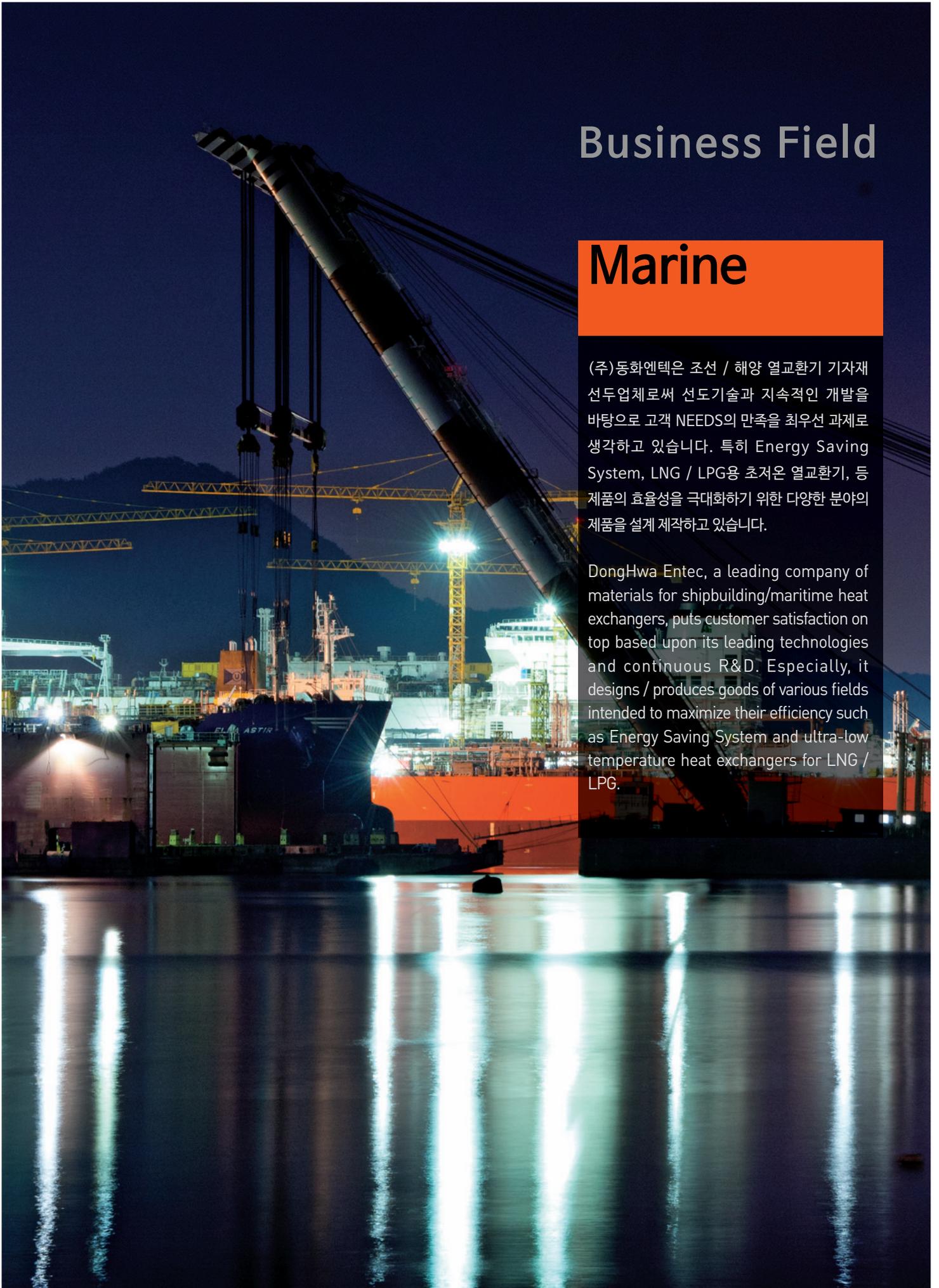


Business Field

Marine

(주)동화엔텍은 조선 / 해양 열교환기 기자재 선두업체로서 선도기술과 지속적인 개발을 바탕으로 고객 NEEDS의 만족을 최우선 과제로 생각하고 있습니다. 특히 Energy Saving System, LNG / LPG용 초저온 열교환기, 등 제품의 효율성을 극대화하기 위한 다양한 분야의 제품을 설계 제작하고 있습니다.

DongHwa Entec, a leading company of materials for shipbuilding/maritime heat exchangers, puts customer satisfaction on top based upon its leading technologies and continuous R&D. Especially, it designs / produces goods of various fields intended to maximize their efficiency such as Energy Saving System and ultra-low temperature heat exchangers for LNG / LPG.



FGSS

FUEL GAS SUPPLY SYSTEM for LNG fuelled Small/Mid-Scaled ship

• System configuration _시스템구성

Vaporizer package unit _기화기 일괄 구성

고압 2행정 주엔진과 저압 4행정 발전엔진에 연료를 공급하는 시스템 구성

Main fuel supply system package unit for both high pressure 2 stroke engine and low pressure 4 stroke generator engines

- 두가지 연료를 사용하는 2행정 고압 주엔진

고압기화기 : 초임계 상태에서 LNG를 기화시켜 주엔진에 공급

- 4행정 저압 발전엔진

강제기화기 : 공급받은 LNG를 기화시켜 기수분리기로 공급

연막분리기 : 공급받은 NG를 비등점 차를 이용하여

무거운 탄화수소 계열과 수순 Methane으로 분리

가스연료가열기 : 엔진에서 요구되는 온도로 연료를 가열시키는 가열기

- For 2 stroke high pressure main dual fuel engine

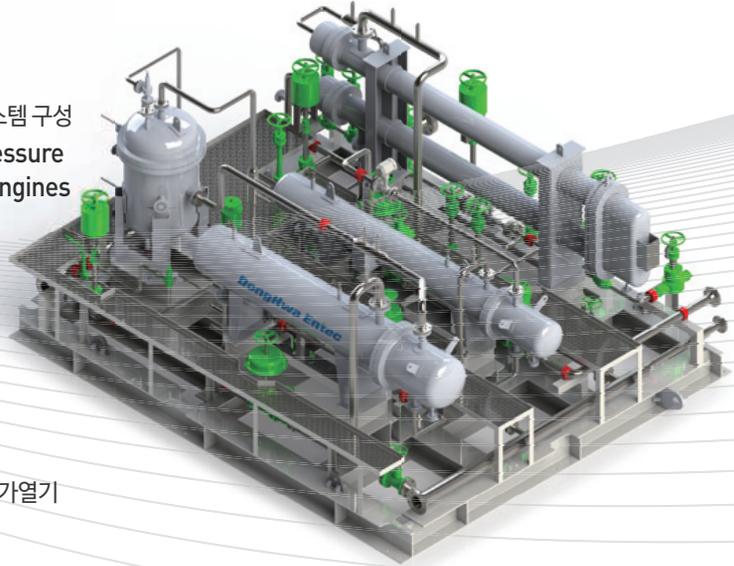
High pressure vaporizer : Vaporization of high pressure super-critical LNG to the main engine

- For 4 stroke low pressure generator engines

Forcing vaporizer : Controlled vaporization to keep high methane number

Mist separator : Separation of heavy hydro carbons and flows only high methane gas to the engines

Fuel gas heater : Fuel gas heating to meet the requirements of the generator engines



IHM(intermediate Heat Medium) Heater package unit

_중간 열매체 가열기 일괄 구성

중간 열매체 저장용기 : IHM(글리콜 50%+물 50%)

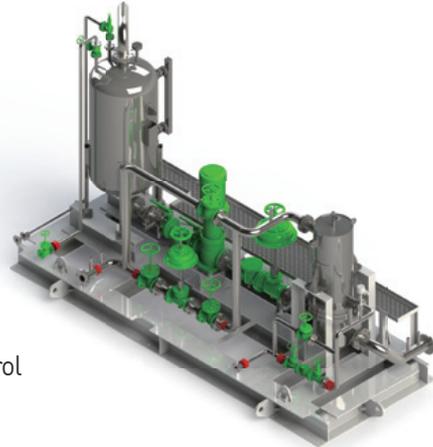
IHM펌프 : 중간 열매체를 기화기와 가열기에 순환시키는 펌프

IHM히터 : 포화증기를 이용하여 중간 열매체를 가열시키는 장비

IHM Tank : Container of IHM(50% Glycol + 50% water)

IHM Pump : Circulate the IHM from the LNG vaporizer to the IHM heater

IHM Heater : Heating IHM using steam with automatic temperature control

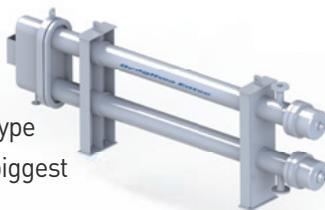


• Type of Vaporizer

Hairpin type High Pressure Vaporizer

Shell & Tube 형태의 열교환기로 고압의 사용환경에 맞게 개선한 기화기

Already field proven shell & tube type can be opened for maintenance biggest installation area needed



Spiral Flow type Pressure Vaporizer

Hairpin 형태의 열교환기 단점을 보완, 동일 용량의 Hairpin 열교환기 대비 설치공간이 작고 유지보수공간 또한 작음

Compact installation area needed already field proven heat exchanger





HP Vaporizer for RV/FSRU

LNG를 육상 수요처에 직접 공급하는 신개념 선박으로 LNG운반과 인수기지 역할을 하는 RV, FSRU에 주로 설치되어, 액화 천연가스를 해수를 통해 천연가스로 기화시키는 재기화 설비로서 공급되는 장비

As advanced concept technology ship in which LNG is supplied to the land directly, this is mainly installed in RV / FSRU which is making a role of LNG transportation and unloading facility. This is also re-gasification facility that vaporizes LNG through seawater.



BOG Recondenser

BOG 를 재액화시켜 CARGO TANK에 다시 저장시키는 설비로 LNG의 손실을 줄이는데 적용되는 설비

BOG Recondenser is to re-liquefy remained BOG and re-store them in cargo tank, so this facility can prevent LNG loss.



LNG Vaporizer / Forcing Vaporizer

LNG 상차 / 하역 시 LNG / N2를 기화하는 장비이며, 엔진 / 보일러 등에 연료로 사용되는 BOG 발생량이 적을 경우 강제로 액화천연가스를 기화하여 공급하는 장비

LNG Vaporizer is an equipment vaporizing LNG / N2 while LNG is being transported, if BOG generation used to fuel in engine / boiler is low, this supplies by vaporizing liquefied natural gas in force.

Glycol Water Heater for cofferdam

극저온의 LNG CARGO로부터 선체를 보호하기 위해 CARGO와 CARGO사이의 임시 물막이에 설치된 HEATING COIL 내부로 90°C로 가열된 GLYCOL WATER를 순환시키는 장비

In order to protect body of the ship from extremely cold LNG Cargo, Glycol Water Heater is circulating Glycol water which is heated up to temperature of 90°C through heating coil that installed in temporary water-board between cargos. This is used to heat Glycol water supplied to the vaporizer.





Energy Saving System

선박의 중앙해수냉각시스템의 S.W.Pump와 Engine Room Fan, Cargo Hold Fan의 전력을 최적화하기 위한 지능형 제어시스템 장비

Energy Saving System is intelligent control system to optimize power of Engine Room Fan, Cargo Hold Fan and S.W.Pump of central seawater cooling system of the ship.



MGO Cooling Unit

냉매를 이용해 선박용 연료유(MGO)의 공급이 원활하도록 연료유의 온도를 낮춰 점도를 높여주는 장비

MGO Cooling Unit is used to cool temperature of fuel oil for its smooth circulation of fuel oil (MGO) using refrigerants.



Fuel Switch

Bunker Change 과정을 자동 컨트롤 시스템을 통하여 수행하는 장비

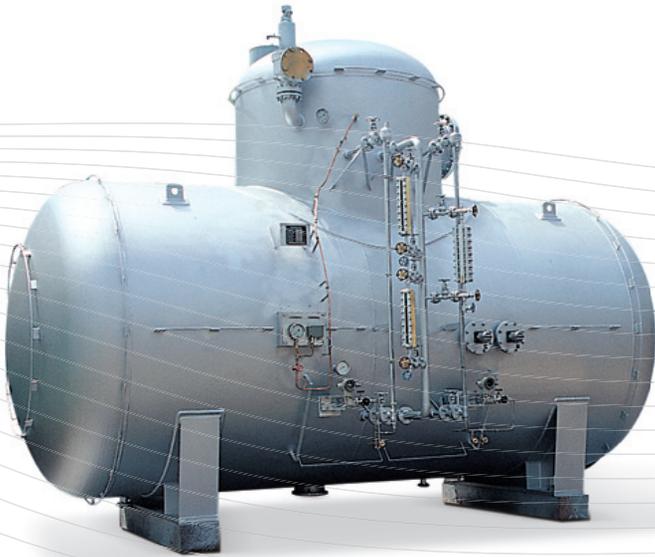
Fuel Switch is conducted for bunker change process through automatic control system.



Electric Heater

선박의 주요기기에 사용되는 윤활유, 연료유, 청수 등을 운전 상태에 적합하게 가열하거나, OIL TANK / BILGE TANK를 가열하는데 STEAM 대신에 전기로 가열하는 장비

Electric heater is used to heat lubricant oil, fuel oil, and jacket water in operating condition and this is used to heat Oil tank / bilge tank with steam instead of electricity.



Deaerator

보일러용 급수에서 보일러, 배관, 열교환기 등의 내부 부식의 원인이 되는 가스(산소, 이산화탄소)를 제거하고, 가열하는 가열기의 기능을 하며 급수펌프의 Net Positive Suction Head(유효흡입양정)가 일정하게 유지되도록 하는 기능을 가진 장비

Deaerator is used to remove gas (oxygen, carbon dioxide) from feed-water for preventing corrosion inside of boiler, piping and heat-exchanger, and utilized to heat feed-water, and maintain stable NPSH (Net Positive Suction Head) of feed-pump.

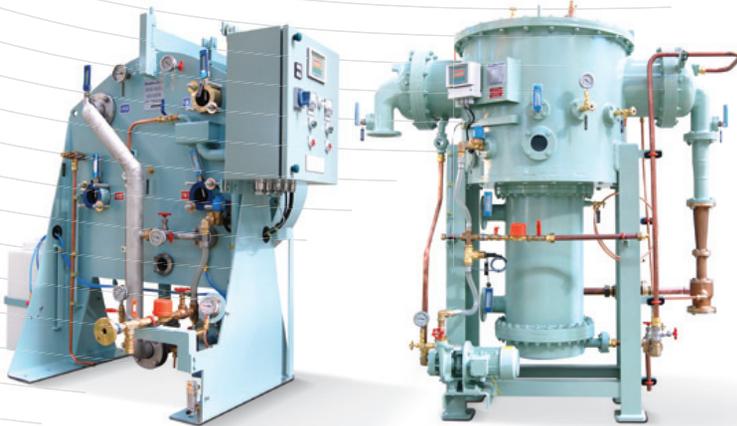


Plate Type

Tubular Type

Fresh Water Generator

M/E JACKET WATER를 이용하여 해수를 선박에서 필요한 담수로 만드는 장비(S&T TYPE 과 PLATE TYPE)

Fresh Water Generator is equipment for making seawater into fresh water required in the ship using M/E jacket water (S&T Type and Plate type)



Plate Heat Exchanger

Plate Cooler는 얇은 금속판에 주름을 만들고 Gasket을 부착해서 Plate와 Plate사이의 좁은 틈 사이로 유체를 빠른 속도로 흘려 짧은 시간에 많은 열 교환을 할 수 있는 가장 단순한 구조의 열교환기

Plate Cooler is making wrinkled-thin metal plates to transfer heat between two fluids using gaskets and this cooler can exchange large amount of heat in short period of time.



Cargo Drain Cooler

LNG선의 시스템을 이루고 있는 장비들에서 사용 되어지는 포화수를 응축하여 급수를 재활용 할 수 있게 하는 장비

Cargo Drain Cooler enables the re-use of feed-water by condensing saturated water which being used in LNG tanker system equipment.



Drain Cooler

Dumping Steam들과 각종 보조기기류 등으로부터 발생되는 STEAM 및 포화수를 보일러 급수로 재활용할 수 있도록 응축시키는 장비

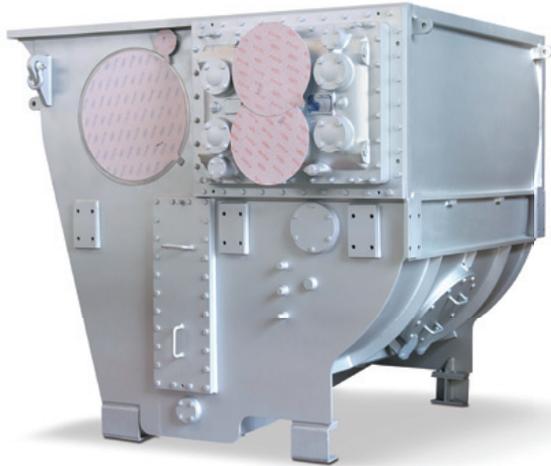
Drain Cooler enables reuse of dumping steam and saturated water generated from various auxiliary components as feed-water of boiler.



Oil Heater

선박에 사용되는 연료유, 윤활유 등 보일러에 의해 생성 되어진 STEAM을 이용하여 가열하는 장비

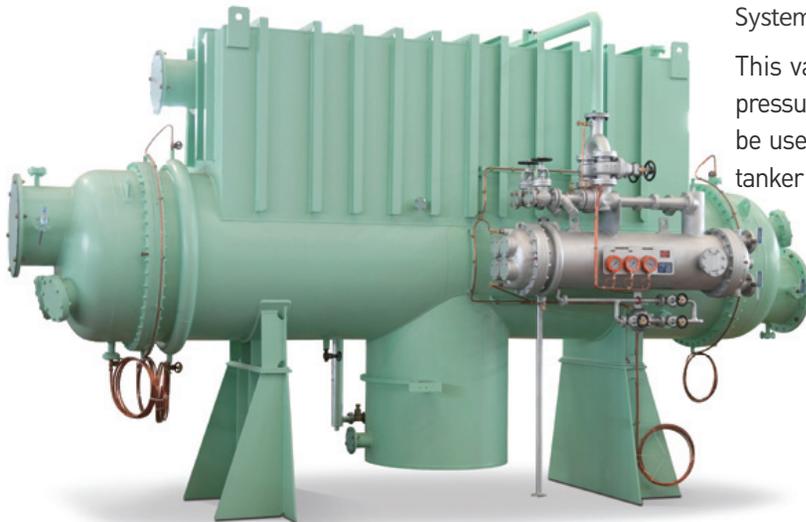
Oil heater is used to heat a fuel oil and lubricant oil for ships by using the steam generated from boiler.



Air Cooler

엔진에 공급되는 AIR를 냉각하는 장비로 20년 이상 저속 및 고속엔진에 사용되는 Air Cooler를 개발 / 제작해 왔으며, 전 세계 Air Cooler 시장점유율 50%정도 차지

An equipment cooling air provided in the engine, we have been developed / manufactured Air Cooler used for low and high speed engine for more than 20 years with taking 50% of market share.



COPT Vacuum Condenser

유조선의 터빈 성능향상을 위해 진공을 발생시키는 용도와 Exhaust Steam 회수를 위한 용도로 설치되며, Tanker선종의 Inert Gas System 적용시 발생하는 증기회수에도 사용 되는 장비

This vacuum condenser is installed to generate back-pressure for improving turbine performance, and this can be used to recollect Exhaust steam that discharged from tanker ship with inert gas system.



Tank Cleaning Heater

화물의 안전수송 및 제품의 오염을 방지 혹은 다른 종류의 기름을 보관용으로 Tank 내 잔존 오일 및 찌꺼기 청소를 위해 S.W 혹은 F.W를 가열하는 용도로 사용하는 장비

Tank Cleaning Heater is used to heat S.W or F.W in order to clean the remaining oil and oil sludge inside of oil tanker as for safe transportation of cargo, storage of different kinds of consignments and prevention of contamination of product.

Business Field

Plant

(주)동화엔텍은 석유화학공업, 발전설비, 방직공장 그리고 식품산업 등의 열회수와 효율적인 설비로 사용되는 모든 종류의 열교환기를 자체 생산하고 있습니다. 특히 대형 회전기기용 열교환기에 많은 실적을 가지고 있으며, 우수 엔지니어링사와 중공업으로 부터 견적을 제출하고 주문품을 제작 납품하고 있습니다.

DongHwa Entec is producing all kinds of heat-exchanger in our factory which are efficient facility and heat-recovery such as the petro-chemical industry, generating unit, textile factory and food industry. In particular, we have a great record on heat-exchanger for large rotation equipments, and submit an estimate from oil-water engineering and heavy industry and then delivery of manufactured goods.



Application for Steam Turbine

- 01_ Surface Condenser
- 02_ Ejector Condenser
- 03_ Gland Condenser



Application
for Gas Turbine

- 01_ Turbine Cooling Air Cooler
- 02_ Fuel Gas Heater
- 03_ FGH & TCA(Combined Type)
- 04_ Gas Turbine Intake Air Heater & Cooler
- 05_ F.G.H After Cooler



Application
for Compressor

- 01_ Inter / After Gas Cooler
- 02_ Lube Oil Cooler



Application for Boiler & FGD of Power Plant

- 01_ Steam Coil Air Heater
- 02_ Flue Gas Cooler & Reheater



Other Types

- 01_ Brazed Aluminum Plate Fin Heat Exchanger
- 02_ H₂ / Air Cooler for Generator
- 03_ Air Fan Cooler



LNG INSULATION MATERIALS



Reinforced Polyurethane Foam

Boil-Off Gas(BOG) is the second largest cost for a LNG charterer, representing 30% of total shipping cost. For your benefit, Our goal is to supply the best BOR and eco-friendly foam for your project.



Flexible Secondary Barrier(FSB)

We have two types of FSB such as HFT-2010 and HFT-2015. HFT-2015 is a combination of Aramid and Glass fiber in order to increase tensile strength. As a result, the value of fatigue test is approximately 6 times higher than HFT-2010. We Can customize the size of FSB to reduce any loss at your site.



Rigid Secondary Barrier(RSB)

The main goal of secondary barrier is to prevent any leakage of LNG when the primary barrier(membrane) has a damage due to the sloshing impact. We are the only company which can produce rigid secondary barrier.



Insulation Panels

We supply various types of LNG insulation panels which can be produced to meet your special needs. Our R-PU foam and secondary barriers(RSB, FSB) greatly improve the insulation performance of IP.



Pipe Insulation

Based on our technologies and know-how, we produce the suitable pipe insulation for your project. We have our own installation team. Thus, you will see the best quality of pipe insulation at your project.



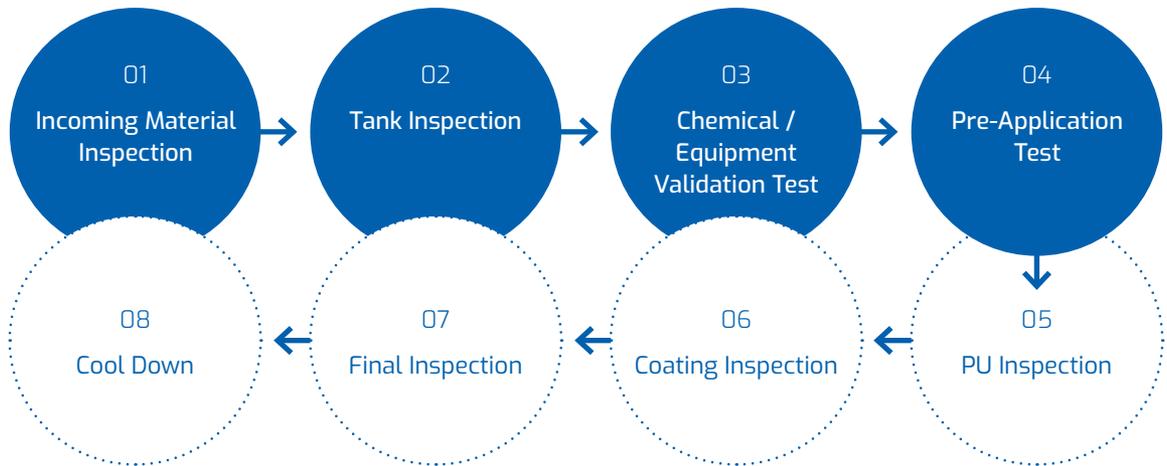
Primary Barrier(Membrane)

Even though, we do not produce primary membrane, we can supply it for your project. You do not need to contact with membrane supplier, you can just contact us.

