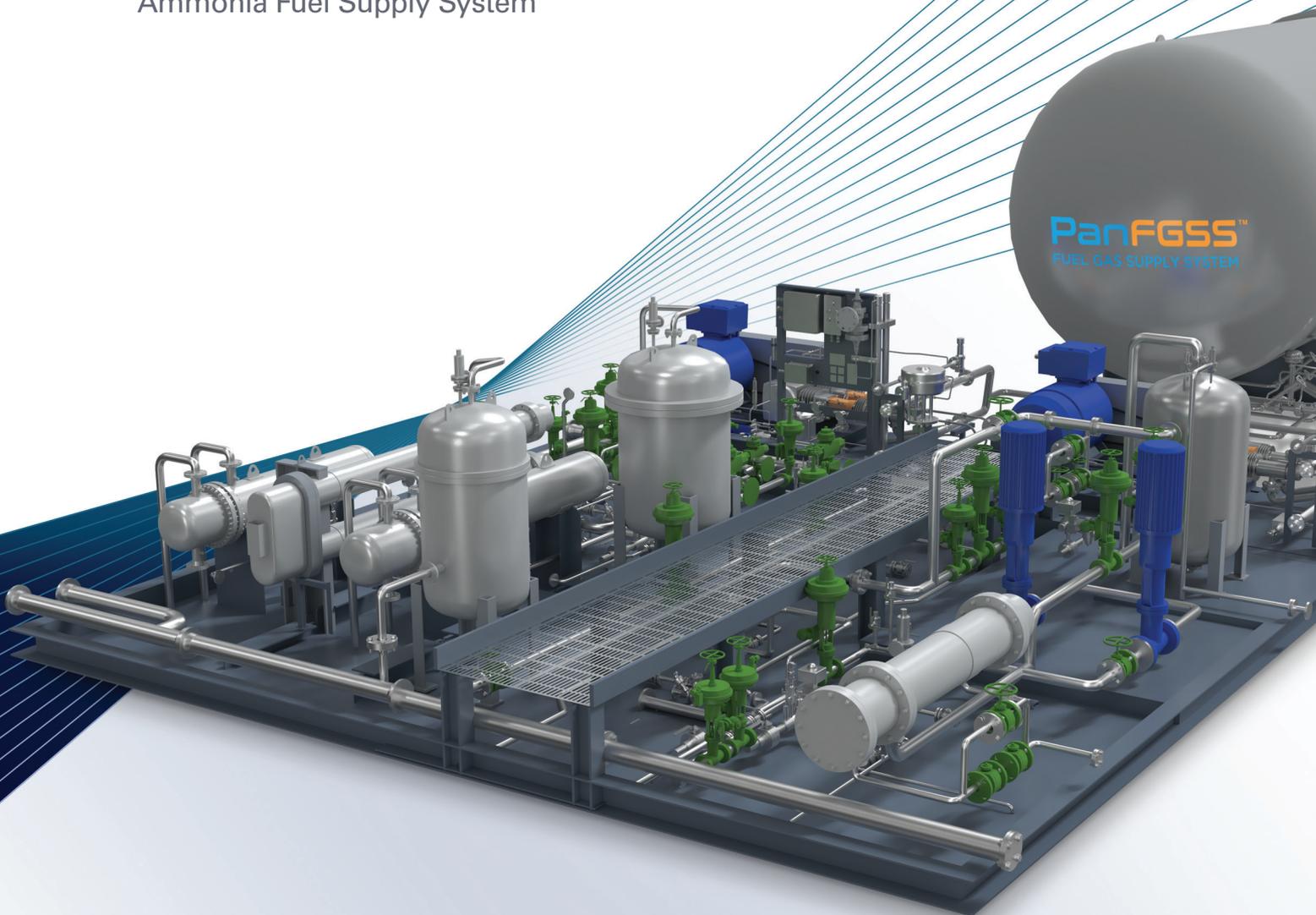


FUEL SUPPLY SYSTEM

Fuel Gas Supply System
Low-flashpoint Fuel Supply System
Ammonia Fuel Supply System



Panasia: We are heading to the future with eco-friendly solutions

PANASIA is a green energy solution provider that leads the way in building a future in which humans and nature coexist.

At PANASIA, we are continuously working to take risks and develop technologies powered by nature based on the standards of nature across various areas, from the air solutions to the water solutions, and to our energy solutions.

We offer high-quality ICT-based products by adopting our unique "SMART PANASIA" system, which encompasses all processes from product planning to design, production, and to services, and allows our technologies to learn and evolve on their own.

With its core technologies and years of experience, PANASIA has become a global leader that uses its technology to respond to demands in various environmental areas.



