



Environmental Friendly ship including SCR system

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I. Outline of Regasification vessel



Outline of Regasification Vessel-components

Regasification system

- | LNG feed pump
- | High pressure booster pump
- | LNG heat exchanger (vaporizer)
- | Gas metering system
- | Suction drum

Dynamic positioning equipment

- | Thruster
- | DP control system

Offshore discharge system

- | Submerged turret system
- | Reinforced C.C.S design for partial filling



II. Environmental restriction of North America



Environmental restriction of North America



Air Emission

Minimized pollutant (NOx) to air (from ship)

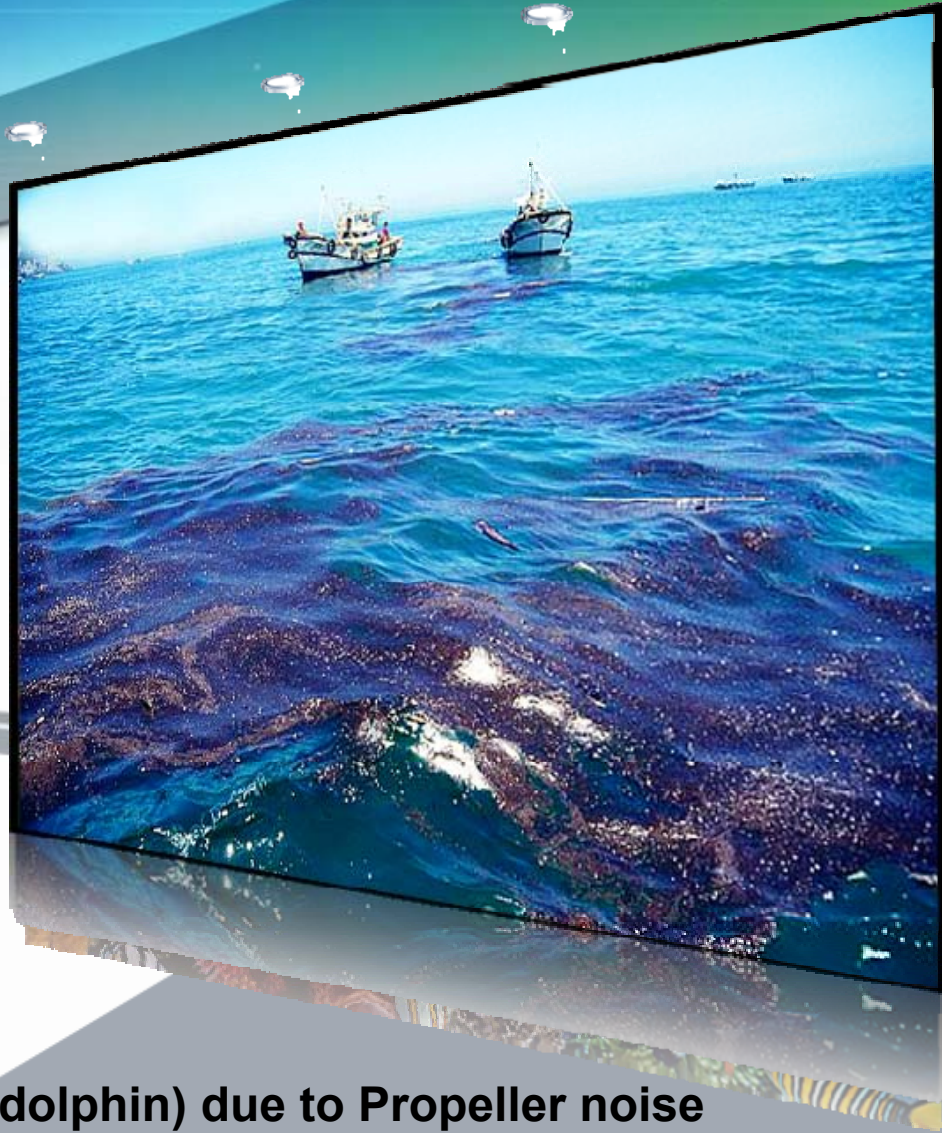
Environmental restriction of North America



