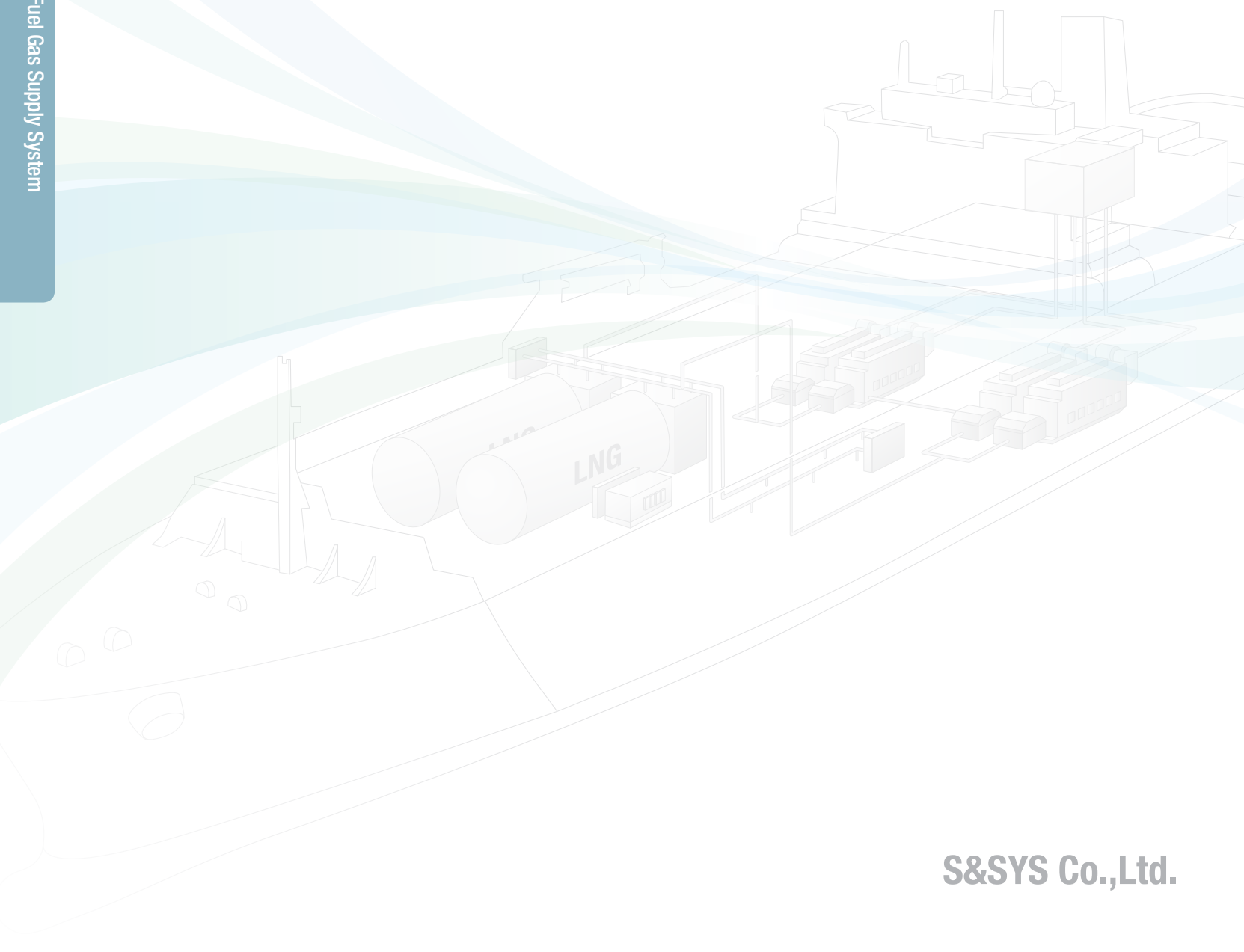


PURIGAS™

Fuel Gas Supply System



PURIGAS™

PURIGAS™ is the package solution for Fuel Gas Storage and Supply System(FGSS). It is named after S&SYS's Ballast Water Management System, PURIMAR™, means **PUR**e and Intel-ligent **GAS** storage and supply system.

Since FGSS is the most effective solution for IMO's SOx, NOx and GHG emissions restriction, a lot of ship owners consider the FGSS solution although CAPEX and installation space are heavy obstacles to adapt FGSS solution.

