HEADWAY

Alternative Fuel, The Pathway Toward Zero Carbon

OceanGuard®

Marine Low Flash-point Fuel Supply System

1 WHY NEW ENERGY?

2 METHANOL? LNG? Or Ammonia?

3 WHY HEADWAY?

Take your question, we go ahead……

Background of emission reductions

Why new fuels?

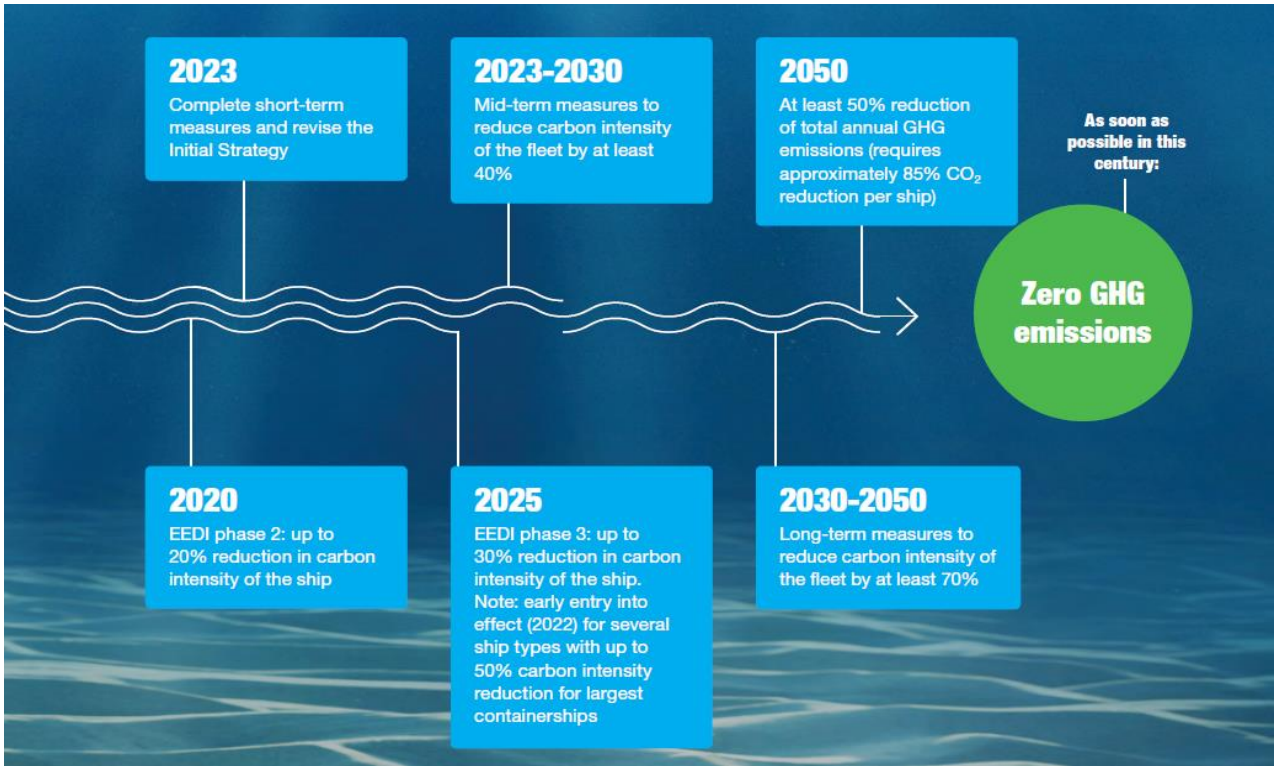
- NOx, and SOx emission reductions
- IMO NOx and SOx Emission Control Areas (ECA) and other local emission reduction requirements
- Lately the global SOx cap is providing the greatest push for alternative fuel

→ LNG fuel, LPG fuel or methanol fuel. And battery propulsion.

- Decarbonization

→ a variety of new solutions and fuels, either carbon free, or produced so that they are carbon neutral

Action plan



Short term → Medium term → Long term

Short term

- EEDI and SEEMP *
- EEXI and CII *
- Methane Emissions and VOC
- Develop GHG Guidelines
- Initiate R&D for innovative technologies
- Undertake additional GHG emission study

Medium term

- Implement measures to incentivize uptake of low-carbon or zero-carbon fuels *
- Operational energy efficiency measures
- Innovative mechanism such as MBMs *
- Develop a feedback mechanism via a lessons learned program

Long term

- Pursue development and provision of low-carbon and zero-carbon fuels *
- •Encourage and facilitate other possible new/innovative emissions reduction mechanisms *

The Immediate Challenges

IMO CII 2023

- CII – Carbon Intensity Indicator, showing a ship's CO2 emission intensity over the past calendar year
- Entry into force Jan 1, 2023
- The CII is dynamic and linked to a rating system
- Corrective Action Plan for CII improvement is required when rated as 3 consecutive D or 1 E

EU ETS 2024

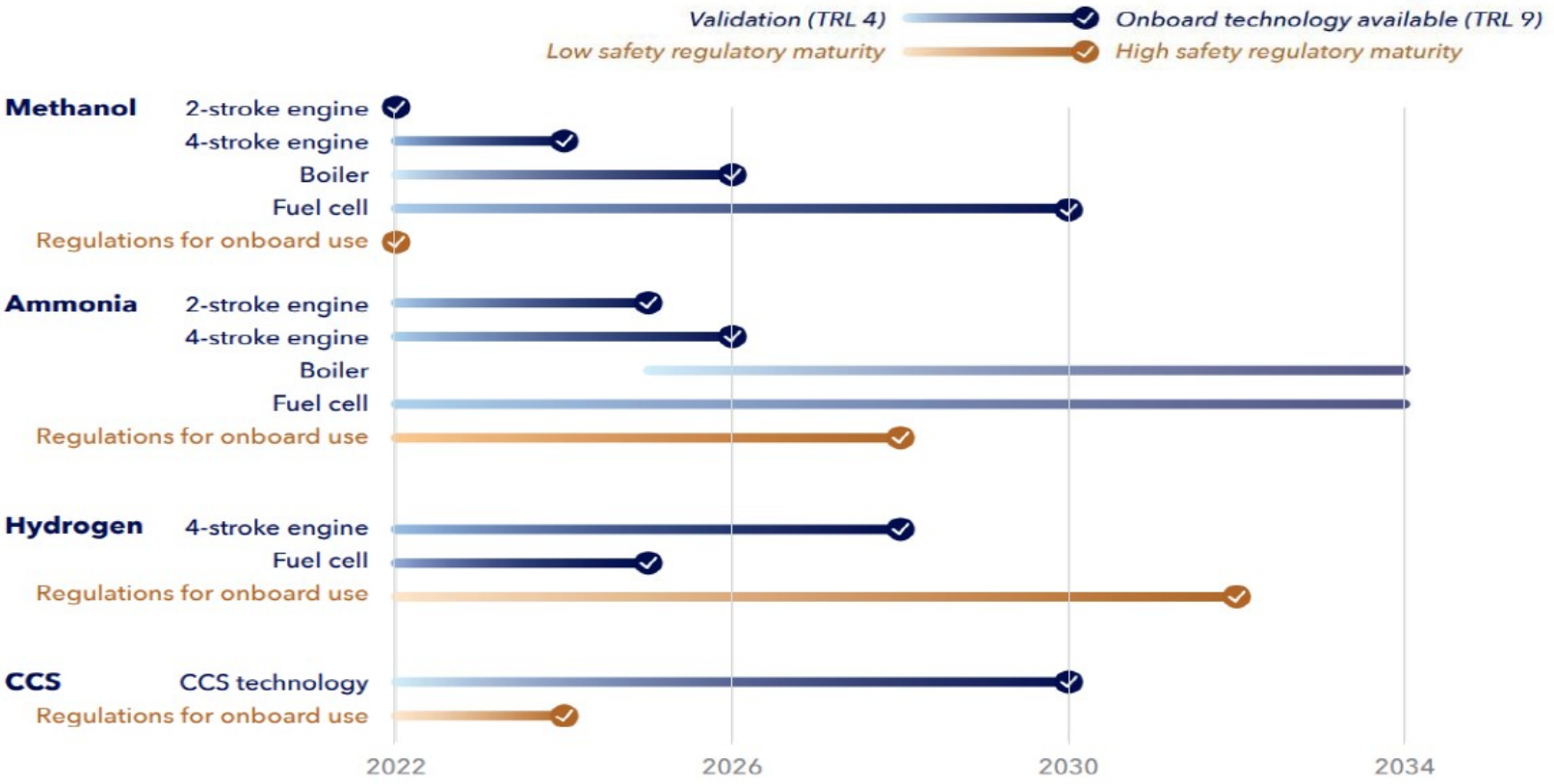
- Shipping will be coming into the ETS from 2024, with vessels accountable for 100% of their reported emissions
- The geographical scope of the ETS expansion includes vessels arriving at and departing from EU ports
- The responsible party for carbon cost is who made the decisions affecting the GHG emissions

FuelEU 2025

- Increase the share of low-carbon fuels in the international maritime transport
- Annual average GHGIEactual to meet required value GHGIEtarget
- Well-to-Tank and Tank-to-Wake components in calculating GHGIE
- Non-compliance will pay penalty

DF engine development status

Key fuel technologies will be available in 3-8 years



Mainstream alternative fuels

Comparison with LNG

Methanol

Methanol (CH3OH) is the simplest alcohol with the lowest carbon content and highest hydrogen content of any liquid fuel.