WATER SOLUTIONS



Ballast Water Treatment System (UV type)



Measurement Control System



WTS for Exhaust Gas System (Chemical / Membrane)

AIR SOLUTIONS



De-SOx System (Scrubber)



De-NOx System (SCR)



Engine Exhaust Recycling System (iCER)

ENERGY SOLUTIONS



Hydrogen Generation System

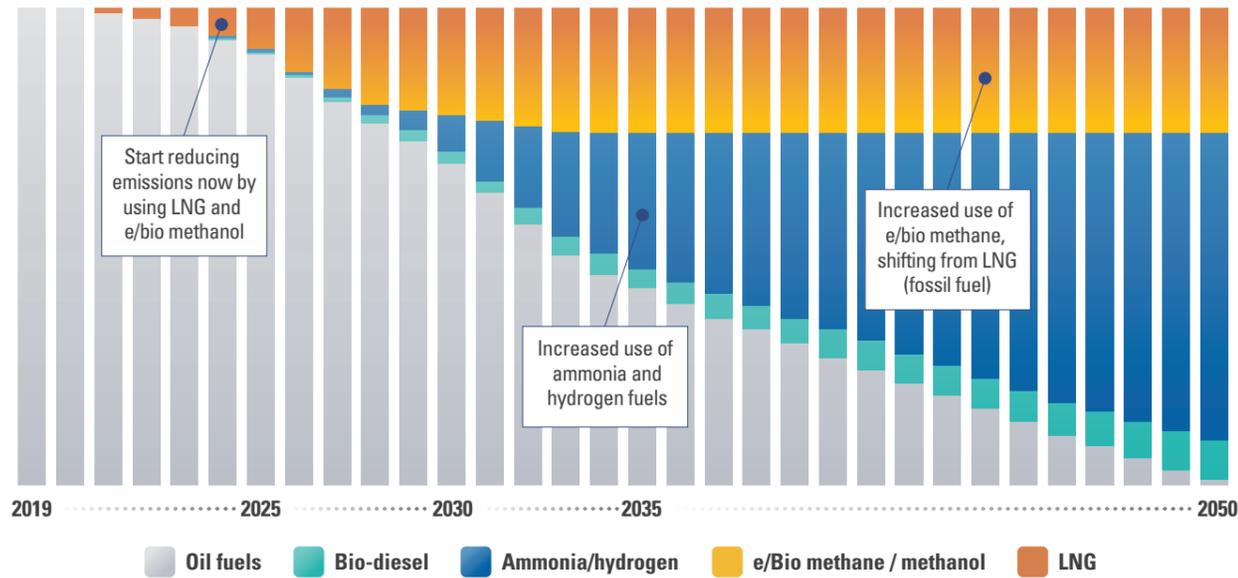


Carbon Capture and storage System (CCS/OCCS)

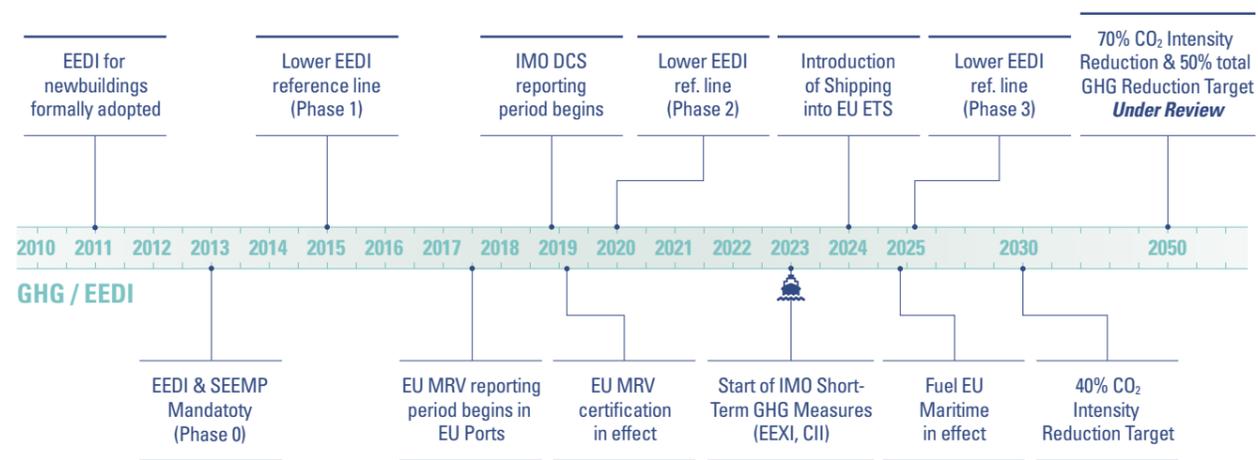


Fuel Supply System (FGSS/LFSS)





Due to numerous environmental regulations, the use of traditional fuels such as HFO and MGO will continue to decline until 2050, starting now. Under this trajectory, LNG may account for the highest proportion in the middle stage but this trend would switch to a Fuel Mix system eventually. Each industry is expected to increase use of alternative fuels such as E-Methanol, Bio-Methanol, Ammonia, and Hydrogen depending on the future infrastructure situation.



In the case of marine industry, environmental regulations are much faster and more powerful. Recently, regulations on greenhouse gases are accelerating, and shipowners are facing challenges to replace into alternative fueled ships or apply additional environmental facilities.

LNG



Fuel Gas Supply System (FGSS) is a fuel supply system for gas-powered ships that makes LNG and BOG in the tank as engine fuel supply conditions, and LNG (Liquefied Natural Gas) has been spotlighted as a preferred fuel oil with the high demand for LNG carriers and LNG fueled ships in environmental and economic aspects.

