



2009 Galveston District Dredging Conference

Texas Region LNG Industry

and

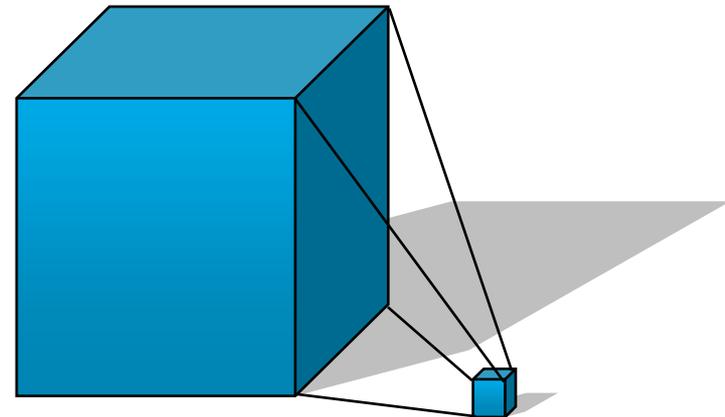
Impact to Economy

**Cheniere's Sabine Pass LNG Terminal
and
Other Regional LNG Terminals**

Captain Daniel Fuller – Director, Marine Operations for Cheniere
Speaking at Galveston, TX - 29 October 2009

What Is Liquefied Natural Gas (LNG)?

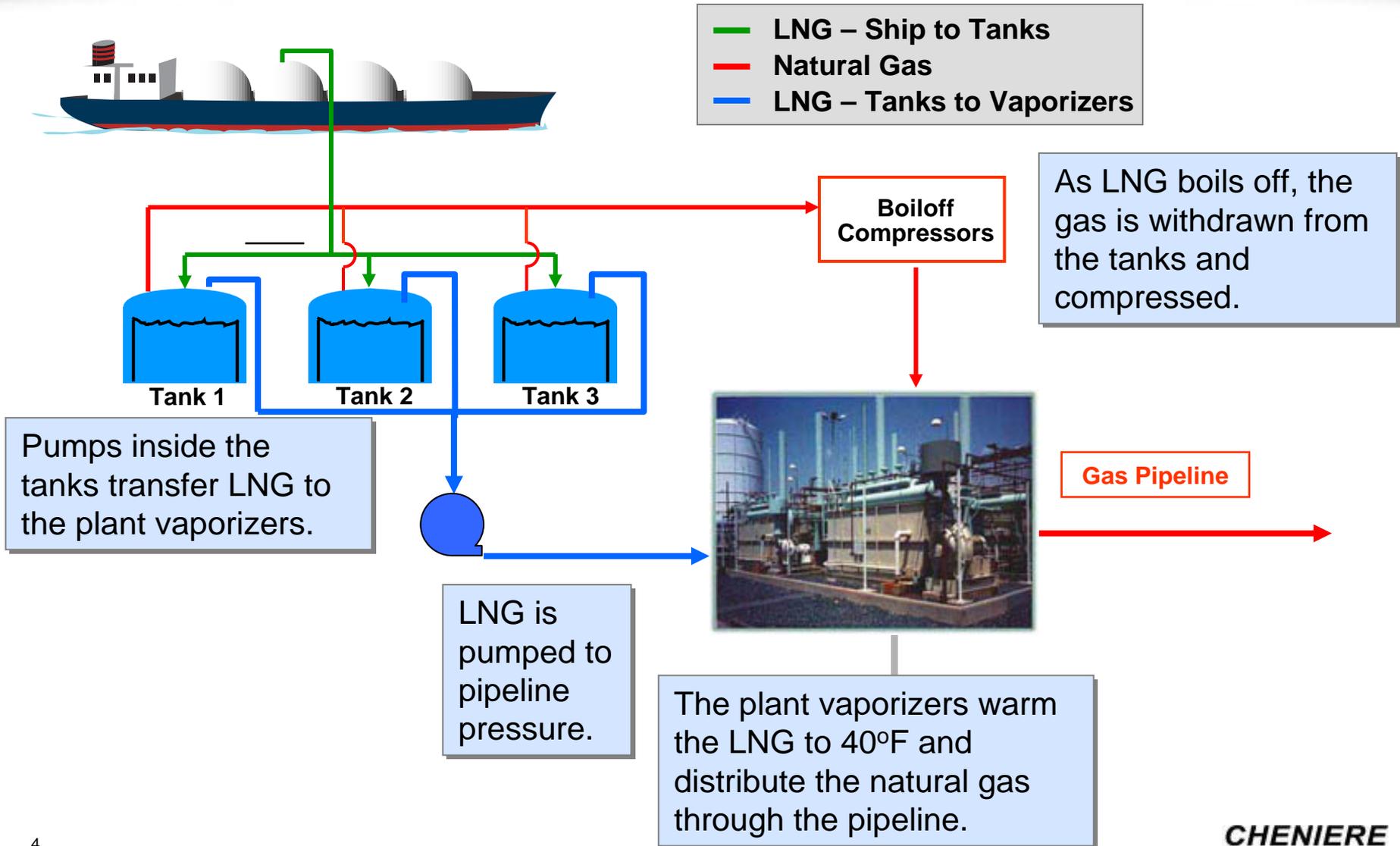
- Natural gas is mostly methane, but will usually also contain a relatively small percentage of ethane and other hydrocarbon and nitrogen trace amounts
- Liquefied natural gas (LNG) is natural gas that has been super-cooled to a cryogenic temperature of approximately -260°F , thereby changing it from a gas to its liquid form.
- Liquefaction reduces its normal gaseous volume by approximately 600-to-1
- One LNG Carrier (LNGC) transports an amount of LNG equivalent to ~600 tankers carrying natural gas in its vapor form at atmospheric pressure and normal ambient temperature range.