Methanol is a low flashpoint liquid, with a flashpoint of 11ºC

Vapour is heavier than air

Wide flammability range in air (6-36%)

Methanol has toxic properties

Methanol is a colourless liquid at ambient temperature and pressure

Ammonia

Extremely toxic

Hygroscopic and water soluble

Gas can be both lighter or heavier than air

Less flammable, not considered flammable in open air

Boiling temperature -33ºC (atm. pressure)

Half of energy density of LNG, so needs double volume of fuel for same endurance

No engines available yet

Hydrogen

No GHG emission after combustion

Wide flammability range (4 – 75% mixture)

High mass energy density

Boiling point at -253ºC

Low volumetric energy density, even as liquid

no practical operation experience on sea

No engines available yet

Comparison of various alternative fuels

	HFO	LNG (Methane)	Methanol	Ammonia	Hydrogen
Chemical Composition		CH4	CH3OH	NH3	H2
Boiling Point, deg.C 1bar	180-360	-161.5	65	-33	-253
Density, kg/m^3 liquid	980	450	790	680	71
LHV, MJ/kg	40.2	49.5	19.9	18.6	120.2
Flash point, deg.C	>60	-188	11	132	<-150
Low Flashpoint Fuel	No	Yes	Yes	No	Yes
Flammable Range, % vol in air	0.6-7.5%	5-15%	6-26%	15-28%	4-77%
Energy density, MJ/lt	39.4	22.3	15.7	12.7	8.5
Volume comparision HFO	1	1.77	2.51	3.11	4.62

Comparison of various alternative fuels

	HFO	LNG (Methane)	Methanol	Ammonia	Hydrogen
CO2, kg CO2/kWh	0.55	0.40	0.49	0	0
CO2, kg CO2/kWh Reduction (Compared to HFO)	0%	28%	11%	100%	100%
SOX Reduction (Compared to HFO)	0%	>90%	>90%	100%	100%
NOX Reduction (Compared to HFO)	0%	~20%	~10%	SCR	100%
Challenge		• methane escapes • investment cost	• low energy density • corrosive & toxic • production of green methanol	• low energy density • no bunkering • corrosive & toxic • not economical advantage	• no engine • Containment explosive

Viewpoint Summary

- LNG is still the mainstream choice in the current stage based on mature infrastructure and rich use experience

- Methanol is the fastest growing alternative fuel for ships, not only because of the conventional storage and transportation conditions, but also because bio-methanol is used as the transition fuel to green methanol

Ammonia is a potential zero-carbon fuel, but the cost and availability of green ammonia is the key to its large-scale application

- The selection of alternative fuels for ships is a dynamic process, which is adjusted with the technology and fuel supply capacity

Overview of technical team

System Process

Combine the configuration/ship layout plan and technical requirements of the project, matching customized technical proposal and provide design of FGSS main system and auxiliary system, skilled in the application of professional heat exchange calculation software like Pro II/ASPEN HYSYS for design verification, to ensure that the most reliable, optimized,reasonable technical solution.

Pressure Vessel

According to system require-ments, design pressure vessels such as low-temperature LNG cryogenic storage tanks, high and low-pressure heat exchangers, and engineers are familiar with ASME codes, low temperature material characteristics, and welding process requirements. By virtue of software, analyze and calculate temperature field distribution/sloshing load/crack propagation on

Electric Control

Guided by the process flow chart, the FGSS control monitoring system and FGSS safety system are independently designed by the electronic control team which fully meets the technical goals of independent design-model selection manufacturing and commissioning, with high system redundancy , safety, and reliablility.

Structural Design

With many years of experience in hull design and familiarity with the requirements of ship piping layout, the pipe spooling team can design to avoid the adverse effects of pipeline low temperature shrinkage and stress Concentration, by use of 3D design, stress analysis, and integrated skid-mounted design.

Configuration of Methanol fuel supply system

Configuration of Methanol fuel supply system:

① Bunkering station

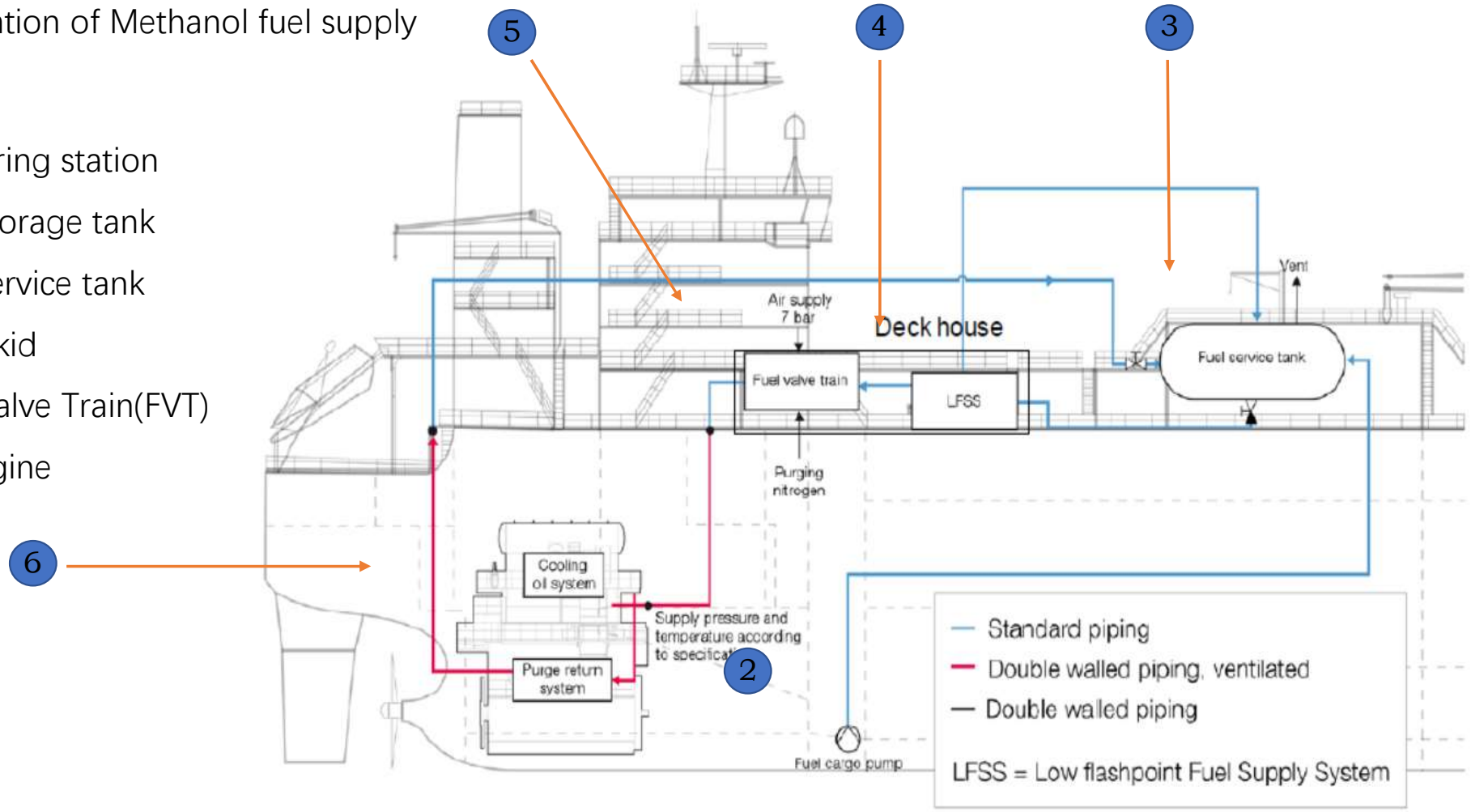
② Fuel storage tank

③ Fuel service tank

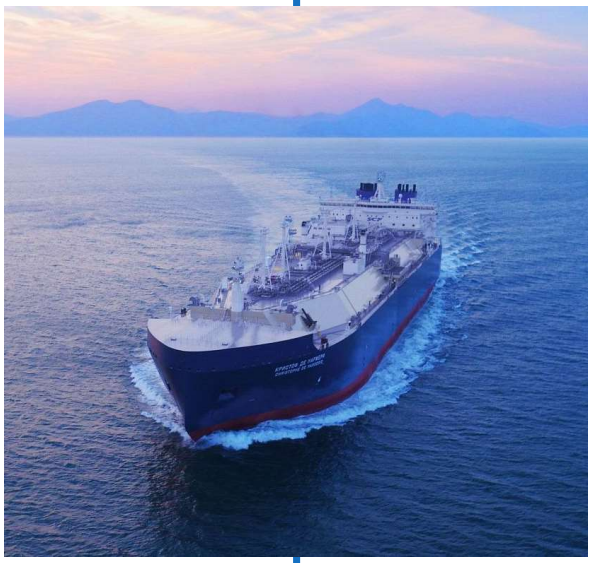
④ LFSS skid

⑤ Fuel Valve Train(FVT)

⑥ DF Engine



Basic concern for LFSS

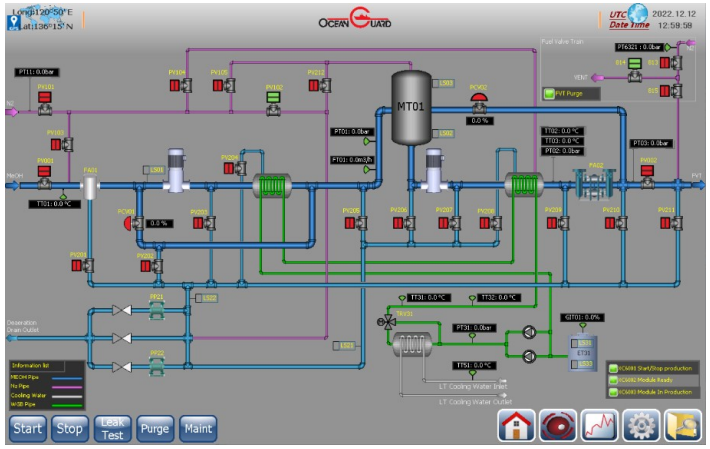


Purpose of LFSS Skid:

Deliver the methanol as secondary fuel to DF engine as per requirement for optimal performance.

