

小型FLNG（Floating LNG） に関する研究開発

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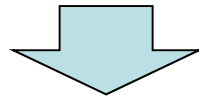
シニアプロセスエンジニア 加藤 道則

Contents

- Objective
- Promotion Video
- Overall Design Concept
- Hull Design Concept
- Topside Design Concept

Objective

- To establish economic solution for development of small-mid size gas reserves with Safety, Reliability, High Efficiency and High Cost Performance.
- To contribute to Japanese offshore development, Ship building and Plant industries.



LiBro™ FLNG Concept

- Technical Feasibility
- Preparation of Generic FEED

Promotion Video



LiBro™ FLNG

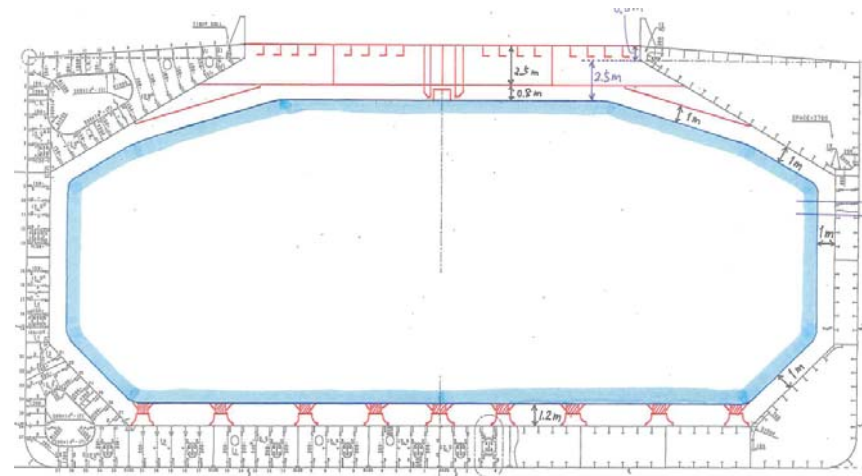


Objectives for FLNG Design – Priority Issues

- ✓ **Safety**
- ✓ **Cost Effectiveness**
- ✓ **High LNG Production Efficiency**
- ✓ **High Availability**
- ✓ **Early Delivery**
- ✓ **Small Footprint**
- ✓ Field Proven Track Records
- ✓ High Maintainability
- ✓ Small Equipment Count
- ✓ Marinization
- ✓ Short Start up Duration
- ✓ Less Flaring

Key Concept - Hull

- Hull Design:
 - ✓ To utilize conventional ship hull design
 - ✓ To expand range of shipyards to be able to build the hull
 - » Conversion of Bulk Carrier at afloat condition
- LNG Tanks Selection: SPB Tank
 - » Fit for conversion
 - » Flat deck available



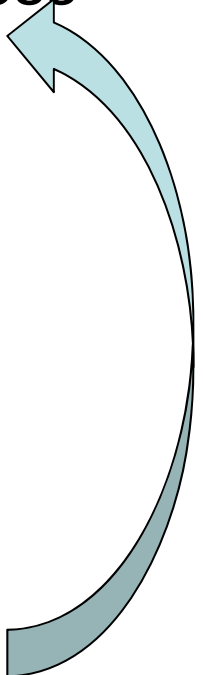
Key Concept - Mooring System

- Mooring System
 - Tower Yoke
 - Water Depth: Abt. 30m
 - 100 year storm condition
 - ✓ Hs: 3.18m
 - ✓ Tp: 11.46sec



- Any Mooring System can be adopted depending on the site environment condition

Key Concept - Topside

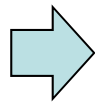
- Liquefaction Process: Air Products® AP-N LNG Process
 - Type of MCHE: Air Products' Coil Wound Heat Exchanger (CWHE)
 - Compressor Driver: Gas Turbine
 - LNG Production Efficiency Improvement: MODEC's LiBro™ Technology (Lithium Bromide based Absorption Refrigeration System)
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What's LiBro™ FLNG?