What Is Liquefied Natural Gas (LNG)?

- LNG is stored cold in insulated tanks slightly above atmospheric pressure (usually between ~ 1.0 to 2.0 psi above atmospheric pressure)
- It is quite safe to store and transport using specially designed and constructed tanks and ships
- LNG is colorless, odorless, non-corrosive, and non-toxic
- Becomes lighter than air when vaporized and reaching the 'warm' temperature of approximately -170 deg F
- Cannot 'burn' while in its liquefied state
- LNG vapors (vaporized LNG) can only burn when mixed with normal atmospheric air in a 5% to 15% 'flammability range'

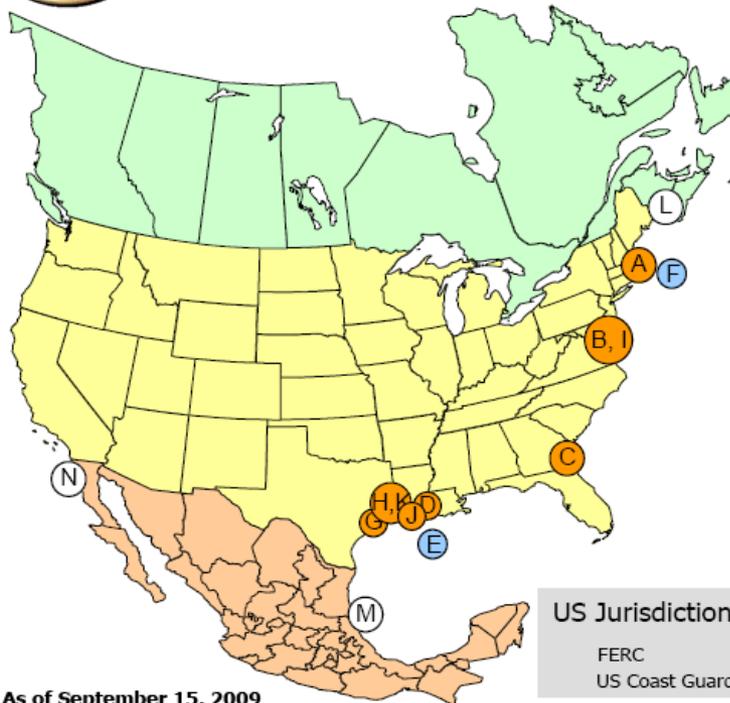
Receiving Terminal – LNG/Gas Flow





North American LNG Terminals

Existing



As of September 15, 2009

Note: There is an existing import terminal in Peñuelas, PR. It does not appear on this map since it can not serve or affect deliveries in the Lower 48 U.S. states.

U.S.