Requirement for Methanol fuel:

- Cleaness
- Temperature
- Pressure
- Flowrate



Mature design scheme

DNV

APPROVAL IN PRINCIPLE

RINA

CERTIFICATE OF APPROVAL IN PRINCIPLE
No. 202200050

This is to declare that the Approval in Principle of the following project:

Methanol Fuel Gas Supply System

Name of the Client: **Headway Technology Group (Qingdao) Co., Ltd**
Keyuan Jing 6th Road, Qingdao, Shandong Province, 266100 P.R. China

Description: **The Approval in Principle refers to methanol fuel gas supply system for marine use.**

has been carried out in compliance with the process described in the "RINA Guide for Approval in Principle of Novel Technologies", on the basis of the technical criteria of the:
- RINA Rules for the Classification of Ships, 2022
- IMO Resolution MSC.1/Circ. 1621 – Interim Guideline for the Safety for Ships Using Methyl/Ethyl Alcohol as Fuel.
- IMO Resolution MSC.391(95) – International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF CODE), as amended.

with the specifications below reported.

The following submitted documentation, provided by the Client, allowed the Approval in Principle certificate issuance.
- HMT-MFSS-SD2202-SP SPECIFICATION FOR METHANOL FUEL SUPPLY SYSTEM
- HMT-MFSS-SD2202-DT THE METHANOL FUEL SUPPLY SYSTEM DESIGN DOCUMENT
- HMT-MFSS-SD2202-AL1 ALARM LIST FOR THE MARINE METHANOL FUEL SUPPLY SYSTEM

The above submitted documents have been examined by RINA for the purpose of the AIP with positive results. Relevant system design related to methanol fuel supply system for marine engine use have been evaluated, and they are deemed to be Approved in Principle, in accordance with RINA Approval in Principle Processes, and relevant IMO regulations and RINA rules as mentioned above.

All requirements detailed in involved IMO regulations and RINA rules have to be fulfilled at final detail design stage, with possible additions of further measures introduced by the Flag and State Administrations.

Issued at Shanghai on

22th February 2022

RINA Services S.p.A.

Mr. Luigi MATTERA

RINA Italy Classification Society (China) Co., Ltd
20th Floor, Metrobank Plaza, No. 1160, Yan An Road West, 200052 Shanghai, China
Tel: +86 21 62482604, 62482905
Fax: +86 21 62482605

- Modular supply;
- Through the double three-way ball valve to complete the switch of two filters;
- Flexible design, less heat loss, small space occupation;
- One-key start, fault self-test;

* Land based LFSS system running this May.

LFSS SKID Configuration interpretation

LFSS SKID：

the methanol fuel treatment unit consists of low pressure stage and high pressure stage.

The low pressure stage includes:

1 x Supply pump ⑨

1 x Heat ex-changer for circulation cooling ②

1 x Pressure control valve ⑩

1 x Coriolis mass flow-meter ④

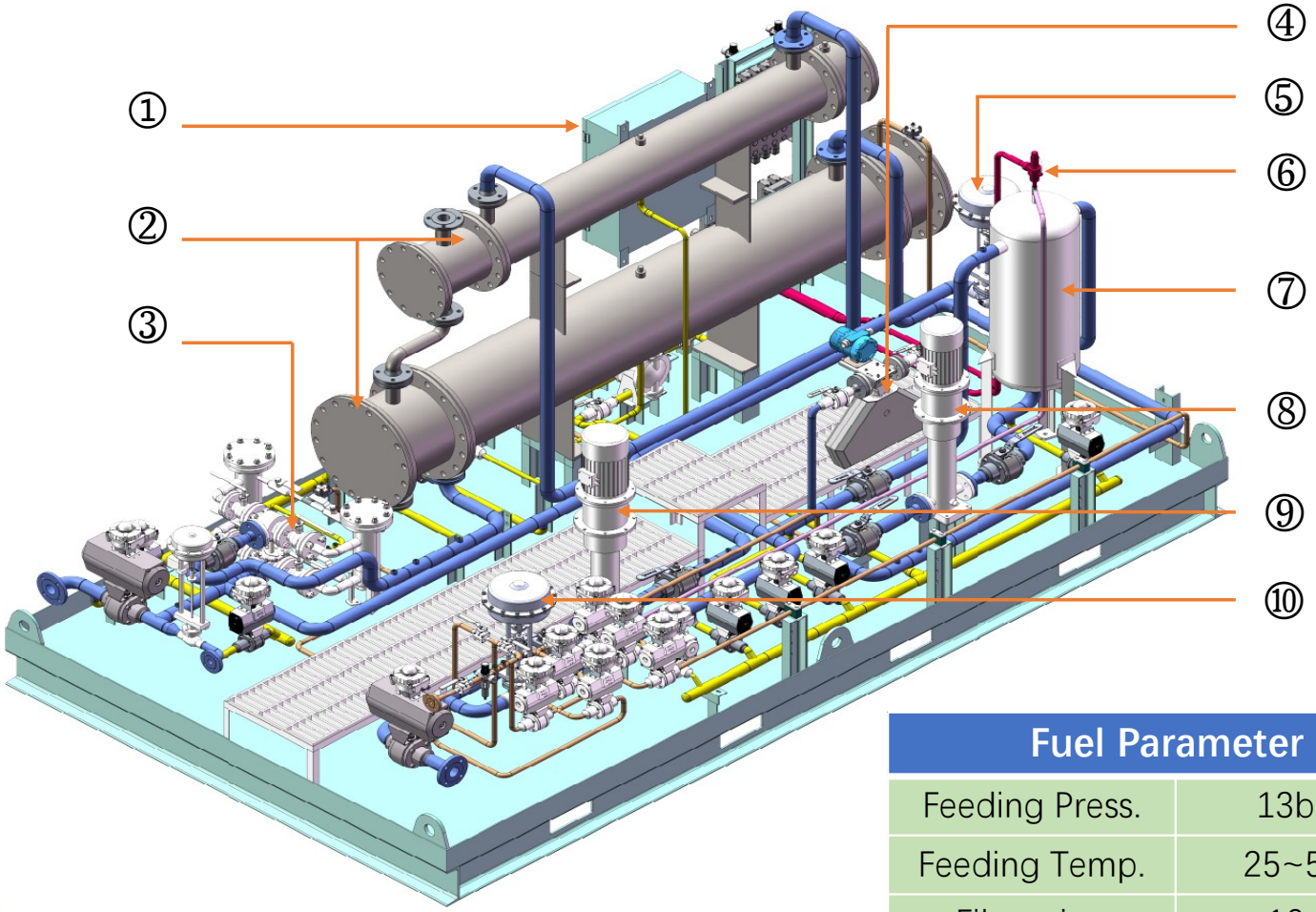
1 x Venting tank ⑦

The high pressure stage includes:

1 x Circulation pump ⑧

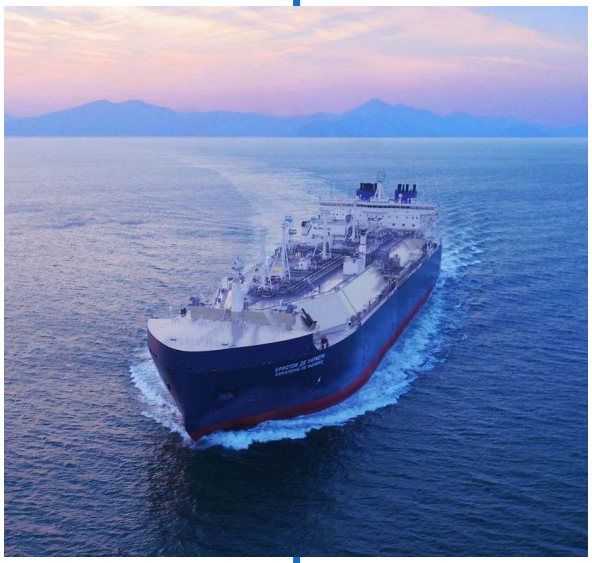
1 x Heat ex-changer for maintaining fuel feeding temperature ②

1 x Duplex filter and 1 x Pressure control valve on back-flow line ③



Fuel Parameter	
Feeding Press.	13barg
Feeding Temp.	25~50℃
Filteration	10μm

Advantages of OceanGuard® LFSS skid



ADVANTAGES

STABLE

Adopting magnetic driving fuel supply pumps eliminates the risk of fuel leakage.