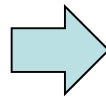
➤ LiBro™ Technology

Based on Lithium Bromide (Li-Br) Absorption Refrigeration System

**Waste
Heat
from Gas
Turbine**



Steam



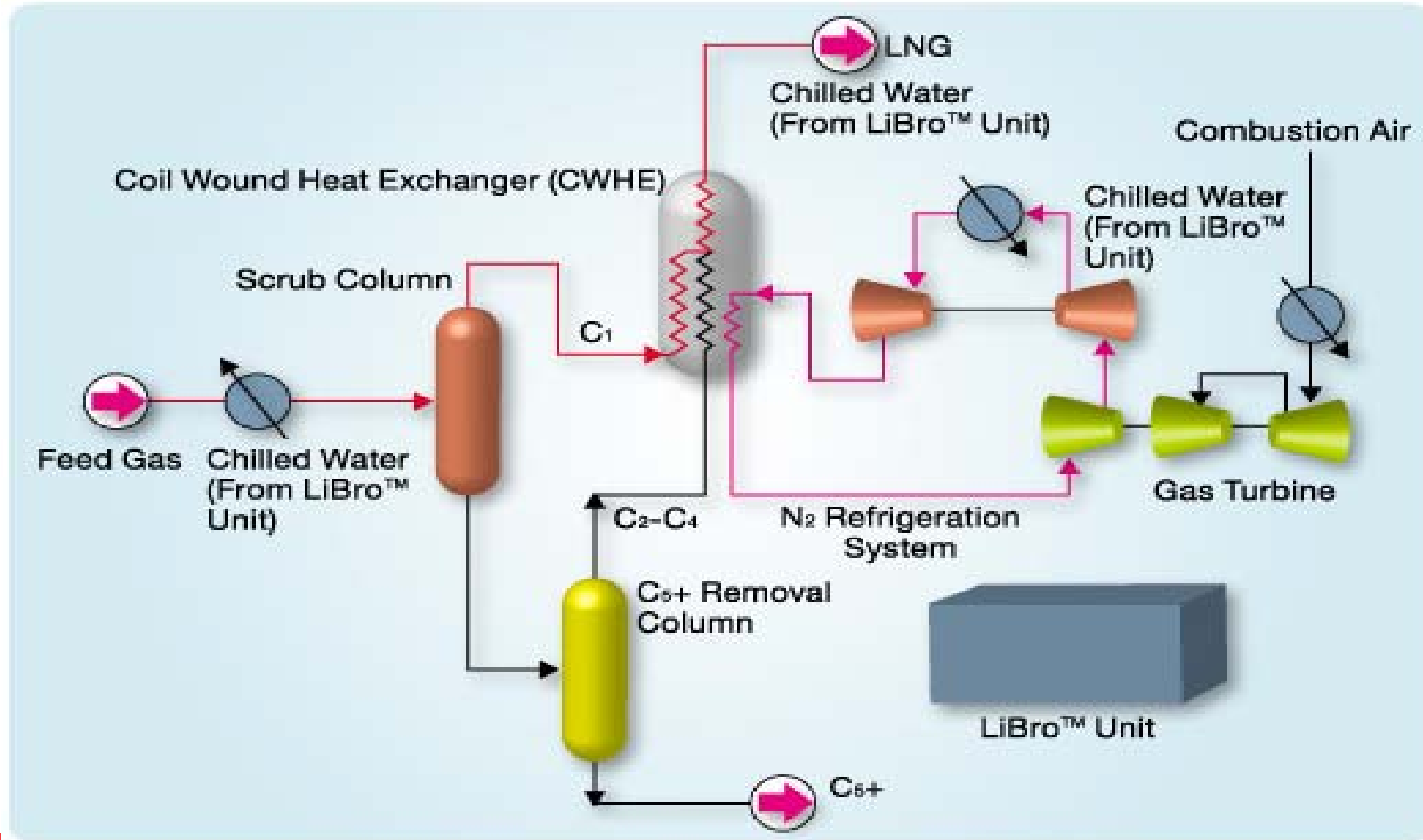
**Chilled
Water**

- ✓ Widely used for centralized air conditioning application on shore
- ✓ Over 10,000 units has been delivered
- ✓ The largest unit applied for LiBro FLNG has been in operation since 2007
- ✓ 20yr + proven operation life
- ✓ **Dynamic motion test was successfully completed**



Flow Schematic

- (Air Products® AP-N LNG Process and the chilled water produced in the LiBro™ unit)