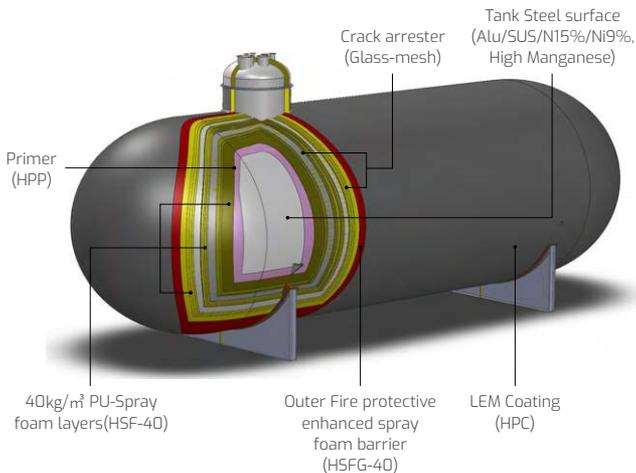
SPRAY FOAM INSULATION FOR LPG/LEG/LNG

- Reduce the application time
- HFC & HFO eco-friendly blowing agent system
- Improved weather exposure resistance during assembly
- No protection needed for outdoor storage of insulated tanks
- Improved insulation shelf-life time
- Seamless operation with enhanced quality
- Streamlined operation with enhanced quality
- Excellent thermal efficiency
- Highly resistant to fire(DIN 4102 Part1, class B2 or higher)
- Minimize the maintenance

Quality Control and Inspection Policy



Type C Tank Spray Foam Insulation



Type B Type Fuel Tank Insulation



Approval in principle :
 HANKUK CARBON's Spray Foam Insulation of IMO
 Type B & C - LPG/LNG Cargo & Fuel Tanks



STORAGE TANK SYSTEM FOR LNG

Ground Storage Tank-GTT

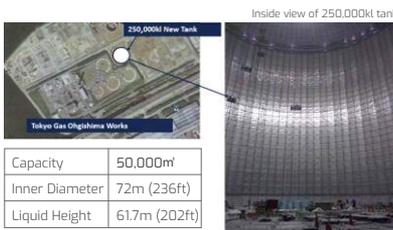
Hankuk Carbon is deeply involved in storage tank business. In case of GST(GTT Ground Storage Tank system), we support and supply our total solution to you. Therefore, you only need to contact us to purchase all of the materials and equipments which shall be installed and used in the tank. In addition, one of our staff specially stay on site to control the delivery schedule and check the product quality.



Source : EWC

Underground Storage Tank-IHI

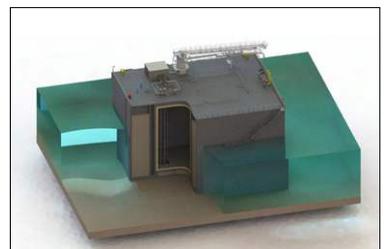
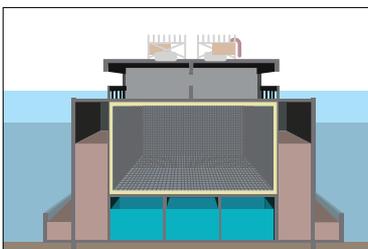
In case of IHI Storage Tank system, we developed 10 different density of foams for cost savings. After contract, we carried out a several tests(thermal shock, creep test....) during 2 years to ensure the quality.



Source : IHI

Gravity-Based System(GBS)-GTT

Gravity-Based System(GBS) is one of storage tank system designed by GTT. It is to support the growth in LNG demand and assist the maritime industry in the energy transition. For your successful GBS business, Hankuk Carbon already set up the supply chain to provide our total solution.



Source : GTT

Energy & Ocean Solutions

Hanwha Power Systems / Hanwha Power Systems Global

www.hanwhapowersystems.com

2024 Total Sales

295 In USD millions

2024 Total Assets

252 In USD millions

Our expertise

Industrial compressors, power generation solutions, after market business, maritime solutions

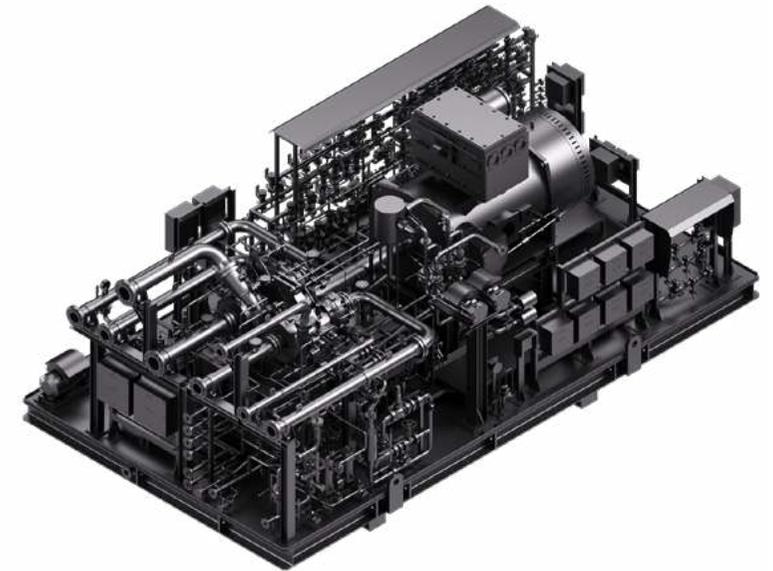
* The above sales and total assets include all business areas of Hanwha Power Systems and Hanwha Power Systems Global.

Hanwha Power Systems launched its energy equipment business, building on our reliable technology and longstanding experience in gas turbine engines. Since then, we've become a global powerhouse and have delivered more than 8,000 air and gas compressor units worldwide. In 2017, we relaunched as an independent company, setting the foundation for stable growth. In 2022, we were acquired by Hanwha Impact.

In the compressor business, we utilize our proprietary design, production, and testing capabilities to develop technology-intensive products, including industrial air compressors for various manufacturing processes; fuel gas compressors for power plants; and boil-off gas compressors and expanders for LNG carriers, terminals, and plants. We offer these products domestically and internationally.

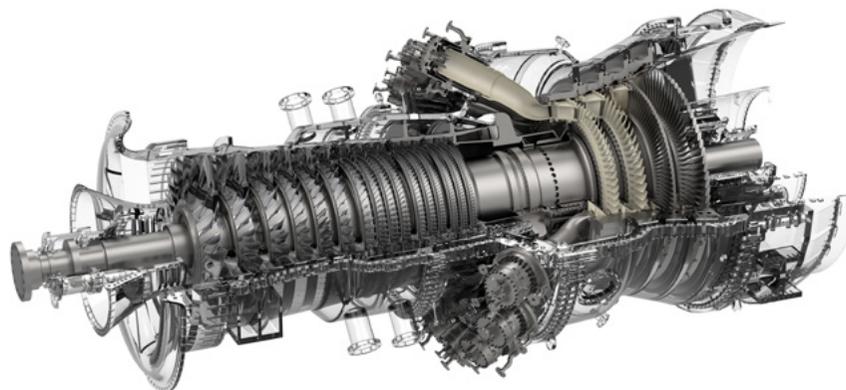
We won a contract to supply the world's first turbo compressor for marine vapor recovery units (VRUs). We also won a contract to provide compressors for floating storage regasification units (FSRU) and LNG carriers. These machines have allowed us to demonstrate our outstanding technology in the global market. Our compressors and expanders use core components developed in-house that permit them to operate with shorter lead times and better performance. Their high efficiency offers a competitive advantage for our customers. In 2021, we were awarded a nitrogen refrigerant system (NRS) project for a liquefied natural gas floating storage unit (LNG-FSU) from Hanwha Ocean, which led to our selection as the standard for NRS specifications. In February 2025, in collaboration with Hanwha Ocean, we signed an agreement with global energy technology company Baker Hughes to jointly develop the world's first ammonia-powered gas turbine propulsion system. This marks a significant step forward in advancing next-generation eco-friendly technologies. Through this collaboration, we aim to complete the development of ammonia-powered LNG carriers and container ships by 2028, playing a key role in leading the decarbonization of the shipbuilding industry.

We operate comprehensive after-sales services to ensure that our customers' facilities continue to run at optimal efficiency even after product delivery. Through our Smart Care service, which combines high-quality genuine parts with proven technical expertise, we support the stable maintenance and operation of compressors. We are continuously improving customer satisfaction through on-site installation, commissioning, inspection, and maintenance services, as well as monitoring systems and long-term maintenance contracts. We also provide energy-saving solutions based on-site energy diagnostics, helping customers reduce operational costs and contributing to the realization of sustainable, eco-friendly value. We operate service centers in major locations in six countries worldwide and have established a global service network with more than 40 service agents.



Turbo compressor for VRU (Vapor Recovery Unit)

In the power generation business, we are pioneering the market for sustainable energy solutions by developing eco-friendly, high-efficiency power generation systems such as supercritical CO₂ (sCO₂) power systems and turbo expander generators (TEG). In 2021, we successfully completed a U.S. Department of Energy (DOE)-commissioned project to develop an sCO₂ power system, passing all commercialization testing. The TEG system converts pressure energy lost during decompression into electricity and is used to enhance energy efficiency across a wide range of industrial settings, including gas pressure regulation stations, power plants, and chemical facilities. In 2023, Hanwha Power Systems installed a TEG at the Korea Gas Corporation (KOGAS) integrated energy hub, which is now fully operational.



Gas turbine for hydrogen combustion (501F_PSM)

We are also developing a hydrogen gas turbine retrofit business to accelerate the global transition to clean energy. We now provide customers in the U.S. and the Netherlands with solutions that retrofit the gas turbines of existing LNG-fired power plants, so they run on hydrogen fuel. Following the 2021 project for the Linden Cogeneration Plant in New Jersey, U.S., we won an order in 2022 from Uniper, one of the world's largest power producers, to retrofit their LNG gas turbines in Rotterdam, Netherlands. In 2023, we successfully demonstrated hydrogen co-firing and hydrogen fuel-based power generation of up to 60% at our South Korean plant together with Hanwha Impact. We are strengthening our eco-friendly power generation business by signing technical cooperation agreements with related companies such as Korea Western Power Company and Korea District Heating Corporation, supporting the transition to carbon-free power generation by retrofitting gas turbines for hydrogen co-firing. In 2023, we opened the Busan Business Center and entered the eco-friendly ship retrofit, maintenance, and operation business. We are also renovating a boil-off gas system for LNG carriers for the British shipping company BW and increasing the container ship capacity for SFL Corporation, Ltd. Additionally, we are actively carrying out conservation projects for floating storage regasification units (FSRU) with global energy companies in response to increasing demand for LNG.

Looking ahead, while we continue to strengthen our existing competitiveness, we plan to expand our business scope through advancements in eco-friendly gas turbines, ship retrofitting, and our service businesses. These include field services (installation, inspection, diagnostics, and maintenance), genuine service parts and kits, performance upgrades, remote monitoring systems, and long-term maintenance contracts (LTSA/LTPA). Additionally, we will grow as a global leader in power and energy solutions by using future engineering technology that supports the environment.



TANKER

HD KSOE is leading the tanker market with its streamlined eco-friendly designs, especially in VLCC (Very Large Crude Carrier) segment ever since its first delivery in 1974. With delivery of LNG D/F Aframax tanker as well as methanol burning MR tanker, we are striving to take another leap in developing greener and more fuel-efficient technology for tankers for the future as well as designing new systems for next generation smart ships.

WHY CHOOSE OUR ECO TANKER

- Highly skilled and fully qualified engineers/workers providing best solution to environmental regulations such as lower SOx limits
- Proven design with unparalleled performance records
- Satisfying customer's needs by providing various technical solutions
- Hull form optimization
- Low friction paint
- Propulsion efficiency with energy saving devices
- Specialized Engine optimization (as an Engine manufacturer)

PRODUCT RANGE

- VLCC
- Suezmax/Aframax Tanker
- LR3/LR2/LR1 Product Tanker
- MR Product/Chemical Tanker
- Shuttle Tanker
- Asphalt Carrier
- Methanol Carrier

1. HSHI: 157,000 DWT Tanker for EURONAV
2. HHI: 153,000 DWT Shuttle Tanker for KNOT
3. HHI: 112,000 DWT Crude Oil T/K for NESTE
4. HHI: 157,000 DWT P/C for AMPTC
5. HHI: 320,000 DWT VLCC for ASC





TANKER

MIPO PRODUCT & CHEMICAL TANKER

- The prestige Product/Chemical Tankers so called "MIPO TANKER" gained a reputation as a world best Tanker from the incomparable performances over 850 vessels with its unbeatable high technology and premium quality.

LNG D/F AFRAMAX TANKER

- The world's first LNG D/F Aframax tanker was delivered in 2018, by HSHI. It is equipped with dual fuel engine, two LNG fuel tanks located on the upper deck and fuel gas supply system.



1. HSHI: 114,000 DWT T/K (LNG D/F Tanker) for Sovcomflot
2. HVS: 75,000 DWT P/C for D'AMICO
3. HMD: 50,000 DWT P/C (Methanol D/F) for Westfal-Larsen
4. HMD: 37,000 DWT P/C for CIDO Shipping
5. HMD: 50,000 DWT P/C for Scorpio Tankers
6. HMD: 25,000 DWT P/C (LNG D/F) for JP Morgan

CONTAINERSHIP

HD KSOE boasts the world's largest performance record in this Containership segment. As the leading eco-shipbuilder, HD KSOE has set the world record by successfully delivering the world's first LNG D/F containership in 2020 and securing the newbuilding for 12 units of the world's first methanol D/F containership recently. As the future builder, will continue to strengthen our leading capabilities for the development/engineering/construction of eco-friendly containerships in a bid to keep our planet clean.

1. HHI: 19,200 TEU Containership for MSC
2. HHI: 16,000 TEU Containership for HMM
3. HSHI: 14,700 TEU LNG D/F Containership for EPS
4. HSHI: 10,500 TEU Containership for Hapag-Lloyd
5. HMD: 2,100 TEU Methanol D/F Containership for MAERSK
6. HMD: 1,800 TEU Containership for MITSUI
7. HMD: 1,000 TEU Containership for CK Line
8. HSHI: 15,600 TEU Container ship TIME SHIPPING



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WHY CHOOSE OUR CONTAINERSHIP

- Highly skilled and fully qualified engineers/workers
- Proven design with unparalleled performance records
- Satisfying customer's needs by providing various technical solutions
- Low friction paint
- Specialized Engine optimization (as an Engine manufacturer)

MIPO CON-GREEN

- HMD Green Containership so called "CON-GREEN" provides customers with an innovative design which ensures maximized cargo capacity with superior fuel consumption in Feeder Containership segment by using neo optimization technique of Hyundai Mipo Dockyard.

PRODUCT RANGE

- 8,000/11,400/13,200/15,900/23,900 TEU Containership
- 1,000/1,400/1,800/2,500/2,800/3,500 TEU Containership

LNG CARRIER, FSRU & LNG BUNKERING VESSEL

HD KSOE is the world's leader in newbuilding of LNG (Liquefied Natural Gas) Carriers and FSRUs (Floating Storage & Regasification Unit) with extensive experience and accumulated know-hows.

We are the only shipbuilder in the world capable of providing both membrane and moss-type solutions for LNG cargo containment. We also offer a wide range of propulsion systems including MEGA, XDF, MEGI and TFDE, allowing us to meet our clients' various operational and technical requirements also in line with environmental requirements.

HD KSOE is always attentive to the needs of our clients and we are constantly striving to offer innovative solutions. With such efforts, we have won the world's first order for FSRU in 2011.

Since then, HD KSOE has managed to sustain its global leadership by securing the largest number of FSRUs (12 FSRUs) in the world and continuously coming up with more cost-effective solutions that make our FSRUs more competitive. In line with the market trend, we also delivered the first high quality LNG Bunkering Vessel in 2018.

WHY CHOOSE OUR LNG CARRIER

- Low FOC: Hull form, propeller & rudder optimization
- Energy saving devices: Hi-RudderRS, Hi-Fin, Hi-ALS, Hi-FCF, Hi-ARS, Shaft Generator
- Low BOR: 0.085% with membrane Mark III FLEX cargo containment system
- Wide-range of BOG management solutions are provided including SMR, Hi-ERS®, Hi-ERS and Hi-SGAS ready for customization

WHY CHOOSE OUR LNG B/V

- BOG management: Dual fuel engine & semi-pressurized tanks
- High maneuverability: bow/stern thrusters
- Efficient operation: Power take-off & power take-home

WHY CHOOSE OUR FSRU

- Performance proven by successful deliveries & operations
- Reliable design of indirect-heating regasification system (Hi-ReGAS)
- Engineering capabilities to satisfy client's diverse operational requirements (reliquefaction plant, mooring system, MSO compressor, etc)

PRODUCT RANGE

- 200,000/180,000/174,000 CBM Membrane LNG Carrier, 173,000 CBM Moss LNG Carrier
- 180,000/170,000 CBM LNG FSRU
- 30,000/18,000 CBM LNG Carrier
- 18,000/12,500/7,500 CBM LNG B/V

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1. HHI: 170,000 CBM FSRU for BOTAS
2. HMD: 30,000 CBM LNG Carrier for Knutsen
3. HSHI: 174,000 CBM LNGC for ALPHA GAS
4. HHI: 150,000 CBM LNG Carrier (Moss) for MISC
5. HMD: 18,000 CBM LNG Bunkering Vessel for Korea Line



LPG, AMMONIA, ETHANE CARRIER

HD KSOE dominates the LPG Carrier market by its technological superiority and outstanding quality. In consequence, HD KSOE is maintaining 60% market share of VLGC & VLAC order-book and 45% market share of VLGC & VLAC fleet. Also, we are maintaining 77% market share of MGC order-book and 59% market share of MGC fleet.

Our constant innovation has resulted in the maximized cargo capacity who can transit old panama canal and overwhelming market share for old-panama VLGC & VLAC together with neo-panama VLGC & VLAC.

1. HSHI: 86,000 CBM LPG D/F LPG Carrier for Hyundai LNG Shipping
2. HSHI: 91,000 CBM LPG D/F LPG Carrier for EVALEND
3. HHI: 91,000 CBM LPG D/F LPG Carrier for SK Shipping
4. HHI: 98,000 CBM Ethane fuelled Ethane Carrier for EPS
5. HMD: 40,000 CBM LPG Carrier for Thenamaris
6. HMD: 23,000 CBM LPG Carrier for E.A.TEMILE AND SONS DEVELOPMENT COMPANY
7. HMD: 12,000 CBM Ethylene Carrier for Eletson



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WHY CHOOSE OUR LPG CARRIER

- Standard application of LPG Dual Fuel
- Deep experience and knowledge
- High technology
- Engineering capabilities and first-class production facilities
- Magnificent performance records with the lion's share of the world VLGC order-book
- Proven designs
- Customer oriented technology (Cargo manifold flexibility: OCIMF & Japanese Ports Compliance, enhanced re-liquefaction plant)
- Flexibility in responding to the client's technical request
- Flexible building capacity
- LPG/Ammonia Carrier oriented newbuilding facilities
- LPG Tank fabrication shop
- Berths specialized for building LPG/Ammonia Carriers

PRODUCT RANGE

- VLGC & VLAC (93,000/91,000/88,000 CBM LPG/Ammonia Carrier)
- * 88,000 CBM LPG/Ammonia Carrier is the maximum available design for old Panama canal transit
- VLEC (98,000 CBM ETHANE Carrier)
- MGC (40,000/22,000 CBM LPG Carrier)

BULK CARRIER, PCTC & RO-RO SHIP

HD KSOE confidently takes on every challenge satisfying needs of times for environmental goals. We have created a new era of Bulk Carrier construction with the successful delivery of the world's first LNG D/F Bulk Carrier.

With accumulated expertise in building vessels with GREEN technology, HD KSOE delivers vessels providing low-carbon transportation to oceantransport and logistics companies for carrying automobiles and other rolling cargo.

PRODUCT RANGE

- Bulk Carrier
- Car Carrier
- Ro-Ro Ship
- Con-Ro Ship
- Ro-Ro Passenger Ship (ROPAX)

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1. HHI: 323,000 DWT VLOC for Bergesen D.Y.A/S
2. HSHI: 180,000 DWT LNG D/F Capesize B/C for H-Line
3. HSHI: 8,000 UNIT PCTC for Wilhelmsen Lines
4. HSHI: 325,000 DWT VLOC for Polaris Shipping
5. HHI: 3,400 L.M. ROPAX for Stena RoRo
6. HMD: 20,000 DWT Ro-Ro Ship for CLDN
7. HMD: 45,700 DWT CLASS CONTAINER, RO-RO, CAR AND TRUCK Carrier for Grimaldi





DRILLSHIP

Since HD KSOE's first drillship was appraised by our customer with its excellent performance, HHI has delivered about 20 drillships to various drillship owners.

WHY CHOOSE OUR DRILLSHIP

- Purpose-built drillship design
- Large free deck area
- Better position keeping
- Protected under deck passageway with electric cable/Utility Line Arrangement
- Canister Type Retractable Thruster (Optional)

PRODUCT RANGE

- Drillship
- Semi-submersible Rig



REGASFICATION UNIT

REGASFICATION UNIT

Re-gasification for LNG (Liquefied Natural Gas)



Main Installation location

Mainly installed in FSRU, FRU, LNG-FSRU, Re-gasification plant

Production record

Customer	Unit No.	Capacity	Size
AG&P (Philippines)	ILIJAN PJT (REGASTAINER)	84mmscfd x 6 Units	12M x 20M x 7M(H)
	ILIJAN PJT (LP PUMP SKID)	84mmscfd x 1 Unit	11M x 8M x 4M(H)
Karadeniz (Turkey)	M001/002	42mmscfd x 2 Units	5M x 8M x 5M(H)
	U002/003	21mmscfd x 2 Units	5M x 5M x 7M(H)
	U004/005	42mmscfd x 2 Units	6M x 9M x 6M(H)
	U006/007	42mmscfd x 2 Units	5M x 8M x 5M(H)
	U008/009	42mmscfd x 2 Units	5M x 8M x 5M(H)
	U012/013	42mmscfd x 2 Units	15M x 9M x 6M(H)

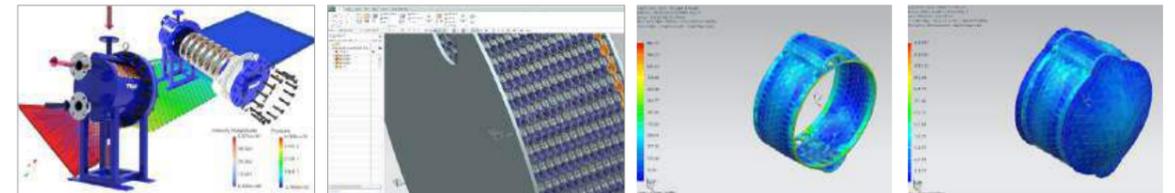


Shipbuilding & Gas Energy Systems

As one of the leading maker of Heat Exchanger in Korea, we have registered and received many orders from not only Korean major shipyards but many customers in worldwide. Steady investment to Development, Customer Satisfaction Management, much Skilful Engineers with lot of experience in many projects are our key strength to have been grown as a major and trustful maker of Heat Exchangers in Marine & Offshore business Field. Our major products are Plate type Heat Exchanger, Shell & Tube type Heat Exchanger, Various kinds of Heaters/Coolers, and Fresh Water Generators, etc. In order to provide worldwide customers with better technical service optimized products to local markets, and on-time delivery, we are now preparing for the newest facilities for overseas territories in near future.

꾸준한 기술연구개발, 고객만족 경영, 풍부한 기술 경험을 가진 팀워크를 바탕으로 한국 Major 조선소뿐만 아니라 해외 여러 조선소에도 업체등록 및 지속적인 수주를 해오고 있습니다. 특히, 판형열교환기(Plate type Heat Exchanger), 관형열교환기(Shell & Tube type Heat Exchanger), 각종 Heater/Cooler, 조수기(Fresh Water Generator)를 주력제품으로 국내외에서 지속적으로 시장점유율을 높여가고 있습니다. 또한 공격적인 연구개발투자 및 영업활동을 통해 고객에게 더욱 다양한 제품군을 소개/제공할 수 있도록 노력하고 있으며, 나아가 더욱 신속한 서비스제공, 현지에 최적화된 제품 개발/생산, 정확한 납기준수 등을 통해 점진적으로 해외시장 판로를 넓혀가고 있습니다.

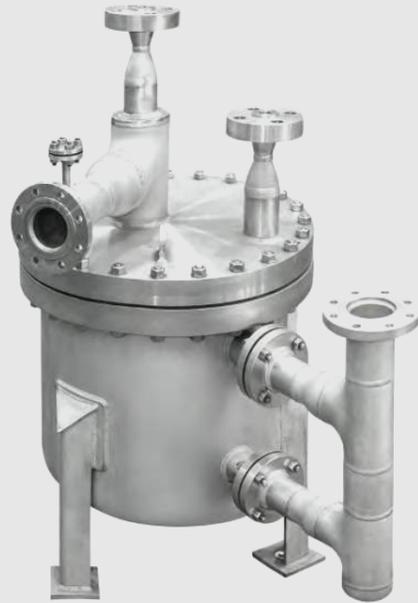
BSPHE (Braze Shell and Plate Heat Exchanger)



Applicable materials and conditions for each fluid of BSPHE

	NON CORROSIVE FLUID					CORROSIVE FLUID
	LNG	MEOH	LPG	CO2	HYDROGEN	AMMONIA
Plate Thickness(mm)	0.35~0.4					0.4
Design Temp(°C)	-190~50	-10~60	-60~50	-100~40	-253~40	-50~70
Design Pressure(bar)	F.V ~350	F.V~30	F.V~60	F.V~10	F.V~10	F.V~100
H.P zone / Connection	Plate Side(65mm, 125mm)					
FILLER MATERIAL	COPPER BASED					SUS BASED
PLATE MATERIAL	SUS304L,SUS316L				SUS316L	SUS316L
Effectiveness	0.4~0.95					
Connection(mm)	20~650					
CORROSION	X	X	X	X	X	O
Stress Cracking Corrosive	X	X	X	X	X	X
Affect of oxidation film	X					
Openable	X	O	X	O	X	X
Partial replacement	X	O	X	O	X	X
Assemble Type	WELDING	GASKET	WELDING	GASKET	WELDING	WELDING
Gasket	X	O(Openable)	X	O(Openable)	X	X
Vibration	Strong					
Thermal Stress	Strong [There is none thermal stress because it is heat treated with brazing.]					
Surface Area(m ²)	0.5~250					
MAX.FlowRate(kg/hr)	10,000	The max. flow rate is subject to change depending on the design conditions and the model.				

