

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

Global Leader in Smart & Green Technology

Global eco-friendly and energy system expert that increases the value of living and opens doors to a sustainable future

About PANASIA

8 Energy Solutions

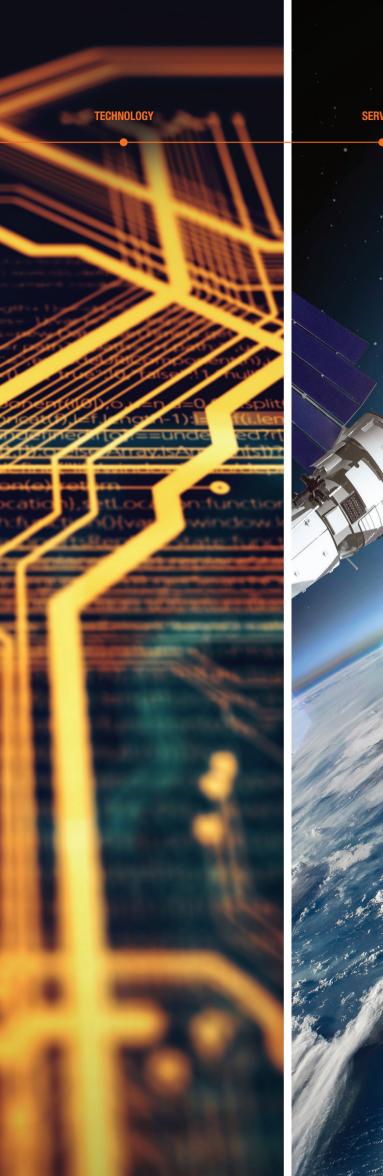
16 Air Solutions

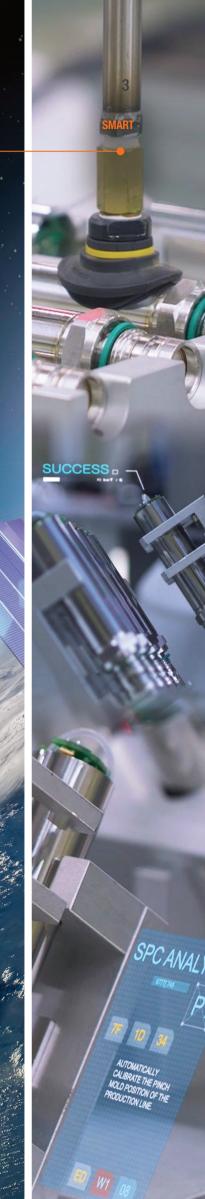
19 Water Solutions

22 Services

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About PANASIA

Panasia Group_

We are heading to the future with eco-friendly solutions

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

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

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

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

WATER SOLUTIONS



Treatment System (UV type)



Measurement Control System



WTS for Exhaust Gas System (Chemical / Membrane)

AIR SOLUTIONS



De-SOx System (Scrubber)





Engine Exhaust Recycling System (iCER)

ENERGY SOLUTIONS





Hydrogen Generation Carbon Capture and storage System(CCS/OCCS)



Fuel Supply System

EM SOLUTIONS



Alternative Maritime Power Amine Based Solvent System (AMP)