Methanol



Low-flash point Fuel Supply System (LFSS) is a generic term for facilities that supply low-flammable fuel such as LPG and methanol with a low flash points (below 60°C). This device makes sure of safely supplies fuel within the flow rate, pressure, temperature, and filtration parameters specified by the engine manufacturers. As one of future eco-friendly alternative fuels Methanol could become leading alternative fuels to meet the limits of the relevant emission standards for ship exhausts and IMO targets in the future.

Ammonia



Ammonia, a carbon-neutral fuel, is one of the most suitable candidates among realistically usable eco-friendly fuels in marine industry, and it is in the global attention as carbon regulations are strengthened. In addition, it has many advantages as a marine fuel with good ventilation easy control of leaked gas, little explosiveness, and excellent safety.

LNG Fuel Supply System

The LNG Fuel Supply System refers to the facility on vessel using LNG (Liquefied Natural Gas) as a ship fuel. Depending on the engine model, it is divided into HP (high pressure) & LP (low pressure) Type.

1. HP/LP Type

Design Data

- **HP Pump** Dis. Press. 300 bar reciprocating pump X 2 sets
- **LNG Feed Pump** Dis. Press 12 bar submersible centrifugal type pump X 2 sets
- **LP Vaporizer** Temp : -163°C → 45°C (Cold side)
- **HP Vaporizer** Temp : -163°C → 45°C (Cold side)
- **Glycol Skid** Glycol Water (Water 50 : Glycol 50)
Glycol Water Pump : Vertical Inline Centrifugal type X 2 sets
Heat Exchanger : Shell&Tube or Equivalent
Glycol Water Tank : abt. 0.5 m³
- **LNG Storage Tank** IMO Type-C Single Shell Tank
IMO Type-C Double Shell Tank
IMO Type-C Lattice Tank
Material 9% Nickel Steel or Equivalent



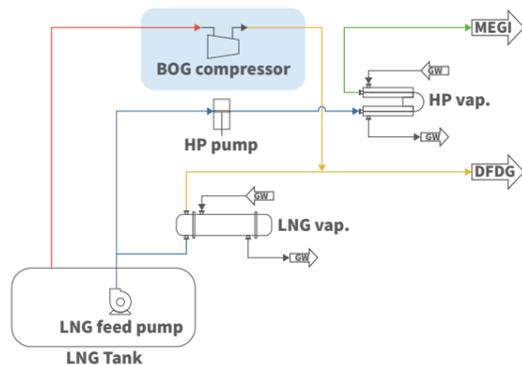
2. LP Type

Design Data

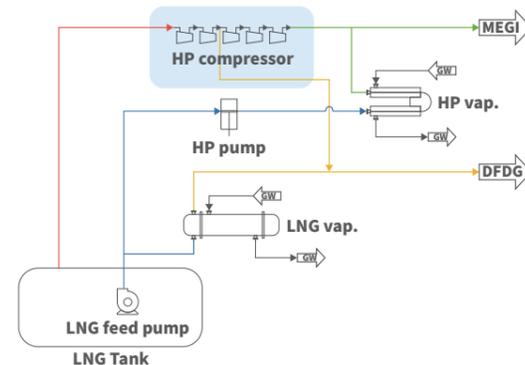
- **LNG Feed Pump** Dis. Press 18 bar submersible centrifugal type pump X 2 sets
- **LP Vaporizer** Temp : -163°C → 45°C (Cold side)
- **Glycol Skid** Glycol Water (Water 50 : Glycol 50)
Glycol Water Pump : Vertical Inline Centrifugal type X 2 sets
Heat Exchanger : Shell&Tube or Equivalent
Glycol Water Tank : abt. 0.5 m³
- **LNG Storage Tank** IMO Type-C Single Shell Tank
IMO Type-C Double Shell Tank
IMO Type-C Lattice Tank
Material 9% Nickel Steel or Equivalent
- **LP BOG Comp.** Injected Screw Type (16 bar) X 1 set



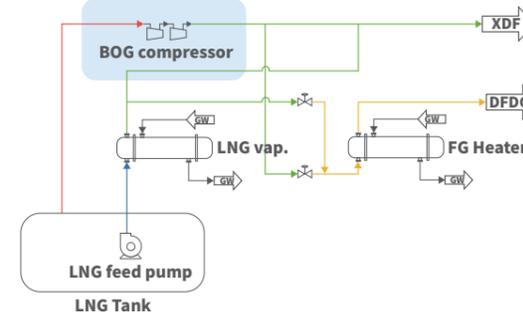
PFD - HP/LP WITH BOG COMP.



PFD - HP/LP WITH HP COMP.



PFD - LP WITH BOG COMP.



Main Component

- LNG Storage Tank
- BOG Compressor (with BOG Pre Heater)
- Glycol Water System
- LNG Feed Pump
- LNG Vaporizer
- Control System

Main Component

- LNG Storage Tank
- BOG Compressor (with BOG Pre Heater)
- HP Vaporizer
- LNG Feed Pump
- LNG Vaporizer
- Control System
- HP Pump
- Glycol Water System

Application

LNG Fuelled Small/Mid-size ship

The FGSS have been in service on almost any type of marine application on container vessels, tankers of all size, bulk carriers, car carriers, RoRo and general cargo vessels.