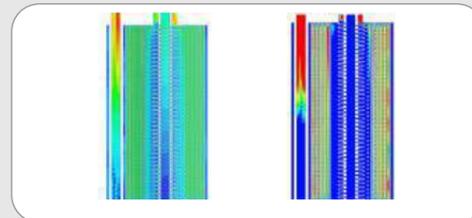
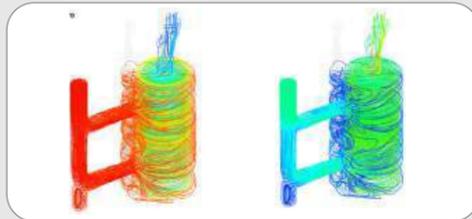
Heli-Flow Type Heat Exchanger



- Very High Efficiency
- Compact Design To Fit into Tight Space
- Simple Design for Easy Maintenance
- High Pressure Application
- High Operating Reliability
- To Accommodate Large Temp. Differentials

Certificates from KR :

- Cold Test
- Function Test
- Hydro Test



Gas Energy System (LNG, LPG, Ammonia)

LNG H.P Vaporizer



LNG L.P Vaporizer



LPG Cargo Heater /Vaporizer



Gas Energy System (LNG, LPG, Ammonia)

Glycol Water Heating System



Glycol Water Heater



BOG Heater



Gas Energy System (LNG, LPG, Ammonia)

LNG H.P Gas Cooler



LNG H.P Pulsation Damper



LNG Expansion Vessel



Shipbuilding & Marine 조선/해양

COPT Vacuum Condenser



COPT (Cargo Oil Pump Turbine) Vacuum Condenser operates to produce the Boiler Water by condensing the Exhaust Steam through the Cargo Oil Pump or Water Ballast Pump from Tanker Turbine. The basic standard of Vacuum is min. 540mgHg, which is to increase the efficiency of Turbine by using Exhaust Steams. This units is consisted of Air Ejector for Vacuum formation and Air Ejector Condenser for condensing the steams after operates Air Ejector

COPT Vacuum Condenser로 Tanker선에서 Cargo Oil Pump나 Water Ballast Pump를 Steam Turbine으로 구동하는데, 이 때 Turbine에서 사용한 Steam (exhaust Steam)을 C.O.P.T condenser에서 회수하여 Sea Water로 냉각(Cooling)하여 물로 만들어 다시 Boiler Water로 사용합니다. C.O.P.T Condenser는 보통 540mgHg의 Vacuum을 유지해야 하며, 이는 Turbine으로부터 Exhaust Steam이 쉽게 빠져나올 수 있도록 하여 Turbine의 효율을 높여줍니다. Vacuum을 형성하기 위하여 Air Ejector가 장착되어야 하는데 Air Ejector를 Steam으로 운전하며 이 Steam도 Air Ejector Condenser에서 냉각(Cooling)하여 회수합니다. 따라서, C.O.P.T Condenser는 Air Ejector와 Air Ejector Condenser와 함께 구성됩니다.

Dump Drain Cooler (ATM Condenser)



This is a kind of Condenser to exchange the excess steams to water and to reduce the temperature of hot drain water. The steams of heat exchange medium are from Oil Cooler, Fresh Water Cooler, and Boiler.

Condenser라고도 하며 steam이 열교환을 한 후 다시 물로 변하여 보일러 Cascade tank로 돌아와 보일러에 보충되는 과정에서 열교환을 다 하지 못한 steam 또는 excess steam(잉여증기)을 물로 변환시키기 위함과 고온의 drain water를 낮춰주는 역할을 하는 장치. Oil Cooler, Fresh Water Cooler와 Boiler에서 발생하는 Steam을 재회수하는 장치인 Dump/Drain Cooler

Shipbuilding & Marine 조선/해양

Tank Cleaning Heater



Tanker ships for cargo oils, chemical products, etc shall clean the each tank (stowage) of the vessel to prevent contaminations and it safety after discharging the goods. Using around 80℃of fresh water or sea water heated from this Heater, each tank (stowage) will be cleaned. This is specially designed heater to heat sea water or fresh water for tank cleaning.

Product Tanker/Carrier(석유화학운반선)의 경우, 각 화물창(Stowage)마다 이종의 제품을 담아 운송을 하기 때문에 각 탱크 별 잔존 이물로 인한 제품오염(Contamination)방지 및 안전한 운송을 위하여 본 Tank Cleaning Heater를 통하여 높은 온도(약 80℃정도)로 해수(S.W)/청수(F.W)를 가열하여 각 화물창을 cleaning하게 됩니다.

Oil Heaters



M/E & G/E F.O.HEATER / H.FO.PURIFIER HEATER / M/E L.O.PURIFIER HEATER / G/E L.O.PURIFIER HEATER / JACKET FRESH WATER PRE-HEATER

CCS (Carbon Capture System)



Shipbuilding & Marine 조선/해양

Plate Heat Exchanger



The Plate type Heat Exchanger is structured with the Frames, rubber gaskets, and Heat Transfer Plates using anticorrosive materials such as Titanium and Stainless Steels. The basic working principle is heat or cool one fluid by transferring heat between it and another fluid through the corrugated shape of Plates. This is mostly using of Main Engine cooler and Generator Engine of Vessel. This has a major advantage over a conventional heat exchanger in that the fluids are exposed to a much larger surface area because the fluids spread out over the plates. And it gives high heat transfer efficiency, Compact design, Low cost of facility, Easy installment & capacity changes.

티타늄 또는 스테인리스 등의 내부식성에 강한 금속 재질로 된 얇은 전열판에 가스켓(합성고무 재질)을 부착하여 적층시킨 구조로 되어있는 열교환기로 전열판의 주름을 통해 서로 상이한 두 유체의 난류를 형성시켜 상호 간 열교환을 극대화한 구조입니다. 주로 선박의 M/E나 G/E의 Cooler로 사용되고 있습니다. 높은 전열효과와 컴팩트한 구조, 저렴한 설치비용, 완전분해/조립식 구조와 용량 증설 및 변경이 용이하다는 장점이 있습니다.

Electric Heater

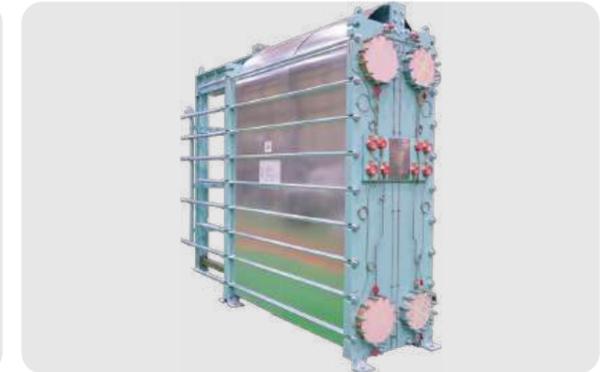


FSRU (Floating Storage and Regasification Unit)

LNG LP Vaporizer



Sea Water Heated GW Heater



Condensate Drain Heater



Steam Heated Glycol Water Heater





Chemical / Petrochemical & Power

석유화학/발전

The Customized Design, New Product Development, and Technical Collaborations with Customers for all kinds of Heat Exchangers Units and Pressure Vessels have been a keen strategy to expand our business area to Industrial fields such as Industrial Engine Builders, Oil & Chemical Factory, Plants, Air Conditioning Factory, etc.

Developed the Air Cooling Radiator for Power Generator in 2008, Mytec has joined PPS(Package Power Station)project and DPP(Diesel Power Plant) project, and has finally delivered the quality goods to the Customers. With Cost Innovation Activity and continuous investment in Development & Quality Improvements, we are aiming to fulfilling with the Customers' needs.

조선/해양 분야에만 국한하지 않고 고객의 Needs에 맞춘 Design 및 기술개발협력 등을 통한 다양한 제품을 발매하여 국내 대형 중공업 엔지니어링부, 각종 석유화학공장 및 공조설비 제조업체 등 다양한 고객층을 확보하여 꾸준히 수주를 해오고 있습니다. 발전용 Air Cooling Radiator를 개발하여 PPS(Package Power Station) project 및 DPP(Diesel Power Plant) project에 납품하고 있으며, 꾸준한 기술개발 및 원가절감 활동으로 수주 실적을 쌓아가고 있습니다.



ITER & Nuclear Power Plant

핵융합 & 원자력 발전

Turing the eye into New Business Area that requires high technology and managements, Mytec is aiming to expand business fields to Nuclear Power Plants. Approved Q Class of KEPIC(Korea Electric Power Industry Code) in 2010, Mytec was finally deserved to participate in the Nuclear Power Plant Business in Korea. Continuously investing R&D and experienced Engineers, Mytec has put great endeavor to promote and join the projects. Then Mytec finally received the Orders of the Radiators, Plate type Heat Exchanger, and Heaters for Emergency Power Generator from Korean Nuclear Power Plant. Starting by this experience, Mytec will do utmost efforts in order to provide the various and better services and technology to the Customers.

2010년 KEPIC(Korea Electric Power Industry Code/전력산업 기술기준)을 획득함으로써 고난도 기술과 꼼꼼한 기술관리를 요구하는 원자력 사업에 적극적으로 참여를 할 수 있게 되었습니다.

지속적인 관련 기술 개발과 System 구축 및 유능한 Engineer 확보를 통하여 많은 프로젝트에 참여하기 위해 노력하고 있으며, 최근 국내 원전사업에서 우수한 품질의 비상발전용 라디에이터(Radiator), 판형 열교환기(Plate type Heat Exchanger), 각종 Heater 등을 공급하고 있습니다. 이를 바탕으로 고객에게 다양하고 폭넓은 기술 및 서비스를 제공할 수 있도록 더욱 노력하겠습니다..

Chemical/Petrochemical & Power 석유화학/발전

Lube Oil Cooler



Lubricant oil uses to reduce the friction between moving mechanical parts and also remove heat from the components. This Lube Oil Cooler is to remove the heat of lube oil to prevent from both breakdown of Oil and damage to the mechanical parts it operates. Lube oil coolers are designed based on the customer specifications (design code : TEMA and ASME) and are available as single coolers or twin coolers.

High Pressure Heat Exchanger



Compressor Gas Cooler

High Pressure(Max.350bar), Quality Inspection Standard : ASME U Stamp

Chemical/Petrochemical & Power 석유화학/발전

Condenser



-Surface Condenser

The primary function of condenser is to receive the exhaust steam from the steam turbine and reject a latent heat to the cooling water so that the condensate may be pumped back through a condensate system into the boiler. The condensate must be free of impurities, either gases or solids which give damage to other parts of the power cycle. The volume reduction resulting from the condensation of steam produces a vacuum in the condenser. By means of this vacuum, various drains can be led to the condenser.

터빈의 출력을 보강하며 터빈을 구동한 폐증기를 응축시키는 역할을 하며, 여기서 응축된 물은 일반적으로 급수펌프, 급수가열기 그리고 탈기기를 거쳐 보일러로 재순환하게 됩니다.

-Surface Condenser



-Gland Steam Condenser

Gland Condenser is a type of condenser in which steam which is coming from the turbine is used for the heating of demineralized water and then this water is sent to the boiler so boiling of hot water consumes less coal and thus we get benefit of it

Steam Turbine의 경우 고온 고압의 Steam이 Turbine의 Blade에 운동에너지를 가함으로써, Turbine을 회전시키고, 이를 통해 발전을 하는 형식입니다. 따라서 Turbine내부에는 고온 고압의 증기가 외부로 유출되거나, 저압 Turbine의 Condenser에 외부공기의 유입을 방지하여야 합니다. 이러한 역할을 하는 것이 Seal Steam System입니다. Seal Steam System의 Leak-Off Steam은 Exhaust Fan을 통하여 외부로 배출되는데, 이때 버려지는 Steam을 GSC(Gland Steam Condenser)를 통해 진공을 형성하여 냉각시켜 Steam의 배출을 용이하게 하는 것이 GSC입니다.



-Ejector Condenser

Chemical/Petrochemical & Power 석유화학/발전

Inter cooler & After cooler



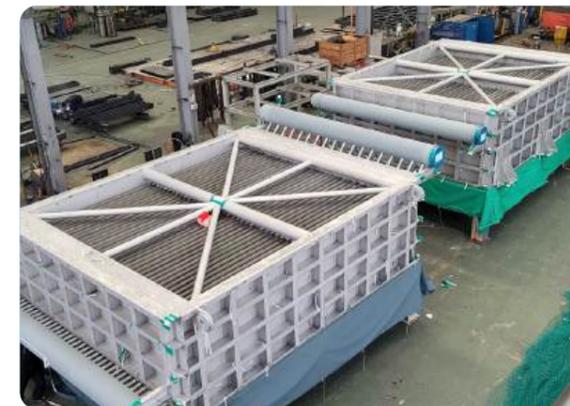
This is designed to cool the Gas temperature using cooling water to reduce the gas volume in each stage of multi Air Compressor.

다단 공기(가스)컴프레셔의 경우 단과 단 사이에 다음 단계 들어가는 가스의 체적을 줄이기 위해 냉각수를 이용하여 가스의 온도를 냉각시키는 열교환기입니다

Finned Tube Heat Exchanger

With wide range of Heat Exchanger type using Extruded Fin or L-footed Fin or Embedded Fin or High frequency welded Fin, this have lots of application in Gas Cooling, Water Cooling, Gas Heating, Water Heating, Wet Gas Condensing, and etc. The key factor of the function is Heat transfer capacity of Air side as a heat resistance of Air Side is bigger than Cooling side.

냉동공조분야에서 응축기 및 증발기로서 광범위하게 사용되고 있는 열교환기로 공기측과 냉매측의 열저항에 의하여 성능이 결정되며, 공기측 열저항이 냉매측보다 크기 때문에 공기측 열전달 성능이 중요한 역할을 합니다. Extruded Fin, L-footed Fin, Embedded Fin과 High frequency welded Fin 등을 이용하여 다양한 형태의 열교환기가 가능하며 Gas & Water Cooling, Gas & Water Heating, 그리고 Wet Gas Condensing 등의 용도로 사용됩니다



- Super Heater



- Steam Coil Air Heater

Chemical/Petrochemical & Power 석유화학/발전

Pressure Vessel & Tank



- ODCB Column



- Propylene Refrigerant Condenser



- Flash Tank



- Devo Vessel with Mixer



- Cracked Gas Chiller Drum



- Discharge Drum

Nuclear Power 원자력발전



- Fin Fan Cooler



- KRSKO CCW



- Plate heat Exchanger



- Electric Heater



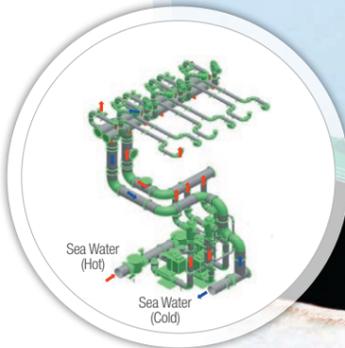
High Pressure Pump

- Boosting of LNG Pressure (100 bar)
- Cryogenic(-162°C) Design
- Submerged Centrifugal type



Recondenser

- Pressure Stabilization
- Feeding of continuous LNG
- Recondensing Boil off Gas



Sea Water System

- Heating Medium
- Sea Water Lift Pump
- Automatic Flushing Filter



Vaporizer (Heat Exchanger)

- Vaporizing of LNG to Natural Gas by Sea water
- Cryogenic / High Pressure / Anti-corrosion Material
- Shell & Tube Type

REGASIFICATION SYSTEM

The regasification system, which is installed in onshore LNG terminal or upper part of the offshore LNG FSRU, is a system that directly gasify liquefied natural gas and supply so that power plants or consumers can use it.

The main equipment for the regasification system includes recondenser, high pressure LNG booster pump, vaporizer and sea water system.

LNG, which is fed up to recondenser from cargo tank by feed pump inside the cargo tank, is pressurized to about 100bar by the high pressure booster pump, and sent to onshore after being gasified to natural gas through heat exchange with sea water in the vaporizer.

The regasification system is a system the core technologies of which are the design and analytics required for extremely low temperature down to -160°C and high pressure up to 100bar and stable control technology.

We have secured price competitiveness through localization of parts and our own technology on the basis of the reliability of the process engineering with various achievement experience, and we have secured good clients in the world and attained high customer satisfaction by supplying EPC turnkey-type packages which can be quickly counteracted if any problem occurs.

In the long term, SHI Power & Control Systems Division will carry on topside turnkey projects based on process engineering by establishing the system where the process facilities included in the offshore topside can be manufactured and supplied as a module type.

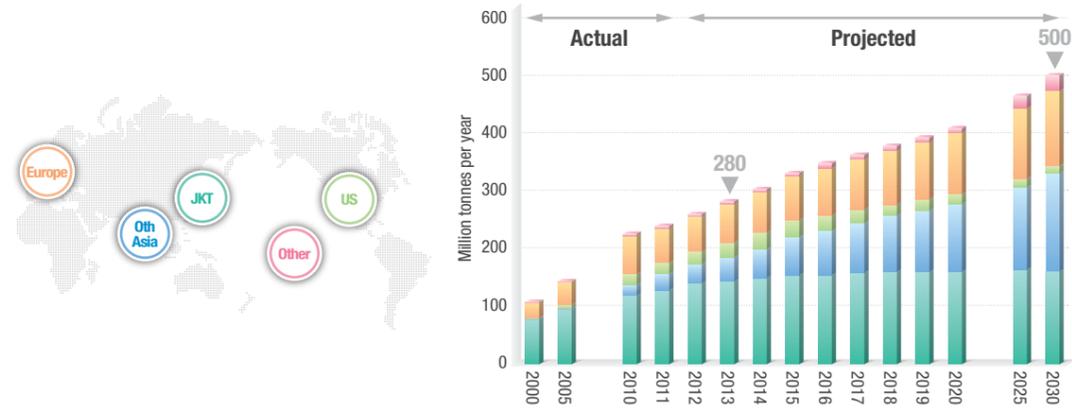
Why SHI S-REGAS Module?



INTRO

Increasing LNG Demand

- Annual demands of LNG
- * Source : Ernst & Young assessment from multiple sources



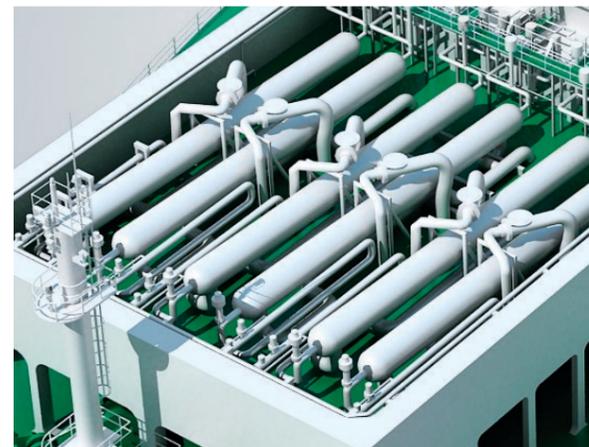
Outline

- Regasification system installed on LNG FSRU/ RV which supplies NG to consumer instead of onshore LNG terminal



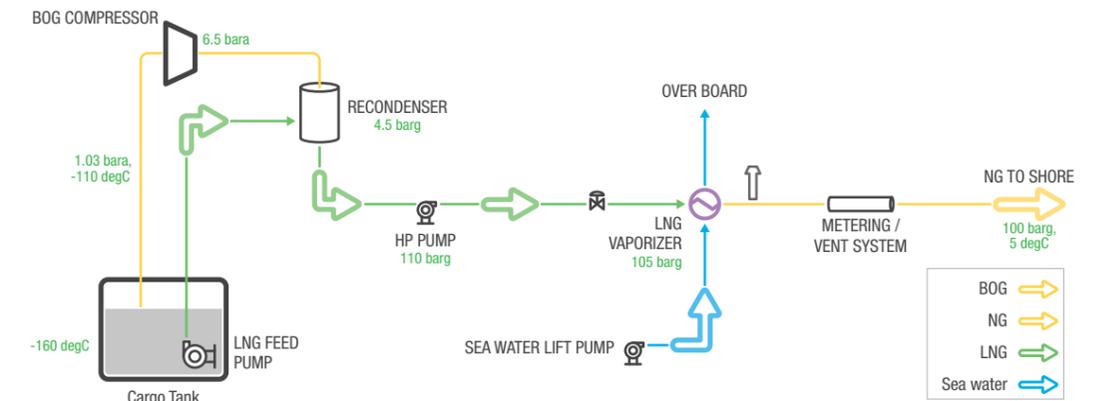
Main Features

- Experiences in LNG FSRU
- Self-developed regasification process
- Localization of equipment; cryogenic high pressure pump and vaporizer
- Unification for engineering, procurement and installation
- Cost-reduction (CAPEX, OPEX)



PROCESS

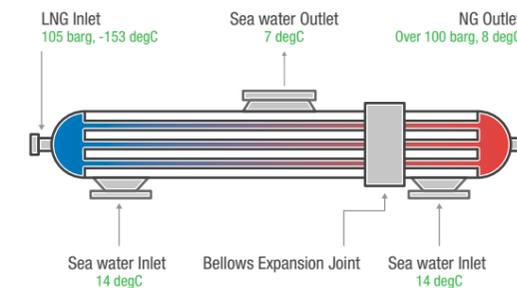
Process Configuration



EQUIPMENT

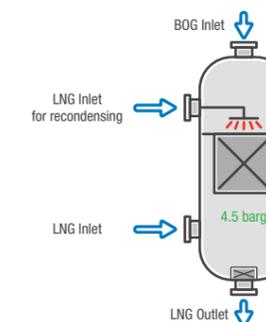
HP Vaporizer

- Shell & Tube type Vaporizer
- Optimum design for requirement



Recondenser

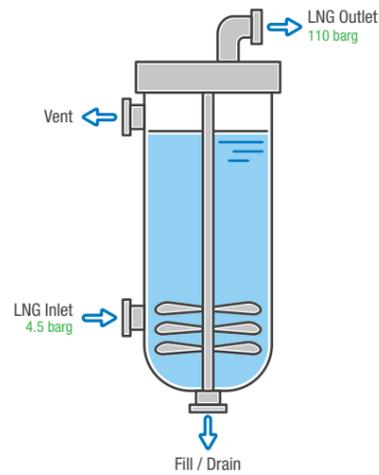
- Recondensing BOG from Cargo tank
- Buffer tank for HP pump



EQUIPMENT

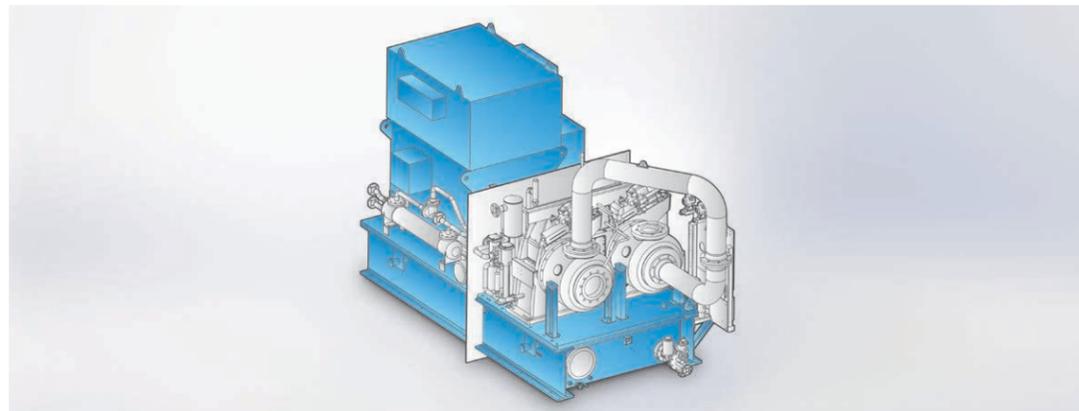
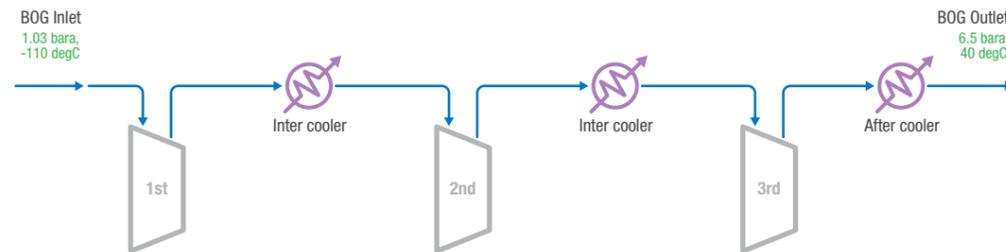
HP Pump