CO₂ Liquefaction System



N₂ Generator

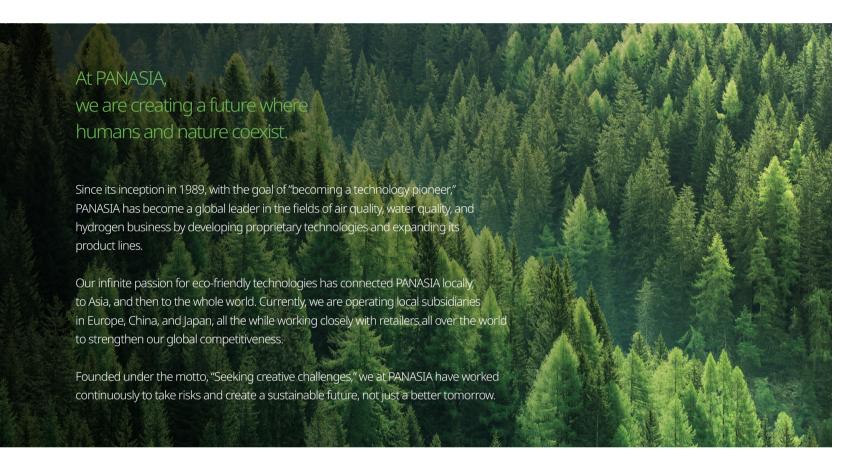






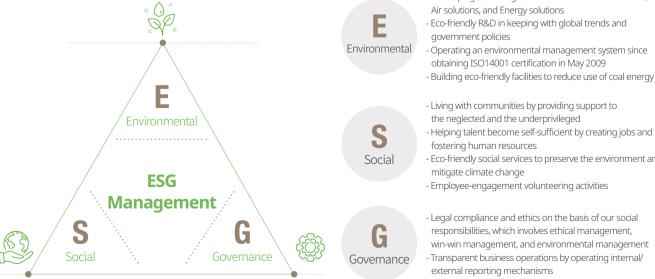
About PANASIA

Creation with the spirit of challenge



I ESG Management

Since its inception, PANASIA has continued its sustainability efforts to grow together through ESG management integrating environmental, social, and governance practices, instead of just pursuing profits.



- Developing technologies in the fields of Water solutions,
- Operating an environmental management system since obtaining ISO14001 certification in May 2009
- Building eco-friendly facilities to reduce use of coal energy
- Living with communities by providing support to
- Eco-friendly social services to preserve the environment and
- Employee-engagement volunteering activities
- Legal compliance and ethics on the basis of our social responsibilities, which involves ethical management, win-win management, and environmental management
- Transparent business operations by operating internal/

Smart PANASIA

Advanced technology for building best-in-class equipment

Smart PANASIA produces 'customized products' at the minimum cost and time by utilizing ICT to integrate all processes, from product planning and design to production and service. Also, even after delivery, it supports the integrated control system, which is used for maintenance and repairs, and services such as our E-Learning Program to increase convenience for our customers.

Process

Design - Delivery Process



Product Review and Ordering

- Online AR & VR Exhibition



Overall Planning and Scheduling

- Advanced Planning and Scheduling System [APS]



Customized Design



- Product Data Management [PDM] System [SCM]

Quality Inspection and Shipping

- Integrated Quality Management System [QMS]



Robot Manufacturing

- Factory robotic automation - Automated Welding System
- [Super-TIG]



Production Management

- Manufacturing Execution System
- Point of Production System [POP]



Material Management

- Warehouse Management System [WMS]

Training – After-sales service (A/S)



Product Training

- E-learning Program
- Maintenance and repair training service that is available anytime, anywhere



Product Management

- Integrated Control System - Integrated monitoring and management of product

conditions and operating status



After-Sales Service (A/S)

- Remote notifications of fault diagnosis and handling methods
- On-site visit



After-sales (A/S) Management

- Claim Handling Service [CHS]
- Managing inspection results and handling outcome history

Energy Solutions



Carbon Capture and Storage System (CCS)

Pan-CCS™

Pan-CCS™ (Carbon Capture and Storage System) is a system that isolates from the atmosphere large-sized fossil fuel-powered steel and cement plants, and ships.



I Application

Pan-OCCS™



for Ship

Capacity 1/2/3 CO₂ ton/h ~ **Purity** 99.9% CO₂

feature Changing concentration of CO₂ Space limitation CCS for marine condition Load change of engine





for Industrial Plant

Capacity $5 / 10 / 15 CO_2 ton/h \sim$ **Purity** 99.9% CO₂

feature Large scale of CCS Long-term Stability Cost efficient

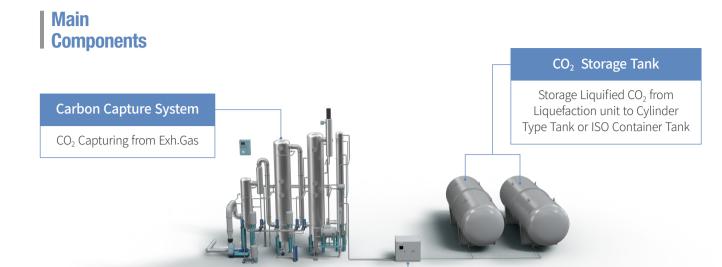


for Hydrogen Generation System

Capacity 80 / 200 / 400 CO₂ kg/h

Purity 99.9% CO₂

feature High concentration of CO₂ Modular design High purity of CO₂



Captured CO₂ liquefaction (-20°C, 20 bar)