Emission To Sea

- No sea water usage for re-gas operation
- No cooling sea water discharge
- No overboard rain water contaminated by oils (on deck)

Environmental restriction of North America



Protection of sea life

! The effect on sea animals (dolphin) due to Propeller noise

Environmental restriction of North America



No Toxic Paint

! Biocide free antifouling



III. Introduction of Eco-SRV

Project outline

Item	Design Condition
Trading Route	Trinidad – Boston (abt. 2016 NM)
Discharge port	Massachusetts Bay (Supplementing the Everett terminal)
Operating Schedule	2009, 4Q
Regas capacity	Max. 750 MMscf/day
Discharge time	4 ~ 6 days (based on 145,000 CBM LNGC)
Building Schedule	S/C : 2008, 1Q D/L : 2009, 4Q



Everett



IV. Environment Friendly Design & Criteria

Regas plant

High Pressure LNG

NG

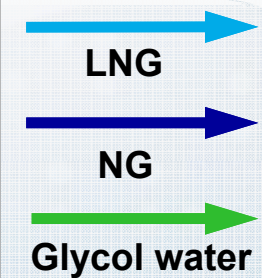
LNG/Glycol-water heat exchanger
(Shell & Tube type)

Glycol-water/steam heat exchanger
(PCHE type)

Glycol water

Glycol-water system

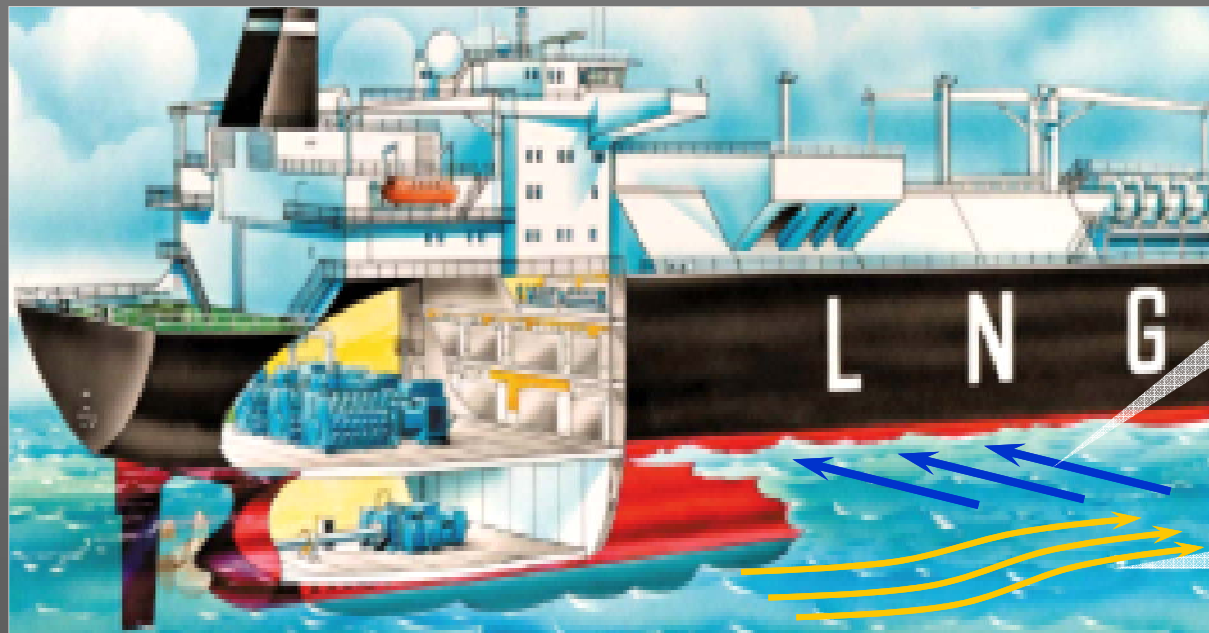
LNG Booster Pump
(High Pressure Pump)