- Submergible multi-stage centrifugal pump
- Control logic materialization according to safety condition



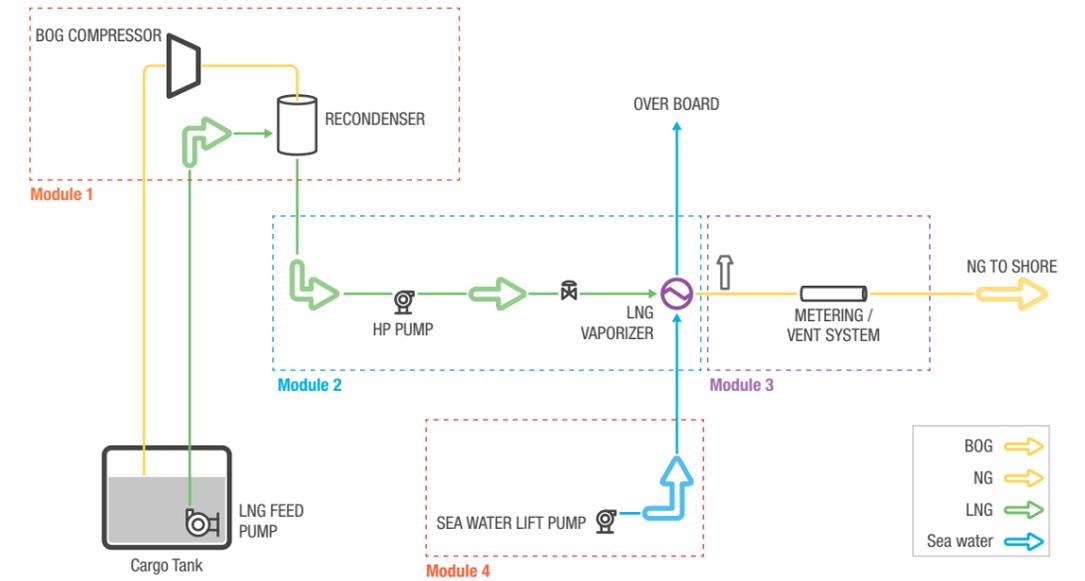
BOG Compressor

- Low pressure compressor shall be designed to transfer excessive boil-off gas to the recondenser during the regasification operation

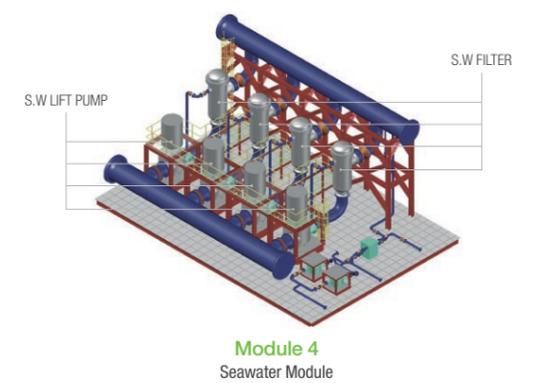
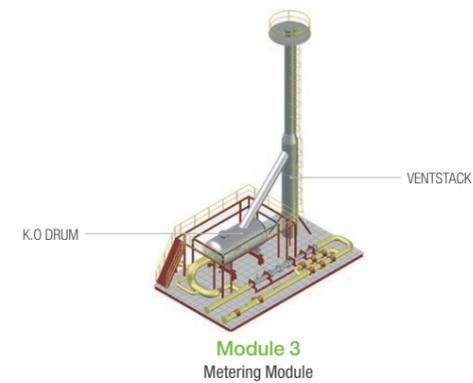
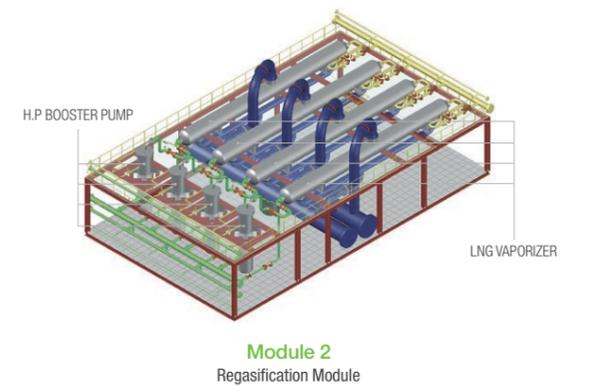
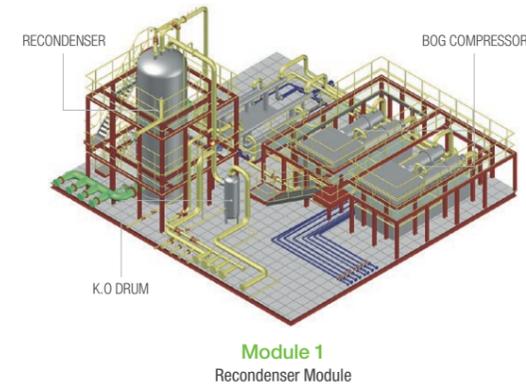


PACKAGE

Module Package Configuration



Regasification Modules



ACFS (LNG, MeOH, NH₃ & LPG)

Alternative Clean Fuel System



FGSS (Fuel Gas Supply System) & FLSS (Fuel Liquid Supply System)

- PLUG and PLAY design for FGSS (For easy on-board installation of each module)
- Performed cryogenic test using SUNBO cryogenic test facilities before the skids delivery to shipyard
- Compact module design, Manufacturing / Assembling by SUNBO (Not outsourcing system fabrication) in the specialized clean factory (Dadae 2 factory), not mixed works with carbon steel
- Standalone control system (Interface with ship's AMS and loading computer)
- Strong engineering capabilities to meet delivery date.
- Sufficient reference lists as EPCC (Engineering Procurement Construction and Commissioning)

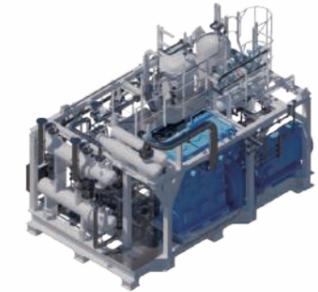
LPG & Ammonia FLSS



Commonly to be used for supplying ammonia without any modifications to ammonia fueled main engine.

Engine Type	Supply Pressure (barG)	Design Pressure (barG)
ME-LGIP	53	100
ME-LGIA	83	100

LPG & Ammonia Reliquefaction System



- Reduced size and weight compared to existing products
- Overall design support for Cargo Handling System for LPG reliquefaction and Ammonia reliquefaction system
- Ship : 91K VLGC & VLGA
- Cooling capacity : 510KW at C₃H₈
- Size (mm) : (W) 6,800 x (D) 4,600 x (H) 4,400
- Weight : Around 28 tons

LNG FGSS



HIGH PRESSURE LNG PUMP UNIT



LNG FUEL TANK



LNG BUNKERING STATION (P&S)



BOG COMPRESSOR UNIT

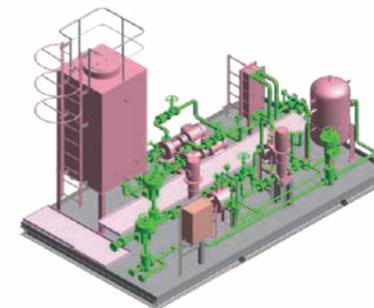


RE-CONDENSING UNIT



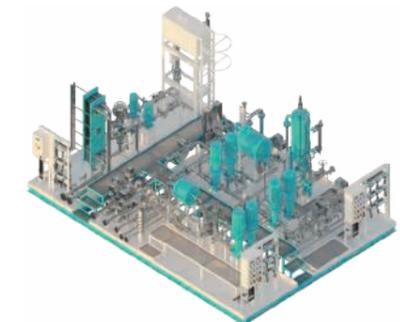
GLYCOL WATER SYSTEM

Methanol FLSS



1st Generation

- **Case 1 as supplier of methanol FLSS only**
 - Bidding stage : OS for methanol supply unit including schematic piping diagram
 - Detail design stage : FS for methanol supply unit including P&IDs

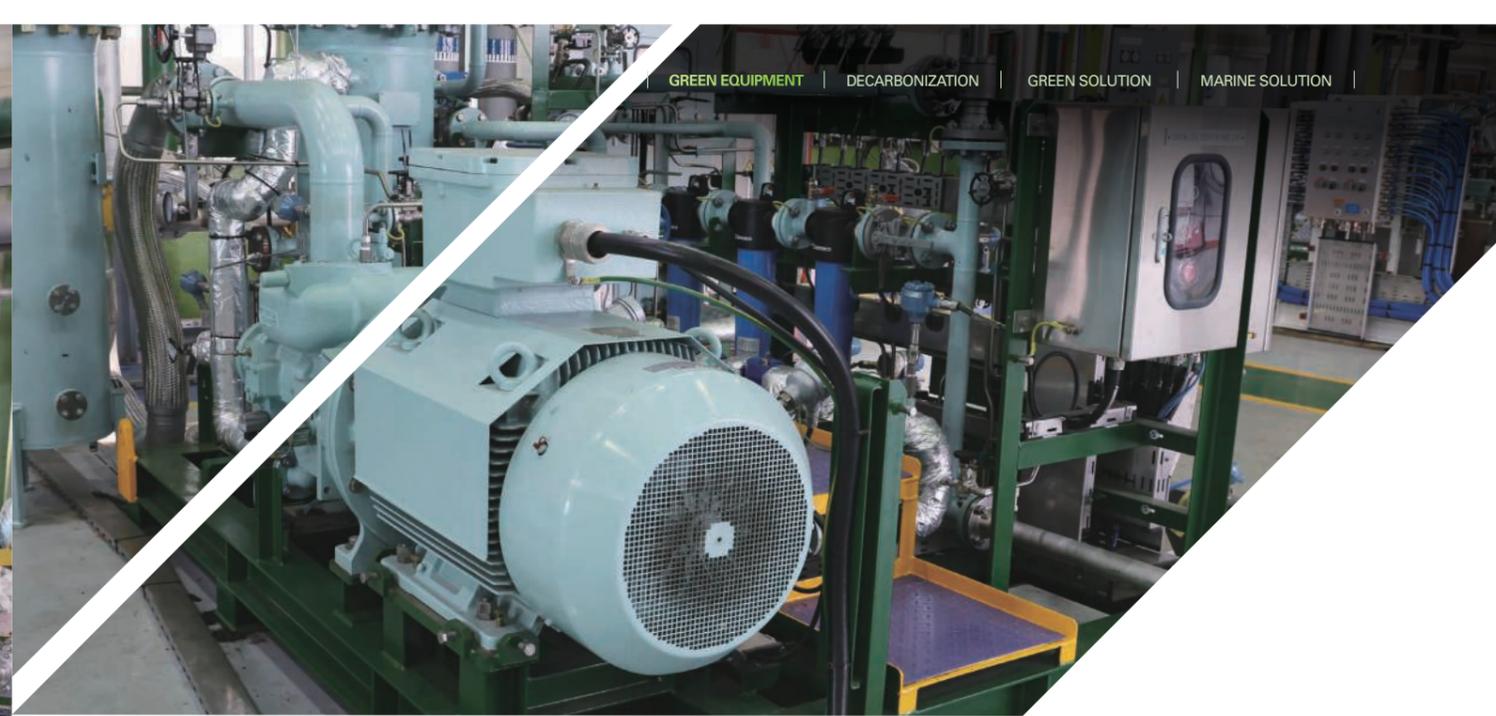


2nd Generation

- **Case 2 as EPCC provider of methanol FLSS (IMO MSC.1 / Circ 1621 & related to class rules)**
 - Bidding stage : OS for methanol FLSS with schematic piping diagram and total scope of supplies for FLSS
 - Detail design stage : FS for methanol FLSS with P&IDs & related systems

SUN-COM[®]

SUNBO
BOG Compressor



The wet type screw BOG Compressor for MEGA, XDF and DFDG

- High efficiency and compact footprint in FPR (Fuel Preparation Room)
- Bare compressor supplied by market proven supplier (GEA)
- Slide valve control and less control valves
- Oil injection system
- Control system integrated into FGSS control system

Design conditions for BOG compressor

- Type : Oil injection screw compressor
- Fluid : Boil Off Gas (CH₄, N₂, etc.)
- Capacity : 300 ~ 3,000 kg/h
- Discharge pressure : ~ 16 barG
- Temp. (Suc./Disch.) : 10/45°C
- Load control : Slide valve or VFD
- Heat exchanger : Gas cooler & Oil cooler
- Oil content : < 0.01 mg/m³ (complying with DF engine)

Proven technology and advantage

Energy-efficiency

- High-efficiency rotors
- Compact and stiff design

Reliability and Safety

- High-performance bearings and hydraulic axial force compensation for long product life time
- Standardized and hermetically sealed slide position indicator

Maintenance

- Easy replacement of bearings & seal



Technical Data

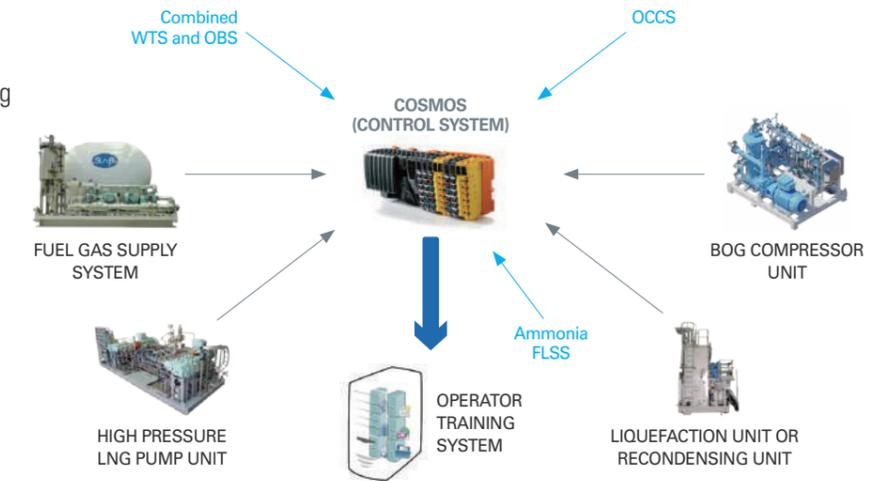
Series	Swept volume (m ³ /h)			Max. design pressor (barG)	Load control
	2940 rpm	3550 rpm	4500 rpm		
SC-300	321	388	491	28	Slide valve or VFD
SC-350	372	449	569	28	Slide valve or VFD
SC-400	471	569	721	28	Slide valve or VFD
SC-450	471	569	721	28	Slide valve or VFD

SUNBO Control system for ACFS

SUNBO Control System & Modern Operator Training Simulator



The control system runs on a DCS (Distributed Control System) with having a various controllers handling a given I/O module simultaneously.



Typical FGSS Communication Scheme

CAMS

- Dual communication
- MODBUS TCP
- Signals, status, alarm
- Receiving other system information (SWBD, GSP, main components, etc.)
- Critical data must be exchanged (FGSS failure, blackout, M/E signal & Status)

BOG compressor

- Dual communication
- MODBUS TCP
- Receiving status
- Remote control command (remote start/stop)

FGSS/FLSS Control

- Dual connection for interfaces
- MODBUS TCP
- Indicators, status, alarm
- Combining with fire detection, it can be used for safety

- Dual communication with control system
- TCP/IP
- Signals, status, alarm
- Hardwired for I/O (loop monitored)
- Safety shutdown command out

✓ Smart web diagnosis

✓ Remote program update

✓ Central data storage

✓ Real-time monitoring & Fast CPU cycle time

✓ Smart management for major equipment

✓ Interface with programming environment (AMS & LC)

Worldwide service & spare part delivery (B&R commercial software)

Around 200 offices in 75 countries



OTS of LNG FGSS & NH₃ FLSS

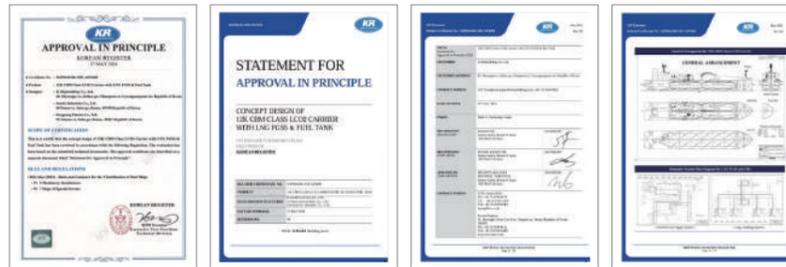
- Crew training
- System verification for new contents



LCO₂ Carrier

Cargo Handling System

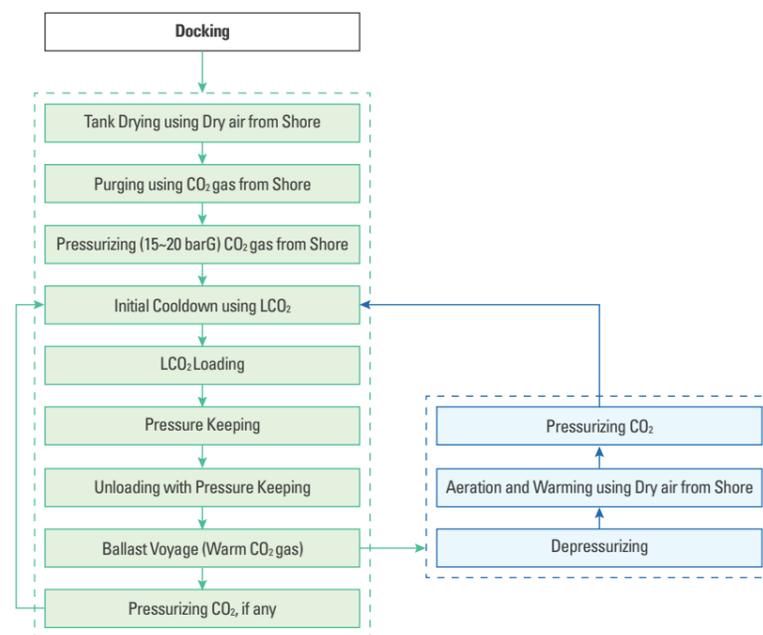
AIP of CHS for LCO₂ Carrier



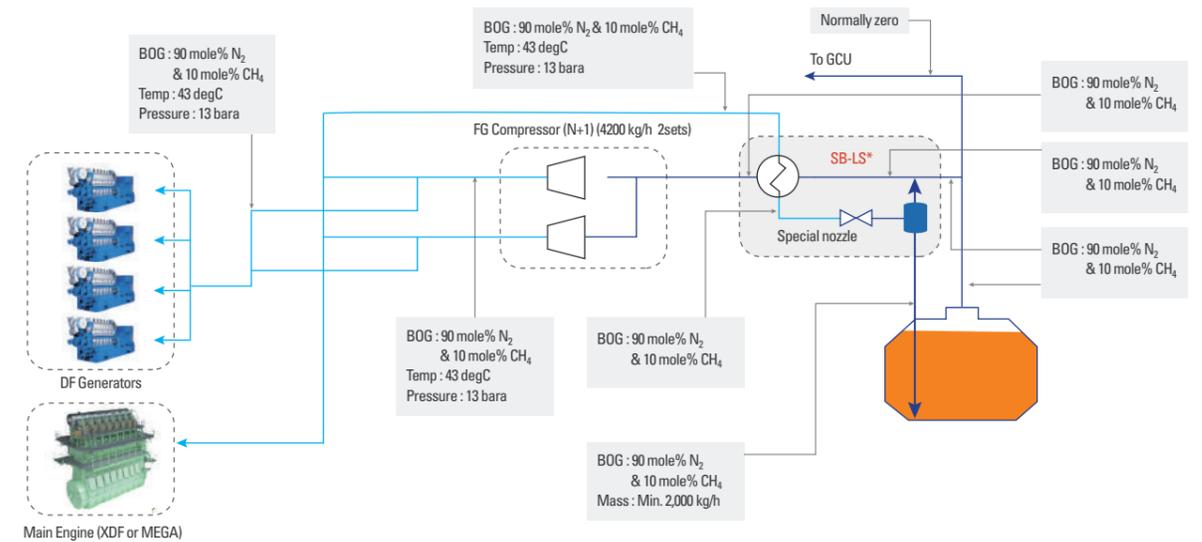
LCO₂ Temperature/Pressure

- Low temperature / Low pressure (7-10 barG, -50°C)**
 - Novel operation
 - Allow larger cargo tanks and reduced cost for shipping
 - High density of cargo
 - Increased cost for liquefaction and conditioning
- Medium pressure (15-20 barG, -30°C)**
 - Mature technology - Decades of operational experience
 - Limitations to cargo tank size
 - Selected regime for northern light initial phases
- Ambient temperature / High pressure (40-50 barG, >0°C)**
 - Novel design
 - Scalable and flexible design
 - Reduced cost for liquefaction and conditioning
 - Low density of cargo

