The latest issues on gas fuelled ship (including New IGF Code)

December 2015

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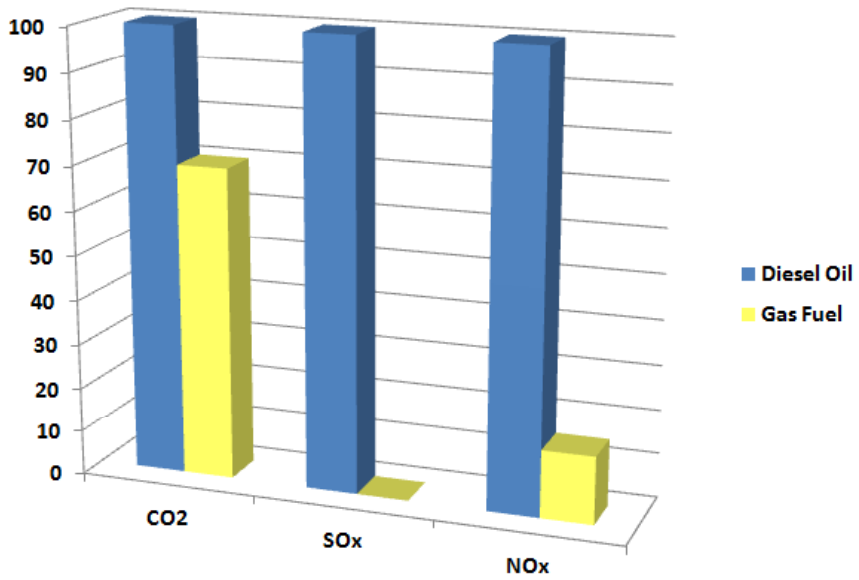
Contents

1. How to decide gas fuelled ship for new shipbuilding ?

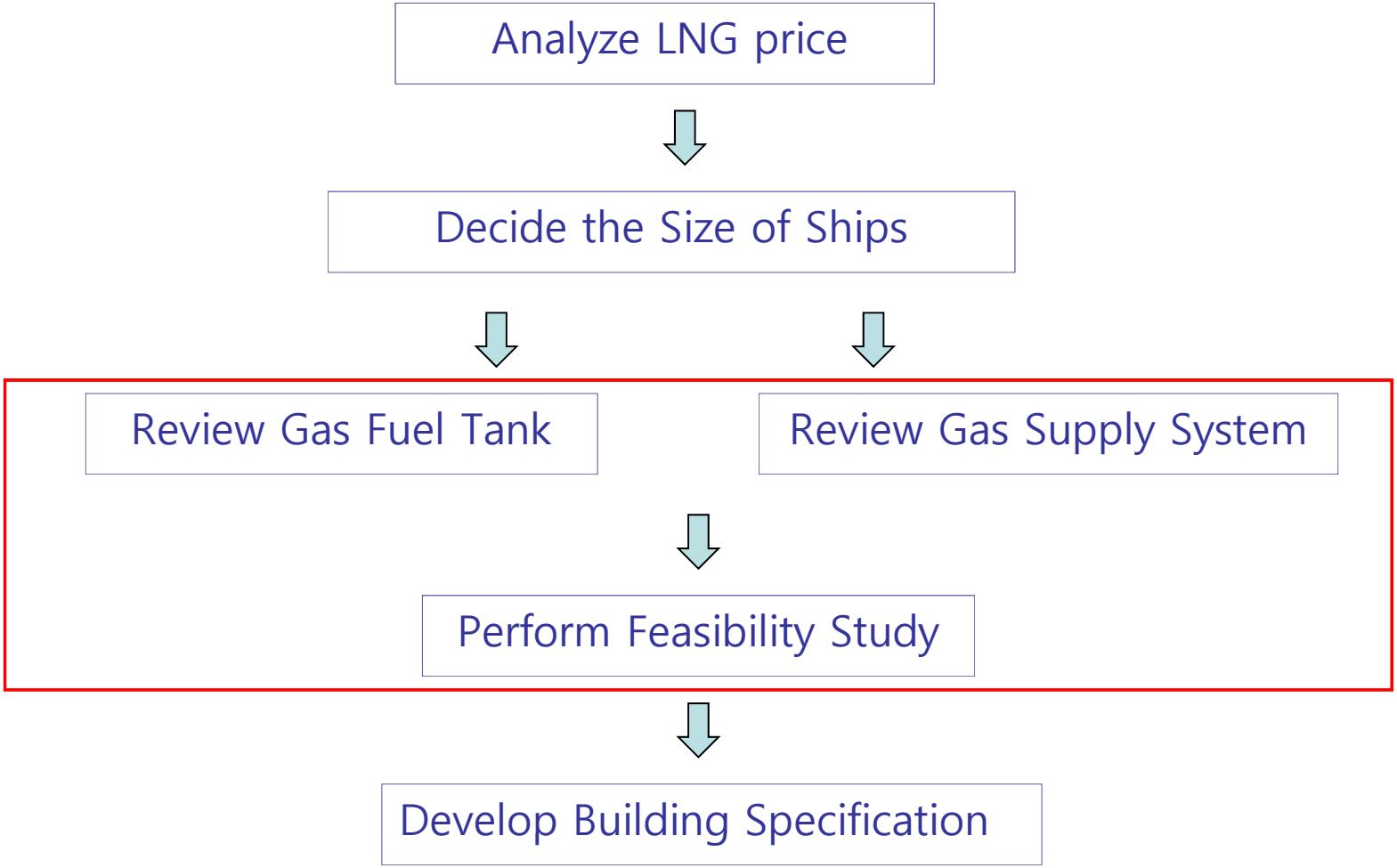
1. Background – Why do we think about gas fuel ?

- CO_2 – Global warming
- SOx & NOx – Make air pollution in the atmosphere.
- IMO prohibits CO_2, SOx and NOx.