Container Ship



Bulk-Carrier



Deck Cargo Vessel



General Cargo Ship



Oil/Chemical Tank



Tug Boat

FGSS Control System

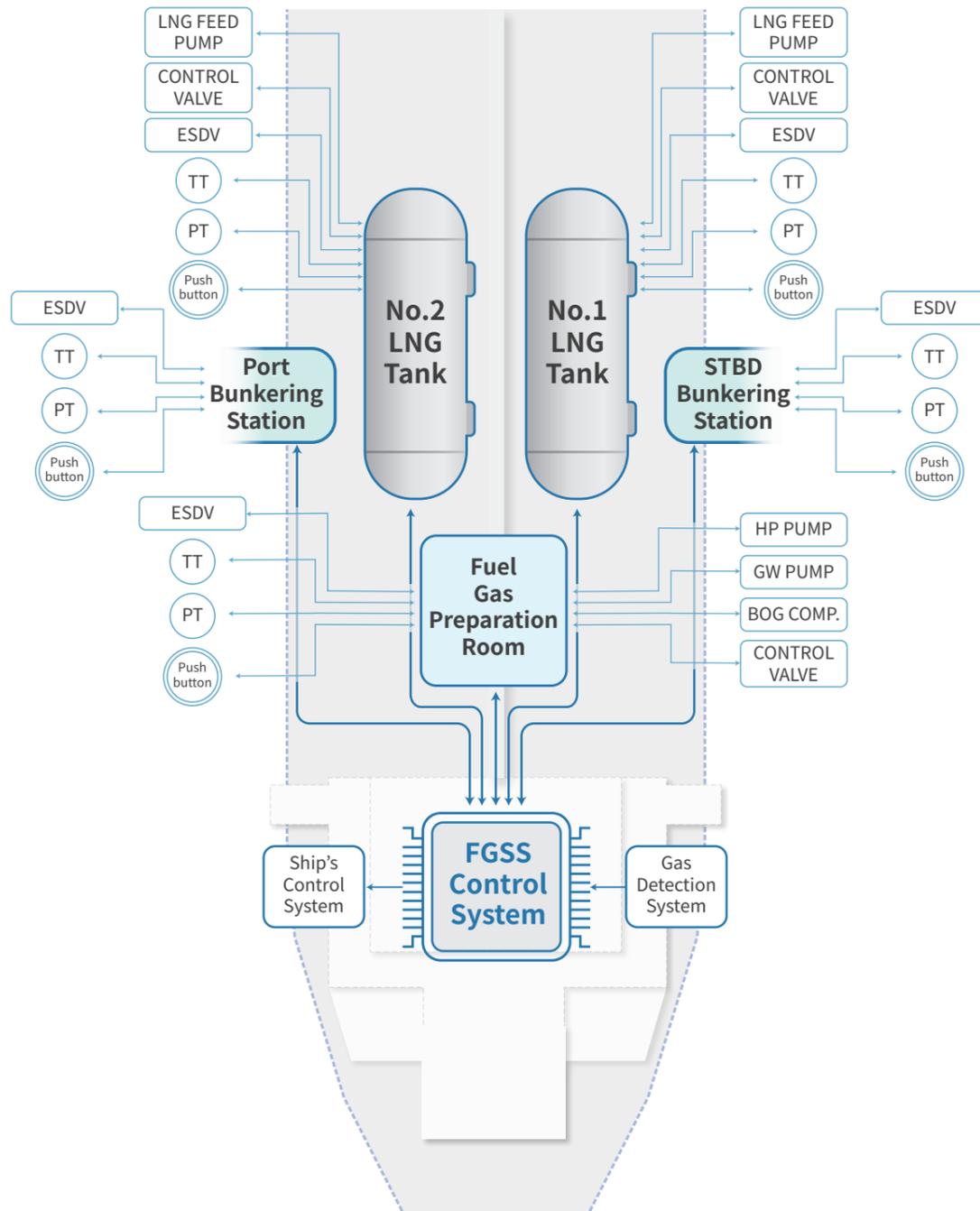
The Panasia FGSS Control System provides optimized control and monitoring functions tailored to the specifications required by each equipment.

Furthermore, with our broad range of experience of BWTS and Scrubber system in control logic, PANASIA can also provide high performance in controlling HP Pump, Vaporizer, Glycol water.