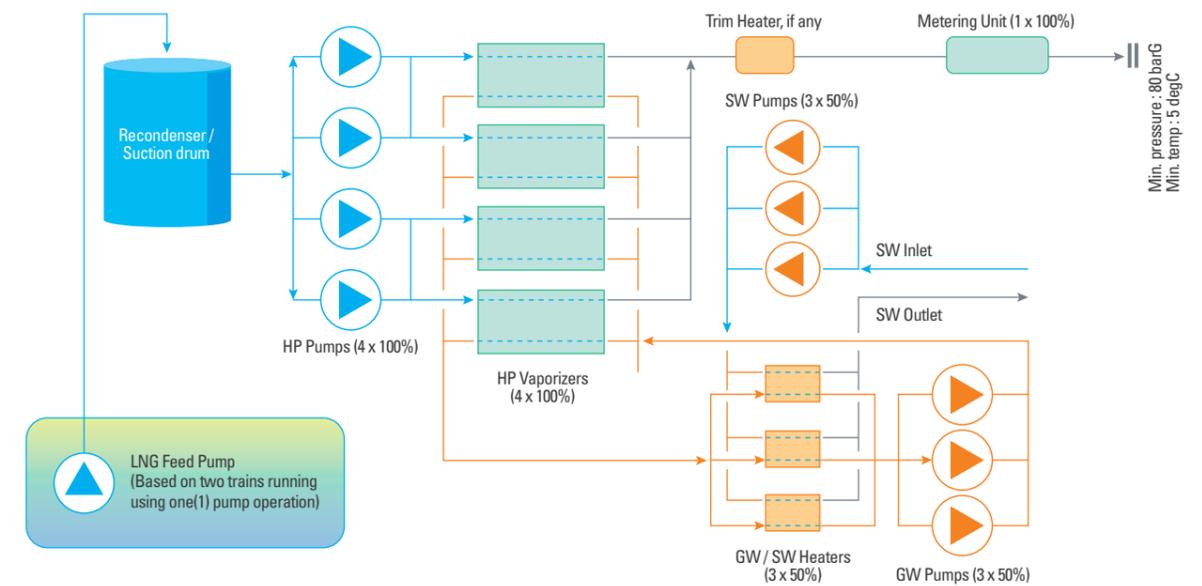
Operation of LCO₂ Carrier



Reliquefaction system for LNGC & VLGC

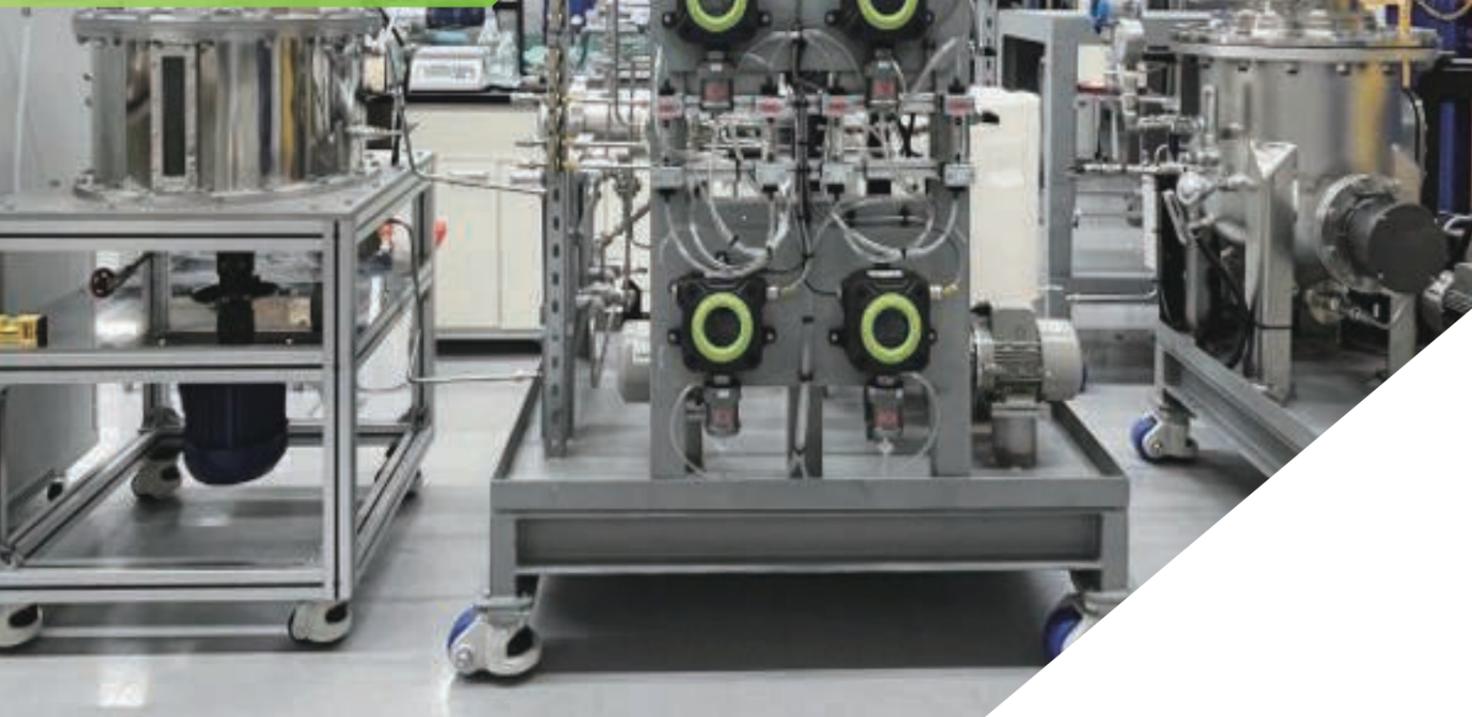


Regasification system for FSRU

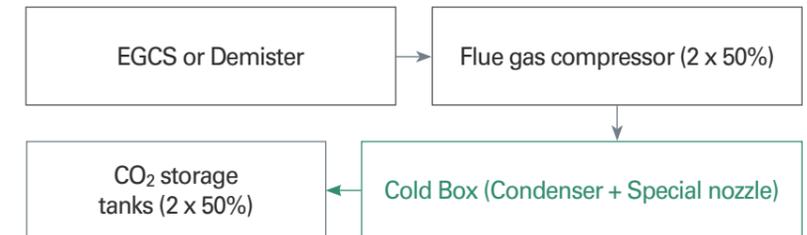


OCCS

On-board Carbon Capture System

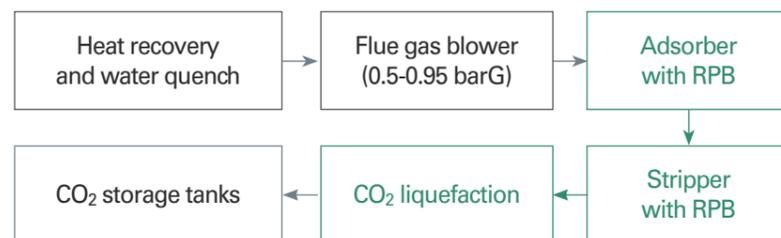


OCCS with Cryogenic Carbon Capture



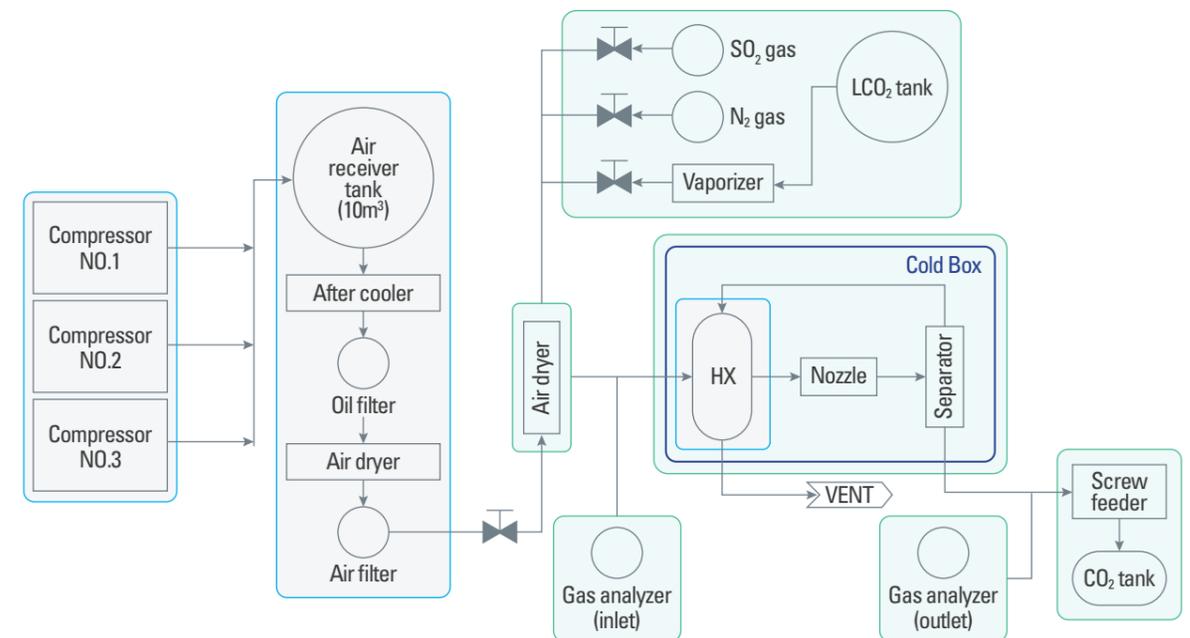
- Cryogenic Carbon Capture including LCO₂, storage tank(s)
- NO solvents required
- NO chemical reactions
- NO CO₂ gas liquefaction system
- NO column design required
- To replace the absorption tower and stripper of conventional wet type OCCS which are main process units of the solvent-based system with cold box
- 90% downsizing compared to the conventional wet type OCCS
- 70% reduction in energy consumption

OCCS with RPB (Rotating Packed Bed)



- System development in collaboration with Carbon value, UNIST (Ulsan National Institute of Science and Technology), SUNBO.
- RPB achieves efficient gas / liquid contact through centrifugal force.
- It is more energy and space efficient relative to conventional packed columns.
- Novel solvents are developed which increase the energy performance of the system and reduce OPEX losses due to chemical degradation (e.g., oxidative and thermal degradation).

Test Facility for Cold Box

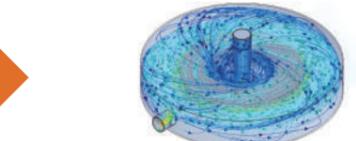


CCUS

Carbon Capture
Utilization Storage

Rotating Packed Bed

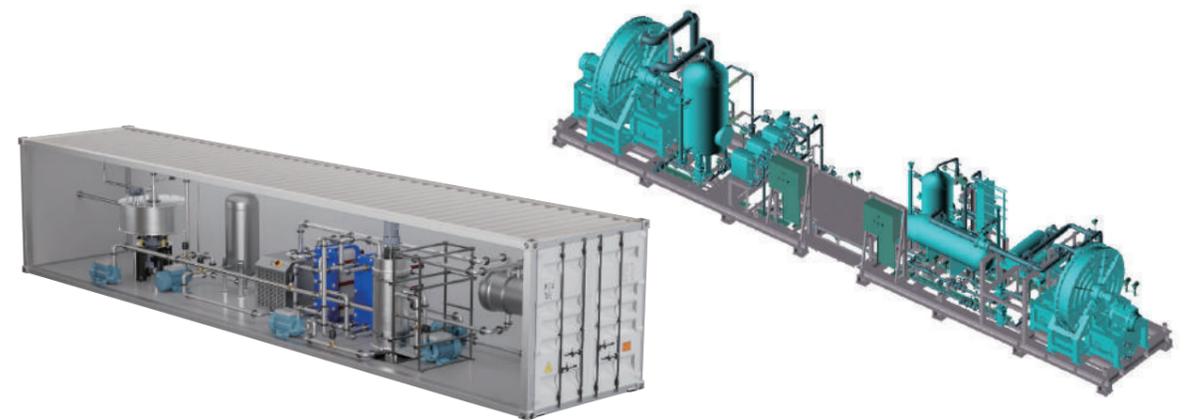
Carbon Capture system to provide the total solution for next generation

RPB process (Rotating Packed Bed)	Solvent process	Optimized system
<p>Conventional wet type carbon capture</p> <p><u>Conventional Type</u></p> <p>Absorption and Stripper packed column. Gravity-driven system, that requires height for efficient separation.</p>		<p>RPB capture system</p> <p><u>Next Generation</u></p> <p>Rotational Packed Bed capture Centrifuge-driven system, that can process large gas flowrates in a compact volume due to enhanced mass transfer.</p>
<p>Gravity scrubbing</p> 	<p>1/10 downsizing</p> 	<p>Centrifugal scrubbing</p> <p>RPB vs Conventional system</p> <ul style="list-style-type: none"> · 10 x reduction in processing volume for the same amount of gas · Process not affected by gravity (more suitable for offshore). · Improved overall separation energy efficiency by 35% on average.

Compact CO₂ Capture System for the Era of Carbon Neutrality

Carbon Value RPB-CC is a fully containerized carbon capture module based on Rotating Packed Bed chemical absorption technology.

Contrary to conventional scrubbing towers CO₂ is captured using a rotational force, greatly reducing total space and height required. CO₂ is captured from exhaust gas via chemically selective solvent. CV's RPB absorber design is such that no high pressures are required to drive the exhaust gas through the absorber (i.e., no compressor only blower). Highly concentrated CO₂ is released from RPB stripper where it is ready for utilization or storage.

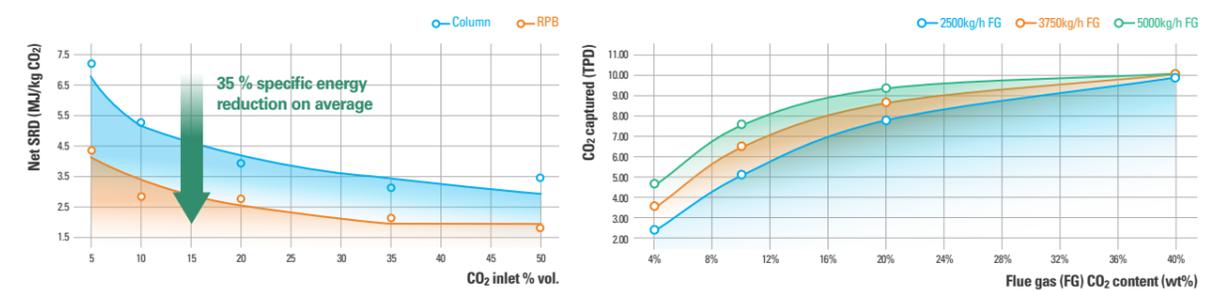


Proprietary Solvent

MEA (30 wt.%) after 25h of CO ₂ Absorption-Desorption	CV-S3	CV-S3 after 75h of CO ₂ Absorption-Desorption
0.56	CO₂ loading capacity [mol CO ₂ /mol solvent]	0.72
100	Regeneration temperature [°C, 1 atm]	90
3.57*	Specific regeneration energy [GJ/ton CO ₂]	1.93*

* Test in Carbon Value

CO₂ Energy Efficiency & Capture Capacity





| A Suitable Hydrogen Production Method for the Era of Renewable Energy



H₂-Gen[®] is a hydrogen generator based on PEM (Proton Exchange Membrane) Technology.

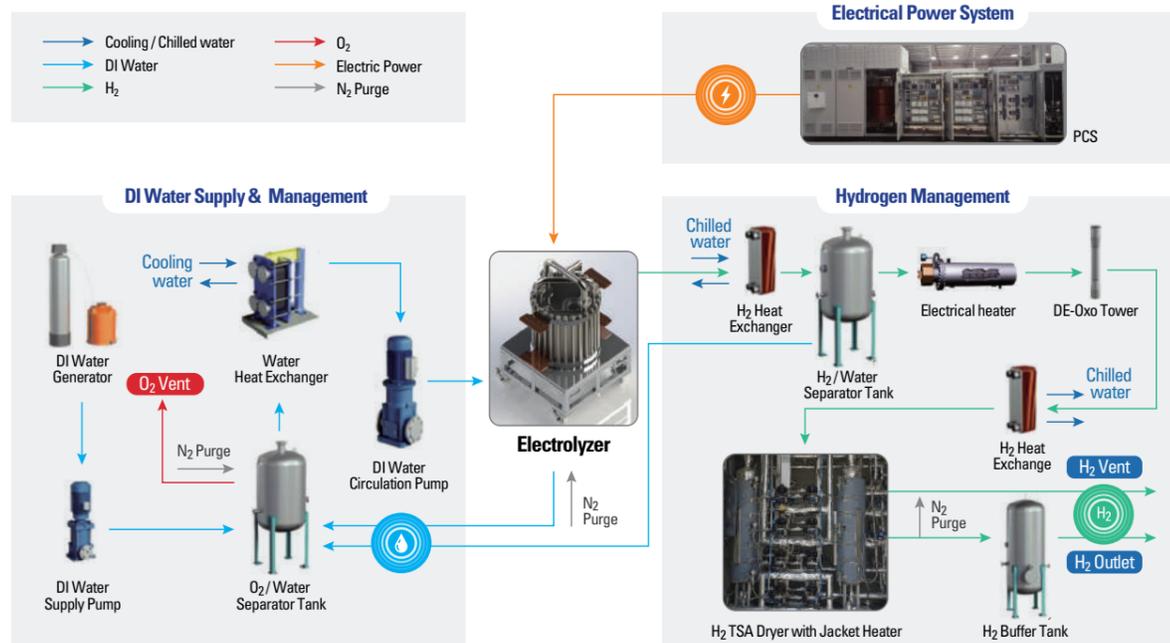
Unlike conventional hydrogen production methods, it produces hydrogen using only water (H₂O) and electricity. H₂ and O₂ are the only by products generated through electrolyzer, and harmful gases like CO₂ are not produced, making it an environmentally friendly hydrogen generator. It is the ultimate hydrogen generation device capable of handling 100% of the load fluctuations characteristic of renewable energy sources.

| SCOPE OF SUPPLY

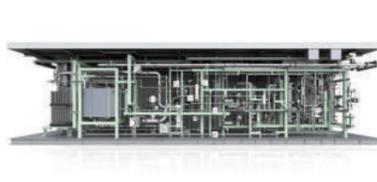
Technical specification as per capacity

Division	Specification	H ₂ Generator Model No. (PEM Electrolyzer System)					
		H ₂ Gen 100	H ₂ Gen 200	H ₂ Gen 600	H ₂ Gen 1000	H ₂ Gen 2000	H ₂ Gen XMW
PEM Stack	Rated Power	50kW	100kW	300kW	500kW	1MW	2MW
Hydrogen Production	Volume (Nm ³ /hr) @ system outlet	10	20	60	100	200	400
	Water Consumption (Liter/hr)	Tap Water for DI Water	25	50	140	240	480
DI Water		11	22	66	110	220	440
	DI Water (Conductivity)	0.05 ~ 0.1μs/cm (Up to 6 barG)					
Utility (Option)	Cooling Water (kg/h) [based on closed loop]	6,400	12,800	38,000	64,000	128,000	256,000
	Chilled Water (kg/h) [based on closed loop]	90	180	530	880	1,750	3,500
Installation Footprint	Installation Footprint (m ²)	28	28	31	31	62	62
	Containerized Size	30ft x 1ea	30ft x 1ea	40ft x 1ea	40ft x 1ea	40ft x 2ea	40ft x 2ea

| Conceptual process for hydrogen production (PEM)



| Reference list

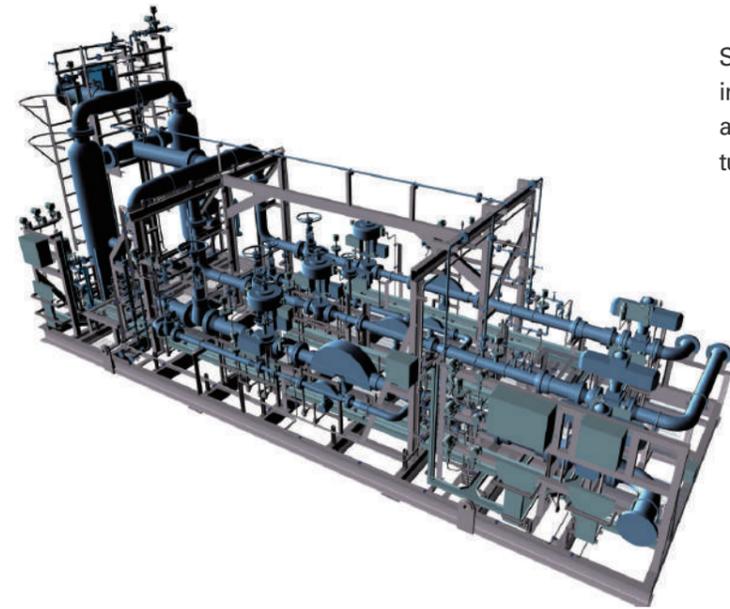
 <p>50kW</p> <ul style="list-style-type: none"> · 10Nm³ per hour · Delivery : 2022 · H₂ Purity : 99.999% 	 <p>100kW</p> <ul style="list-style-type: none"> · 20Nm³ per hour · Delivery : 2023 · H₂ Purity : 99.999% 	 <p>300kW</p> <ul style="list-style-type: none"> · 60Nm³ per hour · Delivery : 2023 · H₂ Purity : 99.999%
 <p>500kW</p> <ul style="list-style-type: none"> · 100Nm³ per hour · Delivery : 2023 · H₂ Purity : 99.999% 	 <p>1MW</p> <ul style="list-style-type: none"> · 200Nm³ per hour · Delivery : 2024 · H₂ Purity : 99.999% 	 <p>2MW</p> <ul style="list-style-type: none"> · 400Nm³ per hour · Delivery : 2025 · H₂ Purity : 99.999%

SUN-FGMS[®]

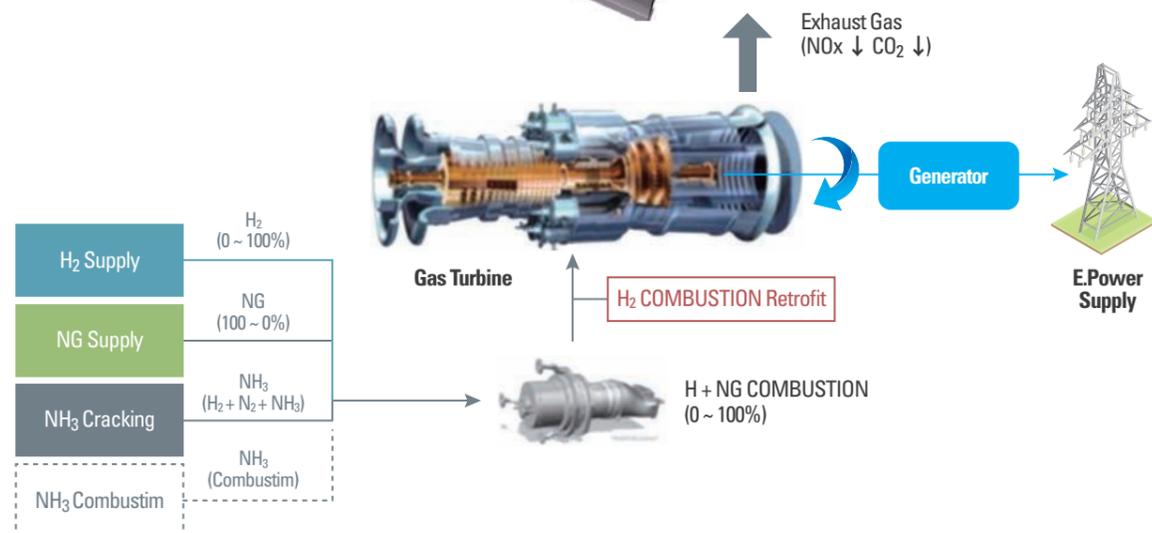
SUNBO Fuel Gas
Mixing System



ONSHORE & OFFSHORE MODULES



SUNBO's Mixing Station is a facility that injects and mixes hydrogen and LNG gas and supplies the mixed gas to the gas turbine through the control module.



REGASIFICATION MODULE

Product	PADUS FSRU	SWAN FSRU	BOTAS FSRU
Client	HHI	HHI	HHI
Delivery	2018	2018-19	2018-19



LIQUEFACTION MODULE

Product	LNG SYSTEM TEST PLANT
Client	SHI
Delivery	2020



HANWHA TOTAL CHEMICAL PLANT Project

Product	Cold Box Package
Client	KSL
Delivery	2018



EGINA FPSO Project

Product	Slop Water Treatment System
Client	GEA WESTFALIA
Delivery	2007



SHWE PLATFORM Project

Product	Produced Water Treatment System
Client	GPS
Delivery	2011



PETRONAS FLNG Project

Product	Pipe Process Module
Client	DSME
Delivery	2014



MARINE MODULE



FLUID TREATMENT SYSTEM

We develop and design our own systems that can process and supply fuel and fluids to various engines and other components, and supply them to our customers.



H.F.O & L.O Purifier Unit



C.F.W Pumps Unit



M/E & G/E & F.O Supply Unit



M/E L.O Filter Unit



NaOH Dosing Supply System



N/G Supply Control System



Main Central Cooler Unit



Mixing Station (H₂ + N/G)

MODULARIZATION

We integrate various devices and pipings for ships and ON/OFF shore plants into modules as per client's requirements. We also provide production design and procurement services.