No Sea water discharge & minimum intake

Sea water intake : **below 1,100 m³/h**
Sea water discharge : **Zero**

**Sea water recirculation
by water ballast tank**



Conduction from
outside sea water

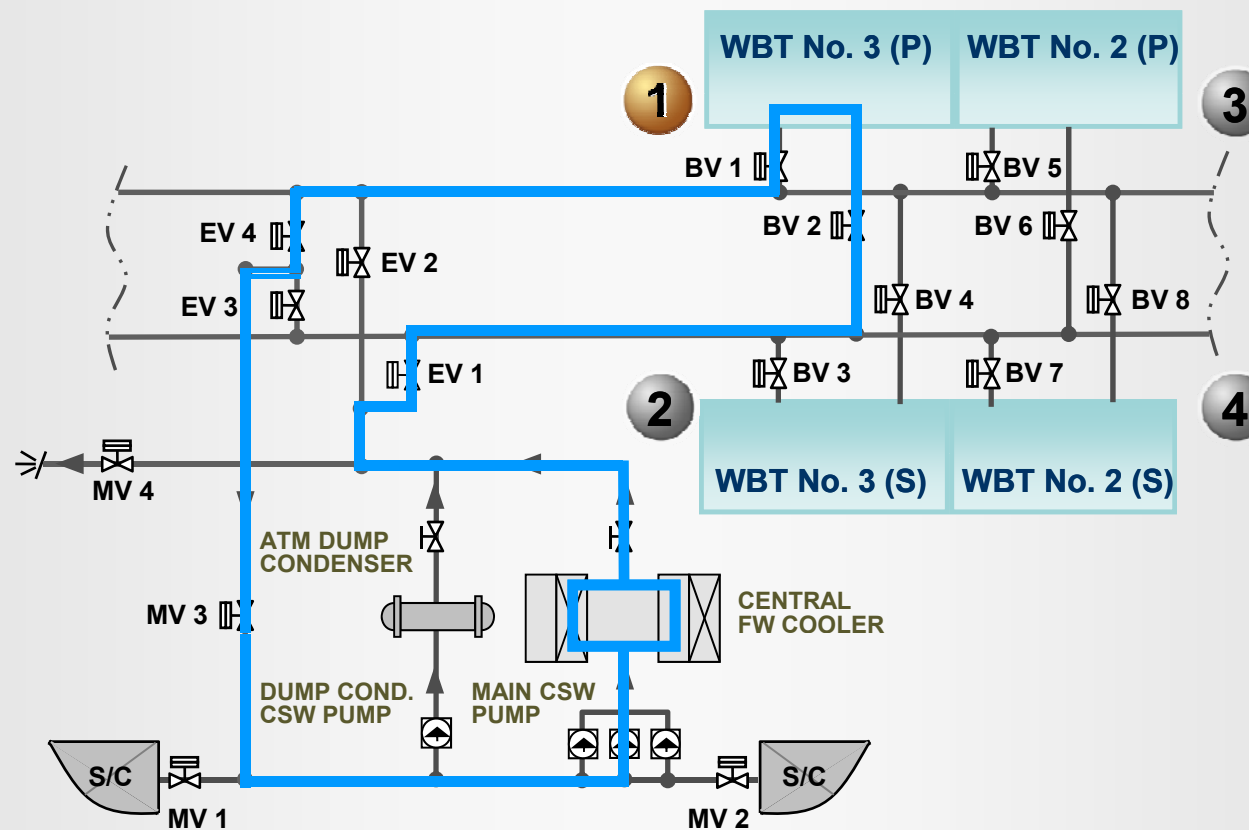
Forced convection
by current

Sea water recirculation concept

- Conduction from outside sea water to Ballast tanks
- Forced convection by current
- Change tank heated by machinery cooling system into tank cooled by conduction and forced convection