LOWER HEAT LOSS

Tailored thermal insulation coat based on the sailing area and ambient temperature.

COMPACT DESIGN

Adopting spiral heat exchangers into the system brings a more compact design and less weight

REDUNDANCY

Empowered by redundancy design, the system can be maintained without stopping the engine.

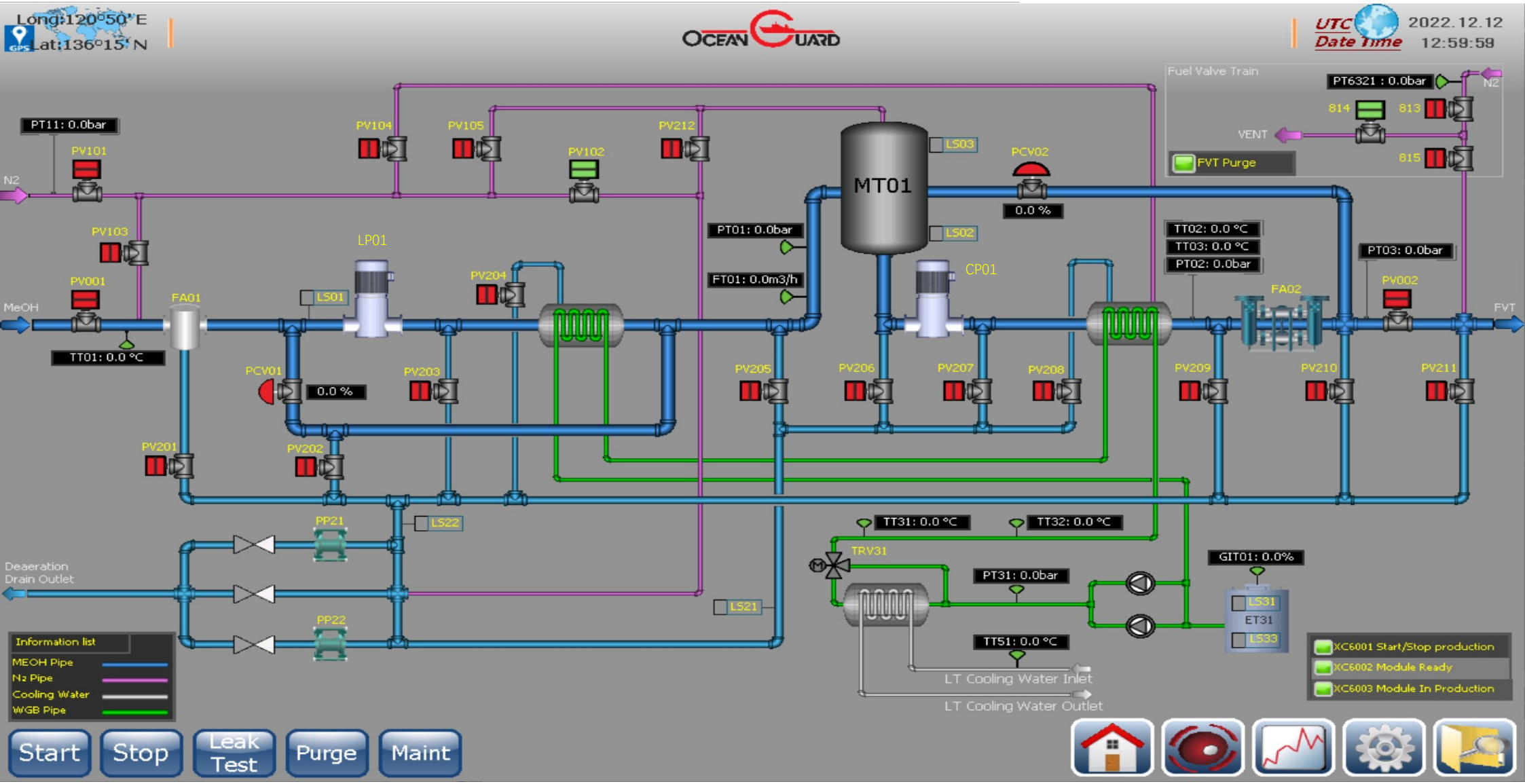
SAFETY PLC

Enhanced by safety PLCs in the Control Unit, provides a realtime self-checking function and one-key operation.

IMPROVED INERTING EFFECTS

Optimized piping layout to ensure an excellent inert-ing effect.

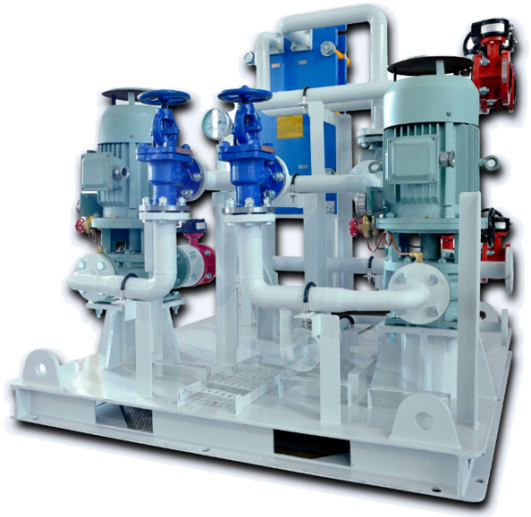
Human-Machine Interface (HMI)



Key auxiliary system - Water glycol heating/cooling unit

WATER GLYCOL UNIT

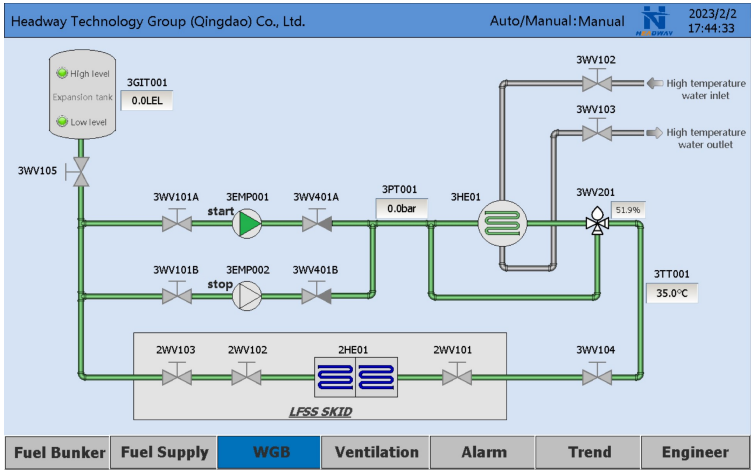
The Water Glycol unit takes water/glycol solution as the heating medium, the unit supplies high-temperature W/G solution to the heater and absorbs heat from the heat source onboard to complete the heat exchange circuit



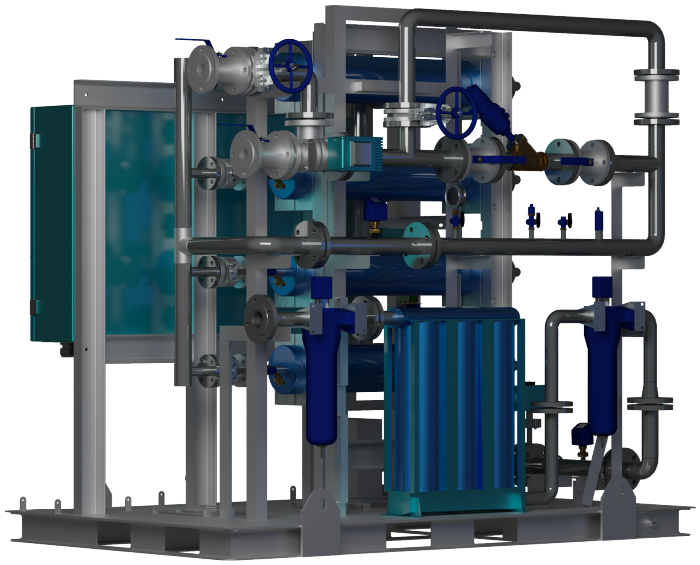
Lower Freezing Point than regular coolant.

Accurate temperature control and management.

Dependable and minimum risk of fuel leakage to engine.

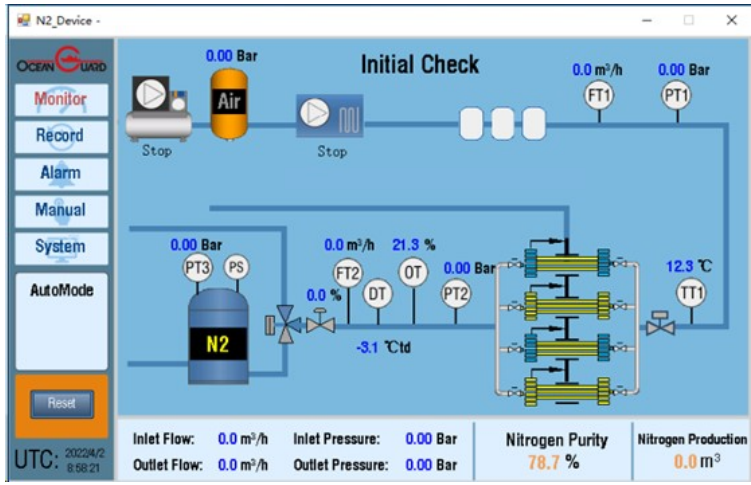


NITROGEN GENERATOR



The Nitrogen Generator can generate required volume of nitrogen at rated purity to be used in fuel gas supply pipelines. With the permeation process, water, oxygen and some of the argon exit through the membrane sides of the fibers. Only nitrogen will remain as product.