TANK TOP Unit with Block



E/R TANK TOP Unit



Under Deck Unit in ER



Passageway Unit for LNGC



Regasification Module



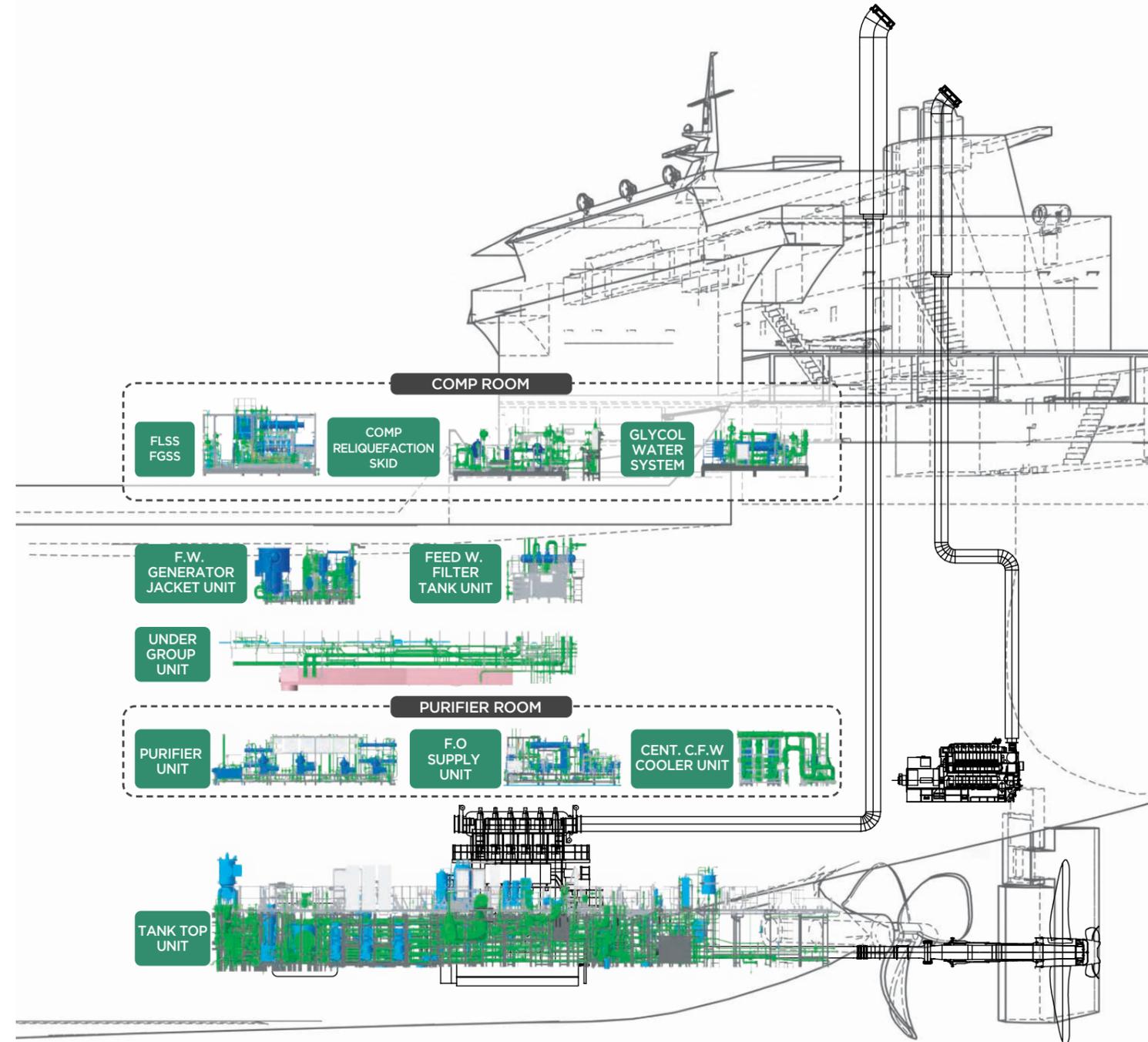
Deoxygenation Package



Pipe Process Module



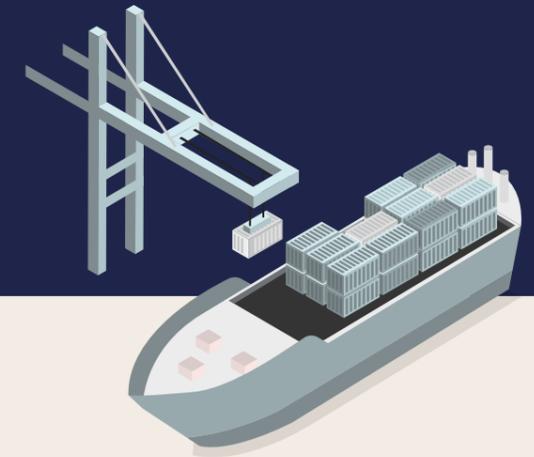
Cold Box



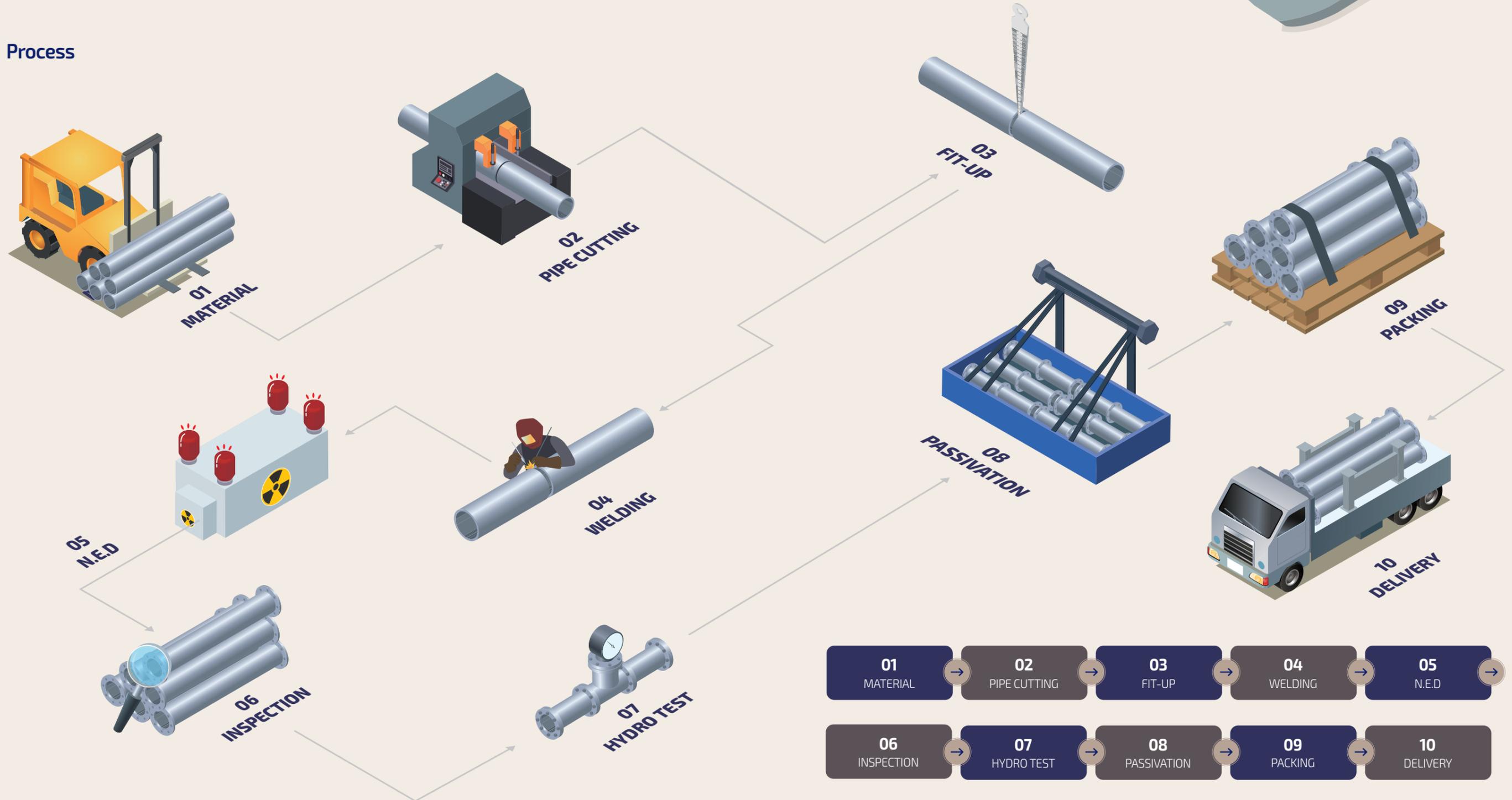


Major production products

Sus & Hydro | Pipe Piece | Reducing Piece | Heating Coil



Process





Major production products

AAV Carburetor | Air Receiver Tank | LNG Tank | Heat Exchanger | PIPE RACK



AAV Carburetor

- Incheon
- Jeju Aewol

INCHEON



Project	IN-CHEON LNG TERMINAL(III AREA) EXPANSION PROJECT		
OWNER	Kyungwha Construction (KOGAS)	FLUID	LNG
STORAGE CAPACITY	1Unit(10Ton/hr), Total 13Unit		
MADP	12.5MPa	MADT	196℃

JEJU



Project	AE-WOL LNG TERMINAL PROJECT		
OWNER	POSCO(KOGAS)	FLUID	LNG
STORAGE CAPACITY	1Unit(7.5Ton/hr), Total 16Unit		
MADP	8.77Mpa	MADT	-170℃

Air Receiver Tank



Project	H.P AIR SUPPLY SYSTEM		
OWNER	Agency for Defense Development /Vitzro Tech Co., Ltd.	FLUID	AIR
STORAGE CAPACITY	5M ³		
MADP	38MPa	MADT	-20 ~ 40℃

Heat Exchanger



Project	-		
OWNER	KHPT/APHE	FLUID	MIX GAS
STORAGE CAPACITY	-		
MADP	2.64MPa	MADT	282℃



Major production products

AAV Carburetor | Air Receiver Tank | LNG Tank | Heat Exchanger | PIPE RACK



LNG CONTAINER TANK



Project	LNG ISO TANK CONTAINER		
OWNER	Steel Flower	FLUID	LNG
STORAGE CAPACITY	40FT		
MADP	2.0MPa	MADT	-196 ~ 40 °C

LNG TANK

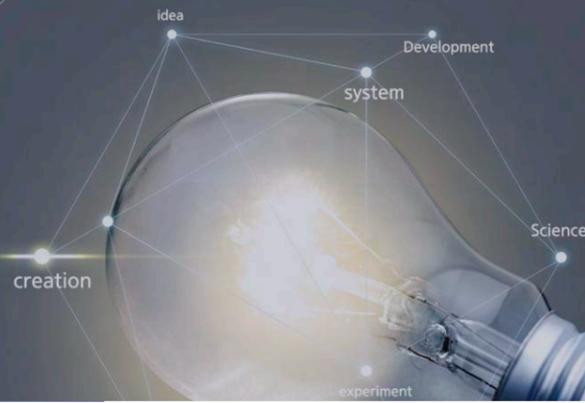


Project	-		
OWNER	Corban Energy grup	FLUID	LNG
STORAGE CAPACITY	1228m3		
MADP	6.0bar	MADT	-163 °C

LPG BALL TANK



Project	Gwangyang 7CGL UTILITY GAS Equipment		
OWNER	POSCO/POSCO ENG	FLUID	H2
STORAGE CAPACITY	127.8M ³		
MADP	1.13MPa	MADT	-10 ~ 40 °C



Major production products

Heater Exchanger | AAV Center | Trim Heater



About R&D Center

As a small but strong company based on technology specializing in cryogenic fields such as LNG, the R&D Center is doing its best to continuously raise issues and improve performance so that customers can be satisfied with products optimized for eco-friendly and global quality standards. Responding to the flow of the 4th industrial structure that communicates with each other through digital technology convergence, we are committed to commercialization of new technologies and new products in the field of cryogenic temperature and hydrogen energy.



R&D Status

• Business Performance

Program (Ministry/Institution)	Project name	Total development period (Start-end date)	Progress
Ministry of SMEs and Startups	Development of atmospheric LNG forced ventilation system localization technology (C0530640)	2017-2018	Product commercialization
Gyeongnam Techno Park	AAV performance evaluation (Performance of performance evaluation of carburetor installed in Jeju-do)	2018-2018	Completed
Gyeongnam Techno Park	Production of NG trim heater prototype	2019-2019	Commercialization of products

• In progress (as of 2020)

Program (Ministry/Institution)	Project name	Total development period (Start-end date)	Progress
Ministry of SMEs and Startups	Development of original technology for localization of seawater vaporizer (S2839044)	2020-2021	In progress

Heater Exchanger (Hydrogen)

Korea Electric Power Research Institute



AAV Center (Cryogenic)



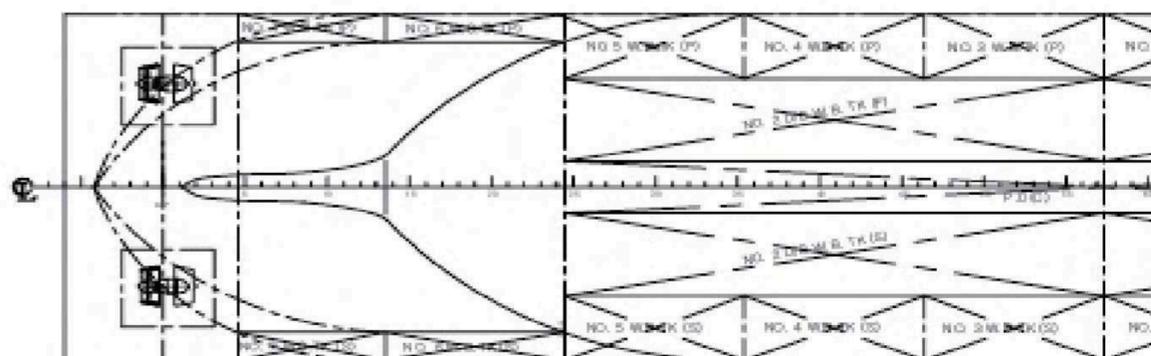
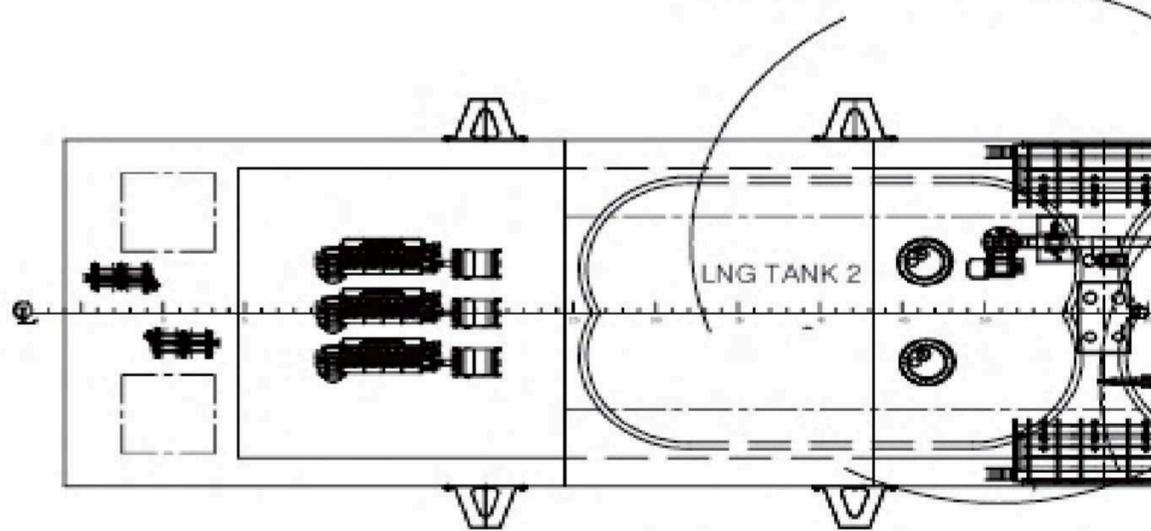
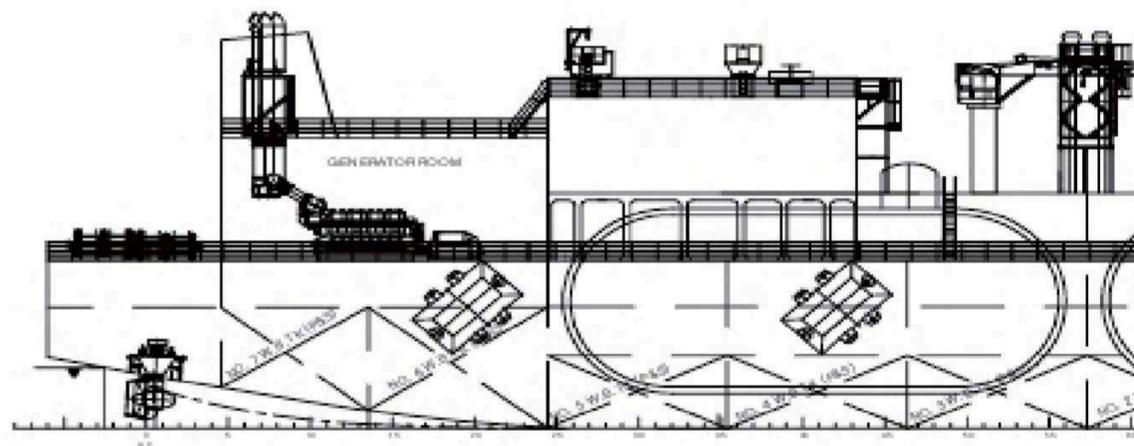
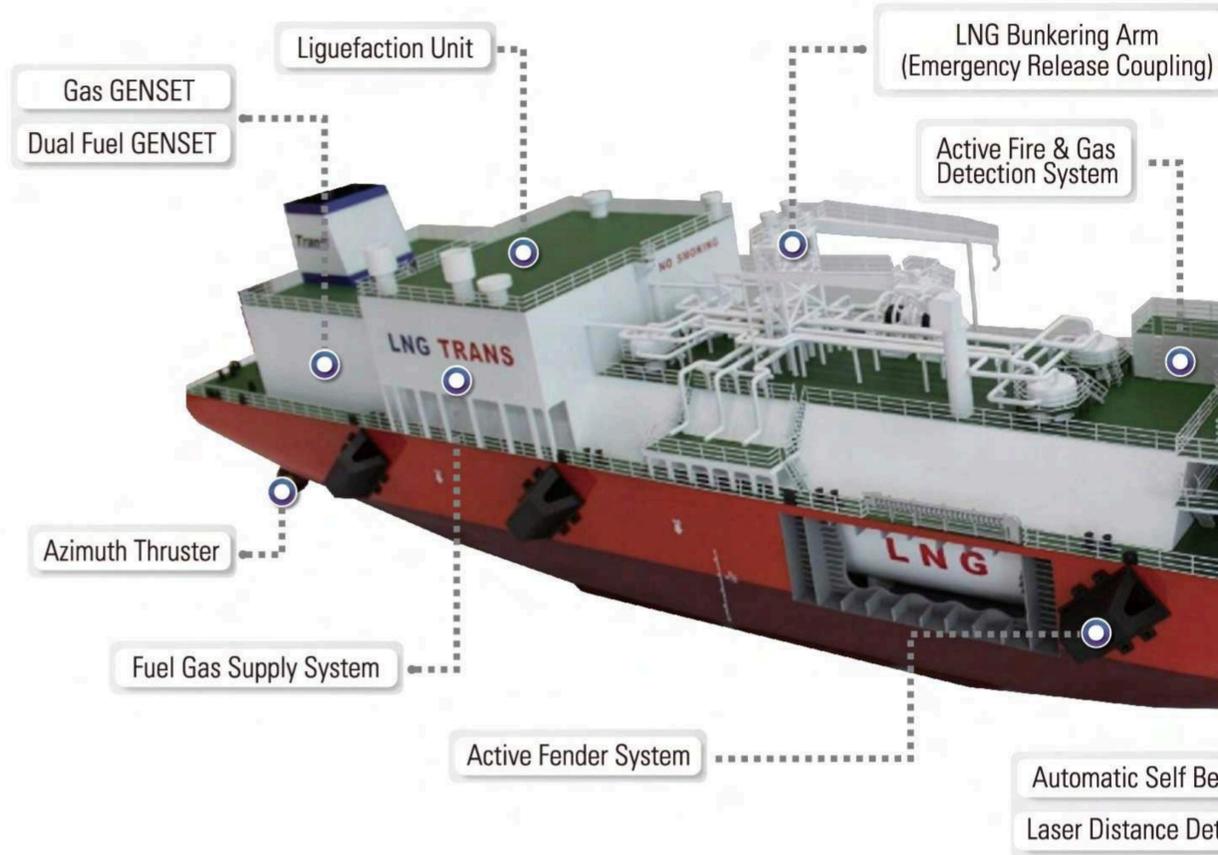
Trim Heater

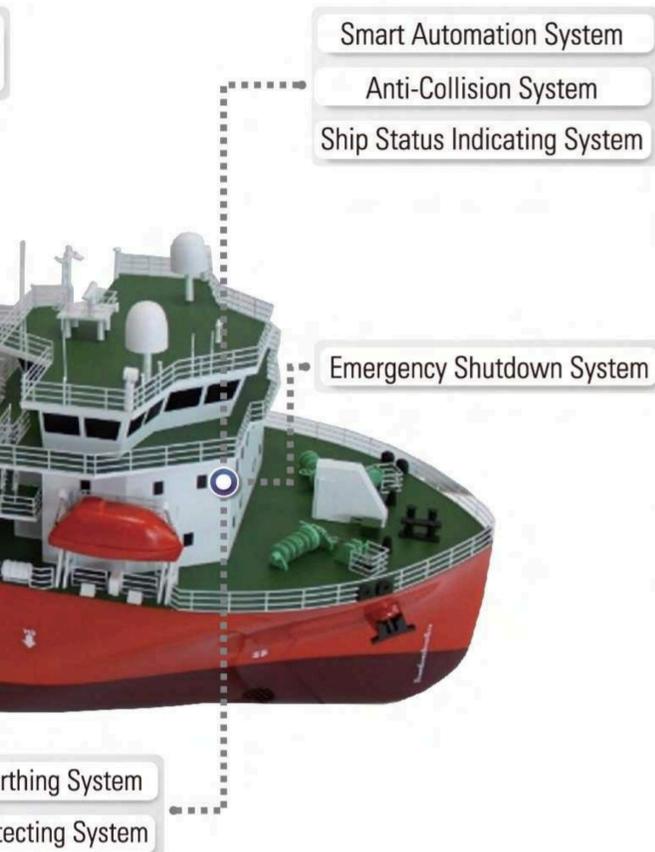
Aerospace Research Institute



Engineering

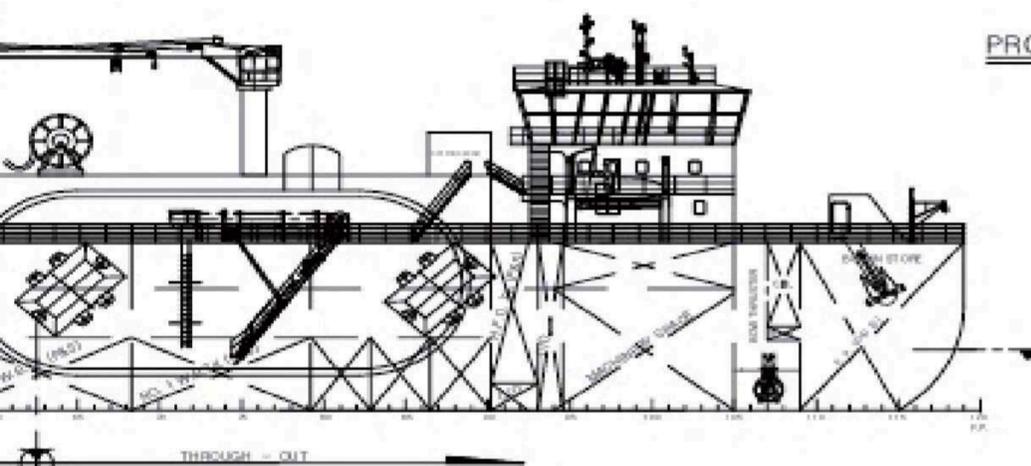
5,000 CBM LNG Bunkering Shuttle [KOLT-05]



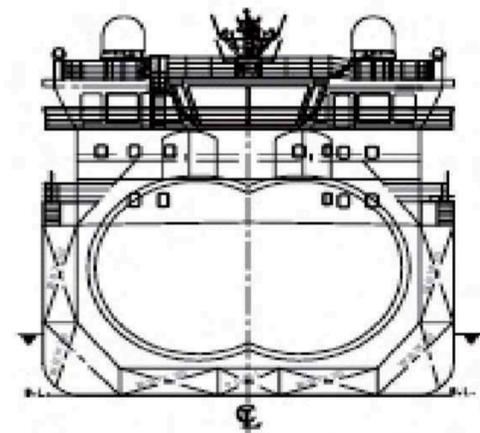


Particular

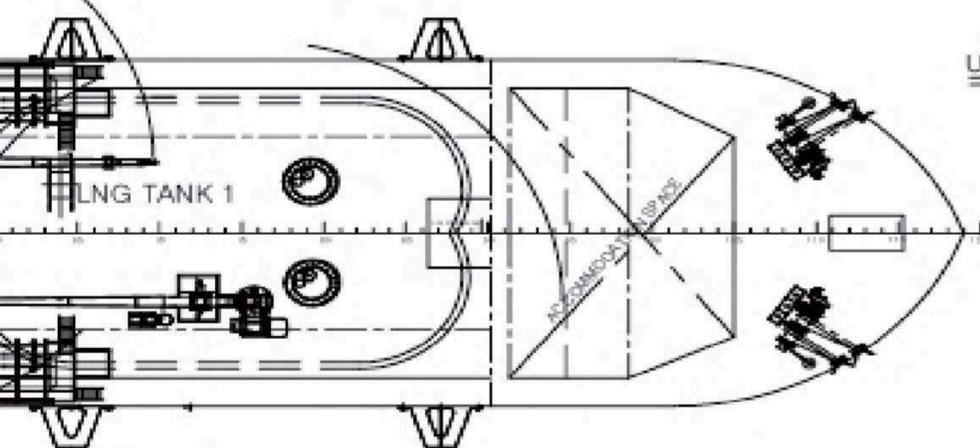
Items	Specification
L.O.A / L,B,P	100.0m / 20.0m
Breadth	20.0m
Depth / Draft	9.7m / 4,0m
Selection of Engine	Gas Engine & Dual Fuel Diesel Engine
Selection of Propulsion System	Electric Propulsion (Azimuth Thruster)
Ship Performance	13knots with S.M. 15%
Electric Power Consumption	1.8MW*3ea
Fuel Supply System (including Arrangement)	Up to 3.4MW
BOG Handling System	0.7t/h
Functional Diagram	LNG Loading/Bunkering, BOG Handling, Fuel Gas Supply, Warming up, Inerting, Aerating, Cool-down, etc.
Berthing & Mooring Method	Fixed Type Fender, QRH with Active Winch



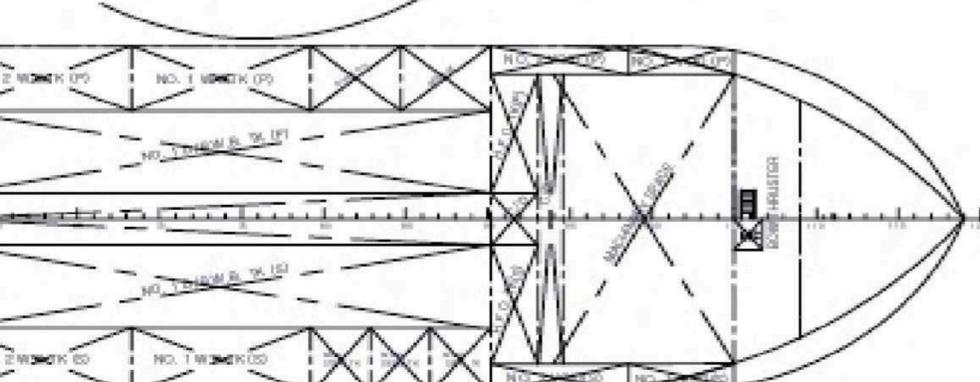
PROFILE



MIDSHIP SECTION



UPPER DECK



TANK TOP

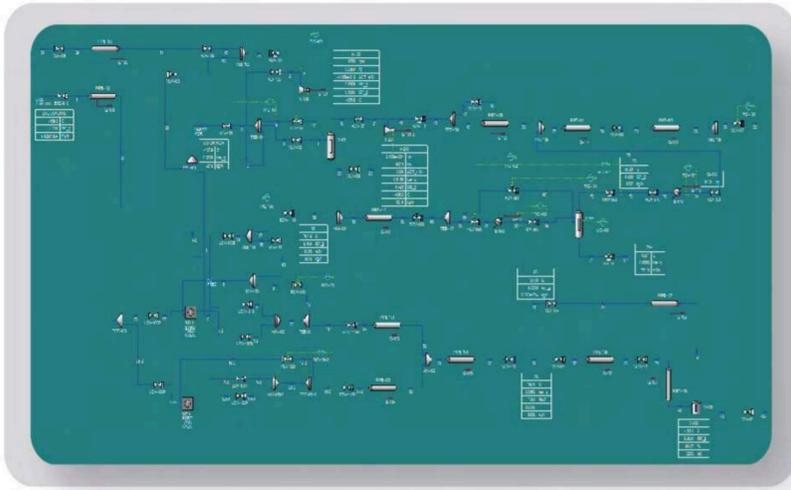
PRINCIPAL PARTICULARS

LENGTH (O.A.)	abt. 100.00M
LENGTH (B.P.)	92.00 M
BREADTH (M.L.D.)	20.00 M
DEPTH (M.L.D.)	9.70 M
DRAFT (O.L.W.L.)	3.50 M
DRAFT (SCANTLING)	4.00 M
MAIN ENGINE POWER	abt. 1,800 kW x 2 SETS
SPEED TRIAL MAX. (MCS)	abt. 13.0 KTS
CLASSIFICATION SOCIETY	HR
COMPLEMENT	12P