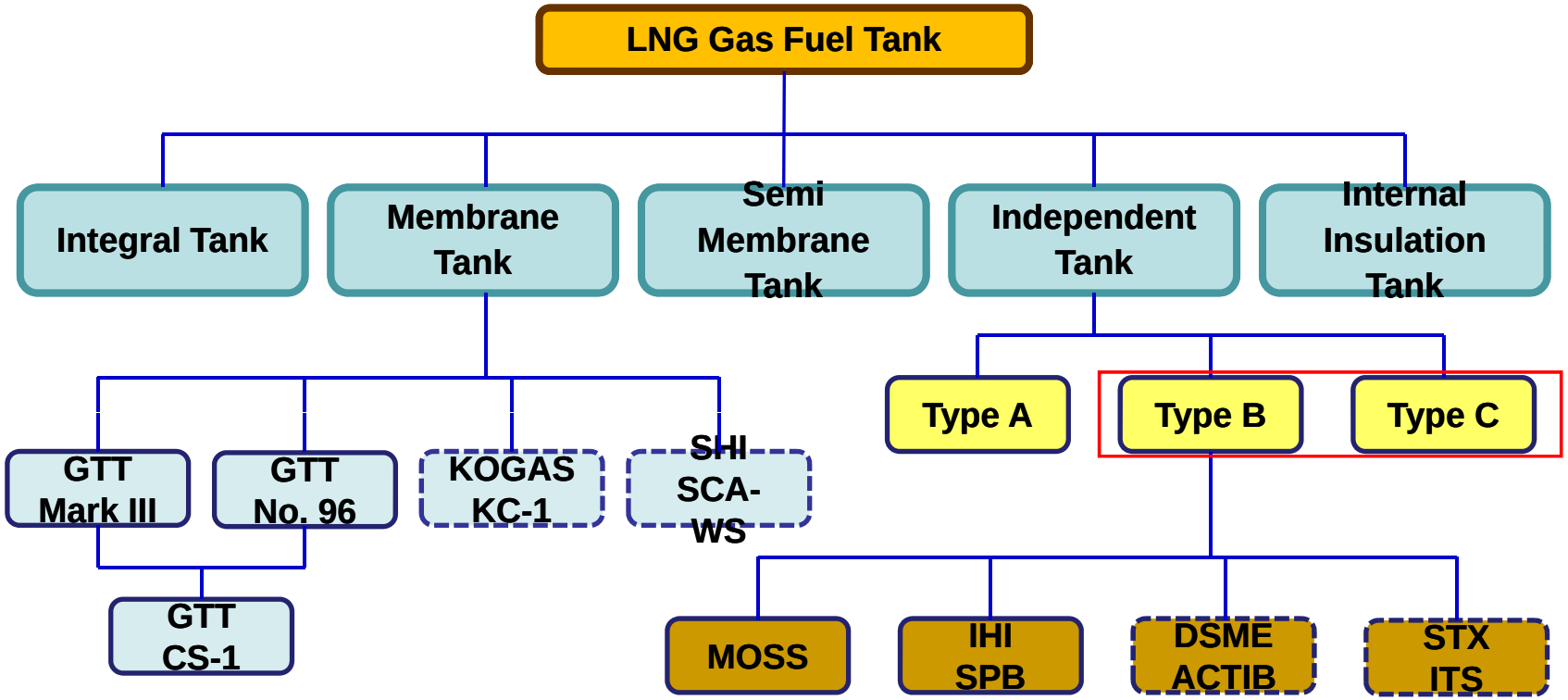
- Shipping industries think an alternative fuel such as gas.

1. How to decide gas fuelled ship for new shipbuilding ?



2. Selection of gas fuel tank

1. Many types of gas fuel tanks (LNG)

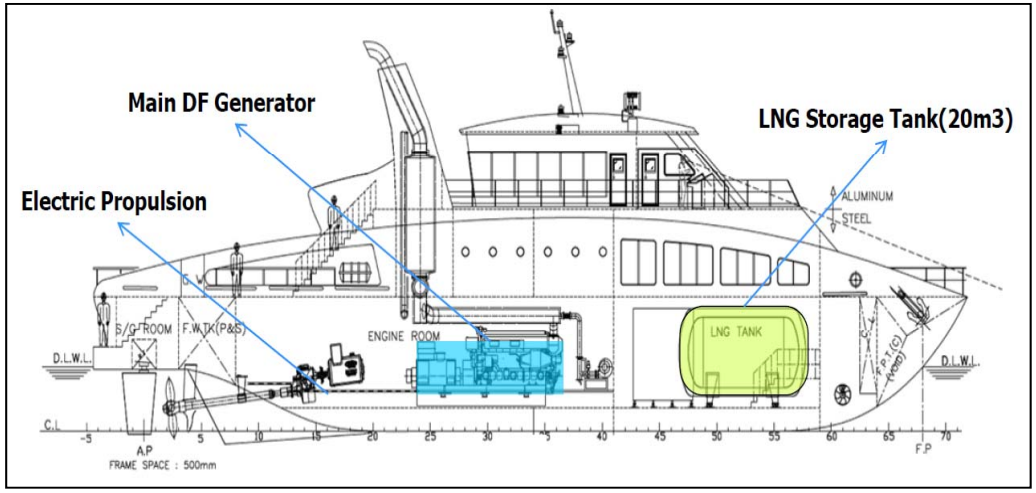


2. Ship owners have interest on independent type C & B tanks.

2. Selection of gas fuel tank

2. Independent tank – Type C & Type B

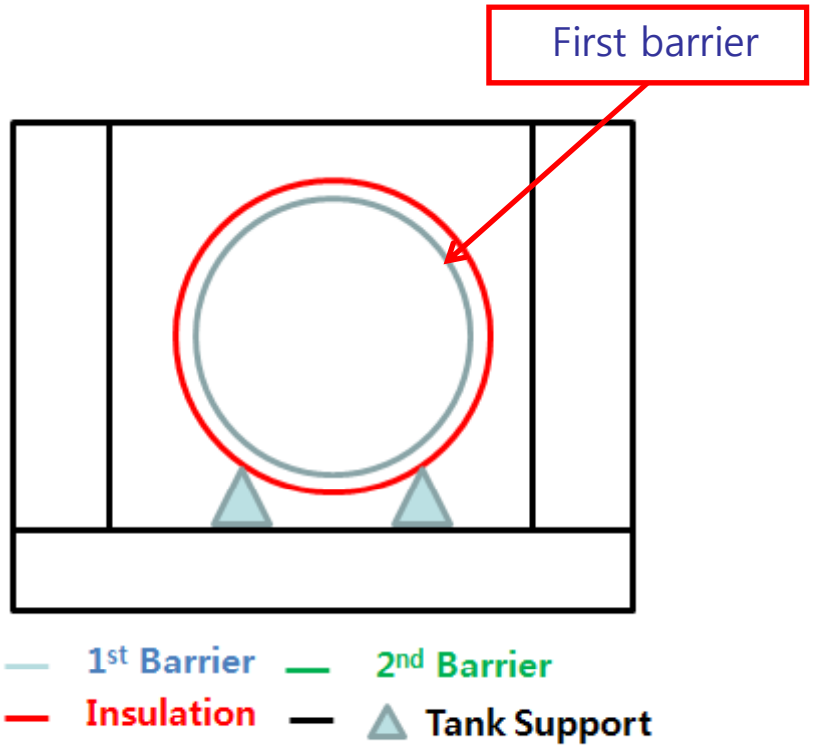
- Independent tanks mean self-supporting tanks which do not form the ship's hull and are not essential to the hull strength.
- All gas fuelled ships (84 vessels) have independent C type tanks so far.