To solve this obstacles, PURIGAS™ has been developed from the accumulated technology for LNG related equipment and engineering capability of S&SYS and Samsung Heavy Industries(SHI). Based on S&SYS's proven technology and know-how, PURIGAS™ will provide the most economical solution and the most reliable package system to our valuable customer with low CAPEX & OPEX in any type of engine ME-GI, X-DF and DFDE.



“EcoNuri”

- > The first LNG fuelled ship in Asia
- > Delivered at the end of 2012
- > L.O.A : 38.0m, L.B.P : 34.0m, Breath : 8.0m, Depth : 4.6m, Draft : 2.2m
- > Displacement : 382 TON, Gross Tonnage : Abt. 200 G/T
- > Main engine : Wartsila 9L20DF, 1584kW
- > LNG storage tank : 20m³ X 1EA, IMO Type-C tank, Double shell
- > Tank room located at the end of LNG storage tank with vaporizer

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- Manufacturing & test facilities
- Quality Management System & HSE
- Global network services

System Configuration _6_7

- Flow diagram for ME-GI engine
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- Flow diagram for DFDE for small vessel
- Equipments for PURIGAS™

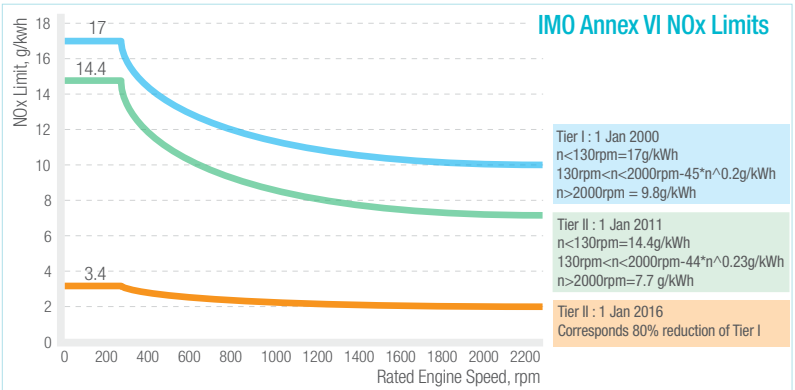
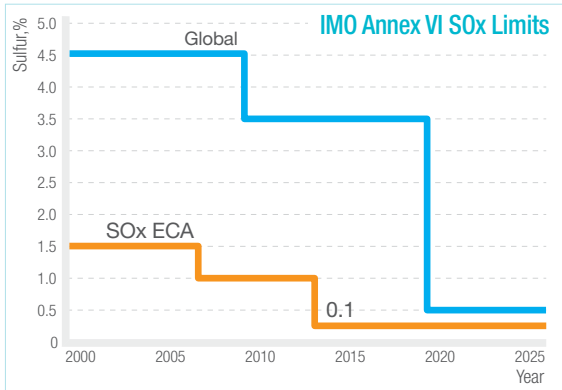
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- Bunkering Station
- Type-C LNG Storage Tank
- Cold Box for small sized Tank
- Vaporizer
- Control & Monitoring Mimic