CO₂ Liquefaction Equipment

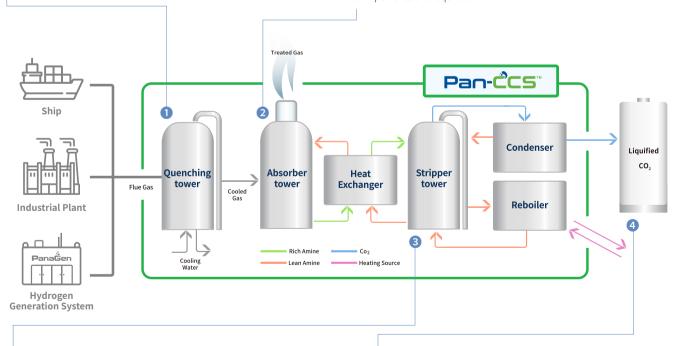
I Carbon Capture Diagram

Pre-treatment of flue gas

Flue gas is cooled in the quenching tower. When the particles and sulfur oxide are removed, the gas is pressurized by the intake fan and transferred to the absorber tower.

2 CO₂ absorption

Once cooled, the gas comes into contact with the chemical solvent in the absorber, and CO₂ is selectively absorbed. To ensure efficient delivery of the substance and keep the tower size to a minimum, high-performance packing and an appropriate layout of the internal components are required.



3 Regeneration

A solvent that has absorbed CO₂ is transferred to the stripper tower. The high-temperature vapor in the reboiler causes CO₂ to be removed from the solvent. In the cooling tower, it breaks down into water and CO₂. Then, the water is recovered and sent to the stripper while CO₂ is transferred to the liquefaction process.

4 Liquefaction & storage

Adding pressure and cooling for liquefaction purposes to meet the needs of storage containers and buyers.

Energy Solutions — 10



Fuel Supply System

PanFGSS**

The fuel gas supply system of PANASIA is a device that vaporizes alternative energy such as LNG, ammonia, and methanol and supplies it to the ship engine.

- · Natural Gas Fuel Supply System
- · Methanol Fuel Supply System
- · Ammonia Fuel Supply System



I Natural Gas Fuel Supply System

1. HP/LP Type



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

2. LP Type



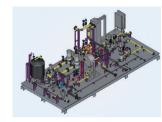
- LNG Feed Pump Dis. Press 18 bar submersible centrifugal type pump X 2 sets
- LP Vaporizer Temp: -163°C → 45°C (Cold side)
- **Glycol Skid** Glycol Water (Water 50: Glycol 50) Glycol Water Pump: Vertical Inline Centrifugal type X 2 sets Heat Exchanger: Shell&Tube or Equivalent Glycol Water Tank: abt.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

I Methanol Fuel Supply System



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

Reference



G/E+G.W LINE SKID

Propulsion Engine Fuel Supply Application

Methanol Supply Pump Dis. Press. 6 bar.g / Sealless VFD Control

Methanol Fuel Pump Dis. Press. 13 bar.g (Diff. Head 71 m) / Sealless VFD Control

Temp: -18 deg.C -> 25 deg.C / Glycol water 25~40%wt. Shell & Plate or Equivalent

Fuel Filter Duplex / 10 micron

Fuel Strainer 100 micron

Fuel Heater

Fuel Pipe Material Austenite Stainless Steel (A213-TP316)



M/E LINE SKID

Generator Engine Fuel Supply Application

Methanol Supply Pump Dis. Press. 8 bar.g / Sealless VFD Control

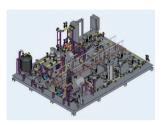
Fuel Heater Temp: -18 deg.C -> 25 deg.C / Glycol water 25~40%wt. Shell & Plate or

Equivalent

Fuel Filter Duplex / 10 micron
Fuel Strainer Y Strainer / 100 micron

Fuel Pipe Material Austenite Stainless Steel (A213-TP316)

Main Frame Material SS400 or eq.



