



Safety in LNG and Floating LNG Facilities

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Workshop 3: "What is the Future of LNG"

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Safety Challenges in

- Offshore LNG Production and Re-gasification
- New Onshore LNG Plants and Terminals
- Aging Facilities (LNG production and re-gas > 20 years)
- New LNG vessels (nowadays from 5 000 to 260 000 m³)

R & D plays a major role for providing solutions

FLNG: Fitting and Operating an LNG Plant on a Ship

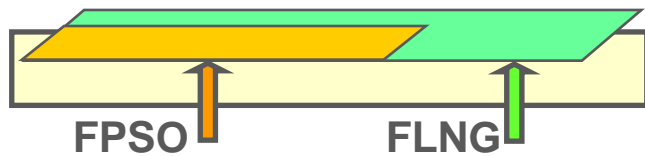
FPSO & TLP & Upstream



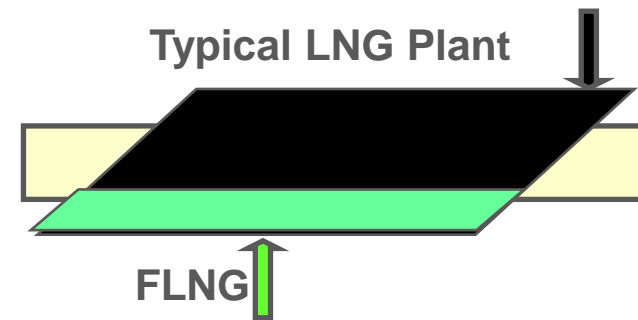
LNG Shipping



LNG Plant



Floating LNG

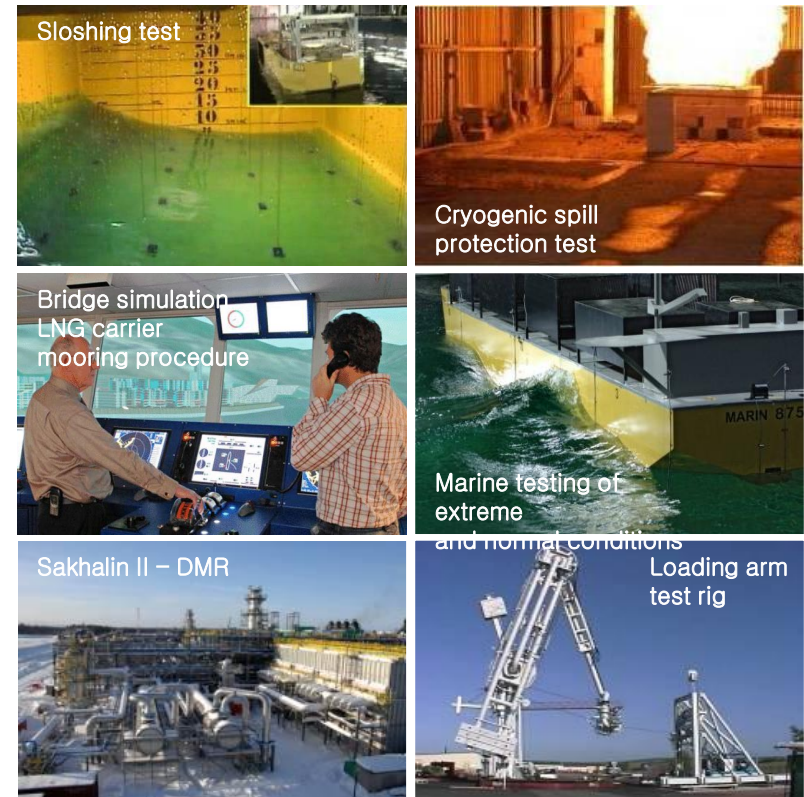


Challenge: Fitting an entire LNG plant on a much smaller area

Shell FLNG: Safe, Robust, Reliable, Available

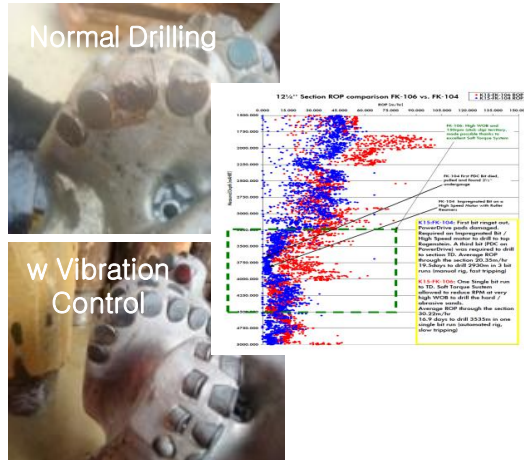
Over 15 years identifying, understanding and addressing all offshore challenges, plus:

- Top side lay out on small plot size – escalation potential
- Fractionation and liquefaction processes
- Integrity of partially filled membrane tanks
- Handling and storage of cryogenic products
- Mooring and offloading of LNG/LPG carriers adjacent to a production plant
- Safety has driven the lay-out, and is on par with modern offshore facilities
- Roll & pitch less than for a typical FPSO
- Reliable supply – availability is on par with onshore plants



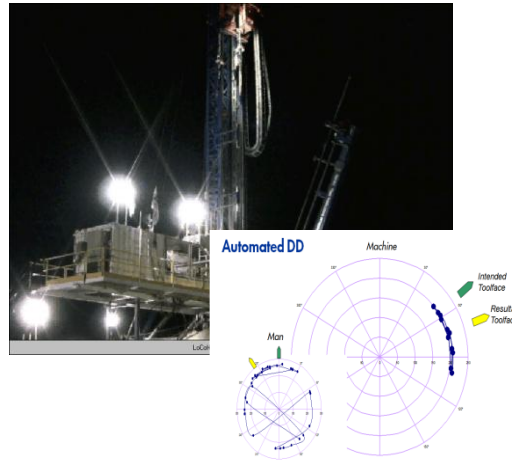
Wells Technology: Enhancing Safety & Reducing Costs

DRILLING EFFICIENCY



- Soft Torque Rotary System
- Faster Drilling (+25%)
- Fewer bit trips required (e.g. 3 to 1)
- Less bit Wear
- Significant Savings (17% in above case)

AUTOMATED DRILLING



- Computerized Directional Drilling
- Low Cost Hole Positioning
- Faster/More Accurate
- Fewer People (Safer)

NEXT GENERATION DEEPWATER RIGS



- Bully/Globetrotter Rigs (Smaller/Lighter)
- Multi-purpose Tower, Drills to 12k ft
- Arctic Capable
- Automated
- Smaller crew req'd (80 vs 120)
- Versatile (Shallow/DW)

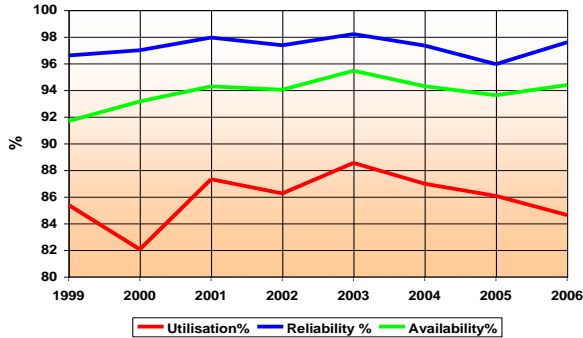
Challenges for new Onshore LNG Plants

- More remote and difficult locations (arctic, offshore, swampy....)
- More "difficult" gas (wet, sour, high CO₂ and N₂, tight gas.....)
- Tight control on emissions, discharges, waste...
- Quality control of equipment
- Local content, training of staff
- Small LNG schemes (trucking, small ships, LNG as automotive and marine fuels)
- Modular construction

New, sophisticated schemes require new approaches to safety

Maximizing Value from Existing Assets

Average LNG Plant Performance 1999 - 2006



Availability, reliability and utilisation



Asset Reference Planning & Rejuvenation



Brunei LNG:

- Extended lifetime to 60 years
- Upgrading to 150%
- Integration with power station



Best practices network



Optimisation & Upgrading

Issues with Rejuvenation and Debottlenecking

- Fatigue and Corrosion (external and internal)
- Cryogenic insulation
- Extend lifetime with 20 – 25 years to satisfy customer demands
- Compliance with new codes and standards
- Replacement parts
- Wish to debottleneck

Start with complete as built assessment and seek best match with new standards