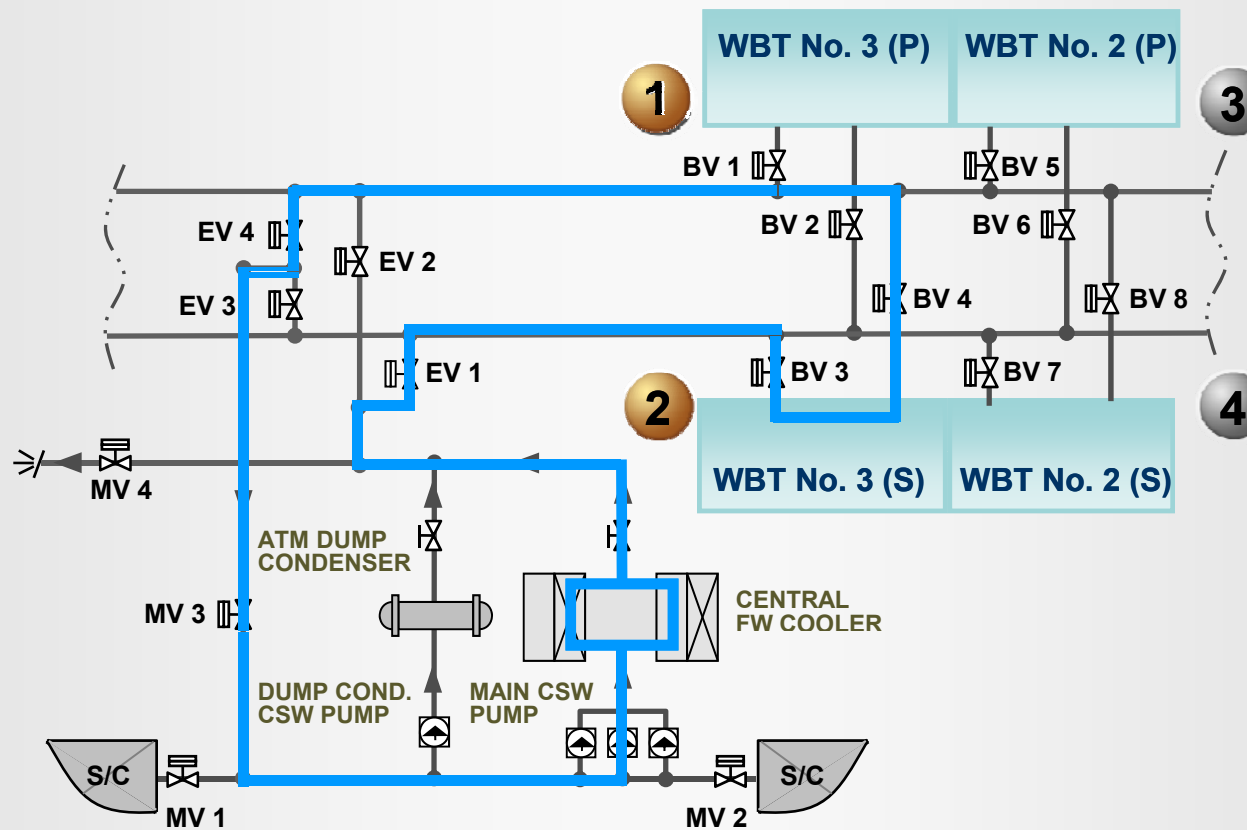
No Sea water discharge & minimum intake

- All S.W. to be filled to ballast tanks up to ballasting limit
- Cooling S.W. **recirculation using ballast water**
- Continuous recirculation up to max. design temperature of cooling system
- Changing the used WBT in turn (1 → 2 → 3 → 4 → 1 → **Repetition**)