ONE SKID

Common Utility System for MeOH LFSS

Glycol water system Vertical Inline Centifugal x 2 set

Medium: Glycol water 25~40%wt. / LT water (36 deg.C)

Glycol water tank: abt. 0.5 m3

N₂ Purge & Drain System N₂ Supply train with valve (Automatic Purge system as an option)

Penumatic acting drain pump: 60LPM / Drainage level control buffer Leak Detection Sensor (LEL 25% H/C)

Automation Control Panel & HMI

I Ammonia Fuel Supply System

Design Data

- LP Pump Dis. Press. 18 bar Multi-stage centr. Pump X 1 set
- **HP Pump** Dis. Press. 88 bar Metering Pump X 1 set
- $\hbox{\bf \cdot BOG Compressor} \quad \hbox{Dis. Press. 18 bar Oil Injection Screw Water Cooled X 1 set}$
- **Vaporizer** Temp: $-24^{\circ}\text{C} \rightarrow -18.7^{\circ}\text{C}$
- Water seal Temp: $-24^{\circ}\text{C} \rightarrow 60^{\circ}\text{C}$

• NH₃ Supply Skid IMO Type-C Single Shell Tank. (abt. 5m³)

Material 9% Nickel Steel or Equivalent

LP, HP Pump

- Heat Exchanger Shell&Tube or Equivalent
- · NH₃ Liquefaction Skid BOG Compressor & Seperator
- NH₃ Dilution Skid, NH₃ Catch Skid IMO Type-C Single Shell Tank. (abt. 5m³)
- Heat Exchanger Shell&Tube or Equivalent
- Aqueous NH₃ Pump Dis. Press 7 bar Diaphragm pump X 1 set





12 **Energy Solutions**



Hydrogen Generation System





I Application

for Houses(Small-capacity)



1~300 Nm³/hr Capacity Purity 75% ~ 99.999% H₂ SMR / Membrane Type **Purification** PrOx / Membrane / PSA

method

for Ship



100/150/300 Nm³/hr Capacity Purity 99.999% H₂ SMR / Membrane Type **Purification** PSA / Membrane method

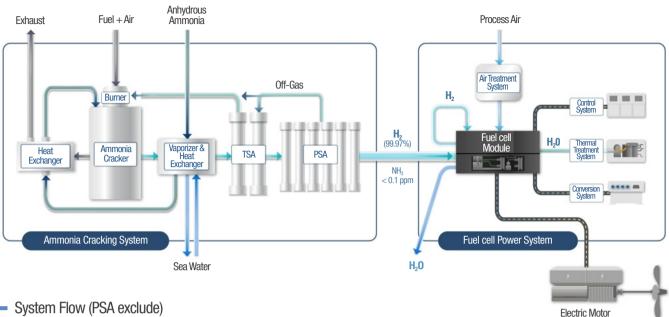
for Industrial Plant



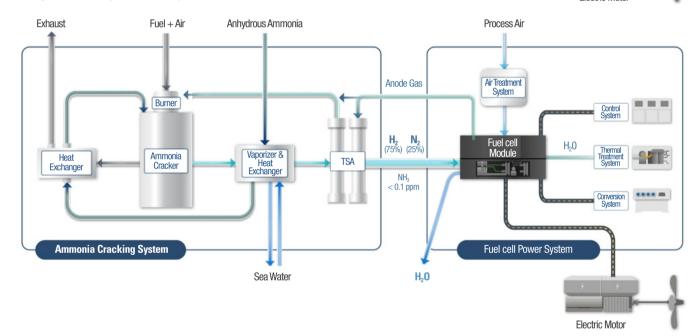
Capacity 500/1,000/10,000 Nm³/hr Purity 99.999% H₂ SMR / Membrane Type **Purification** PSA / Membrane method

I Ammonia Cracking Hydrogen Generation System

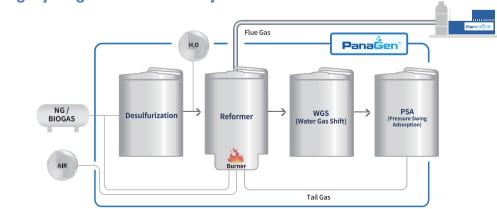
System Flow (PSA include)