[Source: Samsung Heavy Industries]

2. Selection of gas fuel tank

1. Option 1 - Independent Tank C Type

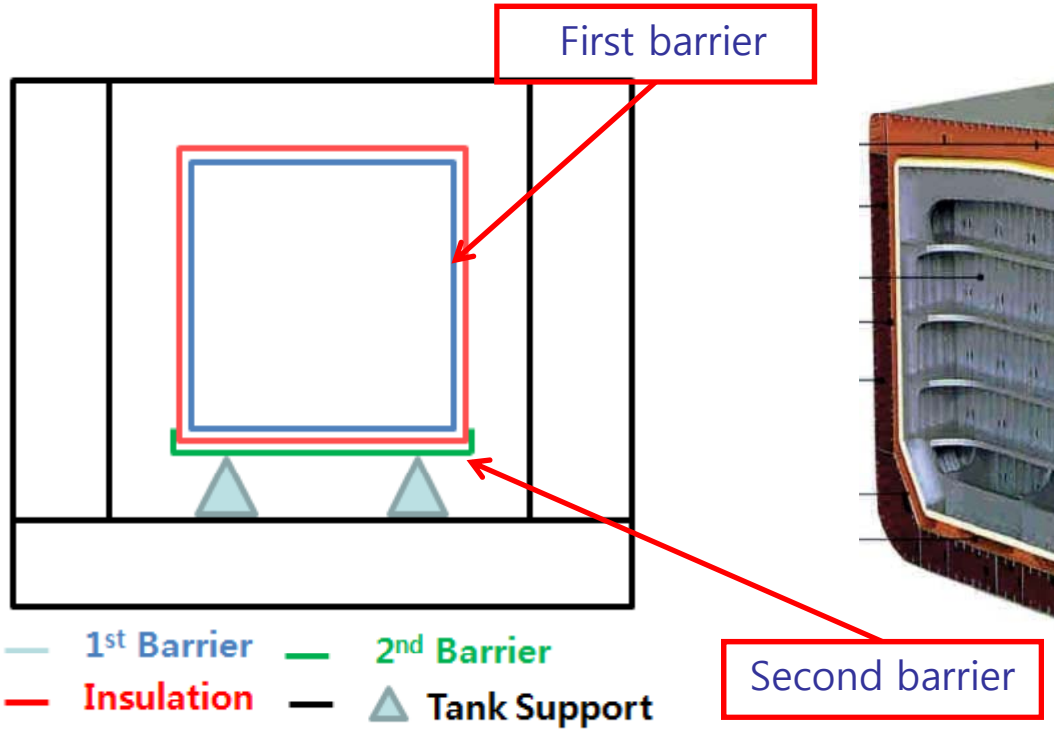


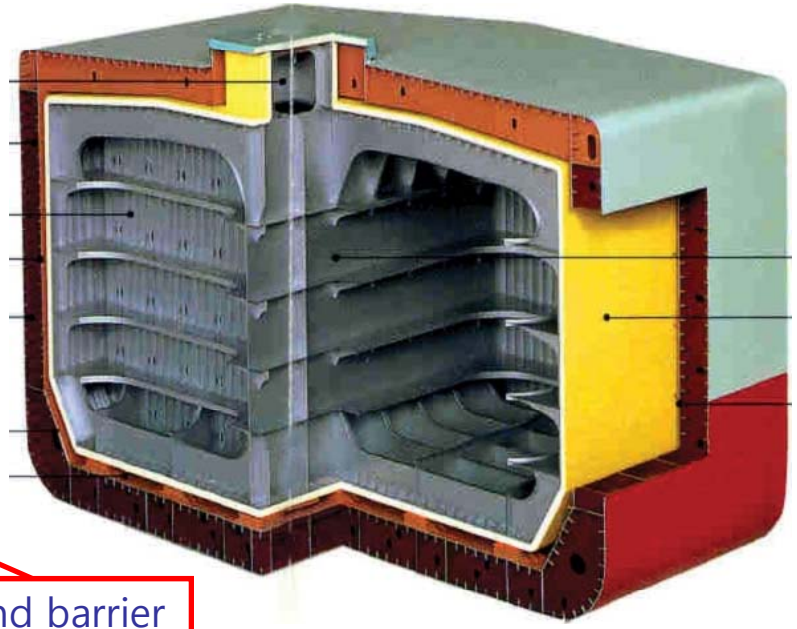
[Source: CRYOS & TGE]

- No secondary barrier is required.

2. Selection of gas fuel tank

2. Option 2 - Independent Tank B Type





[Source : Google]

2. Selection of gas fuel tank

3. Information of Independent tank

	Option 1 – Type C Tank	Option 2 – Type B Tank
Primary Barrier	SUS 304 L	Al 5068 (Aluminum)
Secondary Barrier	No required	Partial barrier
Insulation	Perlite with vacuum	R-PUF (Polyurethane)
Partial loading	Possible	Possible
Space efficiency	Bad	Good
BOR (Vol/day)	0.14 % ~ 0.2 %	0.2 % ~ 0.6 %
Weight	Heavy	Light
Cost to make	Low	High
Total (Weight+Cost)	Good	Medium
Reference	Many	None

- Based on the expense and reference, independent tank C type has been recommended.

