Technological innovation and infrastructure in the LNG industry

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History of the LNG industry

1955 – 1965

Pioneer age

1965 – 1975

Industrial and commercial development

1975 – 1995

Industrial and commercial maturity

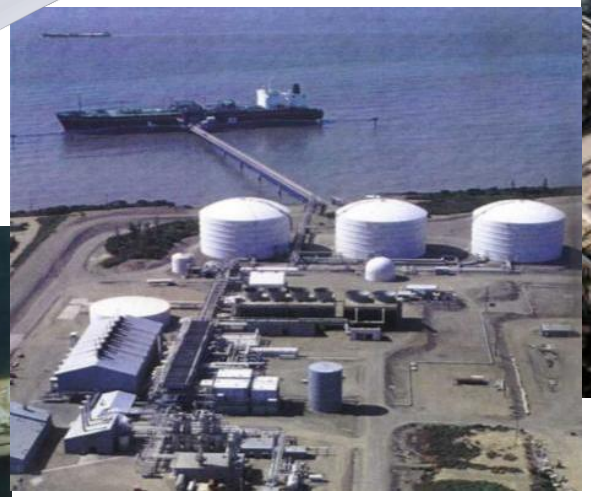
1995 – 2005

New expansion phase : Mega-trains,...

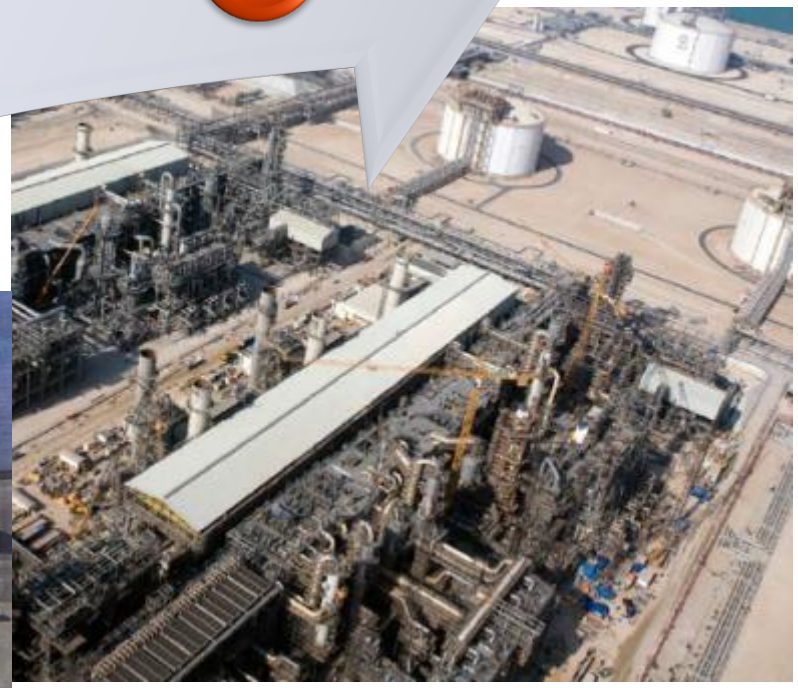
2005 – Present

FSRU,FLNG, Terminal Conversion

Le Havre, France



Kenai LNG Plant, Alaska



Qatari mega trains

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Innovation in Liquefaction

Innovation in Liquefaction

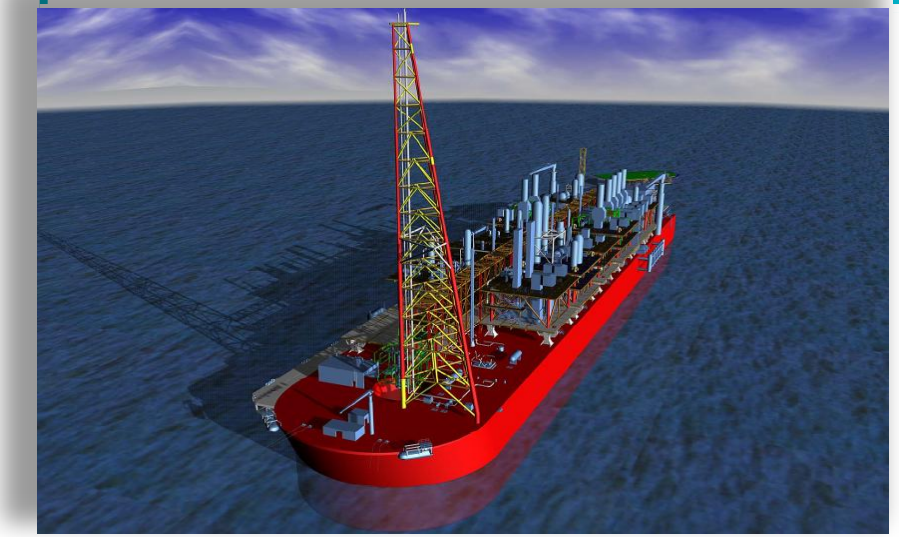
OBJECTIVES	INNOVATION	BENEFIT
Construction cost reduction	• Increase in train sizes from 1.3 to 7.8 mtpa	40% liquefaction costs reduction
	• Conversion of LNG terminal in the US	CAPEX savings: 10%
	• Modularization construction	CAPEX savings: up to 10%
	• Expanders for end flash	1% increase in LNG volumes produced
Operation cost reduction	• Use of aeroderivative gas turbines	• Reduction of feedgas consumption: 20% - 25%
Business Development	• **FLNG / Liquefaction barges** • Ship-to-ship / Offloading system	• Access to more than 800 stranded fields.


Kenai LNG plant


Bonaparte FLNG project

Monetizing stranded gas fields: FLNGs

Advantages	Challenges
• More than 800 stranded fields > 1.5 Tcf in the world, suitable to FLNG solutions	• Meteocean constraints (berthing, cyclones)
• Reduced environmental footprint	• Hull (to remain compatible with shipyards)
• Cost-effective versus onshore options	• Turrets (efforts, safety): Designed to resist a hurricane with a return period of 10,000 years
• Can limit execution risks	• Weight management
• Redeployable	• Congestion
•Adaptation of existing technologies	• Motions management

