LNG Lake Charles Terminal

Main wharf 2006 Berth

Trunkline LNG Lake Charles Terminal

Typical Hooks 2006 Berth

Trunkline LNG Lake Charles Terminal

Berthing Dolphin 1981 Berth

Trunkline LNG Lake Charles Terminal

Mooring Dolphin 1981 Berth

Trunkline LNG Lake Charles Terminal

- Marine Loading Arms
  - 16” Dia Loading Arms
  - Schwelm Verladetechnik (SVT) mfr. MLA’s at New Wharf
  - FMC Technologies mfr. MLA’s at Older Wharf
  - Breakaway Couplings

Trunkline LNG Lake Charles Terminal

Loading Arms w/breakaway couplings

Trunkline LNG Lake Charles Terminal

Marine Loading Arms as seen from shore

Trunkline LNG Lake Charles Terminal

An Active Transfer to LNG Carrier *LNG Cross River. Vessel 66.9KDWT, Built 2005,(cylindrical tanks).*

Trunkline LNG Lake Charles Terminal

Active Loading Arms Are White w/ Coated Ice. Water Curtain Visible

Trunkline LNG Lake Charles Terminal

- LNG Pipelines
  - 9% Ni-Steel w/Vacuum Jacket Insulation
  - 150 psig MAOP (terminal to tank)
  - 1256 psig MAOP (tank to vaporizers)
  - Containment Provided from Wharf to Tank Storage Area
  - Low Temperature Sensors in Containment Areas Provide Leak Detection

Trunkline LNG Lake Charles Terminal

LNG Pipelines Routed Inside Containment. Notice Steel Supports Do Not Extend Into Containment Area.

Trunkline LNG Lake Charles Terminal

Typical Pipeline Support

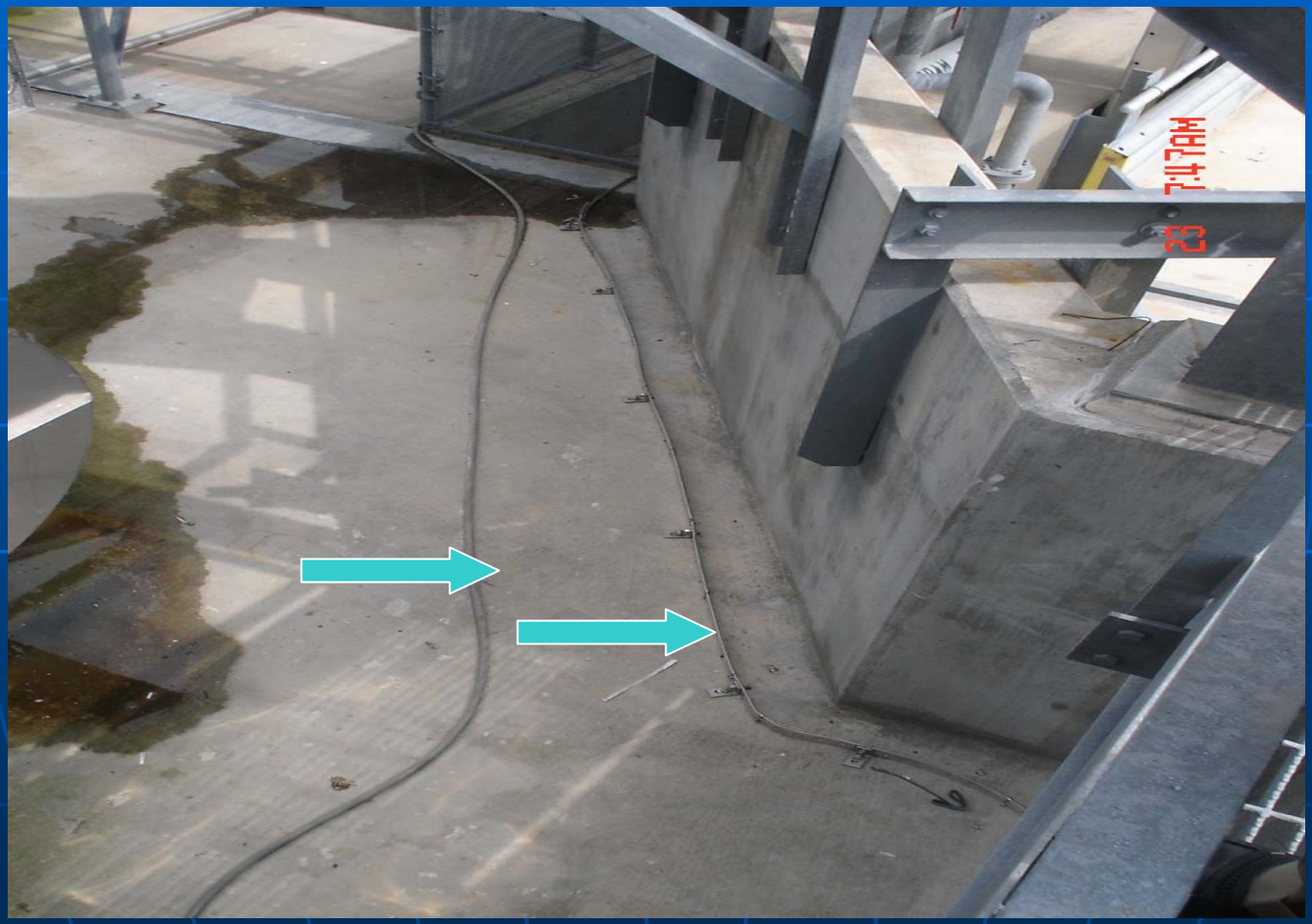
Trunkline LNG Lake Charles Terminal

Pipeline Trestle from Wharf to Tank Area.