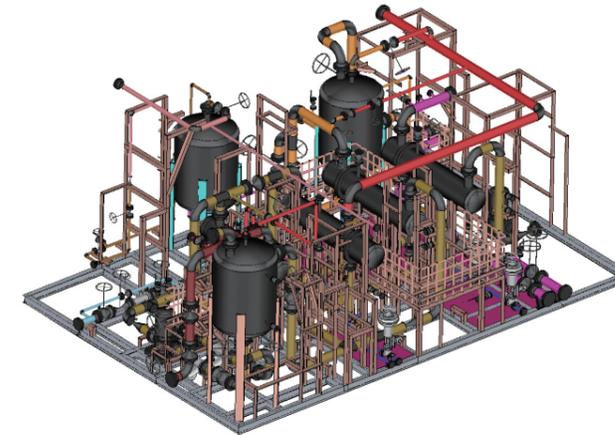
FGSS Control Panel

FGSS Control System Logic



Reference

Aframax Tanker SKID Module



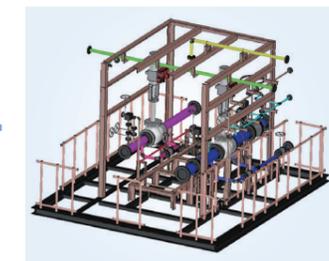
One skid Module



Vaporizer & Buffer Tank Module



Glycol Water Module



Bunker Station

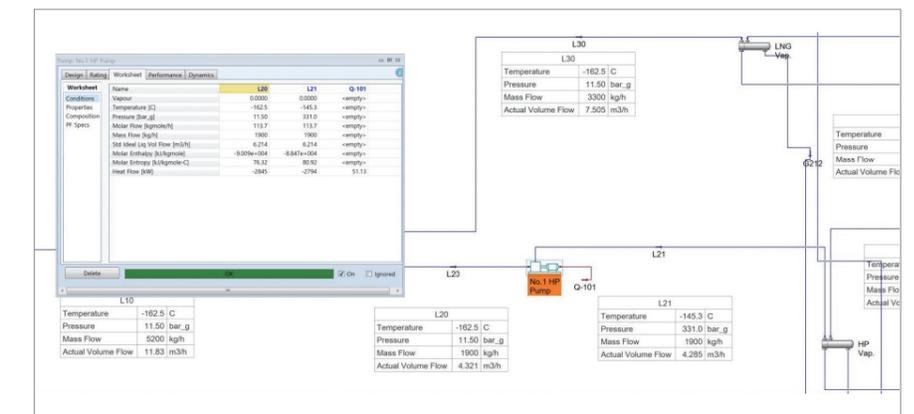
Design Data

- **HP Pump** Dis. Press. 300 bar reciprocating pump X 2 sets
- **LNG Feed Pump** Dis. Press 12 bar submersible centrifugal type pump X 2 sets
- **LP Vaporizer** Temp : -163°C → 45°C (Cold side)
- **HP Vaporizer** Temp : -163°C → 45°C (Cold side)
- **Glycol Skid** Glycol Water (Water 50 : Glycol 50)
Glycol Water Pump : Vertical Inline Centrifugal type X 2 sets
Heat Exchanger : Shell&Tube or Equivalent
Glycol Water Tank : abt. 0.5 m³
- **LNG Storage Tank** IMO Type-C Single Shell Tank
IMO Type-C Double Shell Tank
IMO Type-C Lattice Tank
Material 9% Nickel Steel or Equivalent