- A. Everett, MA :** 1.035 Bcfd (SUEZ LNG - DOMAC)
- B. Cove Point, MD :** 1.0 Bcfd (Dominion - Cove Point LNG)
- C. Elba Island, GA :** 1.2 Bcfd (El Paso - Southern LNG)
- D. Lake Charles, LA :** 2.1 Bcfd (Southern Union - Trunkline LNG)
- E. Gulf of Mexico:** 0.5 Bcfd, (Gulf Gateway Energy Bridge - Excelerate Energy)
- F. Offshore Boston:** 0.8 Bcfd, (Northeast Gateway-Excelerate Energy)
- G. Freeport, TX:** 1.5 Bcfd, (Cheniere/Freeport LNG Dev.)
- H. Sabine, LA:** 2.6 Bcfd (Sabine Pass Cheniere LNG)
- I. Cove Point, MD :** 0.8 Bcfd (Dominion – Expansion)*
- J. Hackberry, LA:** 1.8 Bcfd (Cameron LNG - Sempra Energy)
- K. Sabine, LA:** 1.4 Bcfd (Sabine Pass Cheniere LNG – Expansion)*

Canada

- L. St. Johns, NB:** 1.0 Bcfd, (Canaport - Irvin Oil)

Mexico

- M. Altamira, Tamaulipas:** 0.7 Bcfd, (Shell/Total/Mitsui)
- N. Baja California, MX:** 1.0 Bcfd, (Sempra)

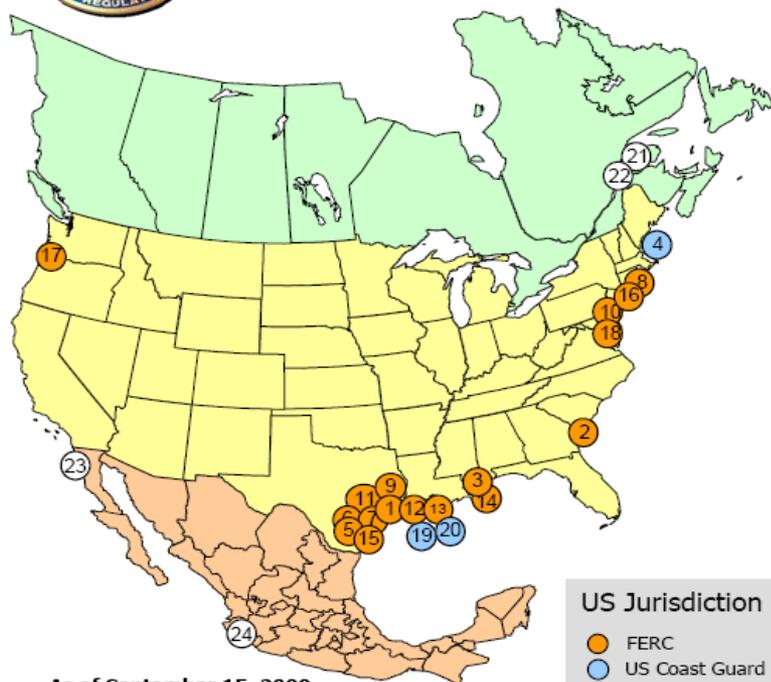
Office of Energy Projects

Ref: <http://www.ferc.gov/industries/lng/indus-act/terminals/lng-existing.pdf>



North American LNG Terminals

Approved



As of September 15, 2009

* Expansion of an existing facility

APPROVED - UNDER CONSTRUCTION

U.S.

1. Sabine, TX: 2.0 Bcfd (Golden Pass - ExxonMobil)
2. Elba Island, GA: 0.9 Bcfd (El Paso - Southern LNG Expansion)*
3. Pascagoula, MS: 1.5 Bcfd (Gulf LNG Energy LLC)
4. Offshore Boston, MA: 0.4 Bcfd (Neptune LNG - Tractebel)

APPROVED - NOT UNDER CONSTRUCTION

U.S. - FERC

5. Corpus Christi, TX: 1.0 Bcfd (Ingleside Energy - Occidental Energy Ventures)
6. Corpus Christi, TX: 2.6 Bcfd, (Cheniere LNG)
7. Corpus Christi, TX : 1.1 Bcfd (Vista Del Sol - 4Gas)
8. Fall River, MA : 0.8 Bcfd, (Weaver's Cove Energy/Hess LNG)
9. Port Arthur, TX: 3.0 Bcfd (Sempra)
10. Logan Township, NJ : 1.2 Bcfd (Crown Landing LNG - BP)
11. Cameron, LA: 3.3 Bcfd (Creole Trail LNG - Cheniere LNG)
12. Freeport, TX: 2.5 Bcfd (Cheniere/Freeport LNG Dev. - Expansion)
13. Hackberry, LA: 0.85 Bcfd (Cameron LNG - Sempra Energy - Expansion)
14. Pascagoula, MS: 1.3 Bcfd (Casotte Landing - ChevronTexaco)
15. Port Lavaca, TX: 1.0 Bcfd (Calhoun LNG - Gulf Coast LNG Partners)
16. LI Sound, NY: 1.0 Bcfd (Broadwater Energy-TransCanada/Shell)
17. Bradwood, OR: 1.0 Bcfd (Northern Star LNG - Northern Star Natural Gas LLC)
18. Baltimore, MD: 1.5 Bcfd (AES Sparrows Point - AES Corporation)