System Flow (PSA exclude)



I Natural Gas-Reforming Hydrogen Generation System



Specifications

Steam Methan Reforming

Feed Gas	Pressure	Product(H₂)			
1 ccu das		Capacity	H ₂ Purity	Pressure	
Methane (Biogas and etc)	9.5 bar.g	Customized	99.999%	6 bar.g	

Energy Solutions —



Alternative Maritime Power System(AMP)

AMP (Alternative Maritime Power) is a facility that allows ships to receive electricity from shore while they are docked in port without using auxiliary engines.

AMP allows for stopping the operation of ship engines during docking, resulting in fuel cost savings and mitigation of environmental pollution caused by exhaust emissions.



| AMP Cable Reel (Cable Management System)



Features

- Encoder + inverter control enables cable automatic tension control
- AMP Cable tensile strength is 11,100N
- $\boldsymbol{\cdot}$ Use $\ensuremath{\mathsf{TPU}}$ (Thermoplastic Polyurethane) for AMP cable outer sheath material
- AMP cable is non-hygroscopic and resistant to oil, **SEA AIR & SEA WATER,** UV and Ozone.

Shore Conn. Panel

AMP Incoming Panel

Socket Box

Transformer





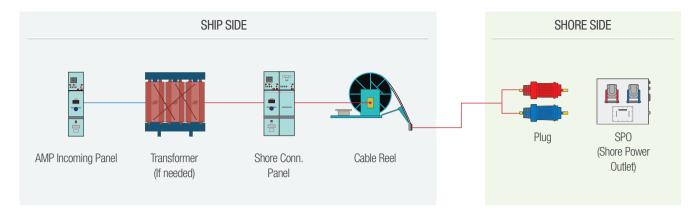




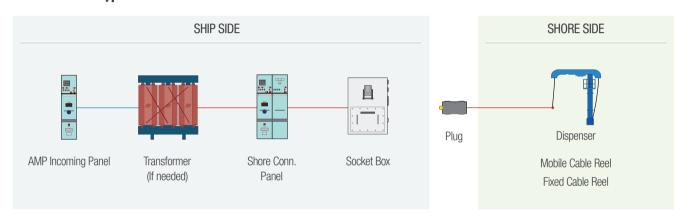
PANASIA

I AMP System Application

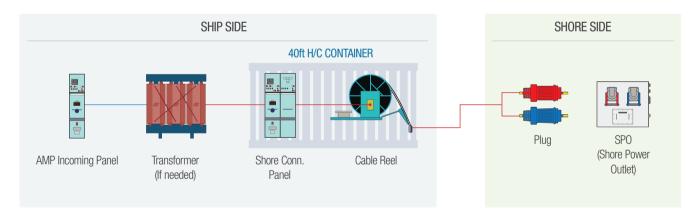
1. Cable Reel Type



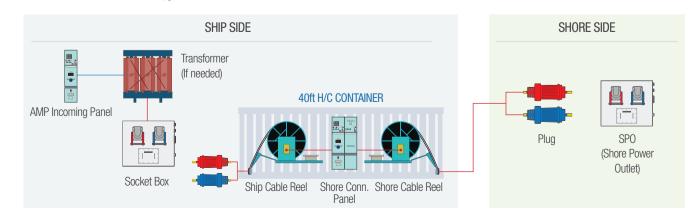
2. Socket Box Type



3. Fixed Container Type



4. Movable Container Type



Air Solutions Air Solutions



De-Sox Scrubber System

PANASIA's De-SOx scrubber system PaSOx™ is an air quality environment solution that reduces sulfur dioxide emissions in exhaust gas caused by burning of engine fuels.



The onshore scrubber is used in power plants or industrial facilities that require reduction of SOx emissions.

The wet scrubber, which uses seawater for ship applications, helps prevent air pollution by reducing sulfur oxide emissions caused by burning of high-sulfur fuel oil.