* BOR : Boil-off rate

2. Selection of gas fuel tank

4. High Mn Steel developed by South Korea

YS(MPa)	UTS(MPa)	El.(%)
≥400	800~970	≥22

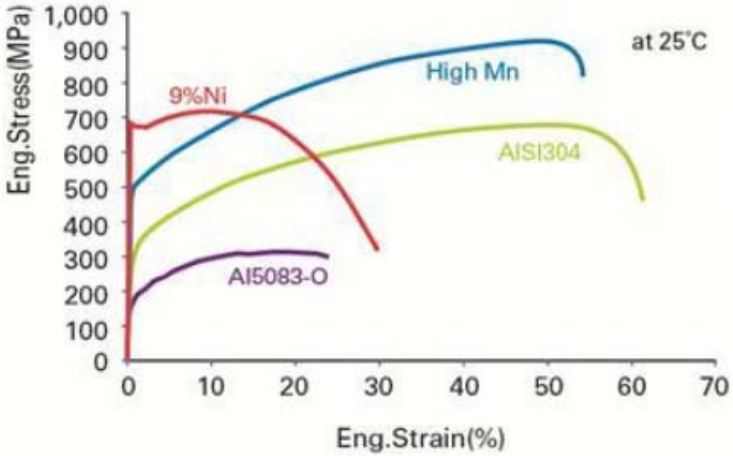


Fig. Strength Curve

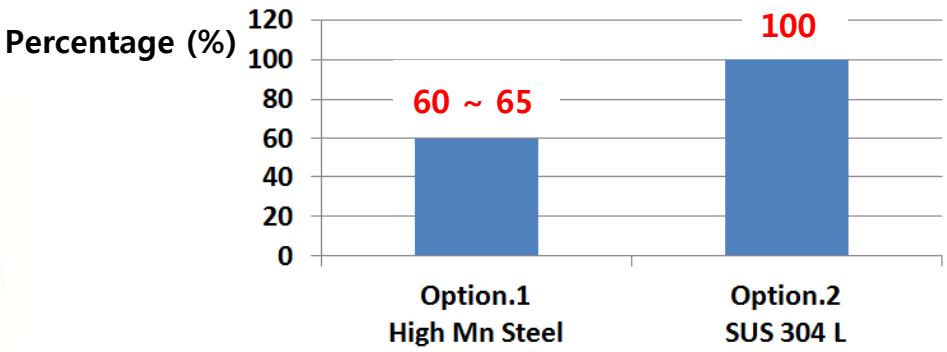


Fig. Expense Comparison

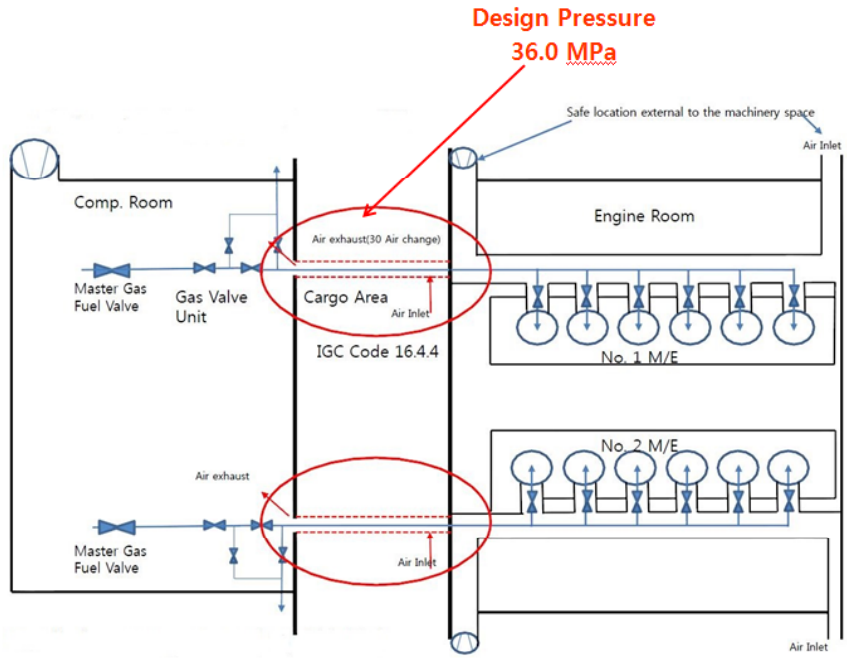
- This material has strength and is inexpensive.

[Source: POSCO]

- KR has developed a standard for this steel and issued the approval cert.

3. Use LNG as fuel

1. New IGF Code Ch.9
2. MAN ME-GI Engine



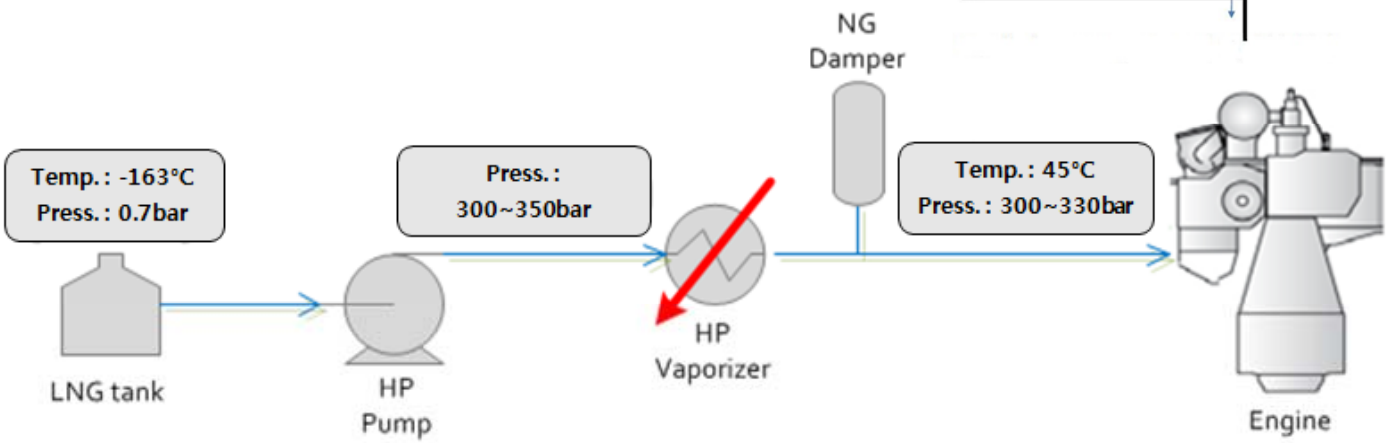


Fig. General Diagram of Gas Supply System

4. Risk assessment (Failure Mode Effect Analysis)

Chapter. 4 General Requirements

4.2.1 A risk assessment shall be conducted to ensure that risks arising from the use of low-flashpoint fuels affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed.