The Nitrogen Generator can meet the nitrogen requirement of most vessels with low power consumption, small size and high purity (no less than 99.5%)

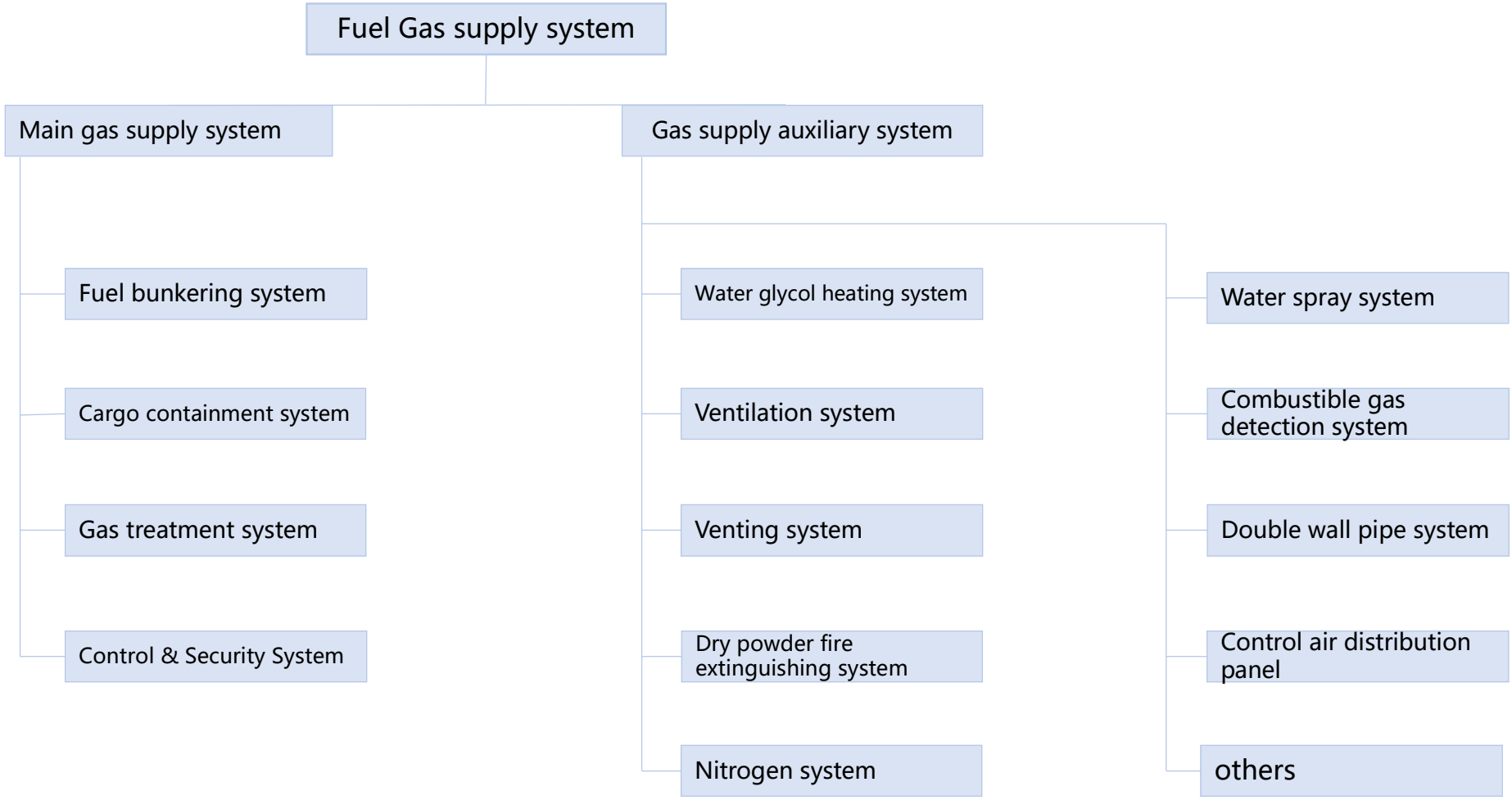


Variable application

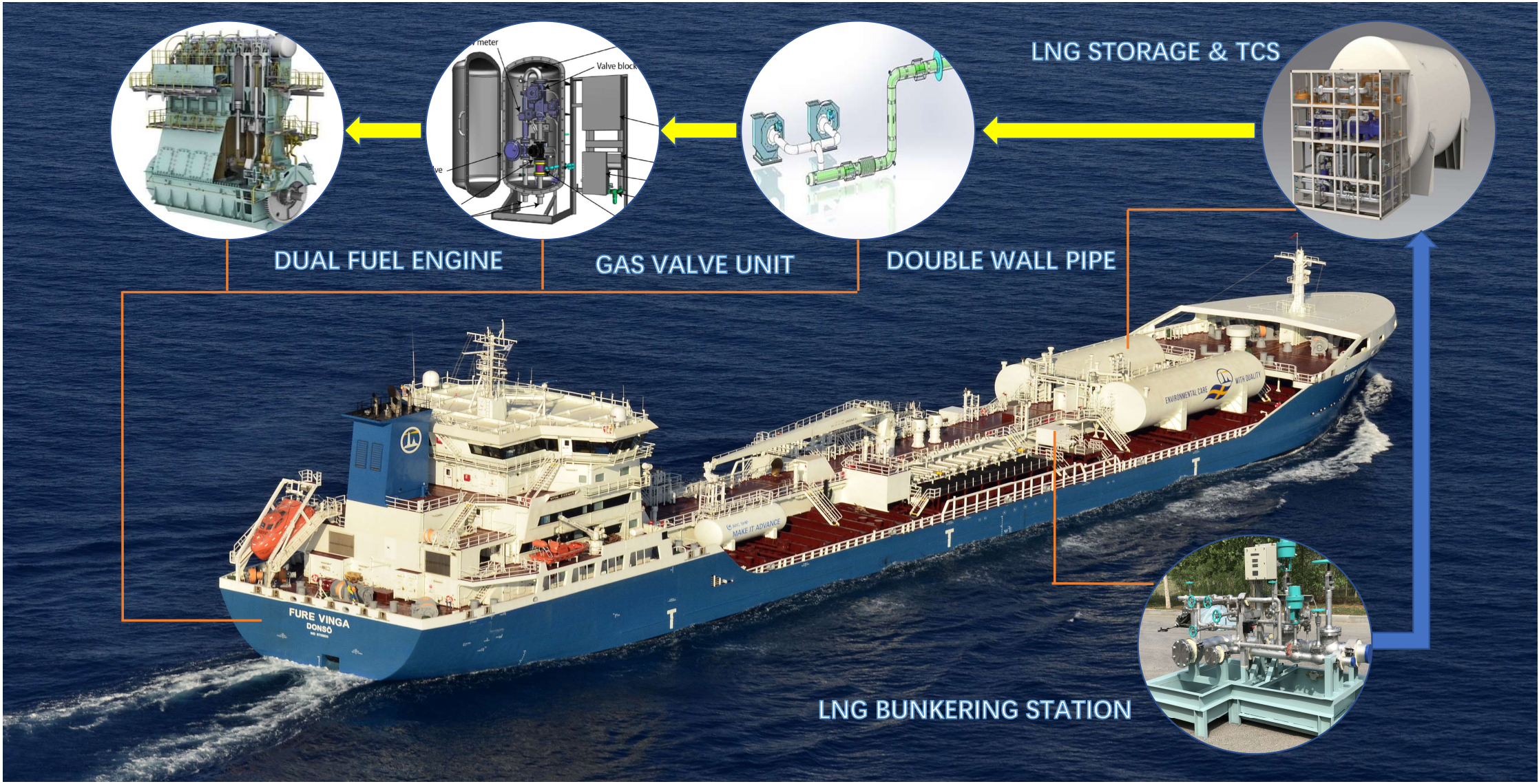
The OceanGuard® marine fuel gas supply system supports comprehensive solutions for low-pressure, medium-pressure, high-pressure, and BOG compressor systems to meet the various fuel requirements of different gas consumer.

