Status of first generation of FLNG and trend and perspective for the next generation

Dominique Gadelle – Technip - Vice-President Upstream / LNG

Atelier 1 – La mer, nouveau terrain de conquête pour le GNL
Natural gas market growth - FLNG & LNG

Cost competition with coal
Political support for environmental benefits

- Highest growth is in Asia
- Drivers are
  - GDP growth
  - Urbanisation
  - Political pressure in favour of clean fuels incl. gas
  - China and India both have air quality issues in the big cities
  - COP21 concluded favourably for gas
- China and India as biggest new markets
  - Primary energy 13% CAGR over the last 9 years
  - Still dominated by coal
  - Gas market share growth will continue

Source: BP Statistical Review of World Energy 2015
Projects with vastly different economics

Only the most profitable projects are likely to go ahead.

Breakeven FOB cost of LNG

- inclusive of
  - Upstream (field development)
  - Pipeline
  - Liquefaction

FLNG

Mature LNG plants
GoM brownfield & Middle East
Greenfield US & East Africa
Australia & Canada
New plant

FID
FEASIBLE
IN
LOW PRICE
ENVIRONMENT

0
2
4
6
8
10
12
14
16

$/MMBtu
Technip an innovator in LNG - Differentiators

- An LNG EPC contractor for over 50 Years
- Delivered with our partners to-date 80 Mtpa of LNG production capacity including the world’s biggest LNG facilities: Qatar, Nigeria and Yemen.
- Yamal LNG EPC currently ongoing
- Leading in floating liquefaction (FLNG)
- Diversity in scale, LNG technology and location
- Leading in innovation rich areas
  - Shell FLNG, Petronas FLNG 1, Browse FLNG (FEED)
  - Mid-scale LNG
- Technologically strong: introduced many concepts to the industry that are widely used today
- Safety in design, modularization, marine works, global procurement...

* Picture courtesy of Shell
Numerous FLNG studies for IOCs & NOCs

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- Pioneer in the 80’s
- Internal studies as investment
- Multiple FLNG capacities and types
- Continuous activities since 2008, in excess of 9 Millions Mhrs
- Several conceptual studies, 7 Pre-FEED, 8 FEED and 2 EPCI

Small <= 1.5 Mtpa < Medium <= 3 Mtpa <= Large
Technip FLNG Main Experience

- **Petrobras FLNG**
  - Lula (offshore Brazil) – 2010

- **Shell Prelude FLNG**
  - Oceania (offshore Australia) – 2010

- **Petronas LNG**
  - Sarawak (offshore Malaysia) – 2010/2011

- **Inpex Abadi FLNG**
  - Indonesia - 2013

- **Shell Generic FLNG**
  - Generic – 2019

- **ENI Coral FLNG**
  - Mozambique – 2015

- **Woodside Browse FLNG**
  - Offshore Australia – 2015

- **Shell Prelude FLNG**
  - Oceania (offshore Australia) – 2011

- **Petronas FLNG**
  - Sarawak (offshore Malaysia) – 2011
Shell Prelude FLNG

- First FLNG project ever sanctioned
- First of two FLNG projects for Technip
- First FLNG under the TP/SHI Frame Agreement with Shell
- Largest floating structure ever built
- Largest multi-centers offshore project ever (Paris, KL, Perth, Chennai)
- 200km from the nearest point on the mainland
- 200 - 250m water depth
- Commissioning at yard on-going

**Prelude FLNG**

- Length: 488 meters, width: 74 meters
- Weight:
  - Steel: 260,000 tons
  - Displacement (tanks full): 600,000 tons
- Comparison
  - Eiffel Tower iron structure = 7,300 tons
  - Prelude
    - Steel: 36 Eiffel Towers
    - Displacement (tanks full): 82 Eiffel Towers
- Annual Production
  - 3.6 Mtpa LNG capacity
  - 1.3 Mtpa condensate
  - 0.4 Mtpa LPG
- Total liquid production: 110,000 boe/day
Petronas FLNG Satu

- Client: PETRONAS
- Location: Sabah - Sarawak waters, Malaysia
- Scope: FEED and EPCIC
- FEED: Jan 2011 - Jan 2012
- EPCIC: Jun 2012 - Completed
- Partner: consortium with DSME
- FLNG towed to site during May 2016
- Commissioning activities on-going
- Floating Liquefied Natural Gas (FLNG) facility of 1.2 million ton per year maximum capacity
- The 300 meter - long and 60 meter - wide FLNG facility will be located offshore Malaysia
## FLNG projects in progress

### 3 open sea projects at construction phase

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<th>FLNG project</th>
<th>Country</th>
<th>F.I.D.</th>
<th>Distance From shore (km)</th>
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Onshore LNG and FLNG export projects

Estimated World liquefaction capacity (Mtpa)

Source: Technip Database

- Qatar: 340 Mtpa (In operation October 2016)
- United States: 126 Mtpa (Under construction)
- Indonesia: 240 Mtpa (Future projects)

FLNG projects include:
- Mozambique
- Tanzania
- Mexico
- Trinidad & Tobago
- Yemen
FLNG possible areas of development
In the current market only the most competitive FLNG projects will fly

- Brazil
  - Pre-Salt Associated Gas
  - Difficult access to land
  - Remote fields and deep water

- Canada & Alaska
  - Nearshore
  - Offshore East Coast
  - High cost of onshore construction

- Arctic Circle
  - Remote Fields

- Eastern Mediterranea
  - High cost of construction
  - Sensitive political environment
  - Difficult shore approach for feed gas P/L

- Africa
  - Better security offshore
  - Remote fields and deep water

- Asia / Pacific
  - Many small fields
  - Presence of subsea trenches

- Australia
  - Remote fields
  - Sensitivity to construction on the coastline
  - High cost of onshore construction
Anticipating the future

- Capitalize on the lessons learnt from the first projects to set the basis of the next generation of FLNG

- When appropriate, repeatability is a must to tackle projects complexity
  - Repeat design and execution plan to reduce EPC cost, schedule and risks
  - Repeat collaborative project execution model

- FLNG economics to be improved by production increase and innovation
  - Individual unit capacity throughput increase and / or intensification to free deck space to increase liquefaction capacity.
  - Innovation: take credit of lessons learnt to validate good solutions and implement new ones
Conclusion

- LNG has a bright long term future in the world energy picture.

- Floating LNG is reaching maturity. Numerous challenges have now been met in design, engineering and construction.

- For given fields FLNG brings advantages over onshore LNG.

- Nearshore LNG can also be contemplated.

- The next generation of FLNG will benefit from:
  - Selective replication bringing schedule and cost certainty.
  - New concepts, that have been developed to improve projects economics:
    - Lean engineering.
    - Large/intensified capacity FLNG concepts, with the possibility of replication, as previously done for onshore LNG projects.