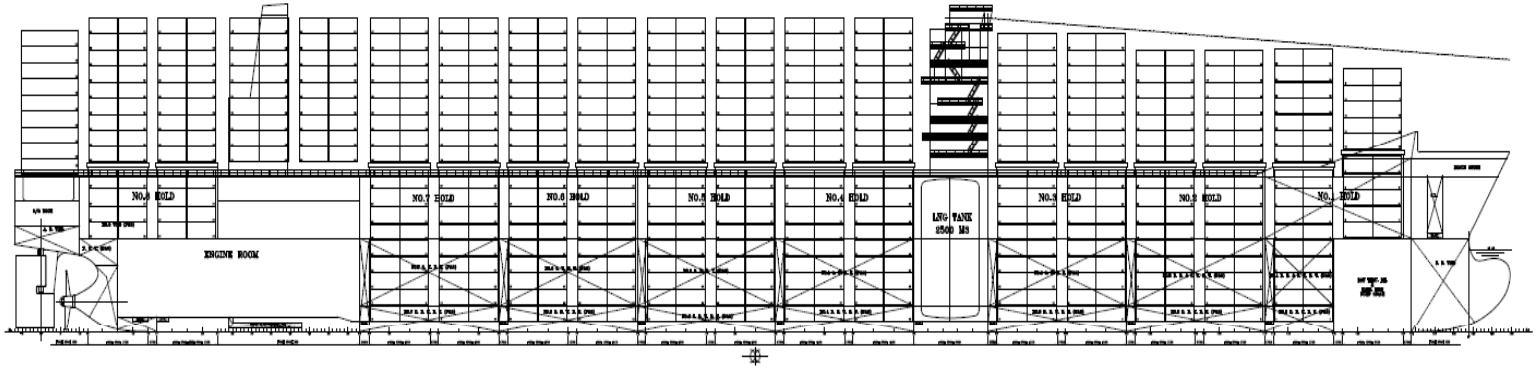
Details of risks, and the means by which they are mitigated, shall be documented to the satisfaction of the Administration*.

This requirement is aligned with IGC Code.

* IEC 60812, Edition 2.0 2006-01 "Analysis techniques for system reliability – Procedure for failure mode and effects analysis(FMEA)"

4. Risk assessment (Failure Mode Effect Analysis)

1. KR carried out a risk assessment in 2012.
2. Target : Ocean going gas fuelled ship
   - Gas fuel tank space
   - Ventilation system
   - Gas supply room
   - Machinery space, etc.



4. Risk assessment (Failure Mode Effect Analysis)

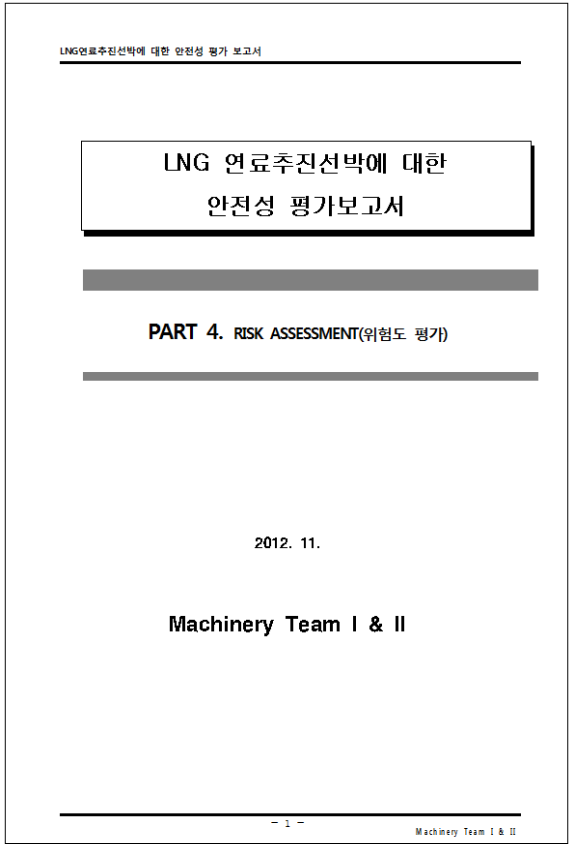
1. Results

Risk ranking	Number of findings
High	**3**
Medium	6
Low	26

2. Finding : 35 cases

3. High risk : 3 cases

- Gas leak in gas supply room
- Gas leak in gas fuel tank space
- Gas leak in gas valve unit room


LNG연료추진선박에 대한 안전성 평가 보고서

LNG 연료추진선박에 대한
안전성 평가보고서

PART 4. RISK ASSESSMENT(위험도 평가)

2012. 11.