Effectiveness of LiBro™ FLNG Concept

	Large Scale FLNG	Mid Scale FLNG	MODEC LiBro™ FLNG
Typical Capacity	More than 2.5MTPA	Less than 2.0 MTPA	1.0 - 2.0 MTPA
Process	SMR/DMR	Conventional N2 Expander	Air Products® AP-N LNG Process + LiBro™
Safety	Mid	High	High
Production Efficiency	High	Low	High
Topside	Big	Compact	Compact
Hull	Purpose Build	Conventional Ship Design	Conventional Ship Design
CAPE	Mid - High	Low	Low
Availability	Mid	Mid	High



Cost Effectiveness

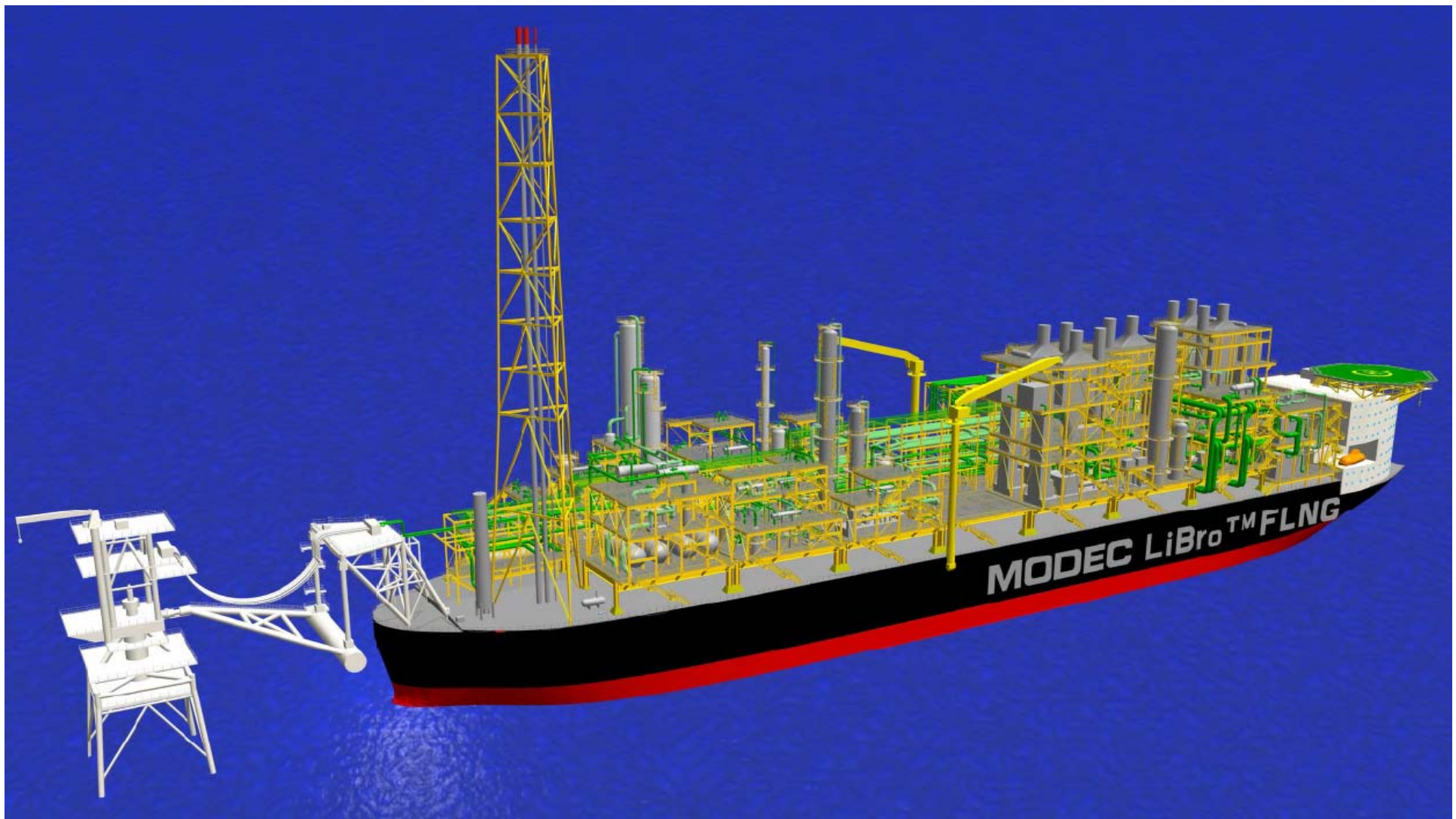
- Utilization of an existing standard hull design
 - ⇔ a purpose designed and built hull, “Fit for Purpose” hull.
- Air Products® AP-N LNG Process
 - ⇒ compact topside design on the limited available deck space.
- Compactness of LiBro™
 - ⇒ can be installed below the gas turbines, not requiring additional deck space
- The turbine inlet air cooling
 - ⇒ can increase power output substantially and resulting in increased turbine output.