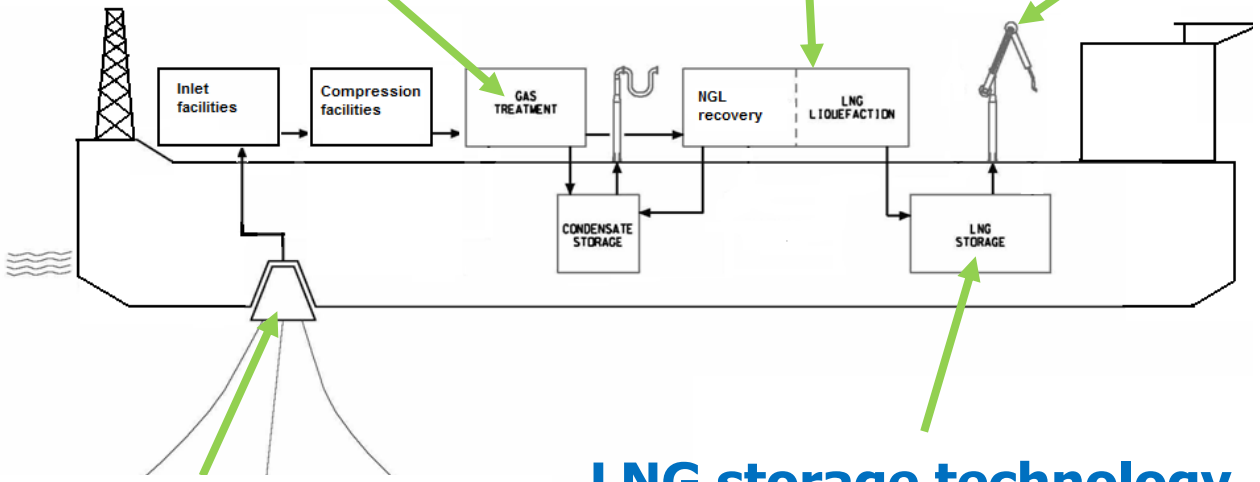


Key technological points to be validated in FLNG design

Gas treatment processes

Gas liquefaction process and mechanical drivers

Offloading system



Turret

LNG storage technology

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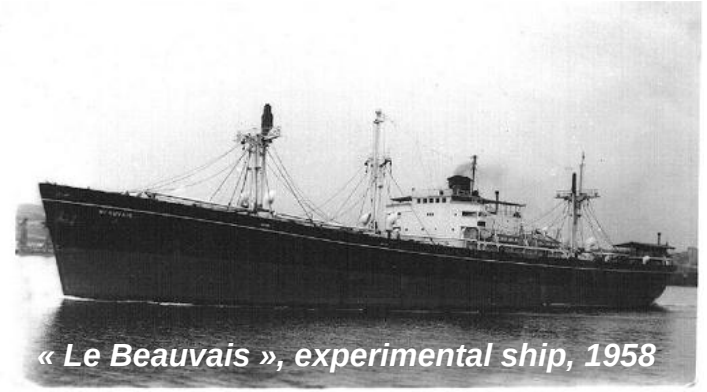
Innovation in Shipping

Innovation in Shipping

OBJECTIVES	INNOVATION	BENEFIT
Operation cost reduction	• Increase in shipping capacity: from MedMax to QMax	→ Decrease shipping costs: by up to 0.5 $/MMBtu*
	• From conventional steam turbines to Dual Fuel/Tri- Fuel Diesel Electric engines, MEGI, …	→ Better efficiency of propulsion: from 25% to 30%
	• Development of membrane containment system technology	→ BOG rate decrease from 0.15%/day to 0.10%/day
Business Development	• **Ice-breaking LNG tankers**	→ Access to new Arctic resources: 30-40 mtpa currently assessed and more prospective areas.

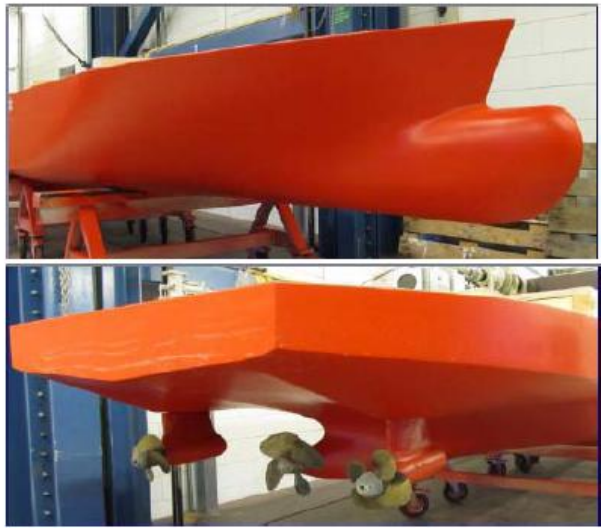
** For a 40-50 days round trip*



« Le Beauvais », experimental ship, 1958

GDF SUEZ Global Energy, 2006

Ice class LNG vessels for Arctic LNG project



- *Ice class LNG vessels to be designed to ship through Kara Sea at all times and in North Sea Route during summer.*
- *Capacity up to 170,000 m3.*
- *Double acting concept, forward and backward*
- *Ships would cost between US $300 million to $350 million each.*
- *Speculative projects post 2025 in Russia, Greenland, Alaska…*

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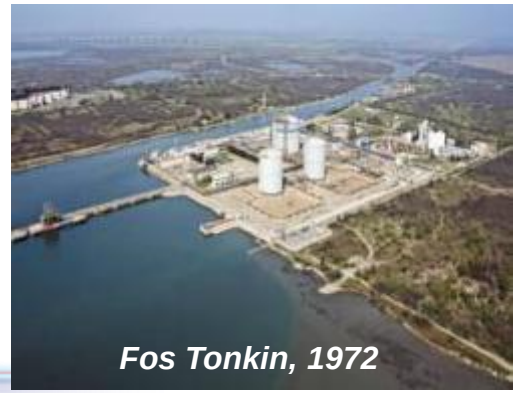
Innovation in Regasification