Machinery Team I & II

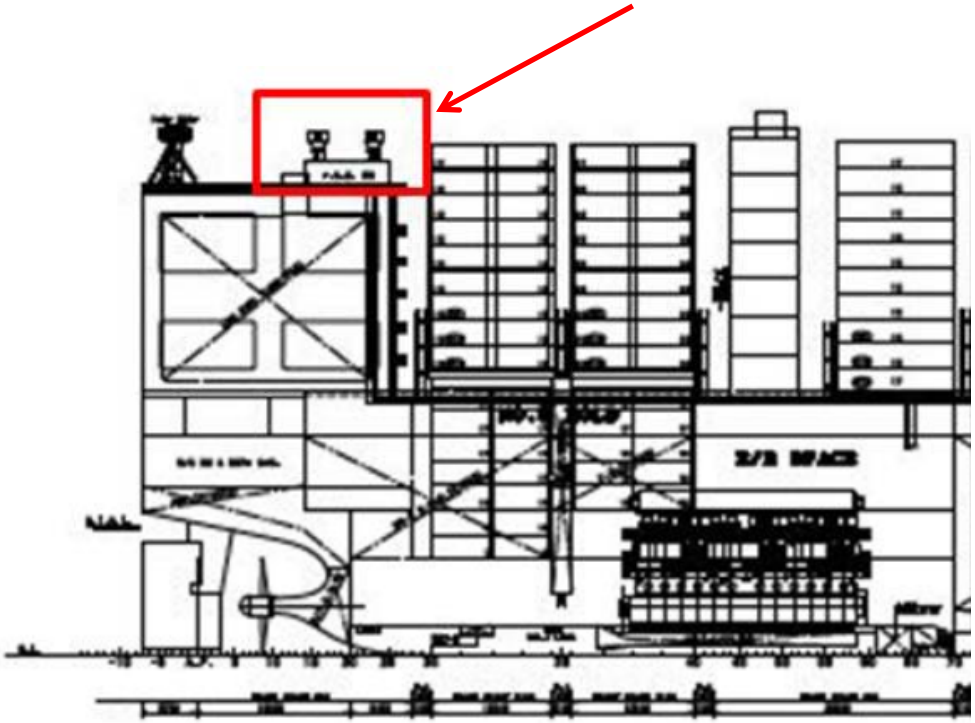
- 1 -

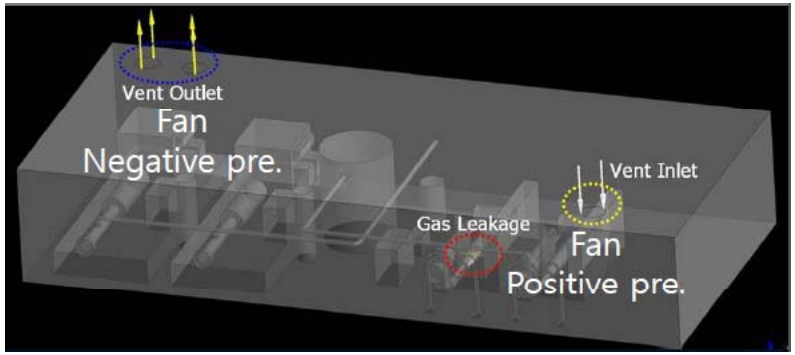
Machinery Team I & II

4. Gas leak and explosion simulation

1. In case of using LNG as fuel

2. Gas leakage/explosion in gas supply/compressor room

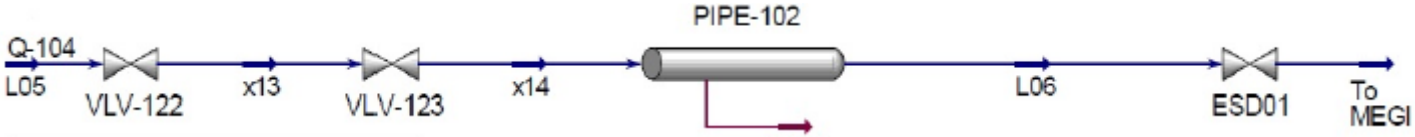




4. Gas leak and explosion simulation

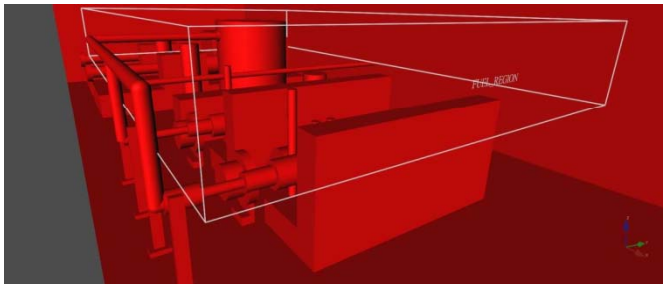
1. Leak conditions of LNG (Pure methane)

- Assuming a leakage at damaged gas supply pipe leading to explosion



2. Modeling Condition

	Leak duration	Gas cloud	Ignition time	Gas press.
Scenario 1	2.1 sec	5.3 kg	0.1 sec	330 bar
Scenario 2	9.6 sec	41 kg		

