The Realities of Certifying LNG Terminals in North America

Bill Westcott
December 9, 2005
Rice Global E&C Forum
Overview

I. Current Energy Picture
II. North American LNG Import Terminals
III. “Certification” Background
IV. Public Safety Concerns
V. Reality
Main driver – strong growth in world energy demand

- Natural gas provides 24% of global energy demand
- This share is expected to increase
Strong growth in world natural gas demand

- Gas demand to grow at 2.8% (compared with oil at 1.8%)
- Problems of meeting local shortages (e.g. UK & USA)
- Power cuts in prospect if severe winters
- UK wholesale gas prices up 32% in 2003
Future Gas Production Forecast

- Gas volumes required to make up oil shortage if no other fuel was available
- Forecast gas equivalent from substitute fuels, especially coal
- Forecast consumption assuming business as usual

Billions of cubic metres per year

© 2005 Lloyd’s Register
Major trade movements
Trade flows worldwide (billion cubic metres)

USA
Canada
Mexico
S. & Cent. America
Europe & Eurasia
Middle East
Africa
Asia Pacific

Natural gas
LNG

BP for 2004
Existing and Proposed North American LNG Terminals

**CONSTRUCTED**
1. Lake Charles, LA: 0.8 Bcf/d (Southern Union - Trunkline LNG)
2. Hackberry, LA: 1.5 Bcf/d (Sempra Energy)
3. Bahamas: 0.14 Bcf/d (AES Ocean Express)*
4. Bahamas: 0.83 Bcf/d (Calypso Tractebel)*
5. Freeport, TX: 1.5 Bcf/d (Cheniere/Freeport LNG Dev.)
6. Sabine, LA: 2.6 Bcf/d (Cheniere LNG)
7. Elba Island, GA: 0.54 Bcf/d (El Paso - Southern LNG)
8. Corpus Christi, TX: 2.6 Bcf/d (Cheniere LNG)
9. Corpus Christi, TX: 1.0 Bcf/d (Vista Del Sol - ExxonMobil)
10. Fall River, MA: 0.8 Bcf/d (Weaver's Cove Energy/Hess LNG)
11. Sabine, TX: 1.0 Bcf/d (Golden Pass - ExxonMobil)
12. Corpus Christi, TX: 1.0 Bcf/d (Inglewood Energy - Occidental Energy Ventures)

**APPROVED BY MARAD/COAST GUARD**
13. Port Pelican, LA: 1.6 Bcf/d (Chevron Texaco)
14. Louisiana Offshore: 1.0 Bcf/d (Gulf Landing - Shell)

**CANADIAN APPROVED TERMINALS**
15. St. John, NB: 1.0 Bcf/d (Canaport - Irving Oil)
16. Point Tupper, NS: 1.0 Bcf/d (Bear Head LNG - Anadarko)

**MEXICAN APPROVED TERMINALS**
17. Altamira, Tampulipas: 0.7 Bcf/d, (Shell/Total/Mitsui)
18. Baja California, MX: 1.0 Bcf/d, (Sempra)
19. Baja California - Offshore: 1.4 Bcf/d, (Chevron Texaco)

**PROPOSED TO FERC**
20. Long Beach, CA: 0.7 Bcf/d, (Mitsubishi/ConocoPhillips - Sound Energy Solution
22. Bahamas: 0.5 Bcf/d, (Seafarers - El Paso/FPL)
23. Port Arthur, TX: 1.5 Bcf/d (Sempra)
24. Cove Point, MD: 0.8 Bcf /d (Dominion)
25. LI Sound, NY: 1.0 Bcf/d (Broadwater Energy - TransCanada/Shell)
26. Pascagoula, MS: 1.0 Bcf/d (Gulf LNG Energy LLC)
27. Bradwood, OR: 1.0 Bcf/d (Northern Star LNG - Northern Star Natural Gas LLC)
28. Pascagoula, MS: 1.3 Bcf/d (Cassette Landing - Chevron Texaco)
29. Cameron, LA: 3.3 Bcf/d (Creole Trail LNG - Cheniere LNG)
30. Port Lavaca, TX: 1.0 Bcf/d (Calhoun LNG - Gulf Coast LNG Partners)
31. Freeport, TX: 2.5 Bcf/d (Cheniere/Freeport LNG Dev. - Expansion)
32. Sabine, LA: 1.4 Bcf/d (Cheniere LNG - Expansion)