PURIGAS™ Global Network _10

Background of Environmental Issue

International Maritime Regulations

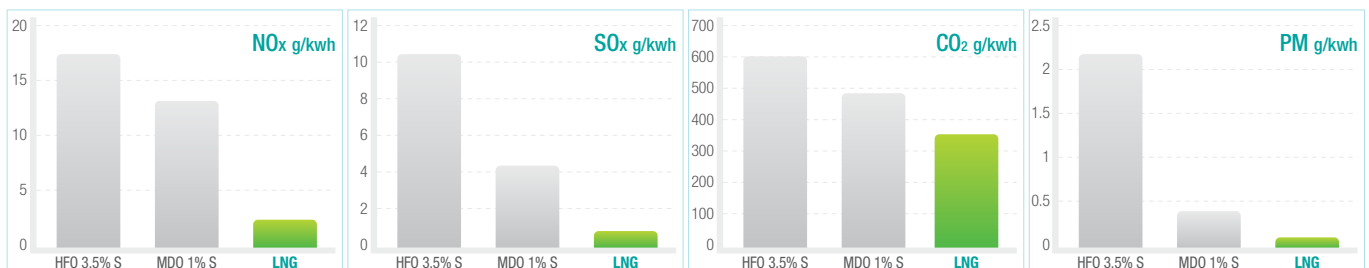


Area		Come into force	Limit of SOx	Limit of NOx
In ECA (Existing)	• North American ECA, US and Canadian coast	- 1st Jan. 2015	1,000 ppm (0.1%)	Tier III (Aftertreatment-forcing) 1st Jan. 2016 ~
	• US Caribbean ECA, Puerto Rico & the US Virgin Islands	- 1st Jan. 2015	1,000 ppm (0.1%)	
	• North American ECA, US and Canadian coast	- 1st Jan. 2015	1,000 ppm (0.1%)	
Global ECA	• China ECA, including 11 ports	- 1st Jan. 2019	5,000 ppm (0.5%)	Tier II (Engine-based controls) 1st Jan. 2011 ~
	• HongKong, all ocean (Local)	- 1st Jan. 2019	5,000 ppm (0.5%)	
	• Australia, Sydney	- 1st Jan. 2020	5,000 ppm (0.5%)	

IMO strategy on Reduction of GHG

LEVEL OF AMBITION	TIMELINE
Carbon intensity of ships to decline - Strengthening of EEDI requirements for new ships Carbon intensity of shipping to decline - 40% reduction per transport work by 2030 relative to 2008 - 70% reduction per transport work by 2050 relative to 2008 GHG emission from shipping to decline - 50% reduction of GHG emissions by 2050 relative to 2008	Short-term measures : 2018~2023 - EEDI (Energy Efficiency Design Index) improvement - Speed regulation - Methane slip regulation - VOC regulation - SEEMP improvement (Ship Energy Efficiency Management Plan) Mid-term measures : 2023~2050 - Low carbon/Zero carbon fuels introduction - Operational energy efficiency requirement - Market based measures Long-term measures : 2050~ - Zero carbon /fossil-free fuels for 2050 and later

Emission Performance by Fuel Type



Why S&SYS PURIGAS™?

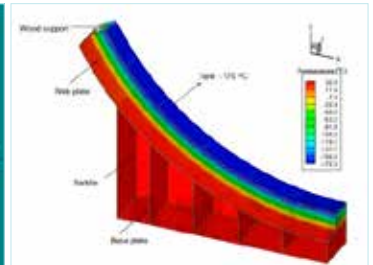
» Proven technology(Reference)

- Successful delivery of Fuel gas storage and Supply System(FGSS) for Eco-Nuri
- Pre-cooling Mixed Refrigerant tank for Shell Prelude FLNG project
- ME-GI engine test bed in HSD(DOOSAN) engine factory
- FGSS Control system for AET A-Max. Tanker
- AIP(Approval In Principle) for AET A-Max. Tanker FGSS with SHI(Samsung Heavy Industries)



» R&D capability

- FGSS Skid Structure & Piping with supports design
- FGSS Piping stress analysis
- FGSS Structure analysis
- FGSS Control system design
- Failure mode & effect analysis
- HAZID & HAZOP