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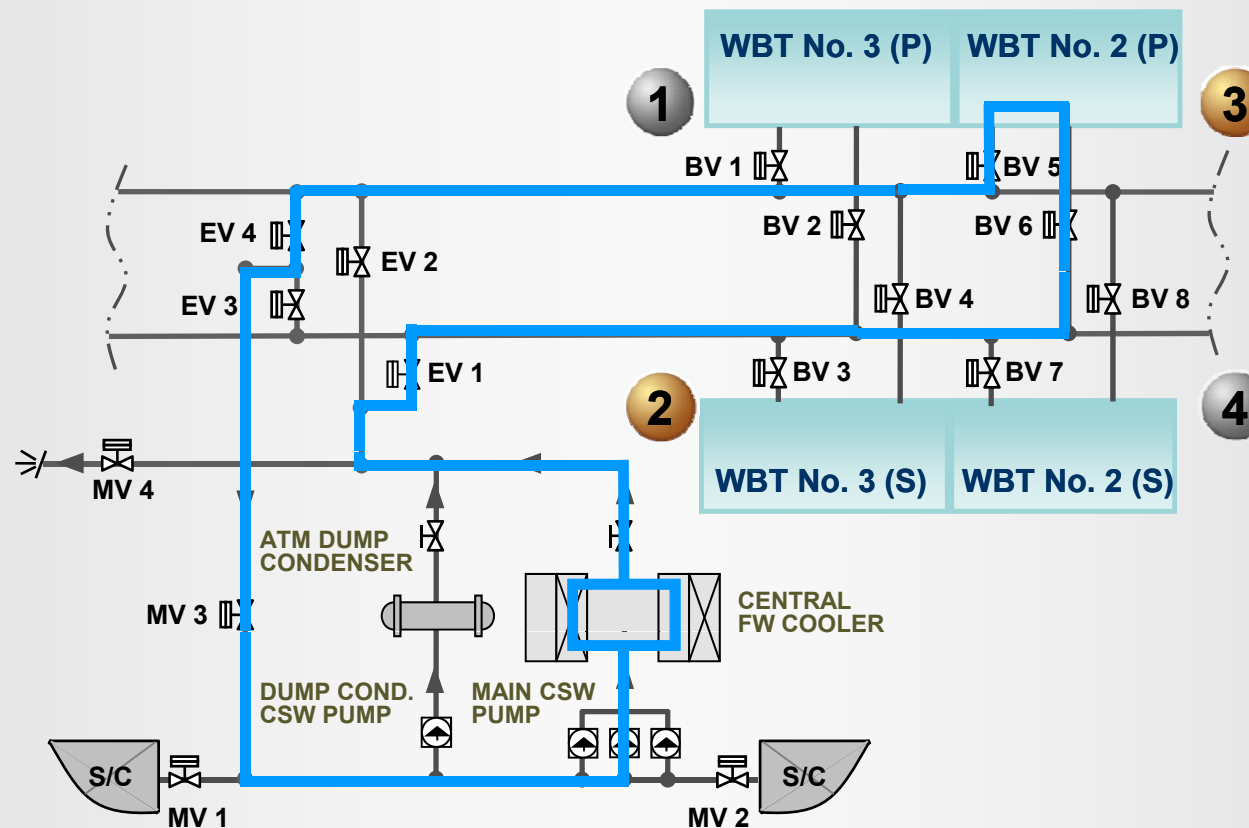