U.S. - MARAD/Coast Guard

19. Port Pelican: 1.6 Bcfd, (Chevron Texaco)
20. Gulf of Mexico: 1.0 Bcfd (Main Pass McMoran Exp.)

Canada

21. Rivière-du- Loup, QC: 0.5 Bcfd (Cacouna Energy - TransCanada/PetroCanada)
22. Quebec City, QC : 0.5 Bcfd (Project Rabaska - Enbridge/Gaz Met/Gaz de France/Gazprom)

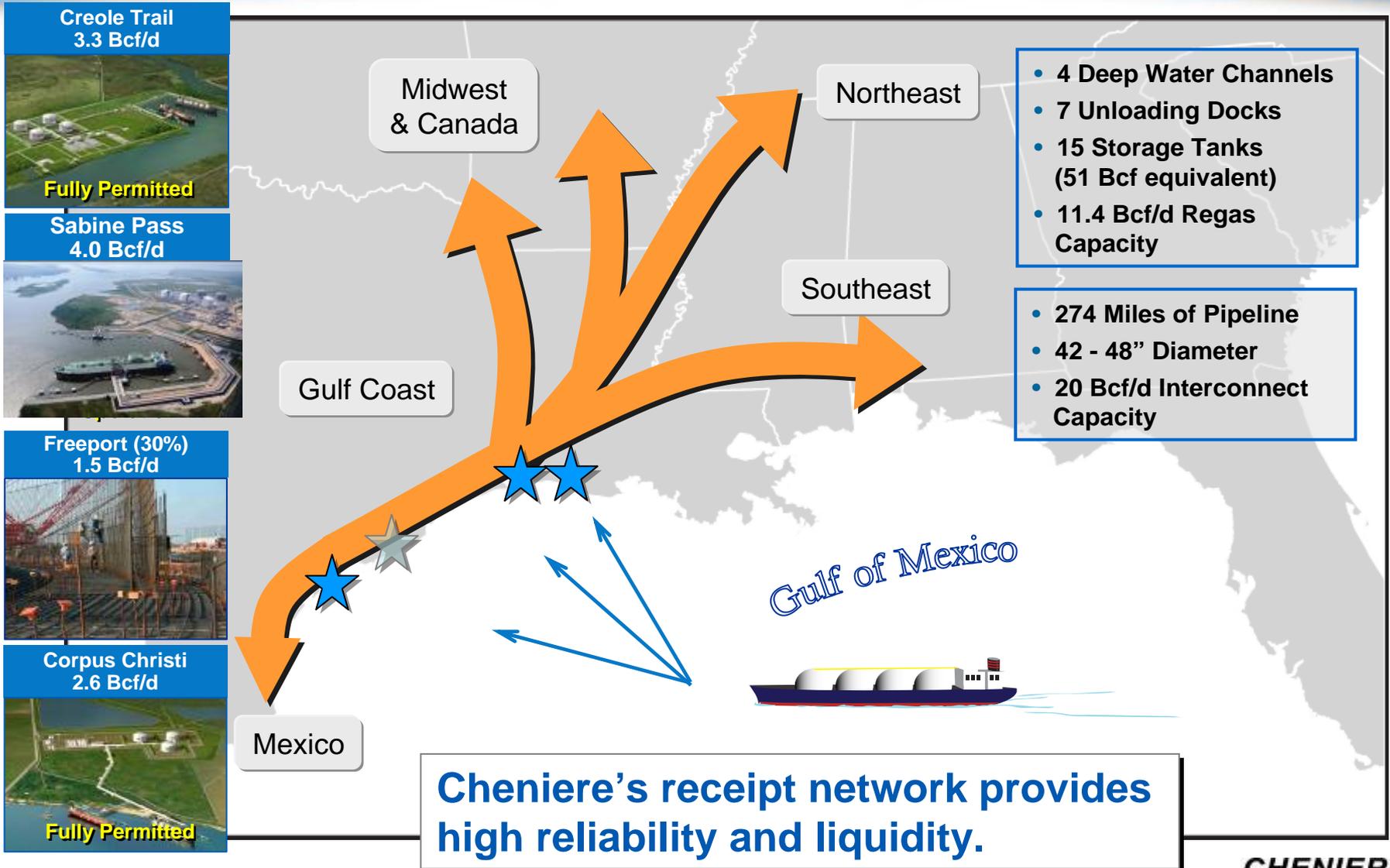
Mexico

23. Baja California, MX : 1.5 Bcfd (Energy Costa Azul - Sempra - Expansion)
24. Manzanillo, MX: 0.5 Bcfd (KMS GNL de Manzanillo)

Office of Energy Projects

Ref: <http://www.ferc.gov/industries/lng/indus-act/terminals/lng-approved.pdf>

Cheniere LNG Receiving Terminals



Terminal Siting Best Practices

- ✓ **Deepwater port access and compatibility with shipping traffic;**
- ✓ **Safety, especially suitability of acreage for safety exclusion zones;**
- ✓ **Pipeline takeaway capacity;**
- ✓ **Acceptance by local communities;**
- ✓ **Coordination of federal and state agencies;**

LNG Permitting

- Federal Energy Regulatory Commission (FERC) is lead agency
- US Coast Guard, has significant oversight/input
- Multiple agencies, some with overlapping jurisdictions
- Over 40 major permits required

Sabine Pass LNG - Cheniere

Sabine Pass LNG Terminal – Sept 2009

Land

- 853 acres in Cameron Parish, LA

Accessibility – Deep Water Ship Channel

- Sabine Pass Channel dredged to 40 feet

Proximity

- 3.7 nautical miles from coast
- 22.8 nautical miles from outer buoy

Berthing / Unloading

- 2 docks
- LNGCs up to ~266,000 cm
- 4 dedicated tugs

Storage

- 5 x 160,000 cm tanks (16.8 Bcfe)

Vaporization Capacity

- ~4.3 Bcf/d peak send-out

Project Status

- Phase I: Complete - Operational 2008