Acquiring AIP cert. from ABS

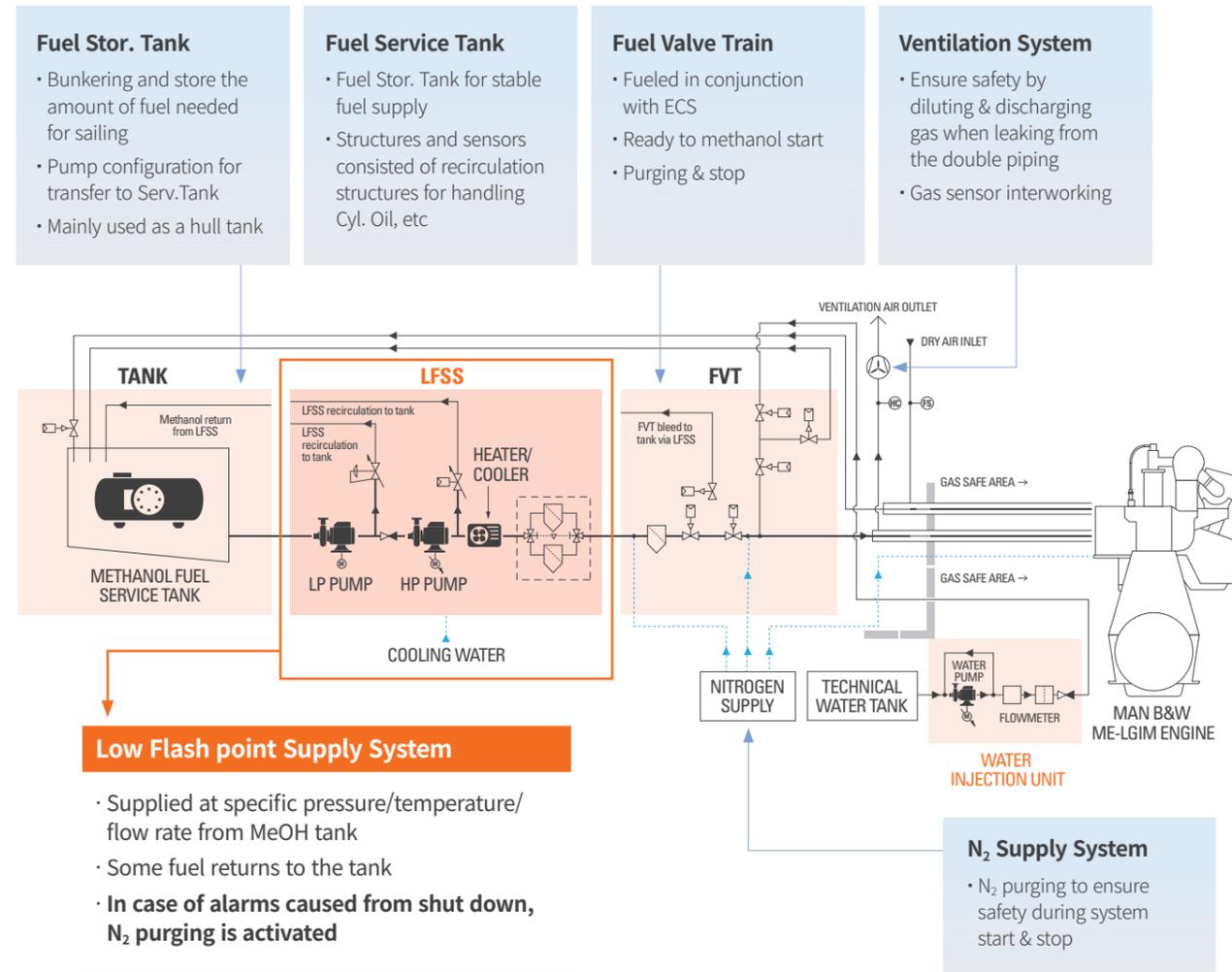


FGSS - Heat & Material Balance

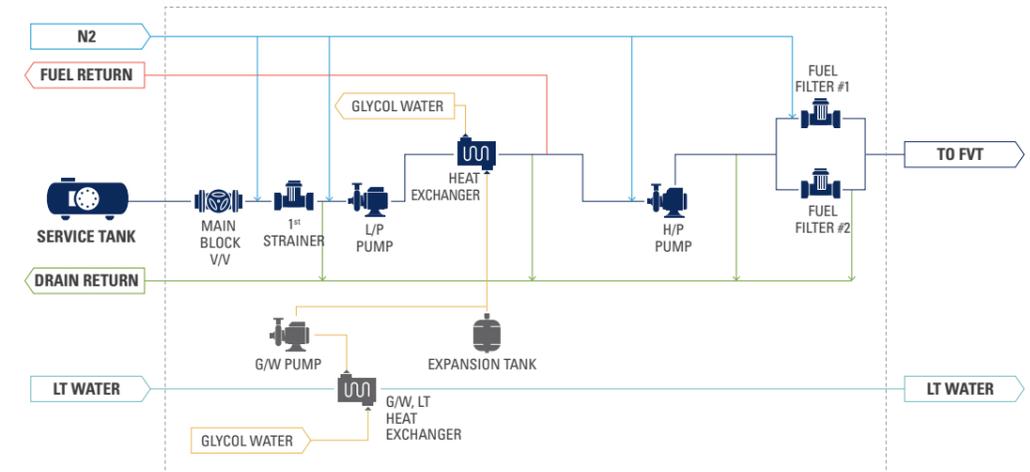
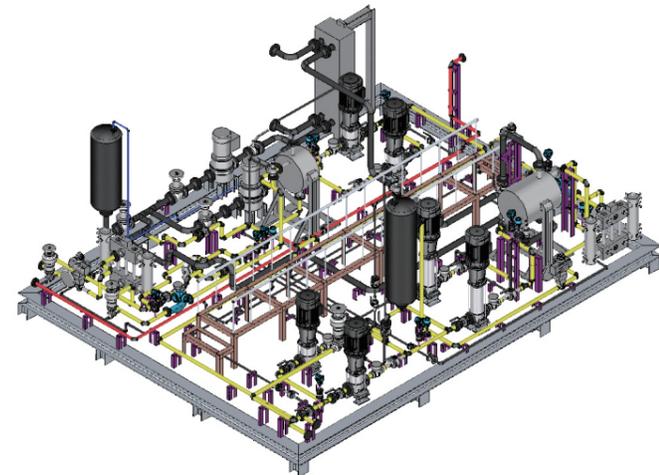


Methanol Fuel Supply System

The Methanol Fuel Supply System uses liquid methanol as a fuel for ships and requires advanced technology.

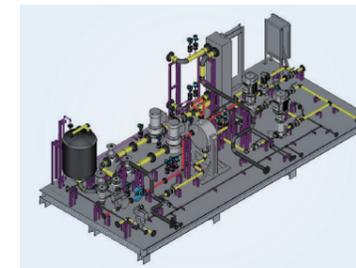


Items	Value
Pressure to engine	13 ± 0.5 bar.g
Temperature to engine	25 ~ 50 °C
Ambient Temperature	-10 °C ~ +45 °C
MeOH Feed Temperature	0 ~ +45 °C
Inert Gas Used	Nitrogen
Heating Media	Glycol Water (25wt.%)
Cooling/Heating Water	L.T.C.F.W(36°C)
ATEX Classification	Zone 1