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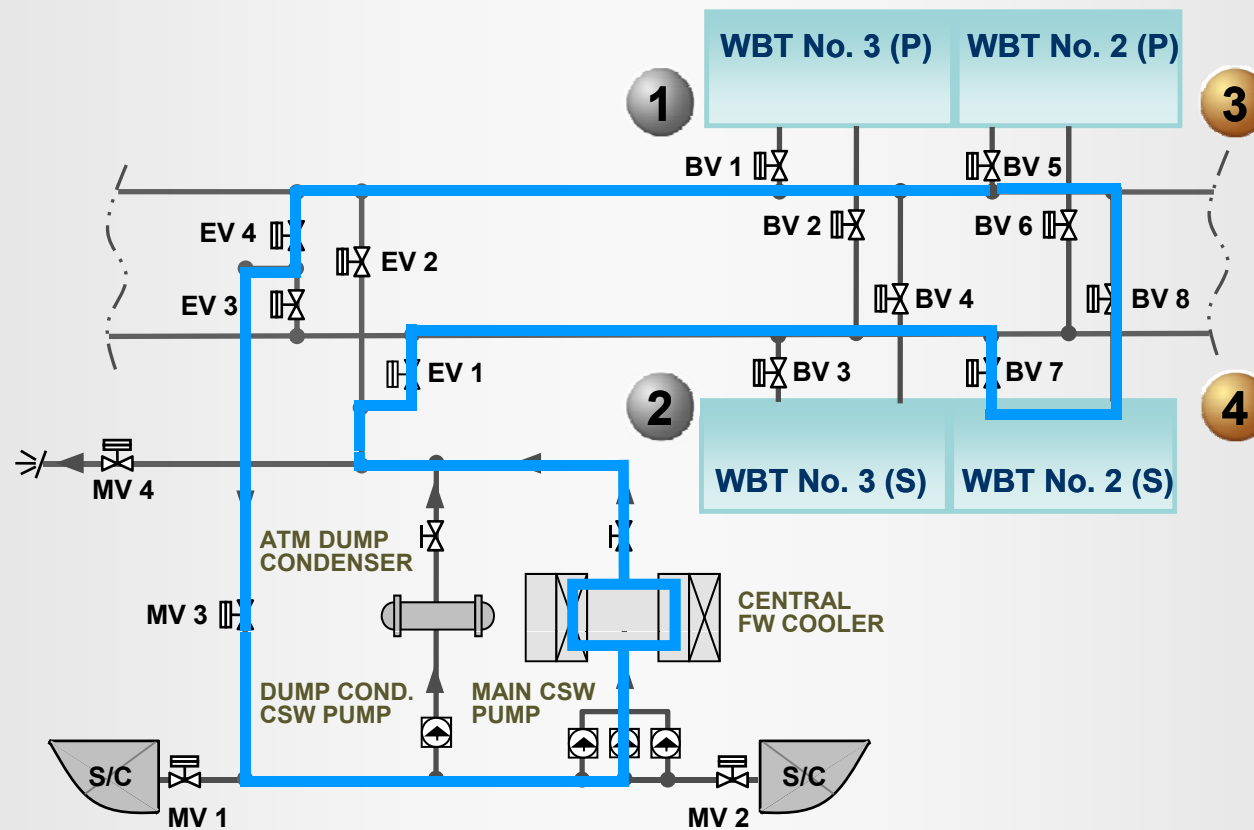
The diagram illustrates a cooling water recirculation system. At the top, four ballast tanks (WBTs) are arranged in a 2x2 grid, labeled 1, 2, 3, and 4. WBTs 1 and 3 are marked with a 'P' (Pump), while WBTs 2 and 4 are marked with an 'S' (Sump). The tanks are connected by a network of pipes and valves. A blue line traces a clockwise path: from WBT 1 (P) through valve BV 1 to WBT 2 (S), then through valve BV 3 to WBT 3 (P), then through valve BV 5 to WBT 4 (S), and finally through valve BV 7 back to WBT 1 (P). This path is part of a larger system that includes a central freshwater (FW) cooler, a main cooling water (CSW) pump, a dump condenser CSW pump, and an atmospheric dump condenser. The system also features several other valves (EV 1, EV 2, EV 3, EV 4, BV 2, BV 4, BV 6, BV 8) and manual valves (MV 1, MV 2, MV 3, MV 4). The diagram shows how the system can recirculate cooling water without discharging it into the sea, by continuously cycling through the four WBTs.