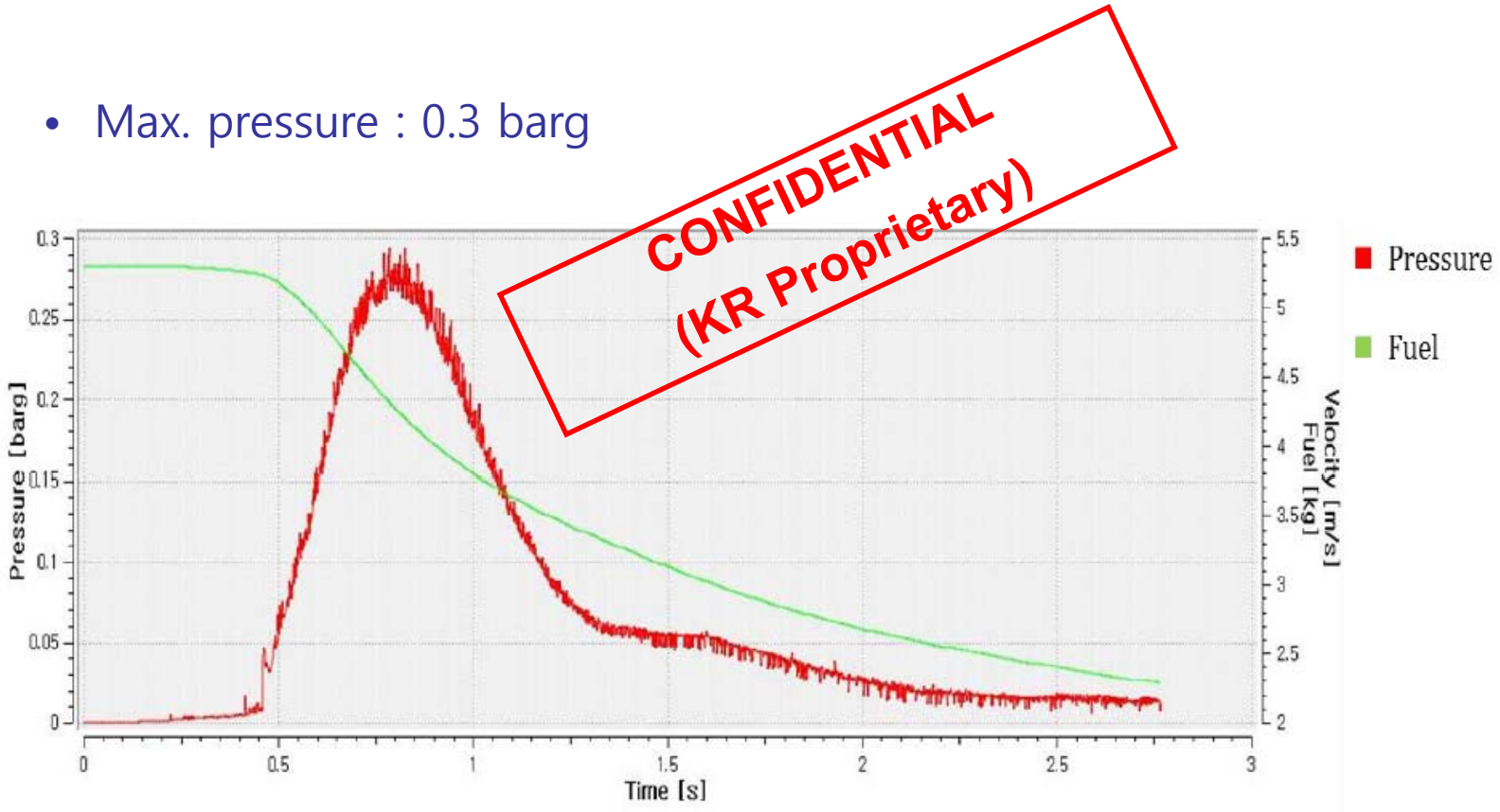


3. Software : Flame Acceleration Simulator (FLACS)

4. Gas leak and explosion simulation

1. Scenario 1

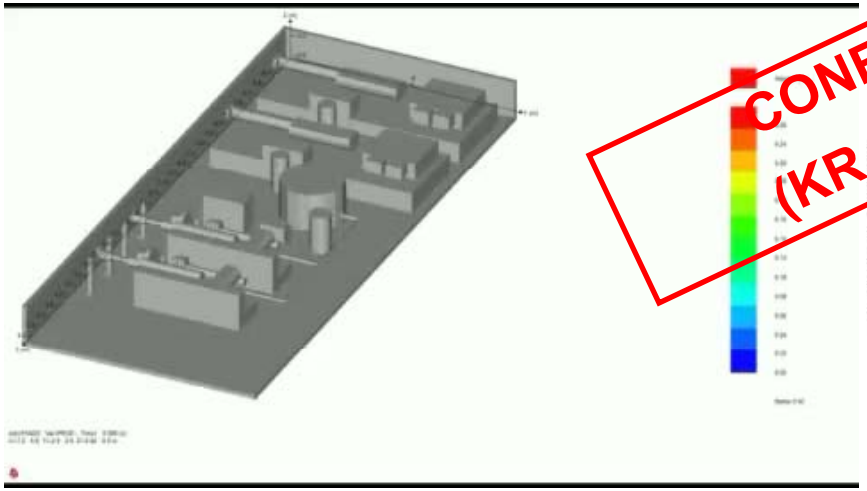
- Max. pressure : 0.3 barg

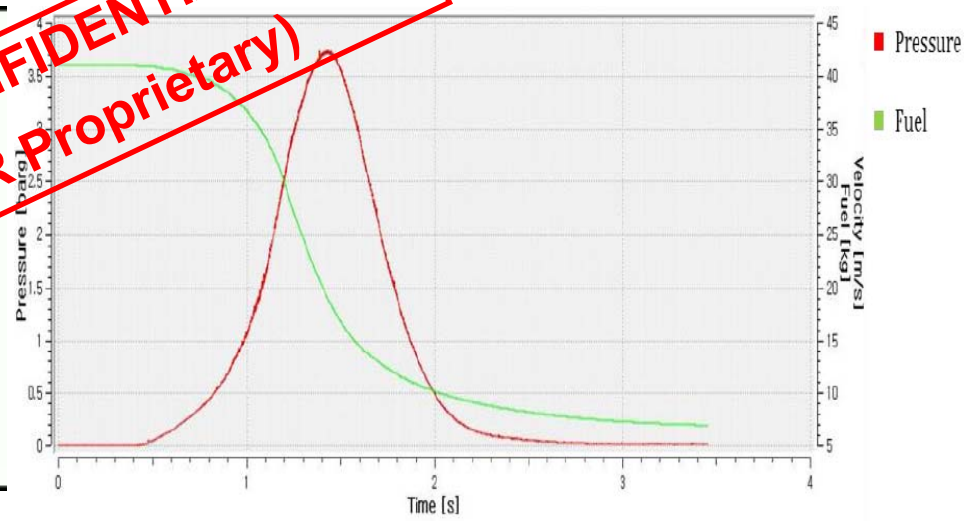


4. Gas leak and explosion simulation

2. Scenario 2

- Max. pressure : about 3.7 barg





- It is quite high value. Anticipate that it may cause severe damage to structure.
- In general, manageable overpressure are thought to be of the order of 1 barg.

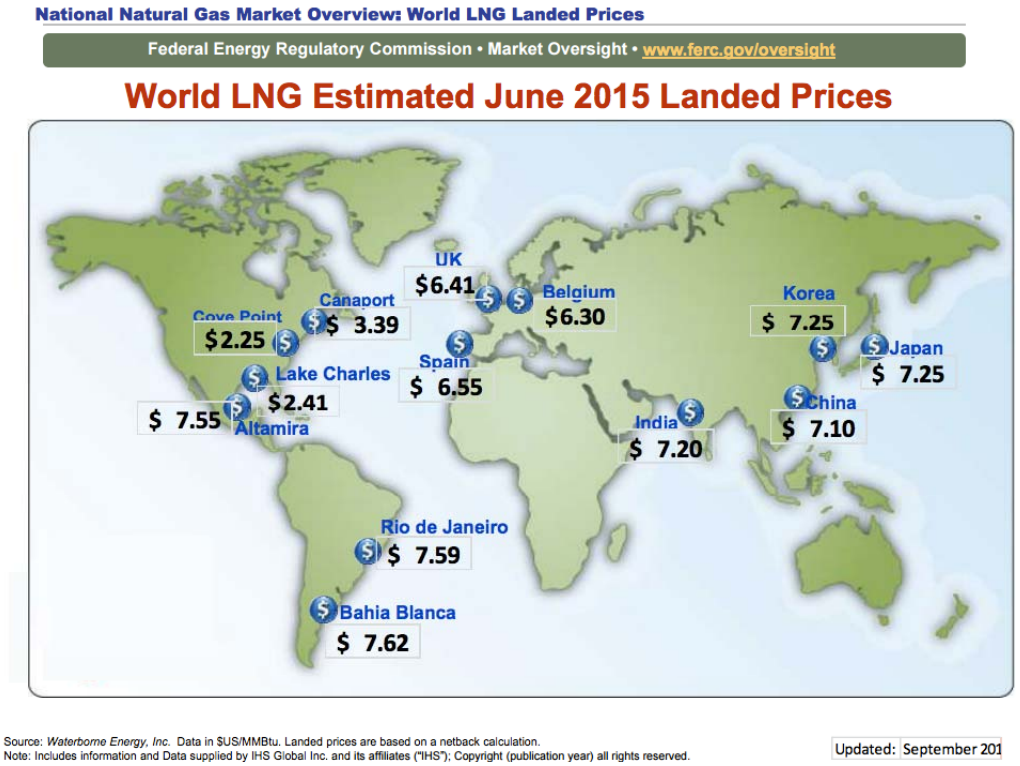
5. Feasibility study

1. 10,000 TEU gas-fuelled container ship

- Operate the vessel at NCR speed (34,700 kW at 21 knots)
- One voyage : abt. 27,000 nautical miles (55 days/voyage)
- Gas fuel tank : abt. 8,000 m^3 / F.O tank : abt. 4,000 m^3

