Immediate & Future LNG Opportunities in the Midstream; Reviewing Innovative Technologies

Kathleen Eisbrenner, CEO
Pangea LNG / NextDecade, LLC

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Agenda Topics

• Demand and the Importance of Floating LNG
• Translation to Upstream FLNG
• Future Innovations
  – Downstream
  – To Midstream
• Closing Remarks
A Precedent...The Past Decade

2000 - Only 11 Countries Imported LNG (No Floating Regas)

2005 - First Floating Regasification Site (Gulf of Mexico)
History of Floating Regasification

CURRENT SITES
- Argentina (2)
- Brazil (2)
- UAE (Dubai)
- Israel
- Indonesia (2)
- Kuwait
- United Kingdom
- United States (2)

POSSIBLE SITES
- Bangladesh
- Bahrain
- Brazil (#3)
- Chile (2)
- China
- Dominican Republic
- Egypt
- Ghana
- India
- Indonesia (#3)
- Italy
- Jamaica
- Jordan
- Kuwait (#2)
- Lebanon
- Lithuania
- Malaysia
- Pakistan
- Puerto Rico
- South Africa
- Sri Lanka
- Ukraine
- UAE (Abu Dhabi)
- Uruguay
- Vietnam

2000 - 11 LNG Importing Countries (No Floating Regas)
2005 - First Floating Regasification Site (Gulf of Mexico)
2010 - 22 LNG Importing Countries
2013 - 12 Floating Regasification Sites
2015 - 40 or More Floating Regasification Sites (Projected)
Floating Regasification Solutions

Near Shore

Offshore
Relevance of New Markets and Floating Regasification Technology

- New market alternatives are liquid fuels, priced at oil, fuel oil and diesel indices; Delivered LNG is price competitive
- Floating regasification has demonstrated how quickly innovative technologies can be adopted and accepted by the LNG industry
- Floating regasification has demonstrated reduced costs for floating solutions ~ $400 million vs. $1.2 billion for land-based equivalent
Future LNG FIDs: Time for a New Model?

- **Land Based**: $2,500 to $4,000/ton
- **Large Scale Offshore**: $750 to $1,500/ton
- **Small Scale Offshore/Nearshore**: $2,500 to $4,000/ton
Vessel-Mounted Liquefaction Will Follow Regasification Growth Trend

Existing and Planned Floating LNG Projects

Floating Regasification Projects

Floating Liquefaction Projects
Potential for Offshore Floating Liquefaction
Potential for Near Shore FLNG

World dry natural gas production by region, 1980-2010

- **North America**: 29
- **Europe**: 11
- **Former Soviet Union**: 26
- **Asia**: 15
- **Middle East**: 17
- **Africa**: 7
- **Central & South America**: 5
- **Oceania**: 2

- **South Texas LNG Export At Corpus Christi**

Unlimited...
Floating Liquefaction Projects – Announced

UNDER CONSTRUCTION OR UNDER DEVELOPMENT

- United States (8)
- Columbia
- Brazil
- Israel
- Malaysia (2)
- Indonesia
- Timor Sea (3)
- Australia
- Papua New Guinea

2013

- 3 Ships Under Construction
- 16 Additional Under Development
Floating Liquefaction Projects – Future Positions

2015
Potential of at Least 5 Additional Projects
Floating LNG Dynamics – How is Value Created?

• NOT in technology per se, except to achieve lower unit costs, but by:
  – MONETIZING stranded reserves not accessible by traditional procedures
  – CREATING new business models for LNG that compete with the Traditionalists on a fundamentally lower cost basis
  – LEVERAGING the power of the Shipyard environment and best practices to keep costs and schedules under control
History of FPSO Development

Installed FPSOs
(1977 to 2012)

Today’s LNG FPSO Opportunity Space
Value Creation Through Korean Built Midstream Solutions

- Lower cost per mmbtu as well as overall investment
- Accelerated schedule through replication, efficiency and controlled construction environment
- Lower contingency required for cost and time to in service
- Attractive financing support
- Ultimate opportunity to benefit across projects from lessons learned and cross-fertilisation
QatarGas LNG Ships at DSME
Future Innovations – Downstream: Floating Power Plant (FLPP)

- **FLPP™ All in One (200~400MW)**
  - Floating LNG Power Plant
  - = Receiving Terminal + Storage + Regasification + Power Plant
- **FLPP™ L200**
  - Length: app. 272.8 m
  - Breadth: app. 44.0 m
  - Depth: app. 26.0 m
  - Draft: app. 8~11 m

About DSEC

- DSEC Co., Ltd. (Daewoo Shipbuilding Engineering Company)/ A subsidiary of DSME
- Date of Establishment: April, 2002
- No. of Employees: Approx. 1,800 including in house subcontractor
Future Innovations – Midstream: New LNG System – Cluster LNG

By LNG Solutions

Cluster LNG: Innovative integrated LNG liquefaction, storage, transportation and regasification systems.

- Increased Pressure Liquefaction
- Cluster type LNG Containment (new concept)
- Integrated LNG System
- Clusters of Producers and Customers
- Sized from 0.1 mtpa to 0.5 mtpa
Cluster LNG Technologies

- Cost Effectiveness of Cluster LNG
  - Lower Cost due to High Efficiency Liquefaction System by Increased Pressure
  - Controlled Cost by DSME Proprietary Storage Tank
Verification – Liquefaction

Bench Scale Pilot Plant

- Cargo/LNG skid
- Compressor skid
- Regasification
- Coldbox and JT Valve
- CO2 Injection Test
Conclusions

• Our Industry is ripe for innovation

• Korean built solutions are a big part of our past, our present and our future in global LNG

• Working together we can make great things happen
Thank You