De-NOx SCR System

PaNDX[™]smart

PANASIA's De-NOx SCR system PaNOx™ is an eco-friendly solution that uses the Selective Catalytic Reduction mechanism (SCR system) to decompose nitrogen oxides from exhaust gas into harmless water (H₂O) and nitrogen (N₂) and releases them. We offer PaNOx™ for large-scale onshore systems for releasing exhaust gas emissions, such as power plants and boilers, and PaNOx™ Marine for onboard applications, which is designed to meet the IMO Tier III standards.



Product Line-up

PANASIA's PaSOx™ provides a customized solution made for various applications, regardless of the plant size, the type or size/shape of the ship.

Pasux[™]smart U-Type

1-80MW

Pasux[™]smart I-Type

1-80MW

PaSUX[™]smart v.sq.

Pasux[™]smart v.mcr









Main Components

Water Treatment Unit WATERCOMMANDER



Water Monitoring System



Gas Monitoring System



Application

PaNDx[™]smart

PaNOxTM has been continuously installed in fuel-burning facilities with NOx emissions, including onshore power plants such as HRSG and boilers. The system has been actively used not only locally but all over the world to meet the regulatory requirements, from California, where the world's strictest NOx regulations apply, to Iran and Saudi Arabia.





Pandx Marine smart

On January 1, 2016, the International Maritime Organization (IMO) brought into effect Tier III, a convention aimed at reducing NOx emissions from diesel engines by more than 80%. To achieve this certification, products must meet the regulatory requirements of Tier III, such as installing systems like SCR on marine engines that meet the Tier III requirements.



I Main Components

V1 / Reactor + Mixer + Pump Unit + Dosing Control Unit + Control Panel

V2 / Reactor + Mixer + Control Panel + IDU

V3 / Reactor + Mixer + PanSIS (KR+ABS Type Approval)

PaN0x smart V2

(Under 6 sets of Engine)

The existing Pump Unit & Dosing Control Unit can be manufactured with one equipment called the IDU (Integrated Dosing Unit) for more efficient installation.

PaN0x smart V3

(Under 4 sets of Engine)

The IDU equipment in V2 is combined with the Control Panel and manufactured with a single equipment called PanSIS (SCR Integrated Control System) to secure footprint and price competitiveness.

SCR Reactor

CI (Compact Injector) - Mixer + Injector







PanSIS (Control Panel + Dosing Unit)





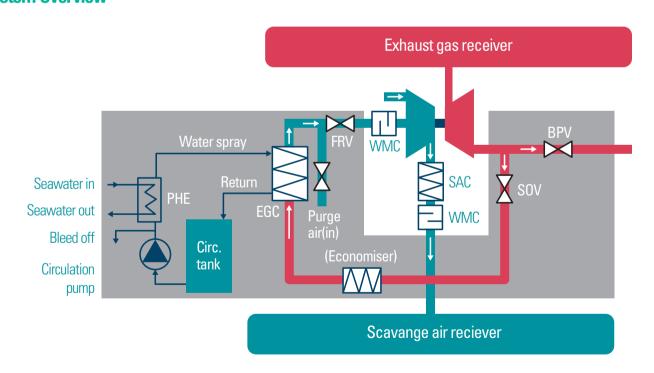
Exhaust Gas Cooler for WinGD iCER (Intelligent Control by Exhaust Recycling)

iCER (Intelligent Control by Exhaust Recycling) is aimed at minimizing emissions by regulating air and exhaust gas flow. By cooling and recirculating exhaust gas back to the engine, more emissions are combusted before they enter the atmosphere.

The benefits are impressive, with gas mode showing a reduction of at least 3% in energy consumption, diesel mode experiencing a 5% decrease in fuel consumption, and up to a 50% reduction in methane slip.



I System Overview



BPV Back Pressure Valve
SOV Shut Off Valve
SAC Scavenge Air Cooler
WMC Water Mist Catcher
PHE Plate Heat Exchanger

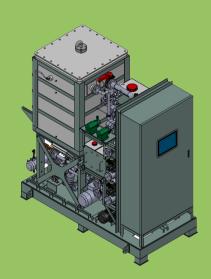


Water Treatment System (for EGR, for iCER)

WTS(Water Treatment System) is a treatment solution proposed to treat scruwater from the exhaust gas cleaning from ships.