- Phase II: Complete – Operational 2009



Golden Pass LNG - ExxonMobil

Golden Pass LNG Terminal – Sept 2009

- **Land**
 - 477 acres in Jefferson County, TX
- **Accessibility – Deep Water Ship Channel**
 - SNWW – Port Arthur Ship Canal Channel dredged to 40 feet
- **Proximity**
 - ~7 nautical miles from coast
 - ~27 nautical miles from outer buoy
- **Berthing / Unloading**
 - 2 docks
 - LNGCs up to ~266,000 m³
 - 4 dedicated tugs
- **Storage**
 - 5 x 155,000 m³ tanks (~16.3 Bcfe)
- **Vaporization Capacity**
 - ~2.7 Bcf/d peak send-out
- **Project Status**
 - Advertised Proposed Start-Up mid-2010



Freeport LNG

- **Land**
 - 233 acres in Brazoria County, TX
- **Accessibility– Deep Water Ship Channel**
 - On Quintana Island – near Lower Turning Basin Channel dredged to 45 feet
- **Proximity**
 - ~6 nautical miles from open waters via the Freeport Harbor Channel
- **Berthing/Unloading**
 - 1 dock
 - LNGCs up to ~266,000 m³
 - 3 dedicated tugs
- **Storage**
 - 2 x 160,000 m³ (6.7 Bcfe)
- **Vaporization**
 - ~1.7 Bcf/d peak send-out
- **Project Status**
 - Operational in 2008



LNG Terminals Send-Out Capacity Perspective

Current US market for daily natural gas consumption in billions of cubic feet (bcf) of volume per day:

- USA = ~65 Bcf / day
- Louisiana = ~3 Bcf / day
- Texas = ~12 Bcf / day

Peak send-out capacity for the Texas region's three Gulf Coast LNG terminals:

- SPLNG = ~4.3 Bcf/d
- FPLNG = ~1.7 Bcf/d
- GPLNG = ~2.7 Bcf/d

TOTAL = ~8.7 Bcf/d combined peak send-out capacity

Texas Area LNG Terminals – Regional Economy Impact

Some of the ‘economic benefits’ (in millions of dollars) to our area:

<u>Construction Expenses (Non-Payroll)</u>	<u>- (Total)</u>
▪ Freeport LNG (FPLNG)	~\$259.00
▪ Sabine Pass LNG - 1 (SPLNG-1)	~\$250.00 (<i>Estimated</i>)
▪ Sabine Pass LNG - 2 (SPLNG-2)	~\$95.00
▪ Golden Pass LNG (GPLNG)	~\$230.00

Construction Expenses Total:	~\$834.00

Texas Area LNG Terminals – Regional Economy Impact

STAFFING

Const & Ops Staff	Const Period	Const Average	Const Peak	Site Ops
▪ FPLNG	36 Mo	~466	~723	~60 (<i>Estimated</i>)
▪ SPLNG-1	36 Mo	~390	~610	~65
▪ SPLNG-2	35 Mo	~198	~448	(N/A)
▪ GPLNG	60 Mo	~440	~941	~60

Const & Ops Staff Totals: ~1,494 ~2,722 ~185

Construction Payroll (millions USD)	(Monthly)	(Total)
▪ Freeport LNG (FPLNG)	~\$2.50	~\$92.00
▪ Sabine Pass LNG - 1 (SPLNG-1)	~\$2.25	~\$90.00
▪ Sabine Pass LNG - 2 (SPLNG-2)	~\$1.90	~\$65.00
▪ Golden Pass LNG (GPLNG)	~\$2.40	~\$142.00

Construction Payroll Total: ~\$9.05 ~\$389.00

World LNG Fleet is Quite Small – but Growing

- 100 LNG Carriers in the world fleet reached in 1998
- 200 LNG Carriers in the world fleet as of 15 Apr 2006
- 300 LNG Carriers in the world fleet as of 29 Dec 2008
 - according to an article dated 1 Aug 2009 on www.transportweekly.com

Compared to...

- Approximately 36,000 Ships of all types (over 1,000 gross tons) in the world fleet
 - as of 2008 – according to UNCTAD’s “Review of Maritime Transport 2008”