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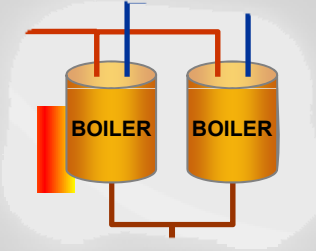
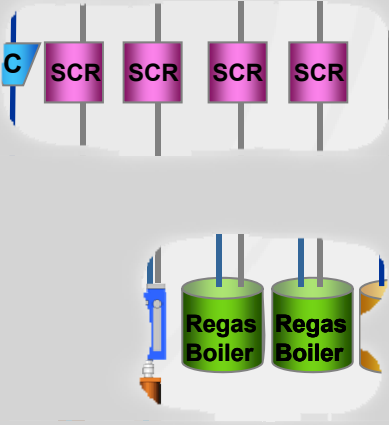


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Special arr't for NOx reduction

Item	Conventional LNG RV (Existing)	Eco-SRV
Main equipment	1 Steam turbine 2 Main Boilers 2 Turbo Gen. Sets 1 Diesel Gen. Sets	4 DF Engine 2 Regas Boilers 1 GCU
SCR Unit	-	4 sets
Diagram	 <p>The diagram shows two yellow cylindrical vessels labeled 'BOILER'. They are connected by a network of red and blue lines representing pipes. A red vertical bar is positioned to the left of the first boiler.</p>	 <p>The diagram is divided into two sections. The top section shows four purple rectangular units labeled 'SCR' arranged in a row, with a blue 'C' in a triangle to the left. The bottom section shows two green cylindrical vessels labeled 'Regas Boiler' connected by blue and yellow piping.</p>

SCR operation and NOx reduction

Conventional LNG Carrier



Eco-SRV



Application of Silicone based foul release system

I Characteristics

- Ultra-smooth, slippery surface
- Eco-friendly and non-toxic paint
- Benefit for fuel consumption



Application of Silicone based foul release system

| Protection of Environment



**Quantity of
released biocide**

Abt 90kg/month



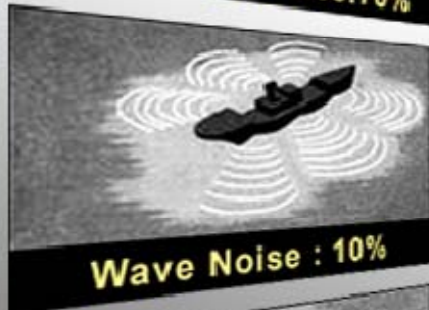
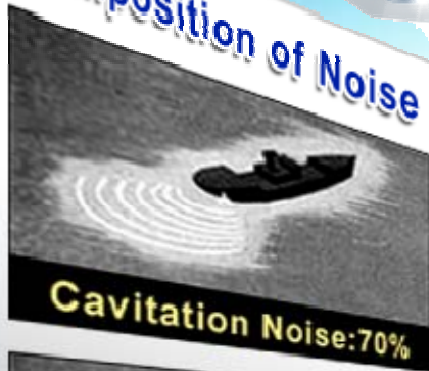
None!

Environmental impacts by underwater noise emission

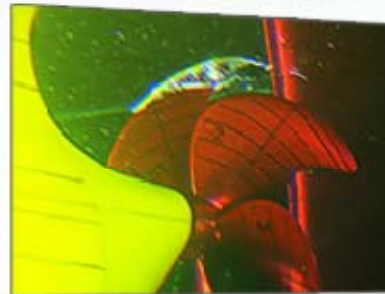


Analysis & Measurement focused on Cavitation Noise

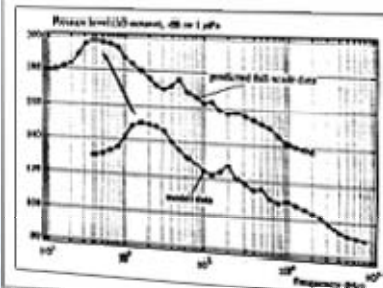
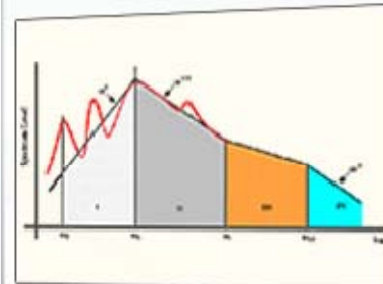
Composition of Noise