System Model	Featuer	Requirement	Application	Engine Brand
Self Pressure Built-up Fuel Gas Supply System	◆ Modular delivery, standardized design ◆ Easy to maintain ◆ Less rotating equipment	◆ Demand Press.: Abt 6 – 8 Barg ◆ Demand temp.: Abt 0 – 60 ℃ ◆ Tank Capacity: ≤100 M3 in usual	Suitable for middle/high speed engines like Rolls Royce, NIGATA, DAIHATSU, WeiChai Power and etc, Applied for harbor tugboat, inland vessel, platform service vessel and etc	NIGATA YANMAR WEICHAI 潍柴
Low Pressure (Pump) Fuel Gas Supply System	◆ Modular delivery, standardized design ◆ Better Stability of fuel gas feeding ◆ LNG booster pump is controled by VFD device ◆ Back flow for LP pump	◆ Demand Press.: Abt 10 – 16 Barg ◆ Demand temp.: Abt 35 – 55 ℃	Suitable for WARTSILA, WIN GD low speed engine, usually to be seagoing ship	WIN GD WÄRTSILÄ
High Pressure (Pump) Fuel Gas Supply System	◆ Modular delivery, standardized design ◆ Higher gas heating effeciency ◆ Higher security level required ◆ Low pressure gas consumer for BOG consumption or re-liquefaction for BOG handling	◆ Demand Press.: Abt 285 – 300 Barg ◆ Demand temp.: Abt 35 – 55 ℃	Suitable for MAN B & W dual fuel low speed engine, usually to be seagoing ship	MAN
BOG Management Fuel Gas Supply System	◆ Modular delivery, standardized design ◆ Normal temperature natural gas compressor applied	The pressure for compressor inlet is as low as 0.5 Barg， inlet temperature is usually not less than -20 ℃	Suitable for single-layer type C tank system with design vapor pressure below 5 barg or type A/type B/Membrane type storage tank, etc.	

Configuration of LNG fuel gas supply system



Basic components of LNG FGSS



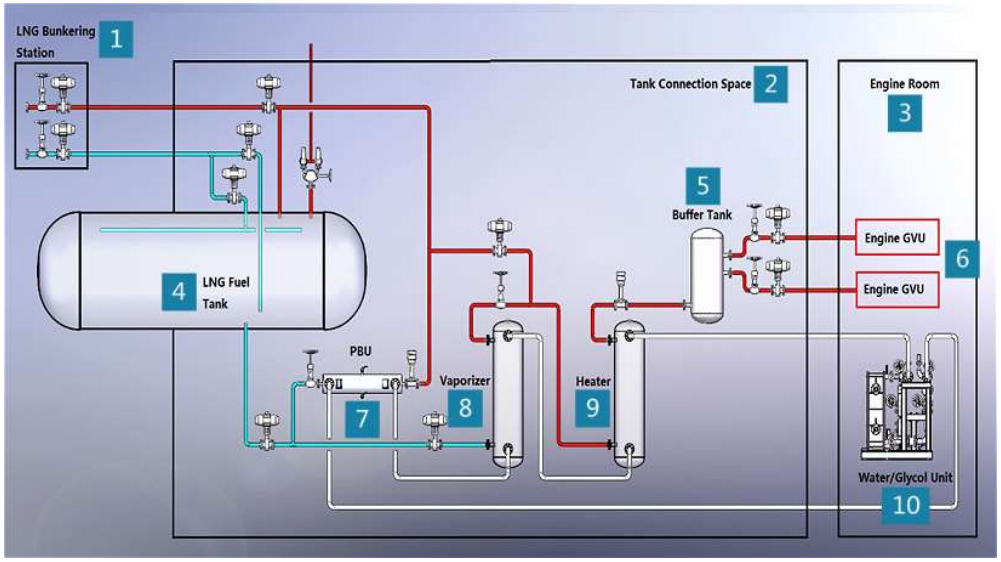
Self Pressure Built-up FGSS

System specification:

Self pressure built-up FGSS relies on the weight of the liquid to make the LNG in the storage tank to fow into the pressure built-up heat exchanger, forced vaporized NG vapor returns to the storage tank to maintain the pressure of the storage tank, then LNG liquid with stable pressure enters the LNG vaporizer and the NG heater, finally delivered to the buffer tank after vaporization, heating and regulation. The qualified gas is supplied to the user through the gas master valve and GVU.

In addition, the excess BOG gas can be heated by the NG heater through a separate pipeline for supplying BOG to the buffer tank and downstream users, so as to achieve the purpose of controlling the pressure of the storage tank.

Schematic diagram



1.LNG Bunkering Station 2.Tank Connection Space 3.Engine Room

4.LNG Fuel Tank 5.Fuel Gas Buffer Tank 6.Gas Consumer 7.PBU

8.LNG Vaporizer 9.NG Heater 10.Water Glycol Heating Unit

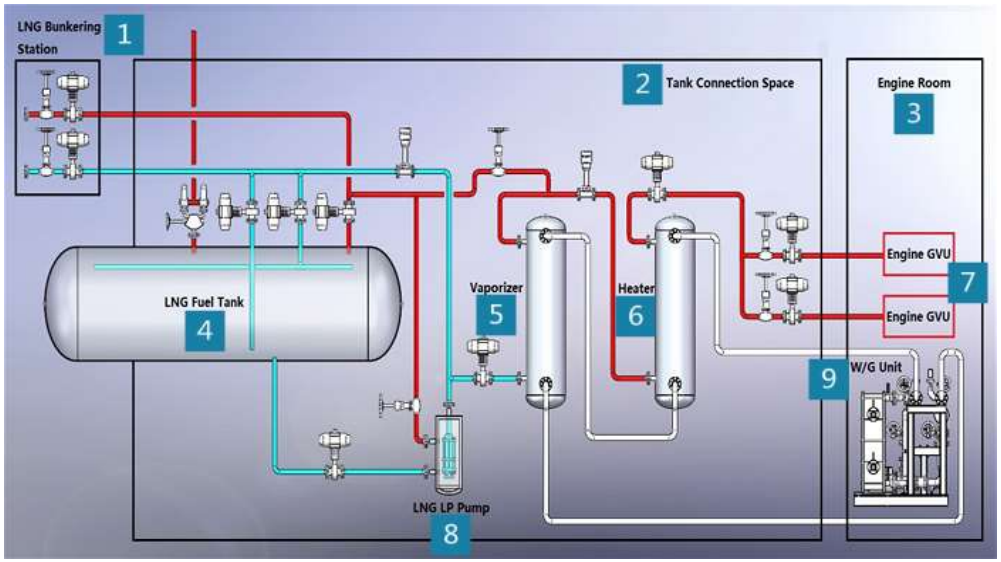
Low pressure FGSS

Low Pressure FGSS

System specification:

The low-pressure (pump) gas supply system uses a VFD controlled centrifugal pump installed in the tank or pump pump as fuel gas booster pump. LNG discharged from booster pump flow into the LNG vaporizer and NG heater for heating. The heated gas is delivered to the gas buffer tank, and the qualified gas is supplied to downstream gas consumers through the gas master valve and GVU.

Schematic diagram



1.LNG bunkering station 2.Tank connection space 3.Engine room

4.LNG fuel tank 5.LNG vaporizer 6.NG heater 7.Gas consumer

8.LNG pump and pump sump 9.Water glycol heating unit

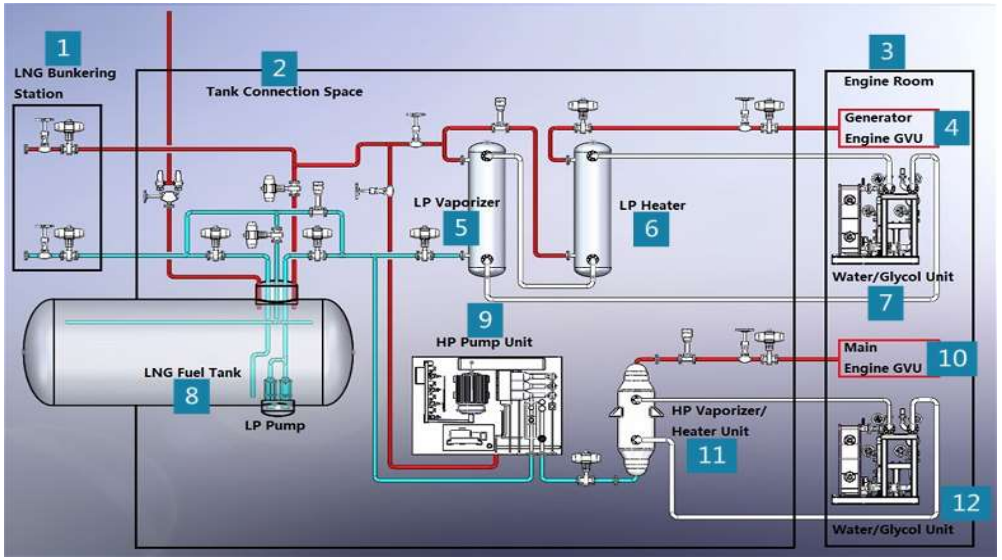
High pressure FGSS

High Pressure FGSS

System specification:

VFD controlled Low-temperature centrifugal pumps installed in tanks or pump sump is used for providing stable suction pressure for VFD controlled high pressure pump. LNG is pressurized to about 300 bar by the high-pressure pump to fullfill the main engine requirement, the heated gas is delivered to the gas buffer tank after heating by LNG vaporizer & heater, qualified gas is supplied to downstream gas consumers through the gas master valve and high-pressure GVT.