**PROPOSED TO MARAD/COAST GUARD**
33. California Offshore: 1.5 Bcf/d (Cabrillo Port - BHP Billiton)
34. So. California Offshore: 0.5 Bcf/d (Crystal Energy)
35. Louisiana Offshore: 1.0 Bcf/d (Main Pass McMoran Exp.)
36. Gulf of Mexico: 1.0 Bcf/d (Compass Port - ConocoPhillips)
37. Gulf of Mexico: 2.8 Bcf/d (Pearl Crossing - ExxonMobil)
38. Gulf of Mexico: 1.5 Bcf/d (Beacon Port Clean Energy Terminal - ConocoPhillips)
39. Offshore Boston, MA: 0.4 Bcf/d (Neptune LNG - Tractebel)
40. Offshore Boston, MA: 0.8 Bcf/d (Northeast Gateway - Excelerate Energy)

As of November 14, 2005

* US pipeline approved: LNG terminal pending in Bahamas

Office of Energy Projects
Potential North American LNG Terminals

As of November 14, 2005

Office of Energy Projects
Cleveland, Ohio
Oct. 20, 1944

**Human Cost**
- 680 Homeless
- 225 Injured
- 131 Dead

**Property Destroyed**
- 79 Homes
- 2 Factories
- 217 Cars
- 7 Trailers
Skikda, Algeria
January 19, 2004

**Human Cost**
Blast Felt Miles Away
74 Injuries
27 Dead

**Property Damage**
$800 Million Facility Destroyed
$200 Million Other Property Damage
Other LNG Incidents

- La Spezia, Italy, 1971.
- **Montreal East, Quebec, Canada LNG Plant Explosion, 1972.**
- **Massachusetts Barge Spill, July 1974.**
- Das Island, United Arab Emirates Spill, March 1978.
- **Cove Point, Maryland LNG Spill, 1979.**
- Bontang, Indonesia LNG Plant Explosion, 1983.
- **Trinidad Tobago LNG Turbine Explosion, June 13, 2004.**
- **Maryland House Explosion March 2005**
- India Tugs Collided with LNG Terminal, September 17, 2005.
Is there a role for Independent Assessment?

LNG Terminal Certification
Principles of Certification

• **Work Independently**
  - Design reviews and inspections are carried out independently from those carried out by contractors and owner.

• **Transparent Process**
  - Certification process is documented and available for review by Regulatory Body as necessary.
LNG Guidance Notes

Classification and certification of offshore gravity based liquefied gas terminals

Guidance notes
April 2004
Revision 1
Safely optimising business performance

Classification and certification of floating offshore liquefied gas installations

Guidance notes
April 2004
Revision 2
Safely optimising business performance
Challenges Faced

• Technological
  • Seismicity
  • Transfer Systems
  • Novel Concepts and Materials

• Safety & Environmental
Seismic environment

Analyses are performed for two earthquake events:

(OBE) Operating Basis Earthquake
1 in 475 years

(SSE) Safe Shutdown Earthquake
1 in 2500 years
Transfer systems

Bluewater

SBM

FMC

© 2005 Lloyd's Register
Novel LNG Concepts

- Containment
- Pipe-in-pipe
Containment

GT No.96

Technigaz MkIII

Exxon Mobil - Modular Tank

All-Concrete Storage Tanks
Pipe-in-pipe

ITP InTerPipe

Technip
Cryogenic
Pipe-in-Pipe
Challenges Faced

- Technological
  - Seismicity
  - Transfer Systems
  - Novel Concepts and Materials

- Safety & Environmental
  - Siting
  - Vaporizers
  - Location of accommodation for offshore terminals
  - Security
Siting

NIMBY

BANANA

• Is LNG safe?  • What about the explosions?  • What about terrorists?
Open Rack Vaporizers (ORVs)

Submerged Combustion Vaporizers (SCVs)
Offshore Accommodations

Figure 1: Terminal Layout
Security

At Boston we now see:

- LNG tankers now inspected at point of origin
- Occasional on-board escort by coastguard “Sea marshals”
- 96 hour advance notice of tanker
- Advance notice to local emergency services, Federal Aviation authority and US Navy
- Boarding of tankers prior for inspection before entrance to harbor
- Armed Escort during entrance
- Security zone 2 miles ahead, and 1 mile either side
- Suspension of overhead flights from Logan airport
Lessons Learned on Previous Projects

- All stages of design should consider how the facility is to be built, commissioned and operated, to ensure that unforeseen conditions do not occur.

- The CA should be involved as early as possible in the design and decision making process to be able to influence safety critical issues while they are relatively easy to change.

- The CA should be involved in the ‘Change Control’ process in order to be able to assess critical issues.
Got LNG?.... Get Lloyd’s Register