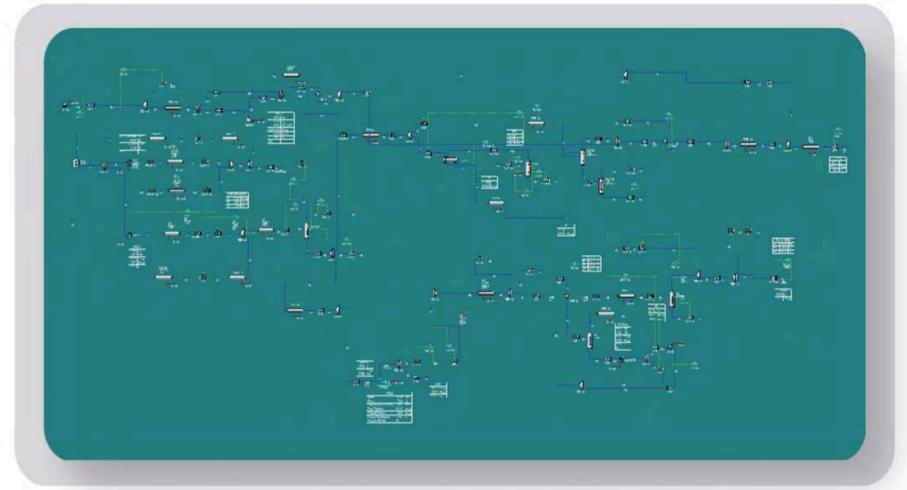
Process Design

Process Simulation

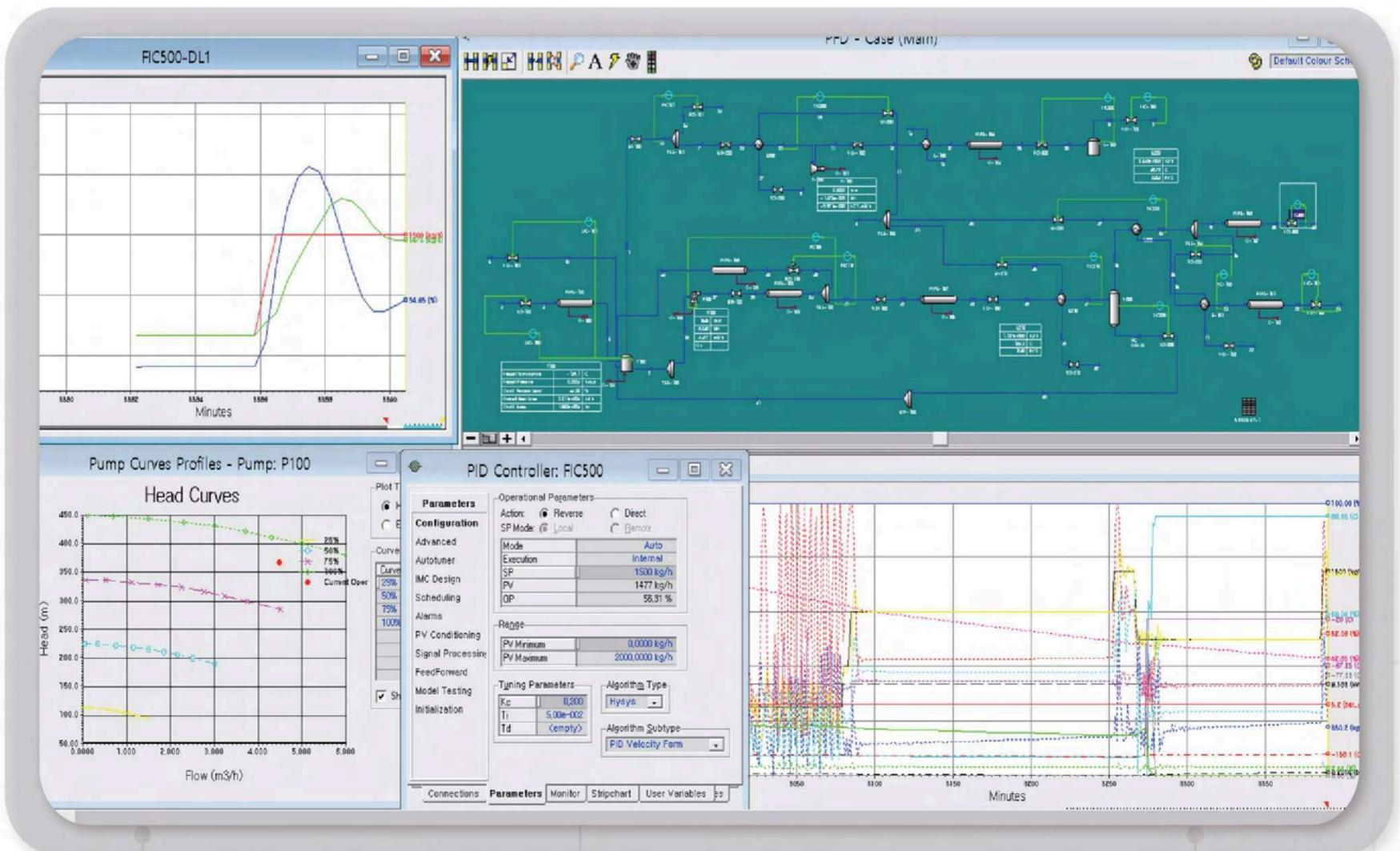
- Accurate process analysis of steady/dynamic simulation
- Confirmation and review of equipment specifications through process analysis



[Floating LNG Bunkering Terminal]



[LNG Fuel Gas Supply System]



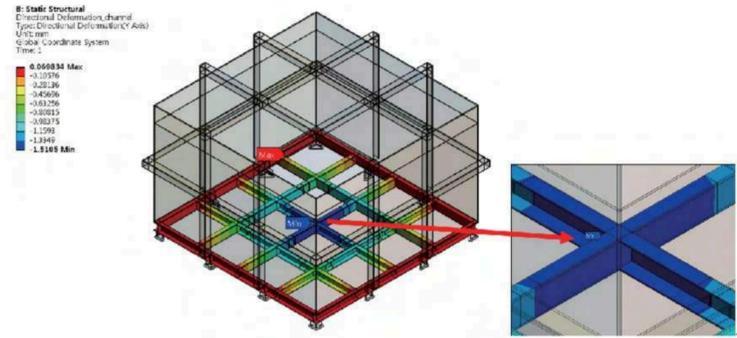
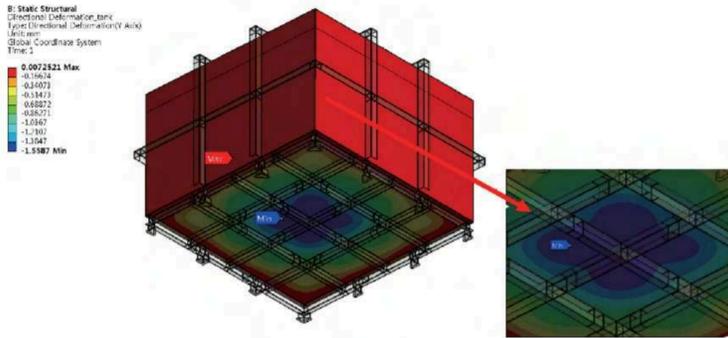
[Dynamic Process Simulation with UNISIM]

Numerical Analysis, CFD

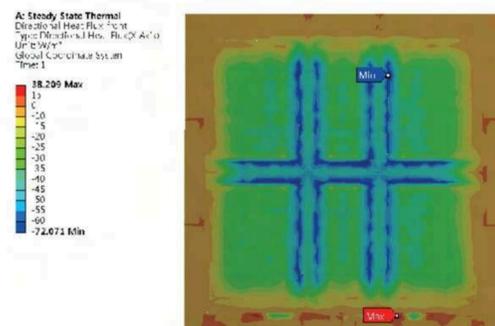
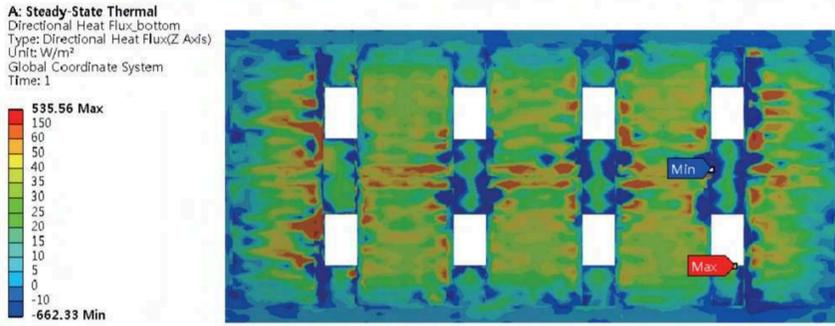
- New Systems and Complex Piping System Design or Problem Analysis of the Existing System
- Accurate Analysis of the Pipe System to Receive Both Static and Dynamic Conditions

1 Tank

Tank Structural Analysis

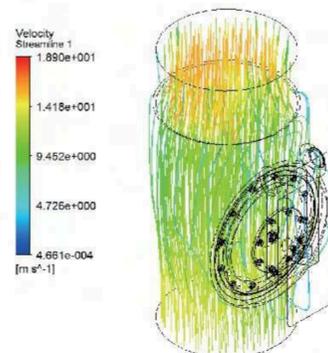
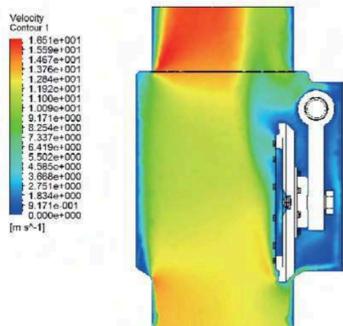
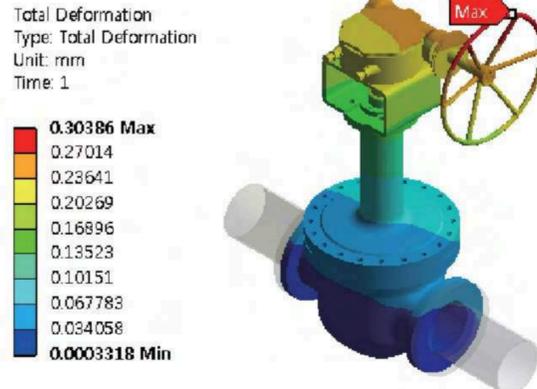


Insulation System Analysis



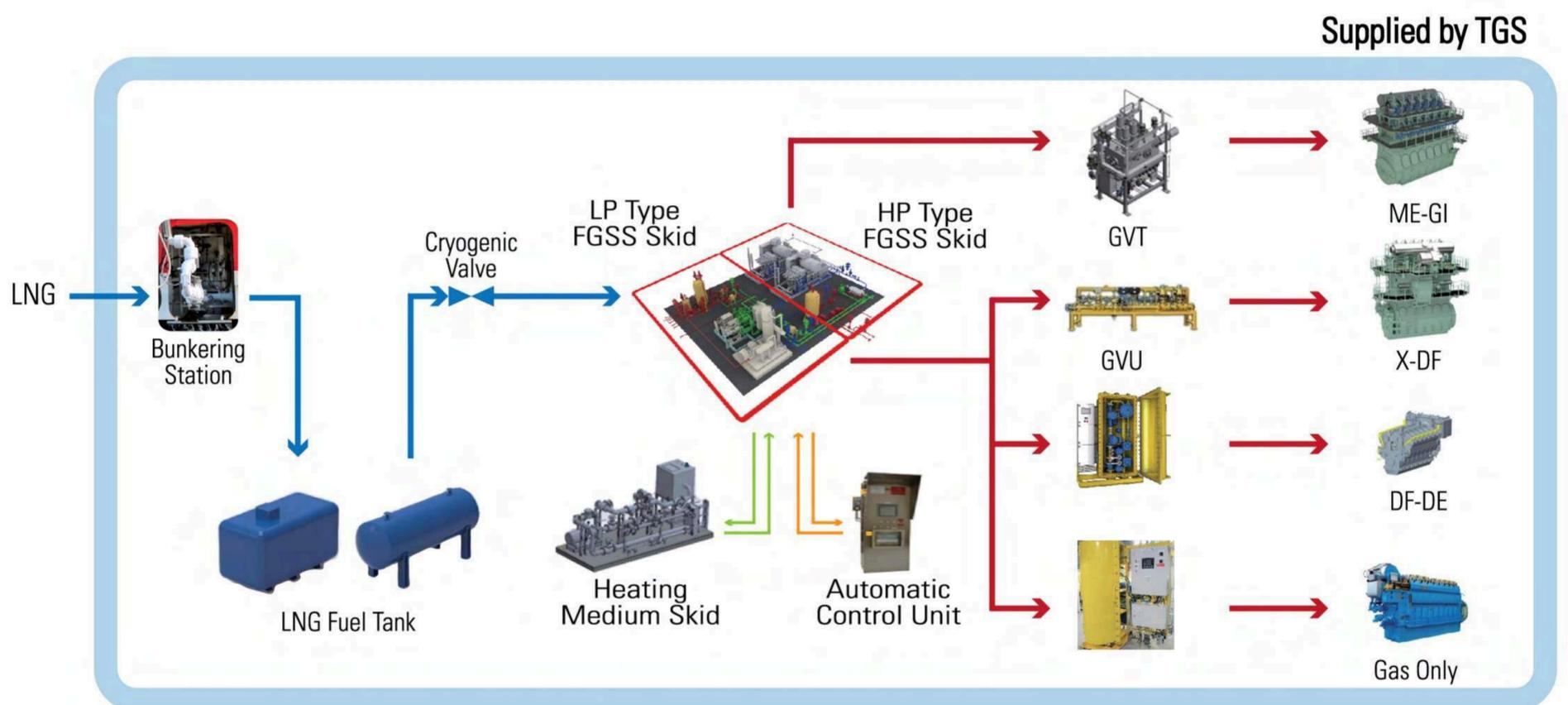
2 Valve

Valve Structure / Fluid Analysis



Procurement

LNG Fuel Gas Supply System Package, GVT/GTU, DF/GAS Engine



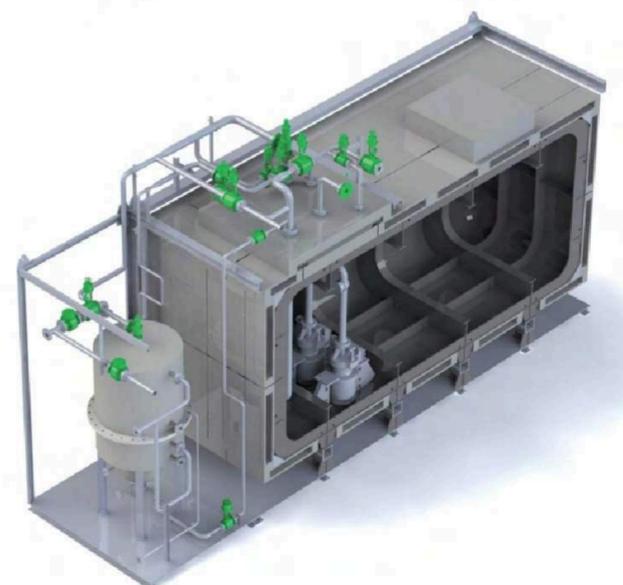
- Bunkering Station, Fuel Tank, FGSS Skid, Heating Medium Skid, Control & Safety System, GVT/GTU, DF/GAS Engine

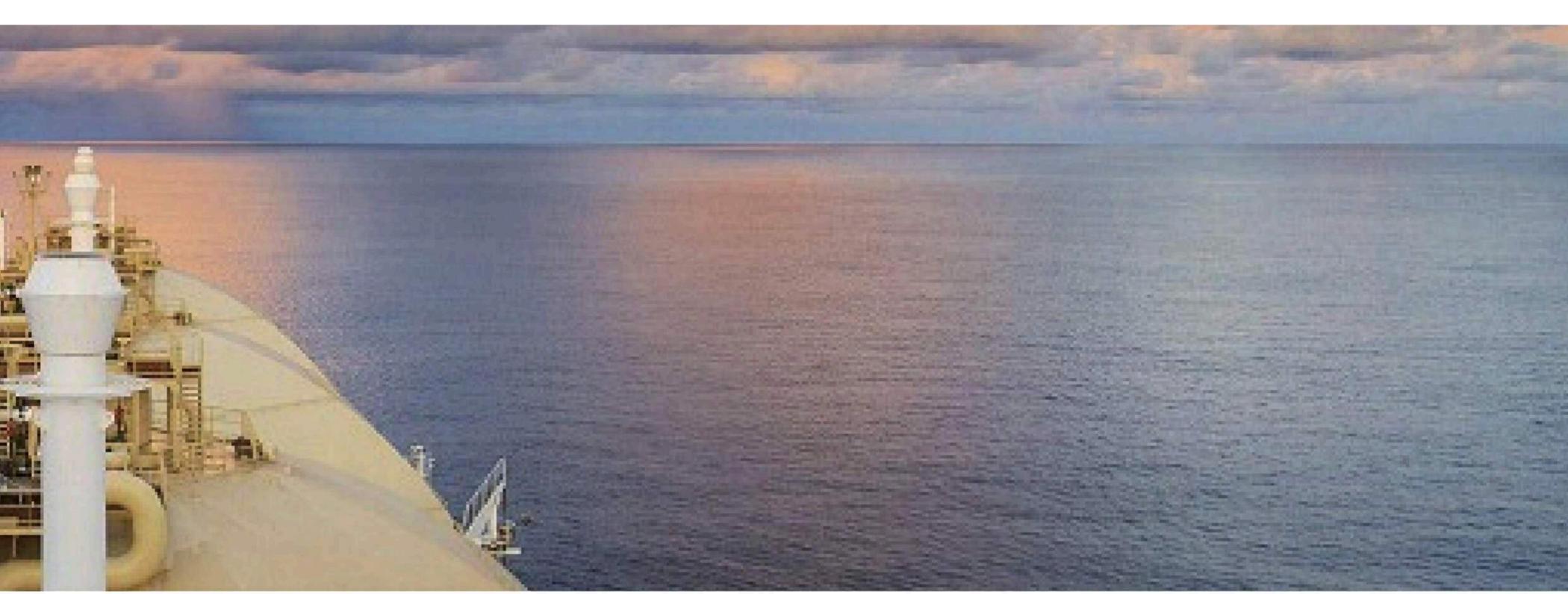
Containerized CRYOPac[®] (40ft size)

▼ Actual Product



▼ 3D modeling

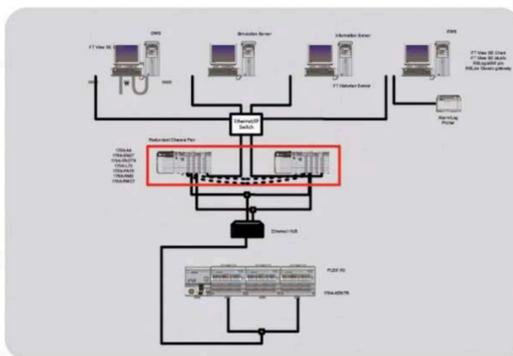




Automation System for LNG Bunkering Supply Chain

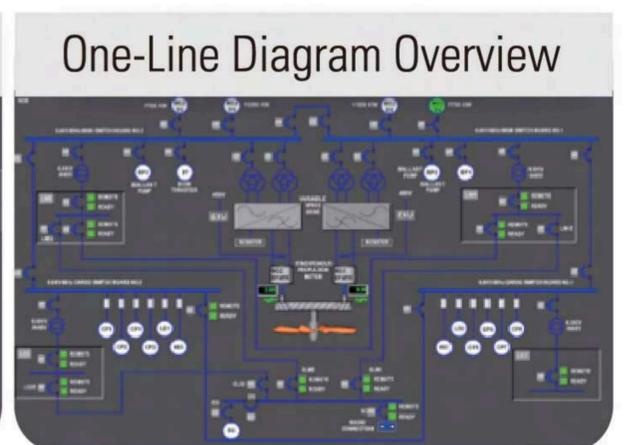
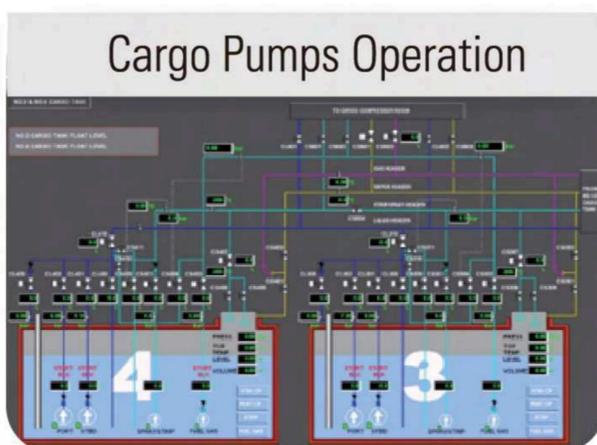
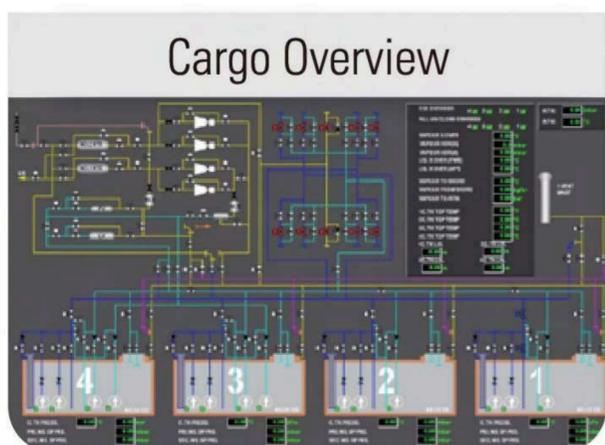
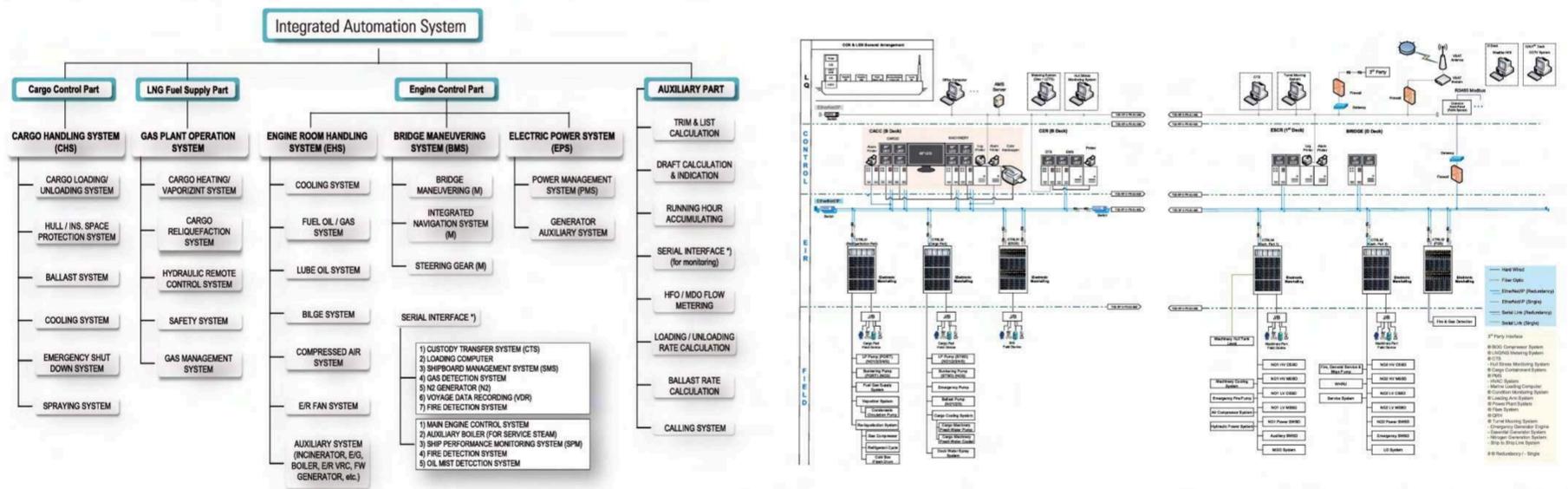
CRYOPac®