Engine power (Bore)	Engine power (MW)	Max. Fuel flow (kg/h)	Model (by capacity)
50ME-Line	~12*	386 ~ 5,400	PanLFSS™-10
60ME-Line	~22*	559 ~ 10,140	PanLFSS™-20
80ME-Line	~42*	1,224 ~ 18,360	PanLFSS™-40
95ME-Line	~82*	1,764 ~ 35,500	PanLFSS™-80

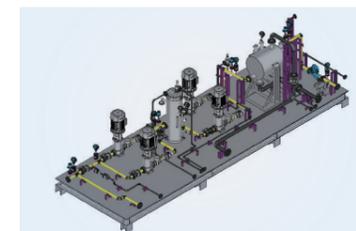
Reference



G/E+G.W LINE SKID

Propulsion Engine Fuel Supply Application

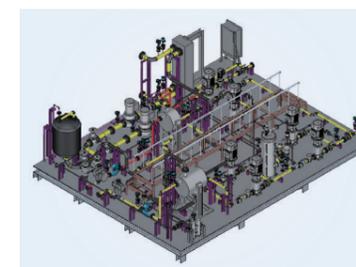
Methanol Supply Pump	Dis. Press. 6 bar.g / Sealless VFD Control
Methanol Fuel Pump	Dis. Press. 13 bar.g (Diff. Head 71 m) / Sealless VFD Control
Fuel Heater	Temp : -18 deg.C -> 25 deg.C / Glycol water 25~40%wt. Shell & Plate or Equivalent
Fuel Filter	Duplex / 10 micron
Fuel Strainer	Y Strainer / 100 micron
Fuel Pipe Material	Austenite Stainless Steel (A213-TP316)



M/E LINE SKID

Generator Engine Fuel Supply Application

Methanol Supply Pump	Dis. Press. 8 bar.g / Sealless VFD Control
Fuel Heater	Temp : -18 deg.C -> 25 deg.C / Glycol water 25~40%wt. Shell & Plate or Equivalent
Fuel Filter	Duplex / 10 micron
Fuel Strainer	Y Strainer / 100 micron
Fuel Pipe Material	Austenite Stainless Steel (A213-TP316)
Main Frame Material	SS400 or eq.



ONE SKID

Common Utility System for MeOH LFSS

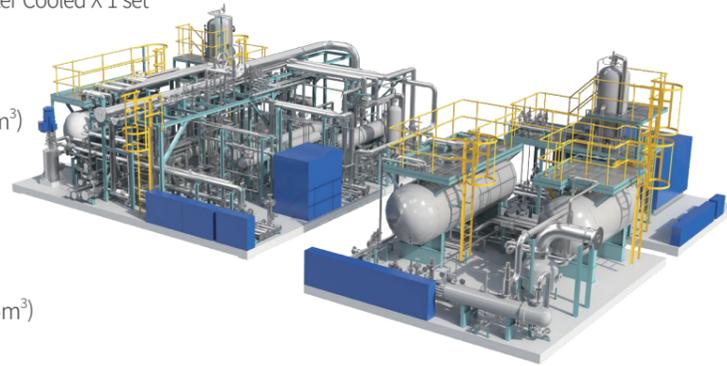
Glycol water system	Vertical Inline Centrifugal x 2 set Medium : Glycol water 25~40%wt. / LT water (36 deg.C) Glycol water tank : abt. 0.5 m3
N ₂ Purge & Drain System	N ₂ Supply train with valve (Automatic Purge system as an option) Pneumatic acting drain pump : 60LPM Drainage level control buffer
Safety Automation	Leak Detection Sensor (LEL 25% H/C) Control Panel & HMI

Ammonia Fuel Supply System

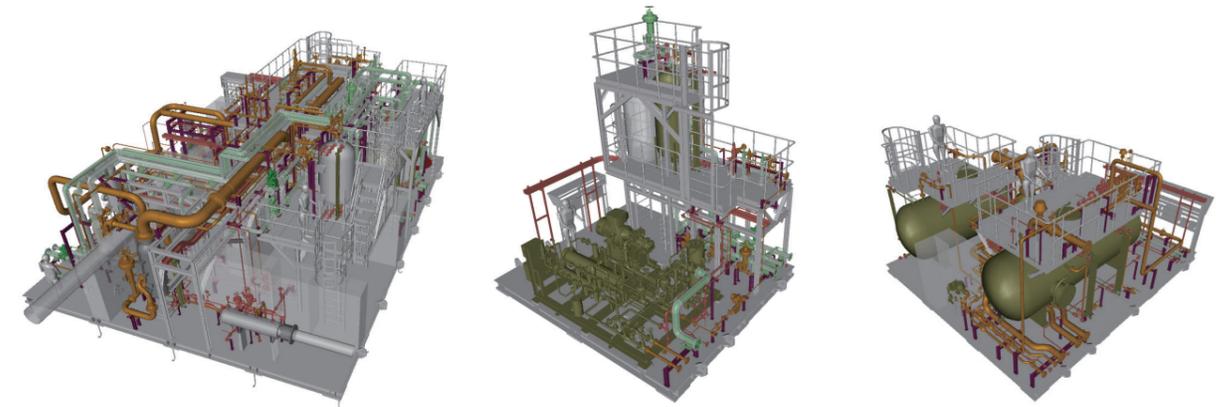
The Ammonia Fuel Supply System uses ammonia with a flash point of approximately 130 degrees, as a ship fuel, and it has commons of LNG, LPG, and methanol supply system in aspect of supplying liquefied forms of fuels into the engine.