Innovation in Regasification

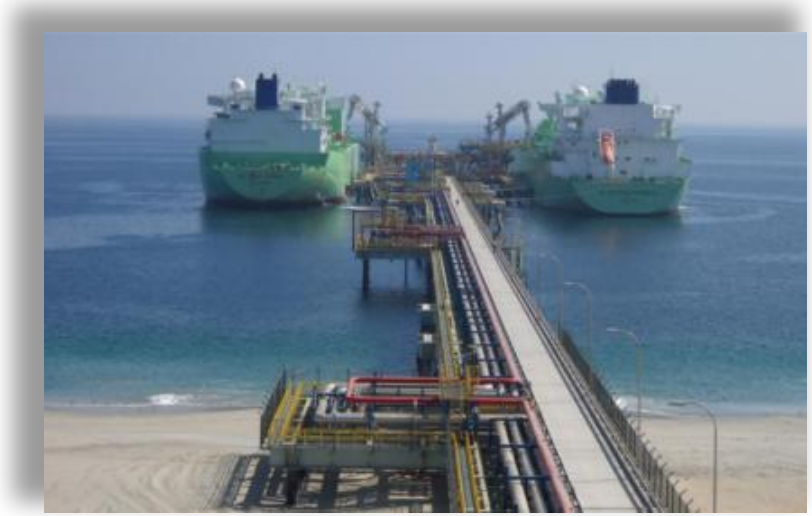
OBJECTIVES	INNOVATION	BENEFIT
Construction cost reduction	• **New FSRUs / Conversion of LNG carrier into FSRUs**	• Lower CAPEX (equivalent to 10-20% of onshore terminal) • Construction time : 10-18 months vs. 36-60 months
	• **Air heating technology**	• Terminal CAPEX reduction:1%
Operation cost reduction	• Improved fuel efficient in FSRUs with open loop technology, recondensers,..	• Savings of up to $100k/day for a 3.5 mtpa FSRU
Business Development	• FSRUs enabling a first step before onshore terminal, lower initial imports and fast installation	• Access to new markets: FSRUs could amount to 60 mtpa in 2020 (10% of regasification capacities)


Fos Tonkin, 1972

GDF SUEZ Neptune, 2010

Floating Regasification

- *A new regasification scheme: FSRUs*
  - **Options: "permanently" moored, offshore or in a port (quay, berth)**
  - **Being regularly used in regasification mode, their efficiency improvements will be :**
    - Open-loop (limit fuel consumption)
    - Recondenser (limit BOG flaring) ; a higher operating pressure of LNG tanks would simplify BOG management
    - LNG transfer: ship-to-ship (aerial flexible hoses, articulated arms) or ship-to-jetty-to-ship



Ship-to-jetty-to-ship – Mejillones FSU (Chile)

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Development of Retail LNG markets

Retail LNG for maritime uses

OBJECTIVES	INNOVATION	BENEFIT
Environmental concerns	• Development of an LNG Bunkering vessel to feed sea-going ships • Ship-to-ship transfer	• Market potential of 25-30 mtpa by 2030

- A 5000m^3 **LNG Bunkering Vessel** is currently developed by GDF SUEZ, together with NYK.
- The Basic concept approval was awarded by **Bureau Veritas** in May 2012.
- The **Ship-to-Ship system** is developed to enable successful and **safe bunkering of various kind of customer ships** (container, ro-ro, etc..)
- Studies ongoing to:
  - **Optimize the BOG management while using pressurized LNG tanks.**
  - **Validate the LNG quality with regards to ageing LNG.**
  - **Evaluate various conditions of the LNG transfer for a safe design of the bunkering system (STS).**

THANK YOU!

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