Schematic Diagram



1.LNG Bunkering Station 2.Dome Cover 3.Engine Room

4.Low Pressure Gas Consumer 5.LP LNG Vaporizer 6.LP NG Heater

7.Water Glycol Heating Unit 8.LNG Fuel Tank 9.HP Pump Unit

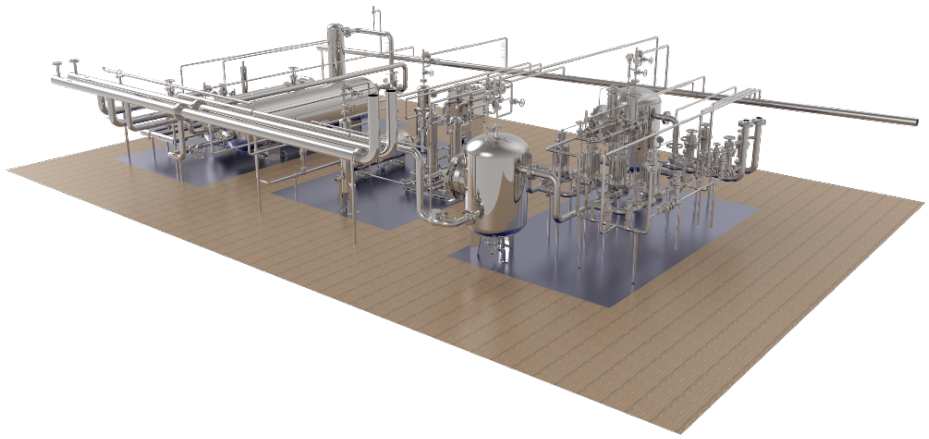
10.High Pressure Gas Consumer 11.HP LNG Vaporizer & NG Heater

BOG (Boil-off Gas) handling system

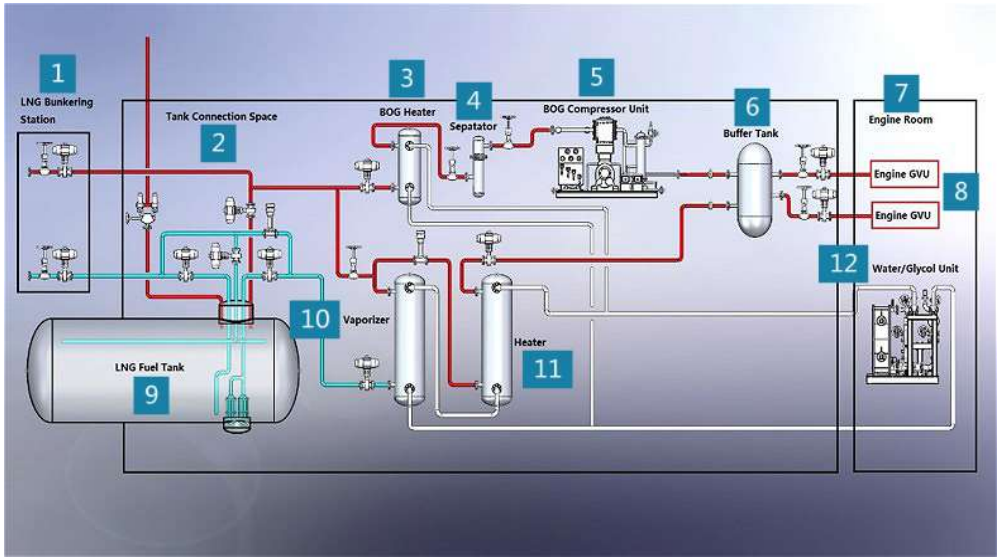
BOG(Boil-off Gas) Handling system

System specification:

The BOG handling system uses a VFD controlled normal temperature BOG compressor to deliver the excess BOG from the LNG storage tank to low pressure gas consumer. Usually the BOG compressor is select to be piston type or screw type.



Schematic diagram



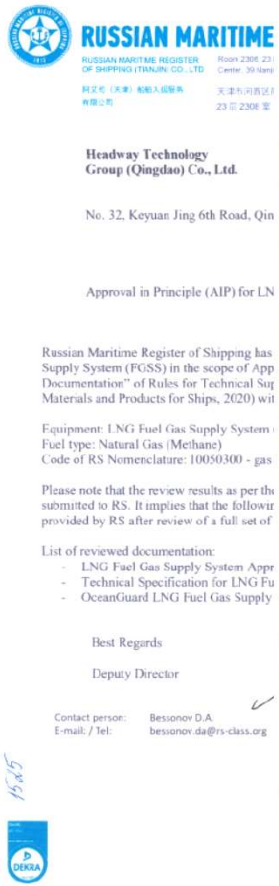
1.LNG bunkering station 2.Dome Cover 3.BOG Heater

4.Mist Separator 5.BOG Compressor Unit 6.Fuel Gas Buffer Tank

7.Engine Room 8.Gas Consumer 9.LNG Fuel Tank

10.LNG vaporizer 11.NG Heat

AiP certificates for LNG FGSS



RUSSIAN MARITIME

RUSSIAN MARITIME REGISTER OF SHIPPING (TIANJIN) CO., LTD

Headway Technology
Group (Qingdao) Co., Ltd.

No. 32, Keyuan Jing 6th Road, Qin

Approval in Principle (AIP) for LN

Russian Maritime Register of Shipping has
Supply System (FGSS) in the scope of App
Documentation" of Rules for Technical Sup
Materials and Products for Ships, 2020) wit

Equipment: LNG Fuel Gas Supply System
Fuel type: Natural Gas (Methane)
Code of RS Nomenclature: 10050300 - gas

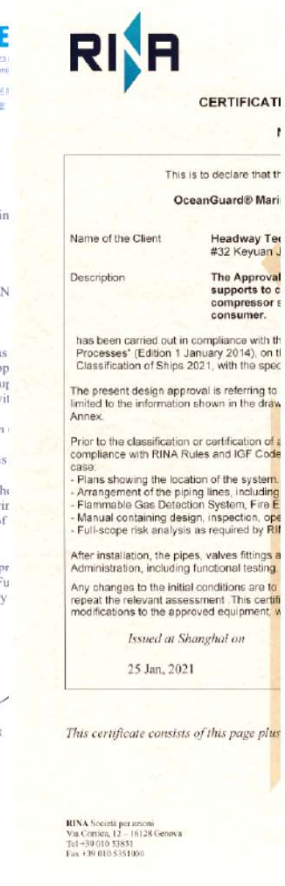
Please note that the review results as per th
submitted to RS. It implies that the followir
provided by RS after review of a full set of

List of reviewed documentation:
- LNG Fuel Gas Supply System Appr
- Technical Specification for LNG Fu
- OceanGuard LNG Fuel Gas Supply

Best Regards

Deputy Director

Contact person: Bessonov D.A.
E-mail: / Tel: bessonov.da@rs-class.org



RINA

CERTIFICATI

This is to declare that th

OceanGuard® Mari

Name of the Client: Headway Te
#32 Keyuan J

Description: The Approval
supports to c
compressor s
consumer.

has been carried out in compliance with th
Processes" (Edition 1 January 2014), on t
Classification of Ships 2021, with the spec

The present design approval is referring to
limited to the information shown in the draw
Annex.

Prior to the classification or certification of
compliance with RINA Rules and IGF Code
case.
- Plans showing the location of the system,
- Arrangement of the piping lines, including
- Flammable Gas Detection System, Fire E
- Manual containing design, inspection, ope
- Full-scope risk analysis as required by RI

After installation, the pipes, valves fittings a
Administration, including functional testing.

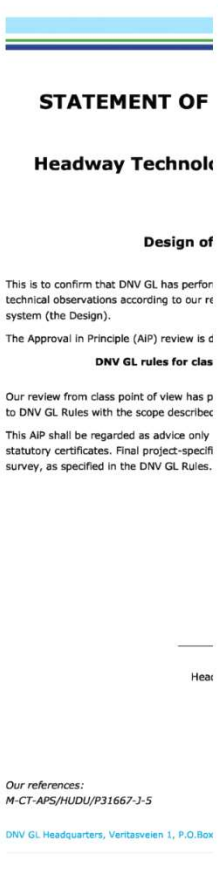
Any changes to the initial conditions are to
repeat the relevant assessment. This certifi
modifications to the approved equipment, w

Issued at Shanghai on

25 Jan, 2021

This certificate consists of this page plus

RINA Società per azioni
Via Corsi, 12 - 16128 Genova
Tel +39 010 53851
Fax +39 010 5351000



STATEMENT OF

Headway Technol

Design of

This is to confirm that DNV GL has perfor
technical observations according to our re
system (the Design).

The Approval in Principle (AIP) review is d

DNV GL rules for clas

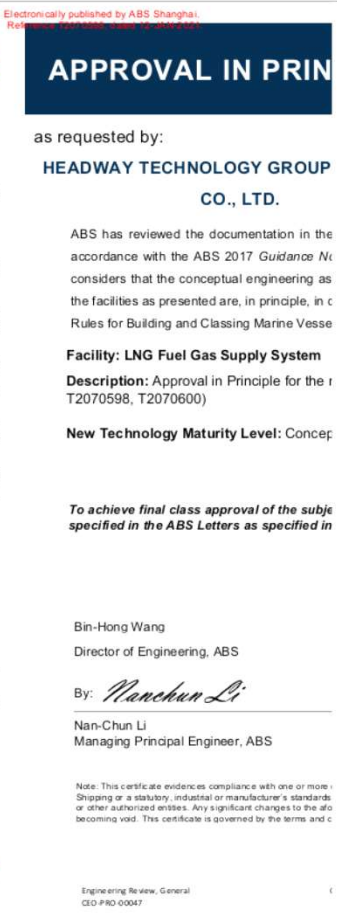
Our review from class point of view has p
to DNV GL Rules with the scope describec

This AiP shall be regarded as advice only
statutory certificates. Final project-specifi
survey, as specified in the DNV GL Rules.