5. Feasibility study

1. Gas price in the world



- Unit : mmbtu (British Thermal Unit)
- C Bunker Oil : 1 ton = Abt. LNG : 41 mmbtu

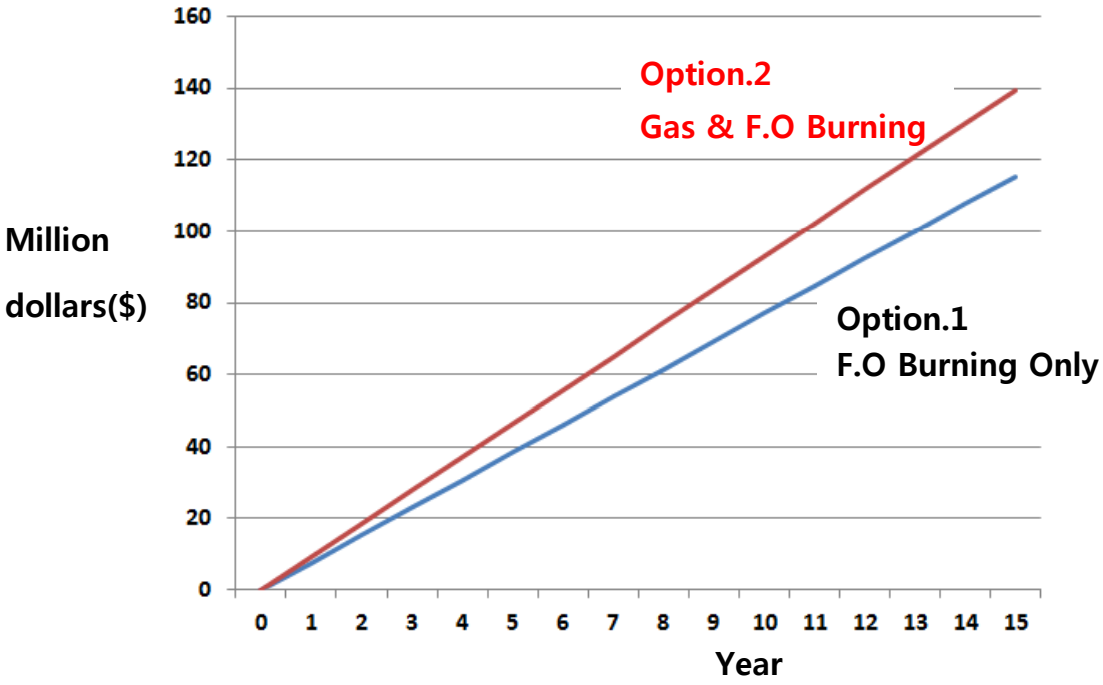
[Source : Waterborne Energy]

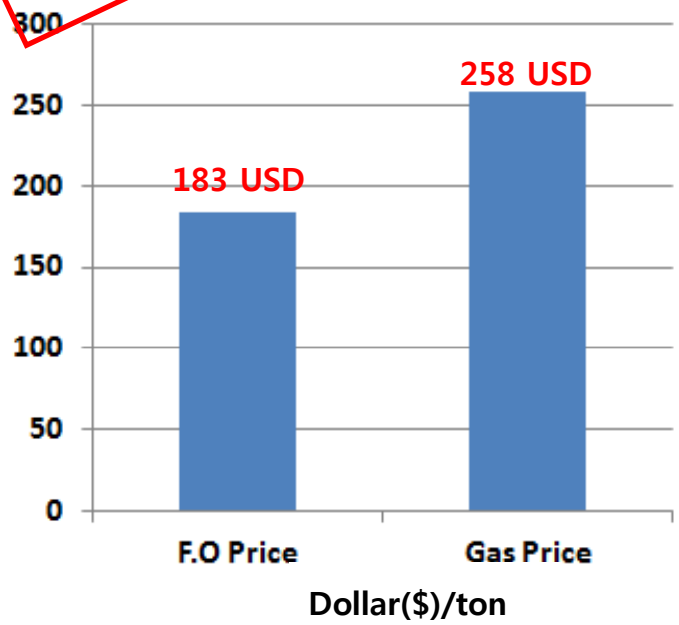
5. Feasibility study

1. Gas price is more expensive than bunker price in these days.

- Comparison of fuel cost for 15 years

* Data used in this calculation has been roughly estimated by KR.

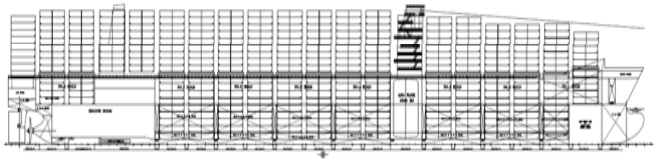




- **However, in the future, we have to use gas fuel because of environmental reasons and gas fuel price.**

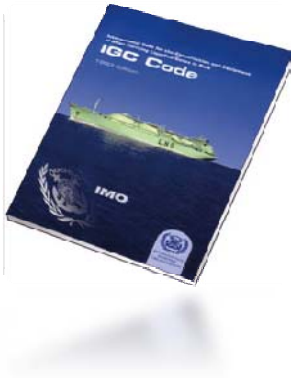
6. Technical services we can provide

1. Help to decide the size of gas fuelled ship.



2. Review gas fuel tank

3. Feasibility study for gas fuelled ship



4. Risk Assessment

5. We can develop the building specification for gas fuelled ship.

Thank you for your attention !