FLNG Specification

LNG Production Capacity	2.0 MTPA (nominal)
Liquefaction Technology	Air Products[®] AP-N LNG Process + LiBro[™]
Gas Turbine (Driver/Generator)	PGT25+G4 Aero Derivative Type
Hull	Setouchi-Max : Conversion of Bulk Carrier
Hull Size	291.4 mL x 50 mW x 28.5 mD
LNG Storage Capacity	160,000 m³
LNG Storage Type	SPB Tank (8 nos)
LNG Offloading Method	Side-by-Side
Condensate Storage Capacity	20,000 m³
Mooring System	External (Tower Yoke Type Mooring)



3D Model Snapshots



3D Model Snapshots



Safety

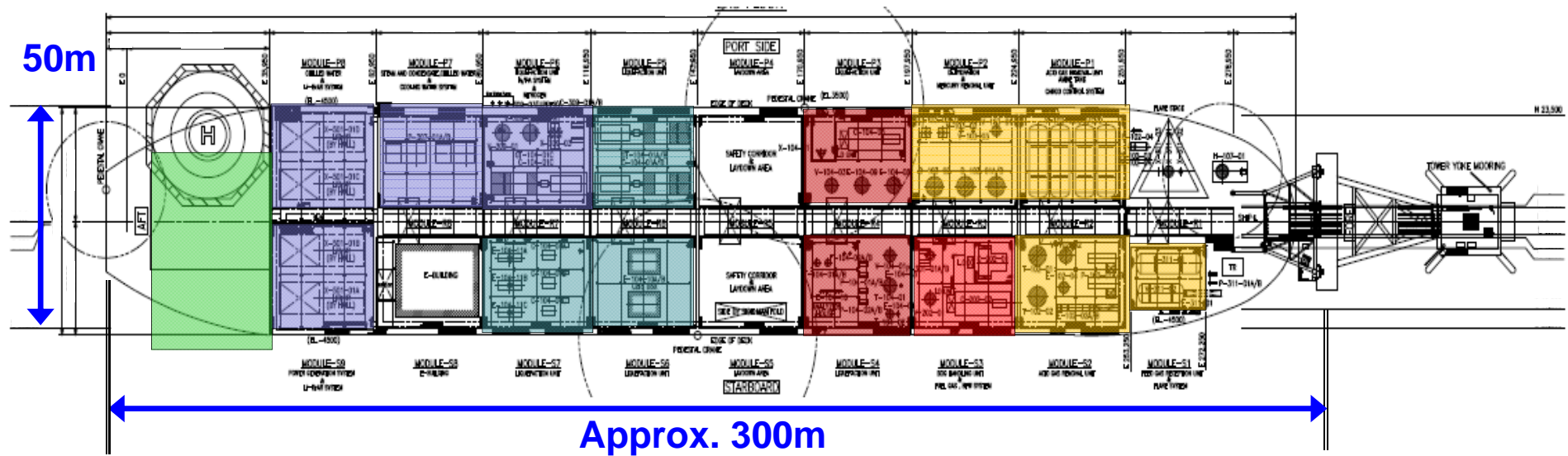
- Non-flammable and non-toxic refrigerant
 - Aqueous solution of Lithium bromide (Li-Br)
 - N₂ refrigerant
- A robust coil wound heat exchanger in the liquefaction system ensures flammable natural gas is double contained.









出典: APCI Homepage

Safety

Topsides Equipment Layout



- | | | |
|---|-----------------------|------------------------|
|  | : NG Pre-treatment | } Flammable |
|  | : Fuel Gas, BOG | |
|  | : NG Liquefaction | |
|  | : N2 Refrigerant | } Non-Flammable |
|  | : Utility(Water, Air) | |
|  | : Living Quarter | |

- 本研究は、一般財団法人 日本海事協会の「業界要望による共同研究スキーム」による支援を受けて実施しました。

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