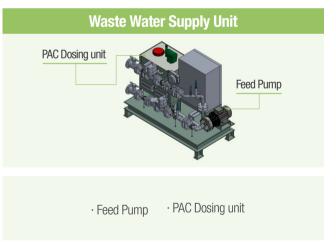
The regulation on the quality of water during the discharge of exhaust gas recirculation (EGR) bleed-off water is defined in the IMO (International Maritime Organization) guidelines for EGR bleed-off water discharge, MEPC 307(73), and the following criteria are provided for the water quality of the discharge water

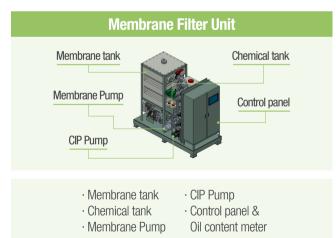
Wash water Discharge Criteria		
Discharge	Oil content of the bleed-off water	
	< 15 ppm	



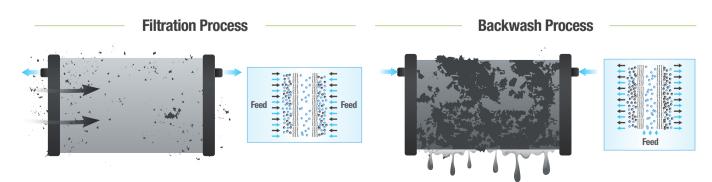
Composition

Treatment Capacity: 3 / 6 / 9 / 12 m³/h





Water Treatment Method



^{*} Source : ADD MORE CERTAINTY TO YOUR FUTURE for WinGD



Water Treatment System



PANASIA's water treatment system GloEn-Patrol™ is a water quality solution that is recognized as the most eco-friendly and safest system as it uses a filtration process, which is a 100% physical treatment method, and the "LVL amp" which is LV disinfection technology.





Measurement & Control System



Ships store and carry volatile substances like crude oil. All sorts of risks must be managed to ensure safety on ships and prevent marine pollution.



| Product | Line-up





|--|

Combination	Original Filter Unit Original UV Unit	
Treatment Capacity	50~700 m³/hr	
Features	Small capacity with single unit	

MEGA Filter U MEGA UV Un	
750~3,000 m³	/hr
High efficiency in consumption and f	

GloEn-Patrol™ GIII

I Main Components

Original Filter Unit

MEGA Filter Unit

Original UV Unit

MEGA UV Unit











PANASIA's measurement control system monitors the levels of all sorts of critical components on board in real time. Using its alarm and analytics features, the system can also increase efficiency significantly in ensuring vessel safety and prevent marine pollution.

I Product Line-up		Cargo monitoring · Radar beam type · Magnetic float type	High & overfill alarm • Magnetic float type
Tank level & draft gauging · Air purge type / Electric pneumatic type · Electric pressure type	04 Vapour emission control	05 Fixed gas detection	06 Water ingress alarm
Pressure / Temperature monitoring	08 Bilge high level alarm	09 Local level gauge / Switch	Pressure switch / Temperature sensor / Pressure transmitter

Services

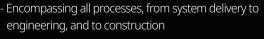
PANASIA SMART SERVICE

puts our customers first

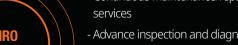
us to treat customer satisfaction as a top priority, instead of just selling products. We offer unique services aimed at