Moss® Type LNGC and Membrane Type LNGC at SPLNG

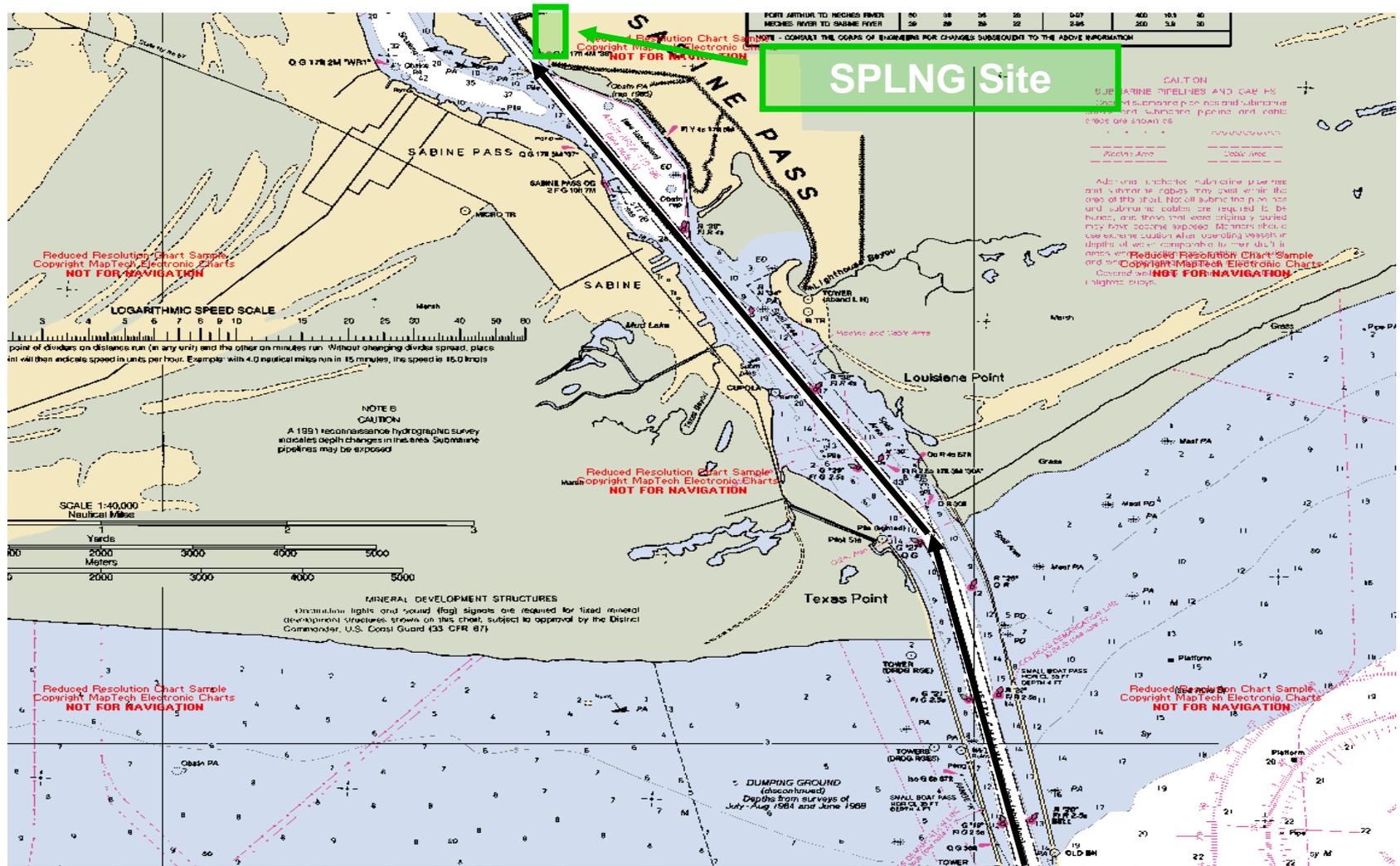


Sabine Pass LNG - April 2008 - Aerial of north view with Celestine River (first cargo)



Sabine Pass LNG - Al Gharrafa Q-flex (216,000 cm capacity) arrived June 21, 2008 from Qatar - aerial of north view of site

Sabine Pass LNG Terminal Location



Approach to Sabine Pass LNG

- SPLNG's visiting LNGCs use ~23 nautical miles of USACE-maintained navigational channel length.
- It normally takes ~4 hours +/- 30 minutes from "Pilot On Board" (POB) to the LNGC declaring "All Fast" after safely mooring in one of the two SPLNG berths.
- The standard preference of a ship's master for his/her LNGC's under keel clearance (UKC) is at least 10% of the draft - which would be ~4 feet for the largest loaded LNGCs.
- The U.S. Army Corps of Engineers maintains the SNWW navigable channels at 42 ft (for outer approach channels) and 40 ft (for SNWW) basis Mean Lower Low Water (MLLW) plus 2 ft additional "advance" dredging and another additional 2 ft permissible "over" dredging.

Ship Sizes and Approach Considerations for All LNG Terminals

- Conducting and posting of regular surveys, plus diligent maintenance dredging of the navigable channels, is considered critical for LNGCs visiting Gulf Coast LNG terminals.
- The largest LNGCs (QMax ships) have a cargo capacity of ~266,000 m³ and have a loaded FW draft of 40 feet (12.19 meters), a length of up to 1132 feet (345 meters), and a breadth of up to 181 feet (55 meters).
- Standard size LNGCs are ~140,000 m³ cargo capacity and have a loaded FW draft of ~36 to ~37.7 feet (~11.0 to ~11.5 meters), a length of ~940 feet (~286 meters), and a breadth of ~142 feet (~43 meters).

Four Dedicated Ship-Assist Tractor-Tugs at SPLNG



Edison Chouest Tugs, 4 permanently assigned to SPLNG

SPLNG Tractor Tugs Have Fire-Fighting Capability



Four dedicated Tractor Tugs with Two Firewater Monitors at 5,000 GPM each

Conclusion

- Planning, Design, Acquisition, Construction, and Operation costs associated with LNG Carriers, LNG Terminals, and Natural Gas Pipelines are expensive.
- There is a very significant economic contribution to local and regional economies where LNG terminals are located.
- As navigable waterways provide the only viable means for bulk LNG to be transported to our terminals, it is absolutely vital to the safety and ability of marine transport that safe navigable depths and widths of our waterways be constantly monitored, fully maintained, and optimally improved where such needs become evident.
- The roles of the USACE and its contractors are therefore key contributors to the success of maintaining a successful LNG trade and its associated economic benefits to our region.

===== THANK YOU!=====