▶ Operator Training System



- Rockwell Automation based Hybrid DCS Control System
- Real Time Dynamic Process Simulation

Small-scaled LNG Carrier / Bunkering Shuttle



Commissioning



0

LNG Bunkering Shuttle & LNG Fuel Gas System, Gas Commissioning



02



03



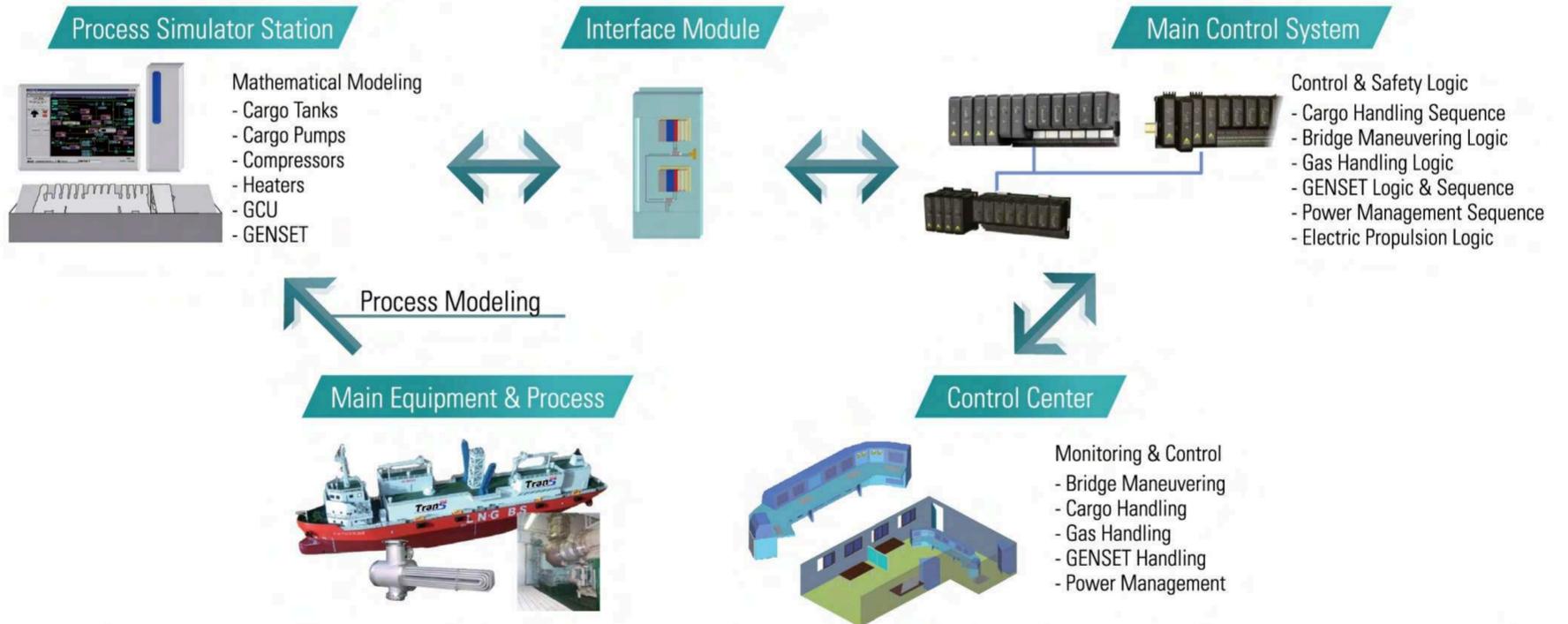
04



05

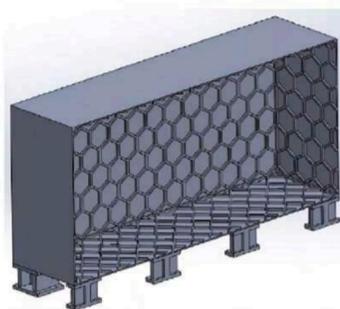
Training for LNG Fuel Gas Supply System, Cargo Handling System

- Dynamic Simulation for Electric Propulsion Type LNGC
- Real Time Check for Control Functions (HILS)



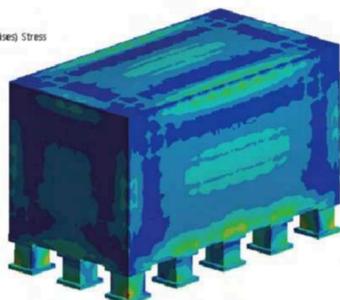
R&D

AL-50830 LNG Fuel Tank, HoneyCell™



B: Static Structural
Equivalent Stress
Type: Equivalent (von-Mises) Stress
Unit: MPa
Time: 1

1118.4 Max
994.18
809.98
745.78
621.59
497.39
373.19
248.99
124.79
0.59612 Min

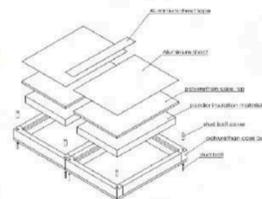


HoneyCell™ means a tank that forms a grid like pentagon or hexagon structure on its internal surface to store LNG and with stand pressure without additional reinforcement for the structure.

Innovative LNG Insulation System, ILIS™

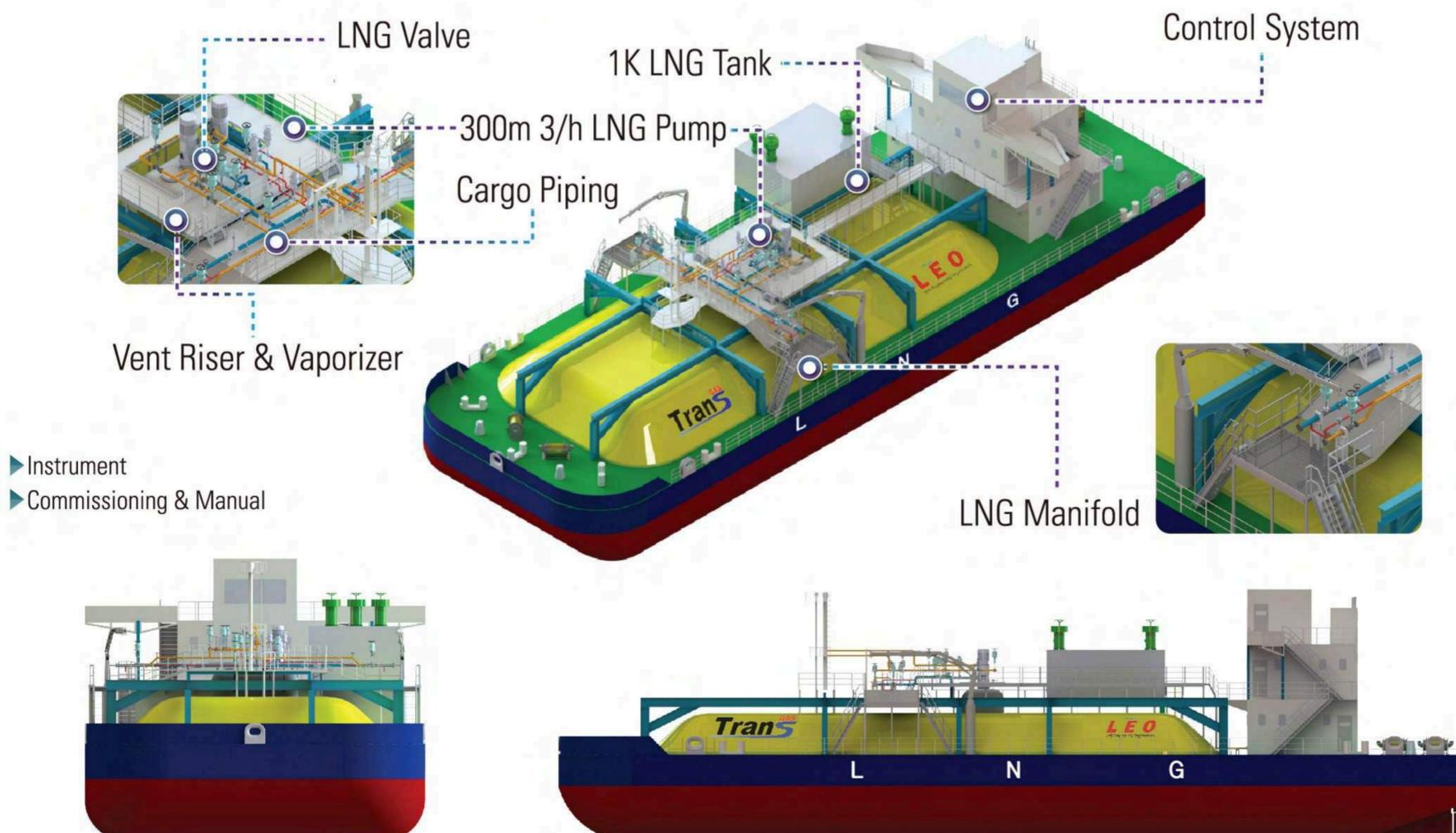
ILIS™ is a pre-formed insulation material for independent-type storage tanks which can be easily attached to the tank walls. And new fire-retardant material is adopted for ILIS™.

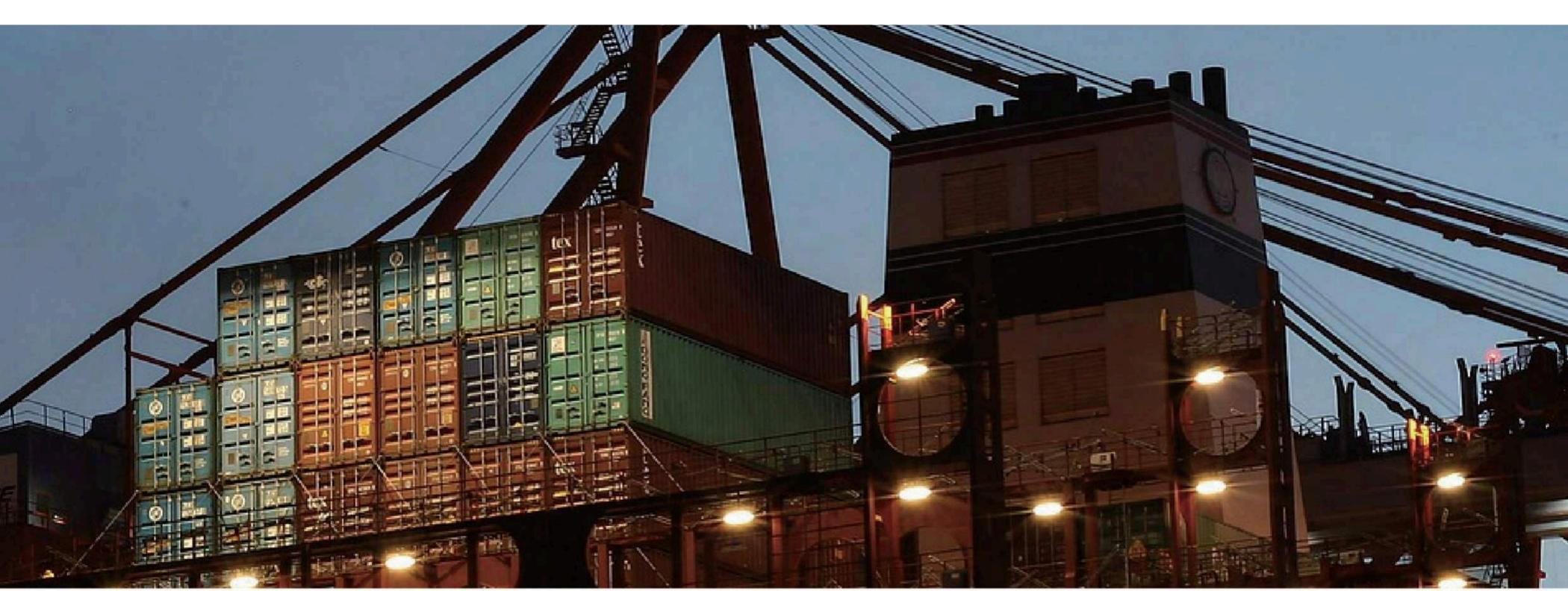
ILIS™



- IMO Type 'C' or Equivalent
- Tank Material Conductivity : 0.02W/m-K
- Overall Heat Flux : 6.6W/m² at 45 °C
- Low Heat Conductivity Material Used : K=0.0061W/ m-K at - 160 °C

1.1K CBM Class Tug Pulling LNG Barge

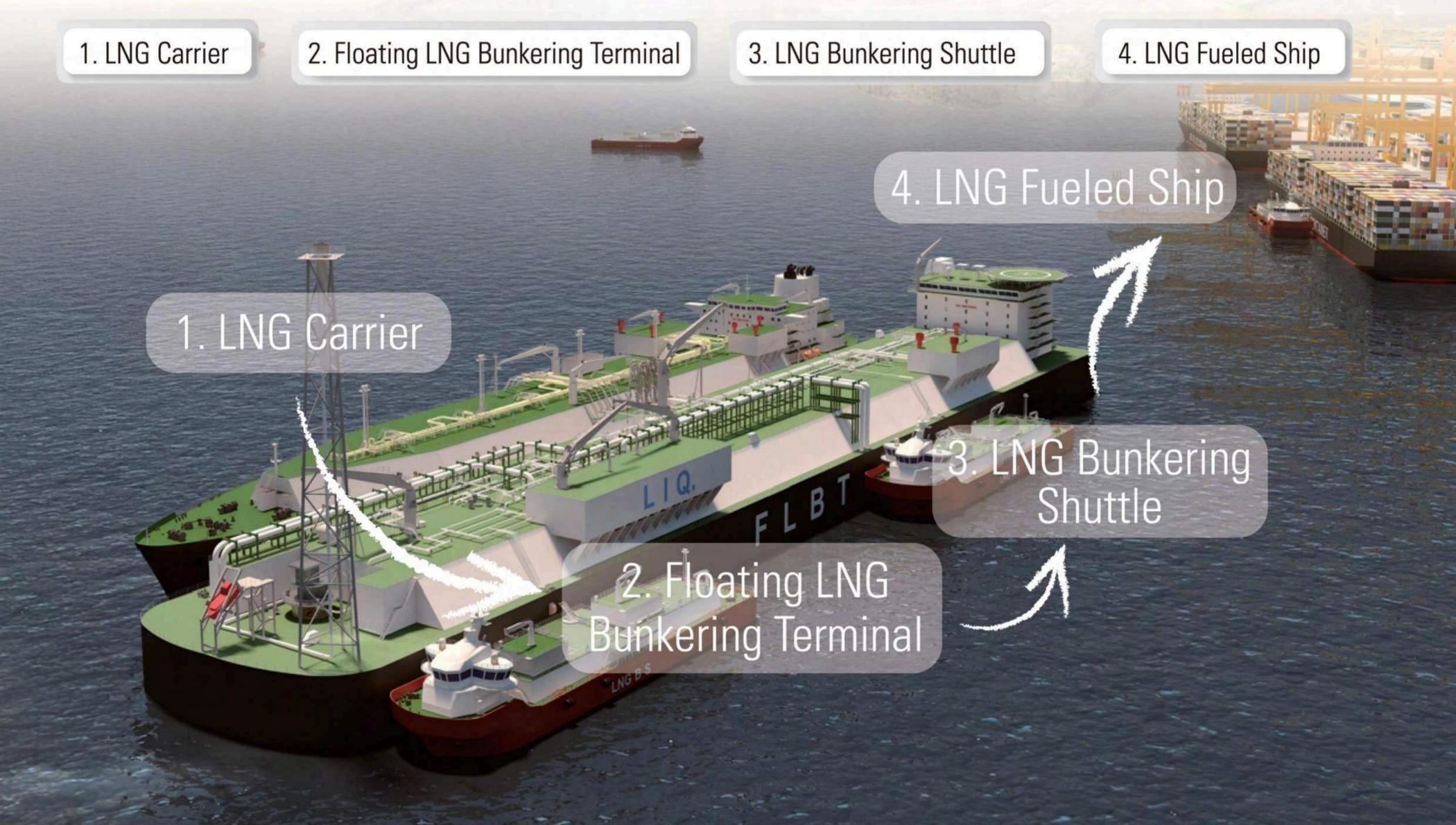




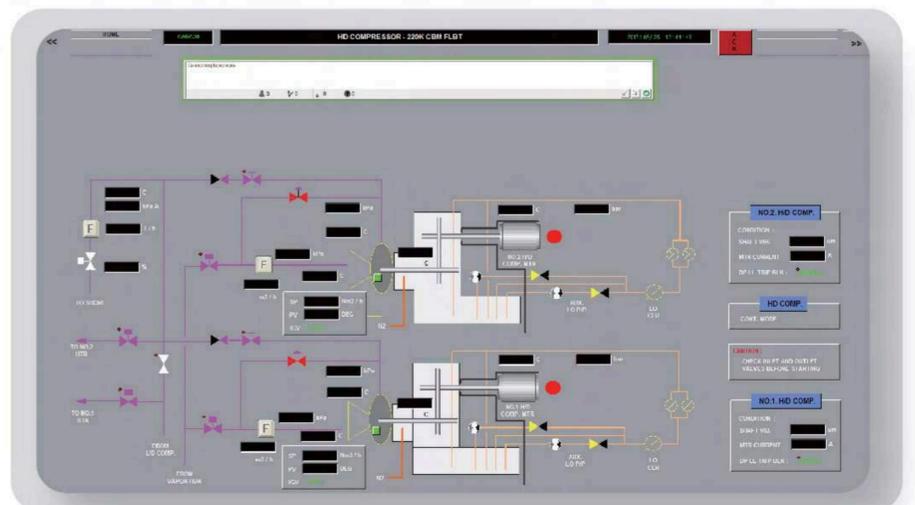
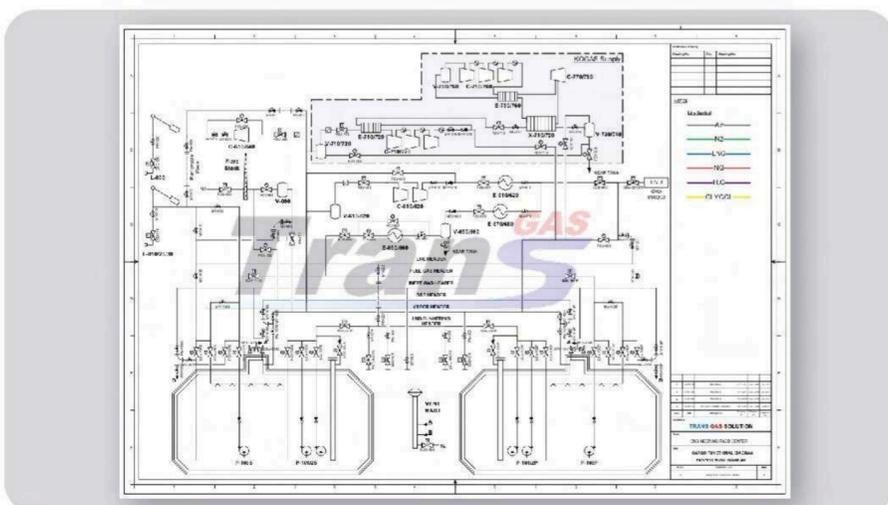
Floating LNG Bunkering Terminal

Developing the topside process and hullside process of FLBT(Floating LNG Bunkering Terminal) and operator training system.

- 1. LNG Carrier
- 2. Floating LNG Bunkering Terminal
- 3. LNG Bunkering Shuttle
- 4. LNG Fueled Ship



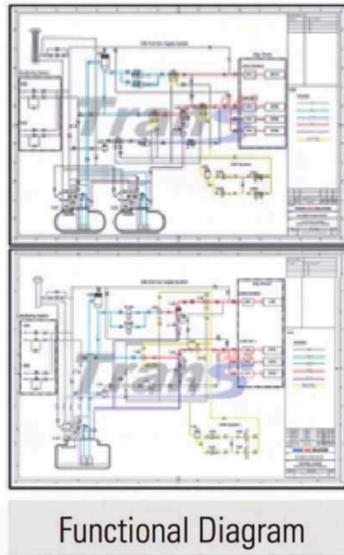
[Cooperation with KRISO]



Fuel Gas Supply System of 50K MR Tanker and 1,000TEU Container Vessel

Basic Design Package for Medium & Small Scaled LNG Fuelled Vessel
 Developing fuel gas supply system of 50K MR Tanker and 1,000TEU Container Vessel

- Functional Diagram
- FGSS P&ID
- Main Equipment Data Sheet
- Instrument Specification
- Alarm Point List & Instrument List
- Functional Design Specification
- Capacity Calculation
- LNG Pump, Vaporizer, IHM Heating System P&ID (included in FGSS P&ID)



Floating LNG Power Plant (FLPP)

A "barge-mounted power plant" is a power plant installed on a deck barge. Sometimes called "floating power plant" or power barge"

- 24MW Gas Engine Power Gen.
- LNG Fuel Gas Supply System
- Waste Heat Recovery System

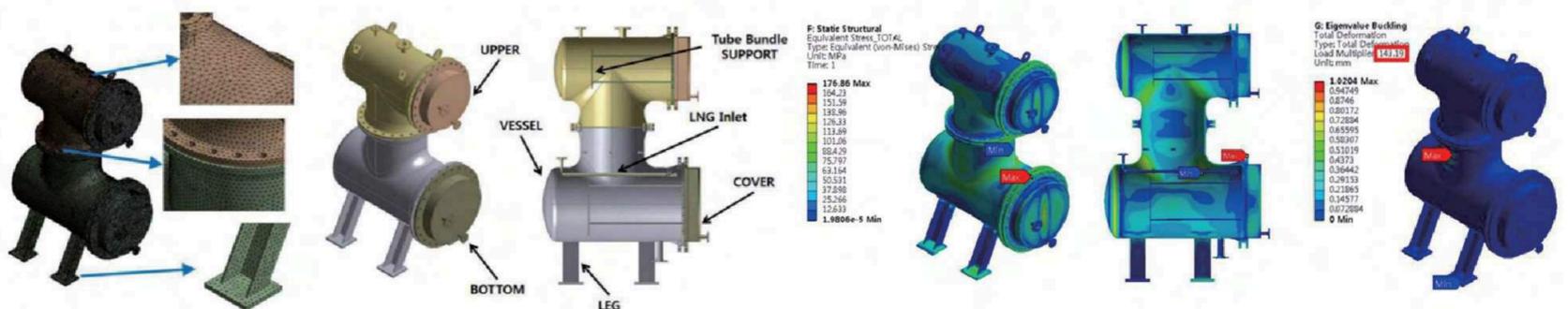
Principal Dimension

- Length OA : abt. 76.00m
- Length B.P : 76.00m
- Breadth : 32.00m
- Depth MLD : 10.00m
- Draft MLD : 3.30m

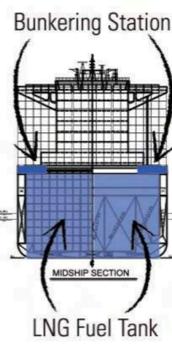
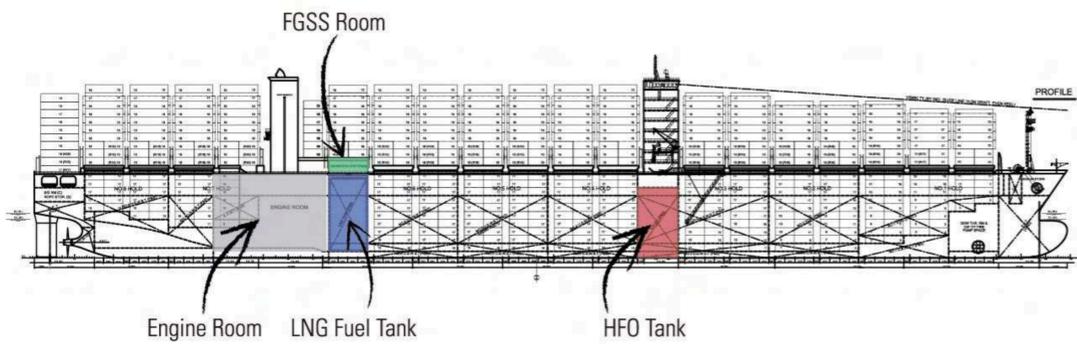


Heat & Structure Combined Analysis, Buckling Analysis and Heat-Flow Analysis of Combined LNG Vaporizer

DF Engine Gas Supply System applied to Small LNG Vessel
 Heat & Structure Combined Analysis, Buckling Analysis, Heat Flow Analysis



11,000 TEU LNG Fuelled Container Vessel



11,000 TEU LNG Fuelled Container Vessel General Information

Main Dimension	Length Overall	334.0m	Main Engine	Type	MAN B&W 8G95ME-C9.5-GI
	Length Between Perpendiculars	320.0m		MCR	40,590 kW x 76.4 rpm
	Breadth Moulded	48.2m		NCR	32,472 kW x 70.9 rpm
	Depth Moulded	27.2m		Type	Wartsila 8L34DF
	Design Draft	12.5m		Diesel Generator	3,840 kW x 4 sets
Dead Weight	Design Draft	89,000 MT	Power Supply	EM'cy Generator	300 kW x 1 set
	Scantling Draft	113,600 MT			

[Cooperation with SUNGDONG SHIPBUILDING & MARINE ENGINEERING]