Hea

Our references:
M-CT-APS/HUDU/P31667-J-5

DNV GL Headquarters, Veritasveien 1, P.O.Box



Electronically published by ABS Shanghai,

APPROVAL IN PRIN

as requested by:

HEADWAY TECHNOLOGY GROUP
CO., LTD.

ABS has reviewed the documentation in the
accordance with the ABS 2017 *Guidance No*
considers that the conceptual engineering as
the facilities as presented are, in principle, in c
Rules for Building and Classing Marine Vesse

Facility: LNG Fuel Gas Supply System

Description: Approval in Principle for the r
T2070598, T2070600)

New Technology Maturity Level: Concep

To achieve final class approval of the subje
specified in the ABS Letters as specified in

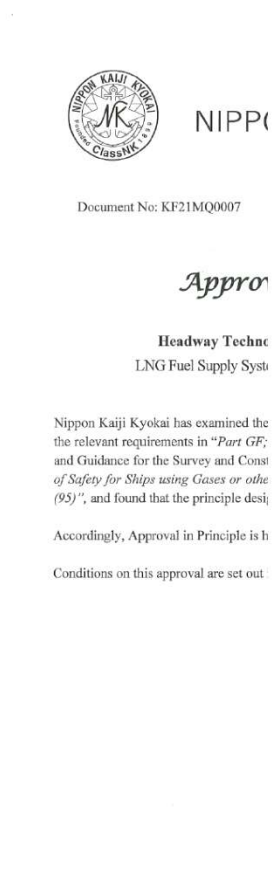
Bin-Hong Wang
Director of Engineering, ABS

By: *Nanchun Li*

Nan-Chun Li
Managing Principal Engineer, ABS

Note: This certificate evidences compliance with one or more
Shipping or a statutory, industrial or manufacturer's standards
or other authorized entities. Any significant changes to the afo
becoming void. This certificate is governed by the terms and c

Engineering Review, General
CEO-PRO-00047



NIPP

Document No: KF21MQ0007

Appro

Headway Techno
LNG Fuel Supply Syste

Nippon Kaiji Kyokai has examined the
the relevant requirements in "*Part GF;*
and Guidance for the Survey and Const
of Safety for Ships using Gases or othe
(95)", and found that the principle desi

Accordingly, Approval in Principle is h

Conditions on this approval are set out

BUREAU VERITAS

Approval in Principle
JDP/FGSS/20002

At the request of:

Headway Technology Group (Qingdao) Co., Ltd.

BUREAU VERITAS, acting within the scope of the General Conditions of the Marine & Offshore Division, declares hereunder that the design of the:

Fuel Gas Supply System (FGSS) of HEADWAYTECH

is **Approved in Principle**, with respect to the aim of the classification as defined in Part A, Chapter I of the latest edition of Bureau Veritas Rules and in the conditions stated in Annex 1.

The present design approval is referring to the general options chosen by the designer, and is limited to the information shown in the drawings submitted within the scope of this Approval and listed in Annex 2.

Prior to the classification or certification of a ship, all relevant drawings, calculation notes, test reports and other documents necessary listed in Bureau Veritas Rules NR529 for Gas Fuelled Ships are to be submitted for review.

The validity of this approval may have to be reconsidered, in case of any major modification likely to invalidate the principles and general arrangement of the Unit.

The approval would become null and void should BUREAU VERITAS not be kept informed of such modifications.

Issued in Shanghai, on 06.01.2021

Richard LIU
Safety & Cargo Section Manager

Tribin CHEN
CPO Department Manager

Shengyue ZHU
Safety & Cargo Engineer

First SIL certificate of marine fuel supply system

DNV

DNV Certificate No.: FSSA-029-1028582
Place and date: Høvik, 16 June 2021
Revision No.: 0

Conditions of Certification

1. This certificate is based on 2021-0479, Rev. 0.
2. Printed and downloaded ce
3. This certificate is based on agreed between Det Norsk Co., Ltd.
4. The functional safety certifi
5. The use of this certificate is DNVGL-SE-0141, Edition A
6. This certificate remains the

DNV Headquarters. Veritasveien 1. P.O.Box 30

DNV

DNV Certificate No.: FSSA-029-10285820-HT
Place and date: Høvik, 16 June 2021
Revision No.: 0

FUNCTIONAL SAFETY CERTIFICATE

DNV Certificate No.:	Initial date:	Valid:
FSSA-029-10285820-HT	16 June 2021	16 June 2021-

This is to certify that the Functional Safety Capability of the
LNG Fuel Gas Supply System (FGSS)

Designed by:

Headway Technology Group (Qingdao) Co., Ltd.
Qingdao, China

have been assessed by DNV AS and found to conform to the following functional safety standards and subclauses:

IEC 61508:2010, Part 1, Clauses 5, 6, 7.1-7.6, 7.10, 7.18, 8.
IEC 61508:2010, Part 2, Clauses 5, 6, 7.1-7.4, 7.9, 8.
IEC 61511:2016, Part 1, Clauses 5, 6, 7, 8, 9, 10, 11, 19, excluding Clause 8.2.4.

When assessed using;
The CASS Scheme for Functional Safety Capability.

The assessed safety instrumented functions are:

SIF	SIL	SIF	SIL
SIF5: Fuel Gas Buffer Tank pressure high high	1	SIF33: Ventilation duct for engine room gas alarm	2
SIF8: Fuel Gas Buffer Tank temperature low low	2	SIF36: Engine room gas alarm	2
SIF15: PS tank level high high (90%) alarm	1	SIF37: Main engine gas alarm	2
SIF16: SB tank level high high (90%) alarm	1	SIF38: No.1 auxiliary engine gas alarm	2
SIF17: PS tank pressure high high alarm	1	SIF41: PS Evaporator water glycol discharge temperature low low	2
SIF18: SB tank pressure high high alarm	1	SIF42: SB Evaporator water glycol discharge temperature low low	2
SIF26: WG Pump Discharge Line temperature low low	2	-	-

for the Accredited Unit:
DNV AS
Veritasveien 1
1363 Høvik
Norway

Fubin Qian
Project Manager

cass

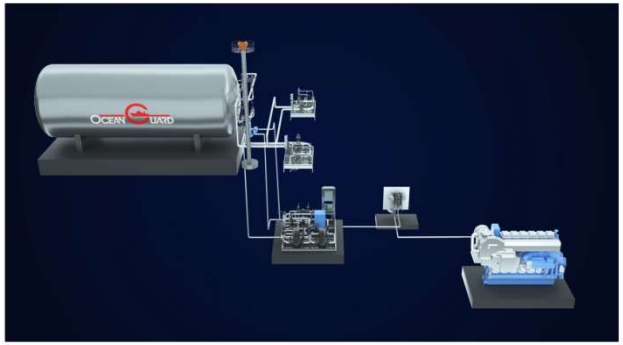
Place and date:
Høvik, 16 June 2021

for the Accredited Unit:
DNV AS
Veritasveien 1
1363 Høvik
Norway

Meine van der Meulen
Certification Decision

DNV Headquarters. Veritasveien 1. P.O.Box 300. 1322 Høvik. Norway. Tel: +47 67 57 99 00. www.dnv.com

LNG fuel gas supply system (FGSS)



- HEADWAY has the packaging service capability of high pressure/low pressure/self-pressurized gas supply system/BOG handling unit which can be adapted to various types of dual-fuel medium-speed engine& low-speed engine.
- 5+5 FGSS supply agreement was signed with Rui Neng Ocean Shipping.
- 2 x 11000DWT LNG powered bulk carriers (CCS Class) have been delivered.
- 1 x High pressure LNG FGSS READY(ABS Class) for 6000DWT teaching ship has been delivered;
- SIL Functional safety certificate and principle recognition certificate of classification societies have been obtained.

Strength of HEADWAY

Item	HEADWAY	COMPETITOR
Product category	Provide customized solutions for environmental protection and emission reduction - LFSS (LNG, Methanol.....) - CHS for bunkering vessel - EGCS+CCSU - BWMS	- Single product category
Technical advantage	- Ability of fuel tank strength design/CAE verification - Debugging with simulation software - Design improvement relying on new energy test center	- The system design relies on theoretical calculation and lacks the support of simulation technology
Manufacturing& Quality Control	- Professional stainless steel welding team with more than 40 people - quality management system and safety production system	- moduleds are outsourced for some package suppliers
Design & commissioning	- generally have more than 6 years of working experience in marine equipment industry - Independent design, assembly and commissioning	- Lack of experience in ship design and commissioning
After-sales	- 90+Service engineers - 3 Overseas spare parts warehouse - 120+ Global after-sales service stations	- Weak after-sales service capability

INNOVATION FOR BETTER LOW CARBON SOLUTION

THANKS !

Headway Technology Group
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Fax: (86) 532 8310 7816
Email: sales@headwaytech.com
http://www.headwaytech.com