Design Data

- **LP Pump** Dis. Press. 18 bar Multi-stage centr. Pump X 1 set
- **HP Pump** Dis. Press. 88 bar Metering Pump X 1 set
- **BOG Compressor** Dis. Press. 18 bar Oil Injection Screw Water Cooled X 1 set
- **Vaporizer** Temp: $-24^{\circ}\text{C} \rightarrow -18.7^{\circ}\text{C}$
- **Water seal** Temp: $-24^{\circ}\text{C} \rightarrow 60^{\circ}\text{C}$
- **NH₃ Supply Skid** IMO Type-C Single Shell Tank. (abt. 5m³)
Material 9% Nickel Steel or Equivalent
LP, HP Pump
- **Heat Exchanger** Shell&Tube or Equivalent
- **NH₃ Liquefaction Skid** BOG Compressor & Separator
- **NH₃ Dilution Skid** IMO Type-C Single Shell Tank. (abt. 5m³)
- **Heat Exchanger** Shell&Tube or Equivalent
- **Aqueous NH₃ Pump** Dis. Press 7 bar Diaphragm pump X 1 set



Reference

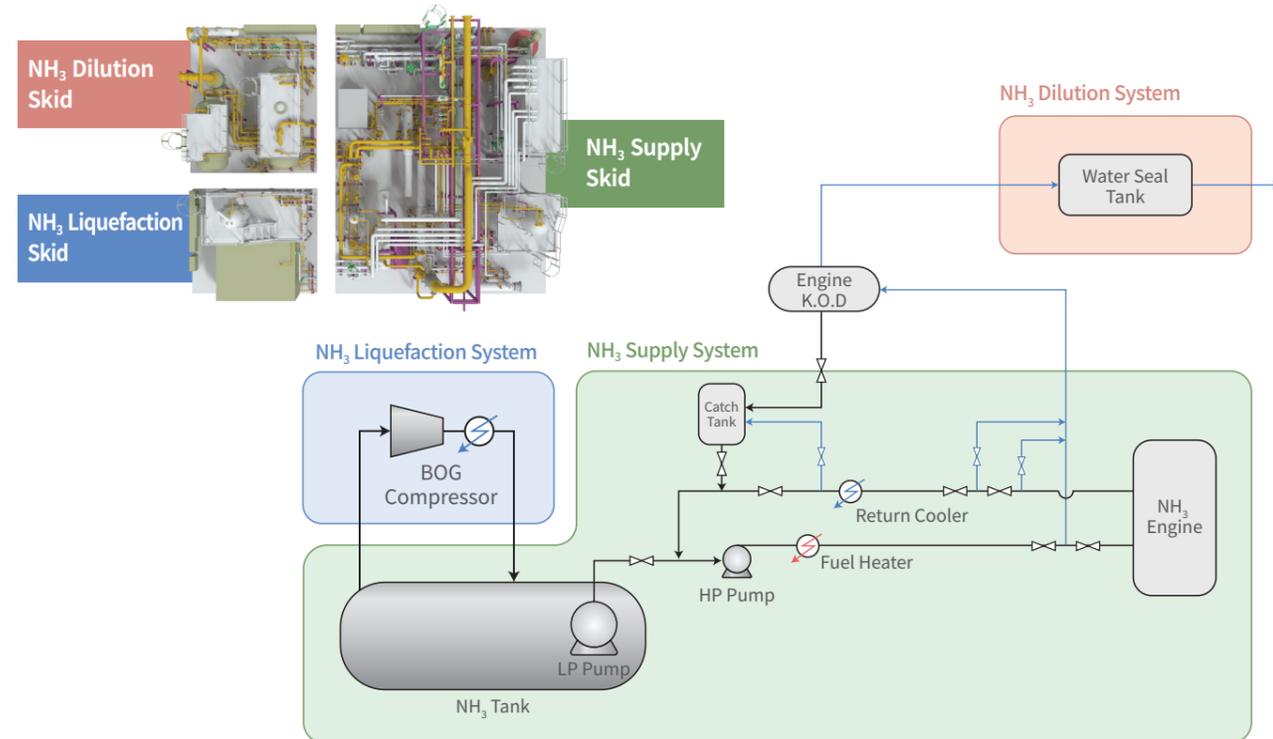


NH₃ Supply Skid

NH₃ Liquefaction Skid

NH₃ Dilution Skid

Ammonia Package Concept





Advanced Smart Services in Panasia

3 OVERSEAS SUBSIDIARIES +
47 GLOBAL SERVICE NETWORKS (37 COUNTRIES)

Global Service Network

PANASIA Headquarter & 1st Factory



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PANASIA 2nd Factory



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PANASIA: A global leader that challenges new creation using eco-friendly technologies

PANASIA

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To reflect PANASIA's corporate philosophy of seeking eco-friendly and sustainable value, this booklet was printed with naturally biodegradable soy ink that makes paper recycling easier.

17th Oct. 2023