» Manufacturing & test facilities

- Manufacturing factory
- Test facilities
- Training center



» Quality Management System & HSE

- ISO 9001
- ISO 45001 & 14001

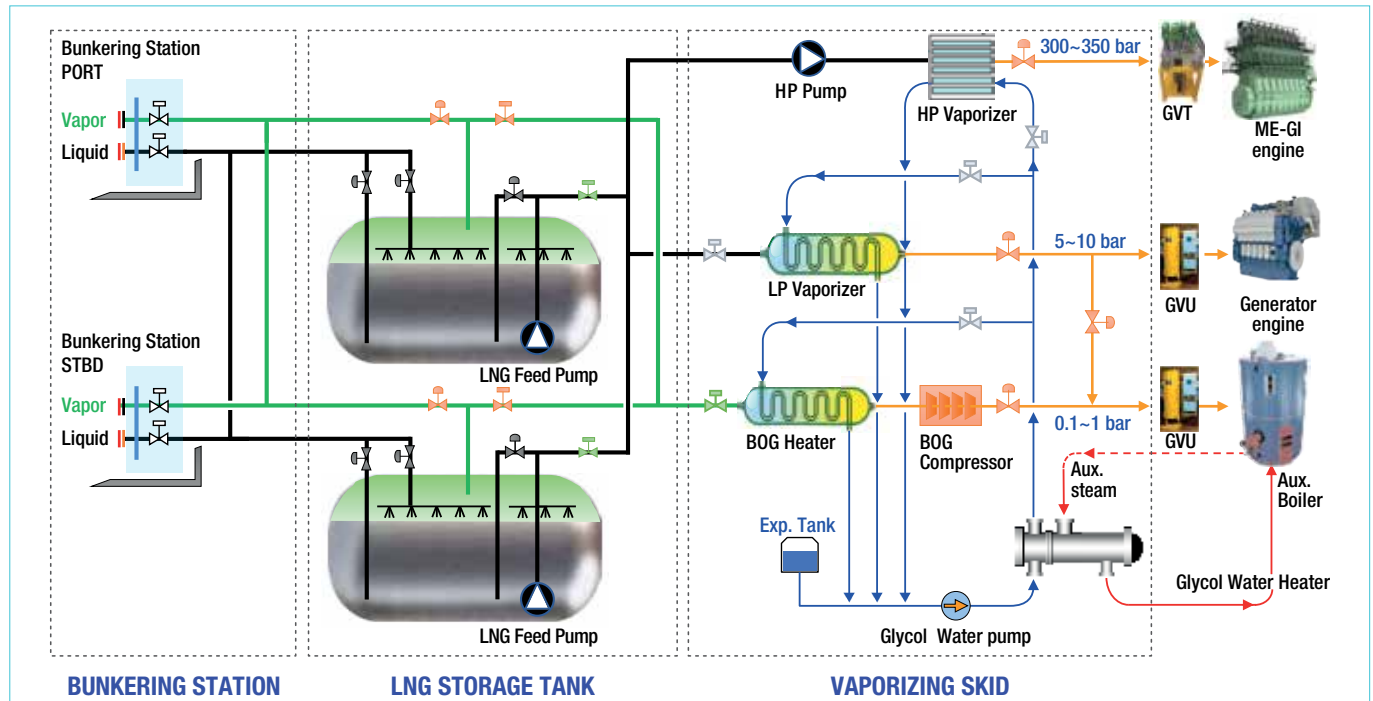


» Global network services

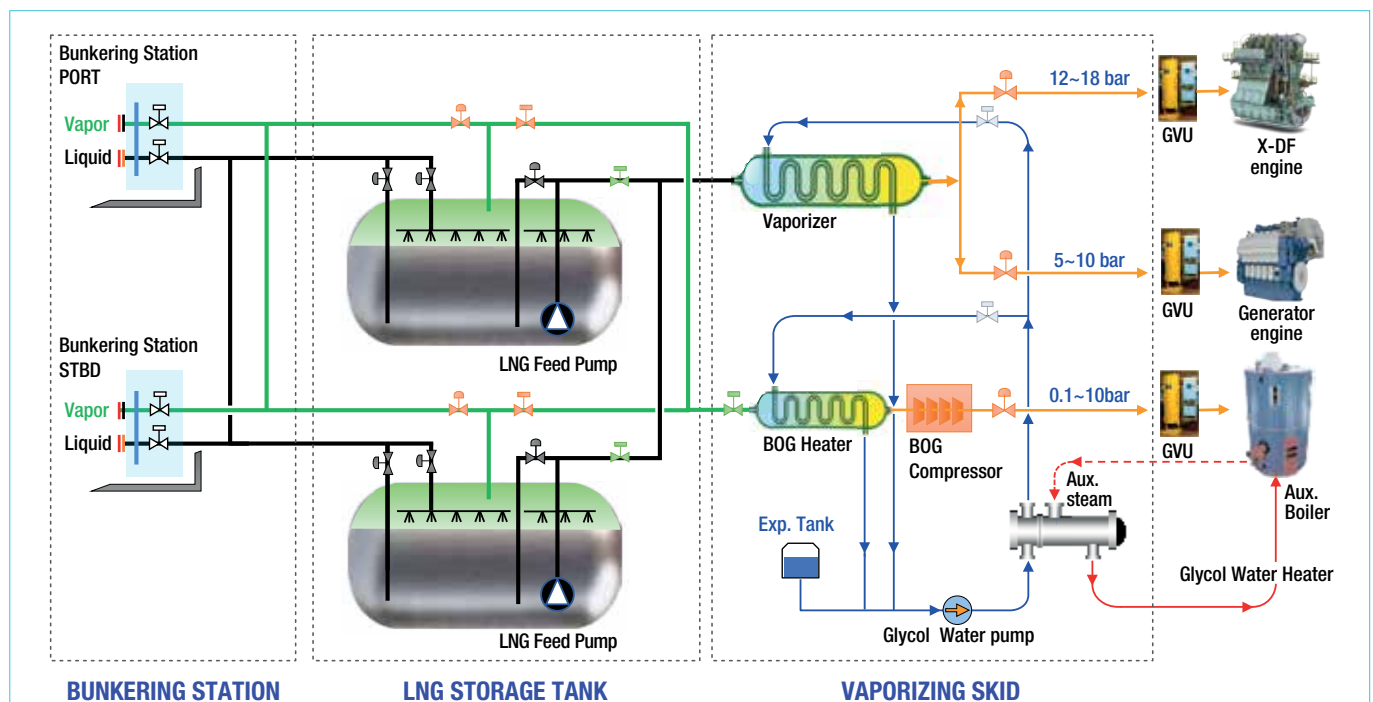
- 19 service agents in 12 countries

System Configuration

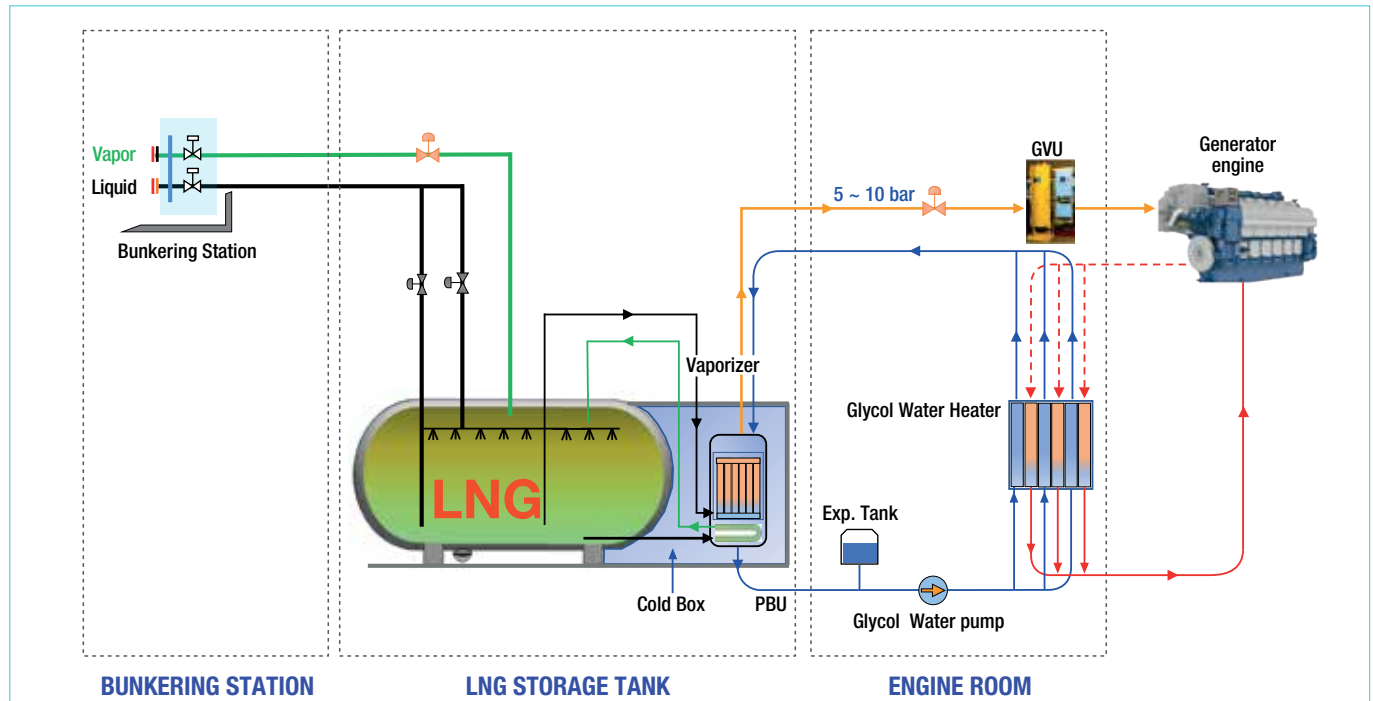
Flow diagram for ME-GI engine



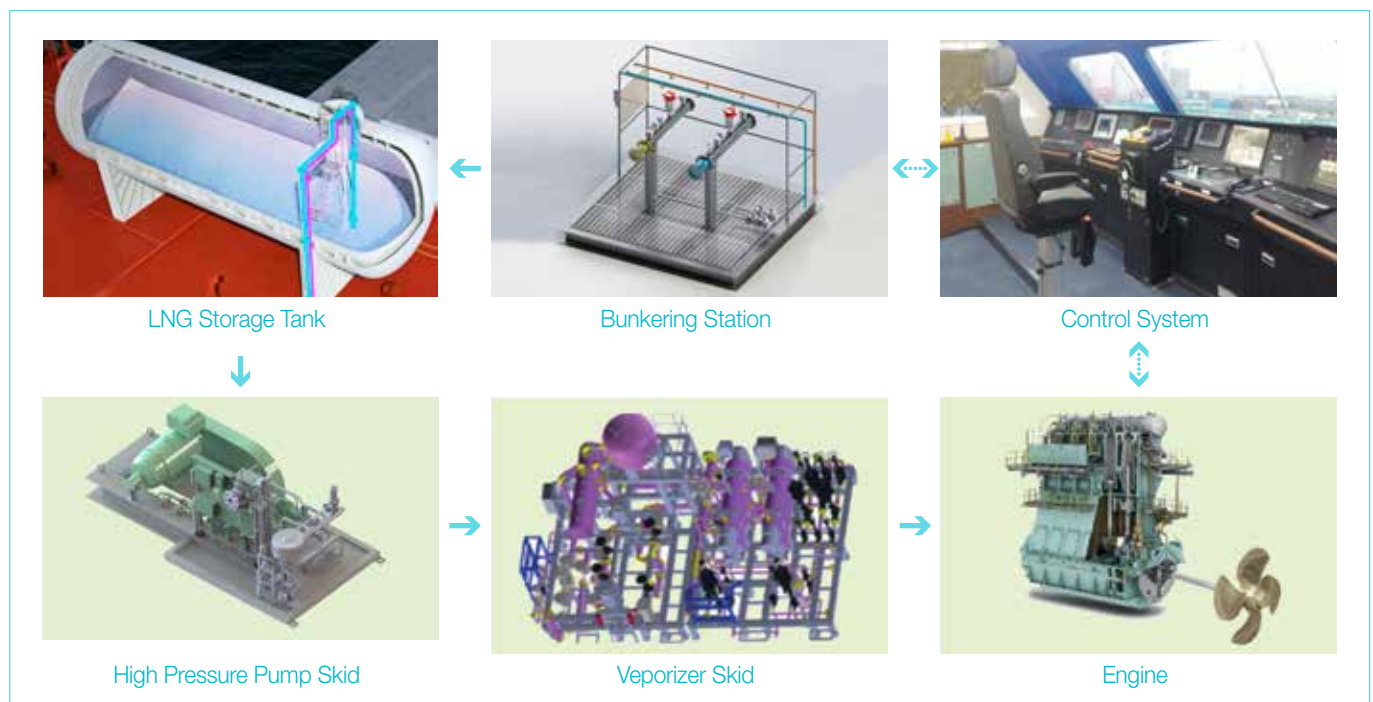
Flow diagram for X-DF engine



Flow diagram for DFDE for small vessel



Equipment for PURIGAS™



System Component



Bunkering Station

- Quantity : 2 sets (Port & Starboard shipside)
- Liquid Line : 4~8" Pipe
Vapour Line : 4~6" Pipe
- Dimension (In accordance with SGMF guidance)
 - Distance of manifold flanges inboard from ship's side : 1,100mm
 - Horizontal distance Between Flange centers : 1250 mm
 - Vertical distance Between Flange center & working platform : *mm (*depend on ship's specification)
- Bunkering Capacity (In General)
 - Max loading rate with vapor return : 415 m³/hr (Based on LNG velocity 6.0 m/sec)
 - * Design fluid velocity (except of bunkering manifold and vent lines)
 - Liquid line : 10m/sec, in general
 - Vapor line : 35m/sec, in general



Type-C LNG Storage Tank

Design specification

- Independent Type-C tank (IMO/IGC)
- Single shell (with PUF) or Double shell (Barrier space with Perlite)
- Vacuum insulation
- Design pressure : 3~9 bar.G
- Working pressure : 1~9 bar.G