Trunkline LNG Lake Charles Terminal

Pipeline Expansion Loop

Trunkline LNG Lake Charles Terminal



Cold Sensors to Detect an LNG Release

Trunkline LNG Lake Charles Terminal

- Fire Protection
  - UV/IR Detectors
  - High Expansion Foam
  - Firewater Monitors
  - Design Follows NFPA 59A

Trunkline LNG Lake Charles Terminal

Typical UV/IR Sensor

Trunkline LNG Lake Charles Terminal

Typical Firewater Monitor

Trunkline LNG Lake Charles Terminal

Firewater Connections at Wharf Trestle

Trunkline LNG Lake Charles Terminal

Typical Foam Generator Located Above Containment Area

Trunkline LNG Lake Charles Terminal

- Storage Tanks
  - Three 95K m^3, One 140K m^3
  - Double walled, double bottomed
  - 9% Ni-Steel lined, CS outer, HE Insulation Between
  - Aluminum Plate Roof, Steel Dome, HE Insulation Between
  - Pipelines Enter/Exit Top

Trunkline LNG Lake Charles Terminal

- Storage Tanks (cont)
  - Auto-refrigerated, BOG Removed
  - Supported by Closely Spaced Pre-stressed Concrete Piles,
  - Air Space under Tank Bottom, No Soil Contact

Trunkline LNG Lake Charles Terminal

Older 95K m^3 Storage Tank. Notice Top Loading/Unloading.

Trunkline LNG Lake Charles Terminal

Elevated Tank Foundation

Trunkline LNG Lake Charles Terminal

Tank Foundation Piles, 14”X14” Pre-stressed Concrete, 70’ Depth, 21” thk Pile Cap

Trunkline LNG Lake Charles Terminal

- Existing Vaporizers
  - 14 Submerged Combustion type
  - Natural Gas Fired
  - Uses 1% LNG
  - Gas Send Out 700 – 1200 psig
  - Not Odorized

Trunkline LNG Lake Charles Terminal

Submerged Combustion Vaporizers

Trunkline LNG Lake Charles Terminal

SCV Closer View

Trunkline LNG Lake Charles Terminal

- New Vaporizers
  - Ambient Air type
  - Under Construction, Online 2008
  - Significantly Reduces Operating Costs and Air Emissions
  - SCV Used as Back-up (Low Temp. Winter Cond.)

Trunkline LNG Lake Charles Terminal

New Vaporizer Construction Site. Two Gas Vent Towers Are Visible.

Trunkline LNG Lake Charles Terminal

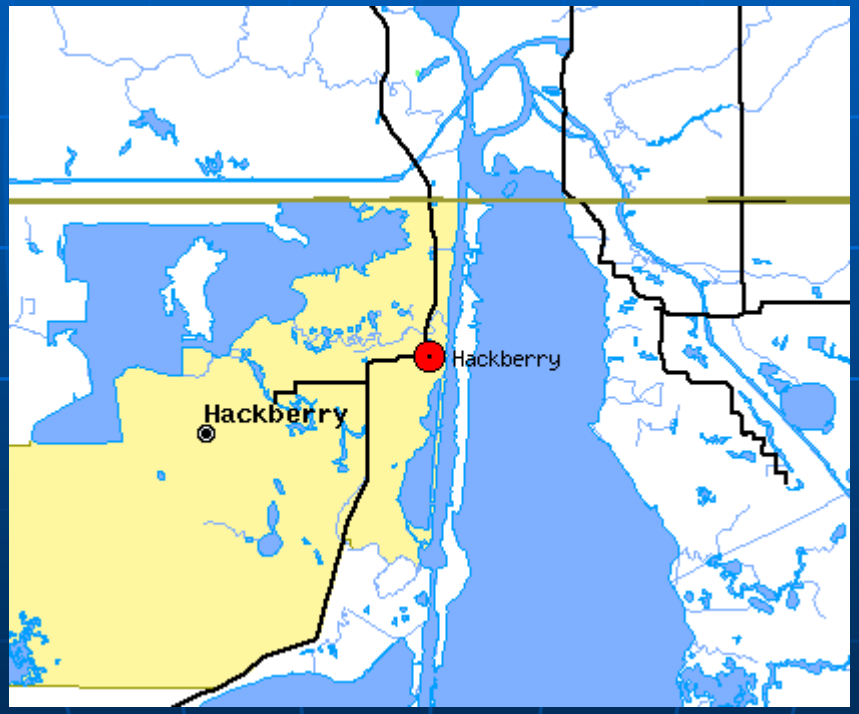
New Vaporizer Construction Site. Storage Tanks Are Seen in the Background.

Other LNG Terminals

- Other Planned On-shore LNG Receiving Terminals in Louisiana.
  - Sempra Energy Cameron Terminal, Hackberry LA
  - Golden Pass Terminal, Sabine Pass, LA
- Three On-shore Terminals to Be Located Within a 100 mi. Radius

Sempra Cameron LNG Terminal

- Terminal Located on the Shore of Upper Calcasieu Lake in Cameron Parish



Sempra Cameron LNG Terminal

Sempra Cameron LNG Terminal

Golden Pass Terminal, Sabine, LA

The End