Model Scale Measurement

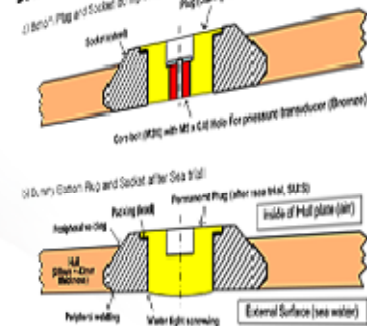


Full Scale Noise Prediction



Full Scale Measurement

Bottom plug system for full ship measurement



Equipments for full ship measurement



SHI has experience for analysis & measurement of cavitation noise (delivered LNGC)

Noise performance verification

NMFS (National Marine Fisheries Service – NOAA's Fisheries Service) has established guidelines for what constitutes harassment and acoustic takes on marine mammals under the Marine Mammal Protection Act (MMPA) and the Endangered Species ACT (ESA).

Two levels of harassment have been defined in the MMPA :

LEVEL A : the potential to injure a marine mammal in the wild

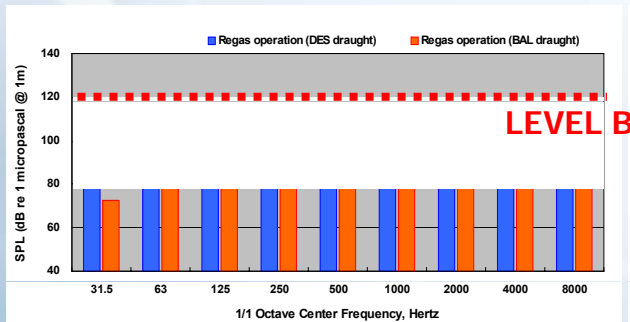
180 dB_{RMS} re 1 µPa

LEVEL B : the potential to disturb a marine mammal in the wild by causing disruption of behavioral patterns, including, but not limited to migration, breathing, nursing, breeding, feeding, or sheltering

160 dB_{RMS} re 1 µPa (impulse)

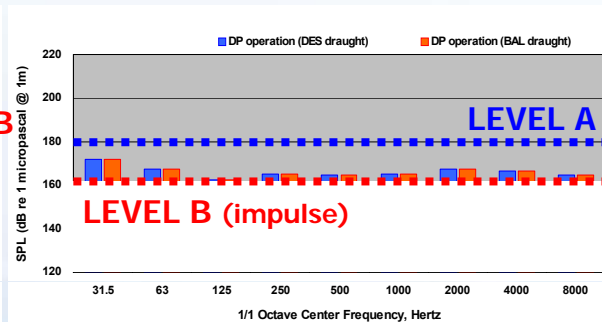
120 dB_{RMS} re 1 µPa (continuous)

* Based on 1/3 octave band analysis



Regas operation

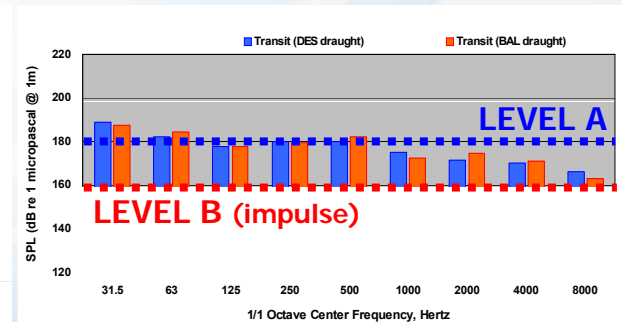
- Main G/E : 55% x 2



DP operation

- Thruster : 80% loading

However,
thrusters will intermittently be operated
in use at 60% of maximum load.



Transit

- 19.70(D) / 19.96(B) knots

However,
vessel speed will gradually be reduced
near shore. Actual noise was not exceed
LEVEL B at regas trial.

Special Sea chest design



Conventional LNG Carrier

Sea chest suction speed : **1.5** m/sec



Eco SRV !

Sea chest suction speed : **0.15** m/sec



Thank you