Cylindrical type tank



Bi-lobe type tank



Tri-lobe type tank

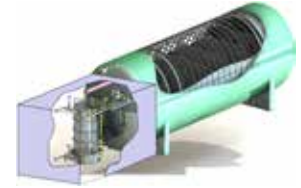
System Component



Cold Box for small sized Tank

Design Specification

- Located at the end of LNG tank
- Vaporizer and valves are installed in Cold box
- Gas & Fire detection(Optional)
- 30 air change / hour with ventilation fan



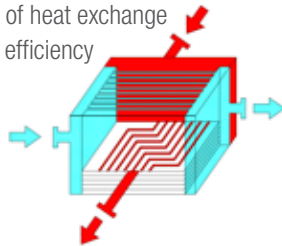
Vaporizer

PCHE(Printed Circuit Heat Exchanger)type

- Proper for high pressure
- Diffusion Bonded
- Chemically etched fluid channels

Merit

- Minimize area and size of heat exchange
- Maximize heat transfer efficiency



Shell & Tube Heat Exchanger type

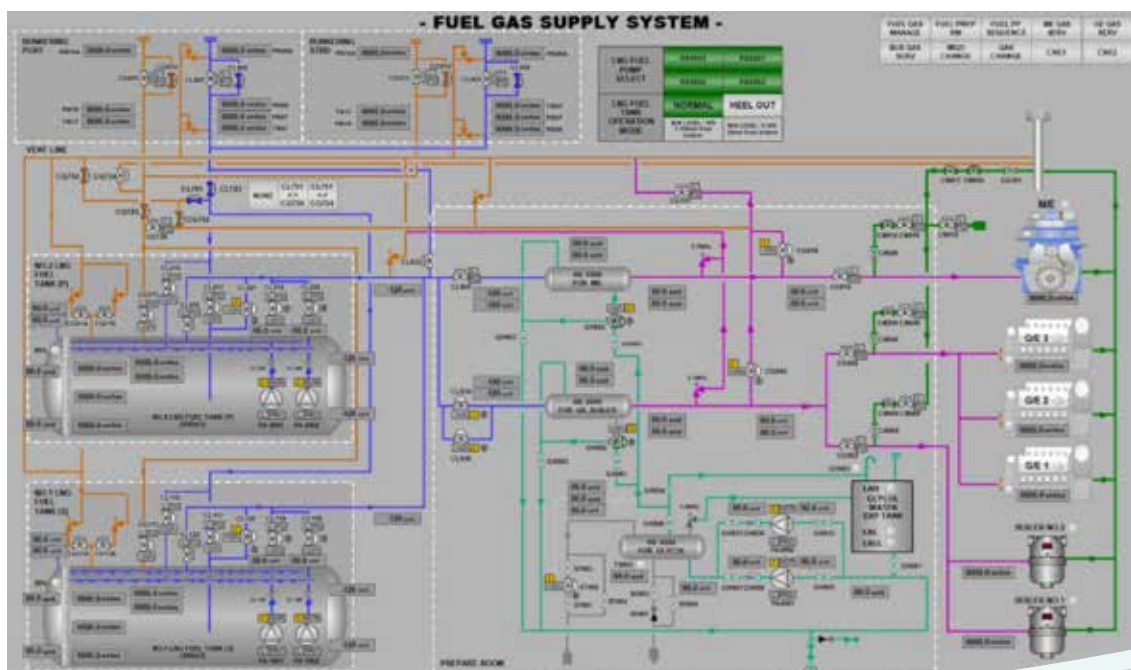
- Proper for low pressure
- Most commonly used

Merit

- Low cost
- Easy maintenance



Control & Monitoring Mimic





ASIA				OCEANIA	
KOREA	S&SYS Co.,Ltd. (HQ)	JAPAN	JRCS Co.,Ltd.	Australia	UNION
KOREA	STK Engineering Co.,Ltd.	JAPAN	 Tsuneishi Co.,Ltd.	SOUTH AMERICA	
KOREA	JEWON Engineering Co.,Ltd.	JAPAN	 Union.Co.,Ltd.	BRAZIL	METALOCK Brazil Ltd.
KOREA	STA	SINGAPORE	Treys Ple Ltd.	BRAZIL	DZETA Marine & Offshore
KOREA	DEX	SINGAPORE	 KTK Group Co.,Ltd.	EUROPE	
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USA	MarineBCTec(NJ)			Nigeria	Radial Circle

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