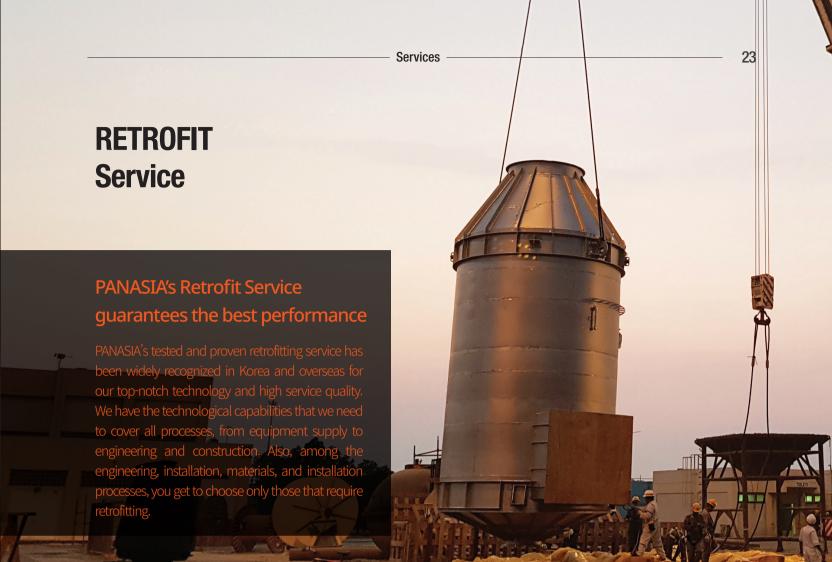
- We provide the solutions best suited for customers' ships
- Wide-ranging technology consulting services
- Reliable partner in the retrofitting of existing ships



- Continuous maintenance/repairs, periodic follow-up
- Advance inspection and diagnosis of consumables
- Product operation and training services
- Aiming to reduce costs and improve performance for customers







Our Services

You may determine the scope of work for installation on sea-going vessels

Equipment	Engineering	Design
BWTS Equipment SCRUBBER Equipment Commissioning Demonstration	Onboard SurveyBasic DesignOwner / Class Plan ApprovalInterface with Existing Automation System	Installation Drawing Manufacturing Drawing
Material Supply	Installation Work	Supervision
Steel Structures Pipe Spools Installation Materials Cables	Pipe Spools Installation Laying & Connection Cables	Schedule Control Quallity Control Instruction to Workers

Retrofit **Contract Cases**

4 Types of Contract Cases

CASE 4

CASE 1 System + Supervision CASE 2 System + Engineering + Supervision System + Engineering + Materials installed (piping, steel outfitting, electrical) + Supervision CASE 3

system + Engineering + Materials installed (piping, steel outfitting, electrical) + Installation + Supervision



Preventive
Check-up Service
& Calibration

Through PANASIA's MRO service, our engineers visit your ships periodically to perform checkups on the delivered products and proactively diagnose any potential issues in need of further inspection. Also, following the inspection, we prepare a report that contains any information and solutions you may need to ensure efficiency in your operations.

Through calibration, we conduct advance inspection for problems that may occur to make system operation as efficient as possible. Customers do not have to take care of every single one of the complicated sensors with many control points. They can also get maintenance/repair services scheduled immediately when it becomes necessary.

MRO Service Training Center & Engineer Training

At PANASIA, we operate Training Centers around the world. Through our learning program, we are training professional engineers on the regulatory requirements, which provide the background for making our products, on how to use our products, and how to respond when problems occur.

In addition, we organize annual field engineer training to provide highly satisfactory product training services.

Components of the Training Program

Chapter	Subject
1	Introduction of Company
2	Basic operating procedure
3	Maintenance requirement
4	Hands on practice (I)
5	Hands on practice (III)
6	Troubleshooting (I)
7	Troubleshooting (II & III)
8	Evaluation & Satisfaction Survey



MRO Service E-Learning Program

At PANASIA, we offer product training programs you can access anytime, anywhere. PANASIA's training program service called the "E-Learning Program" is available both online and on-site, allowing you access training anytime, anywhere. You can also watch videos and try running products on site using a tablet PC or a laptop. Our E-Learning Program contains product descriptions, operating instructions, crisis response, and other details so you can operate products professionally.











GloEn-Patrol™ Learning Program Contents

Chapter	Contents
1	Introduction of GloEn-Patrol™ system
2	Major system component
3	Standard operating procedures
4	Health and safety issue
5	Installation requirement
6	Maintenance requirement
7	Troubleshooting for Filter unit
8	Troubleshooting fot UV unit
9	Troubleshooting for other components

Pa**S**□**x** smart Learning Program Contents

Chapter	Contents
1	Understanding PaSOx™ scrubber system
2	Standard operating procedures
3	Compliance issues
4	Installation requirement
5	Maintenance requirement
6	Troubleshooting for the system/unit
7	Troubleshooting for the component/device

CBT (Computer Based Training Program)



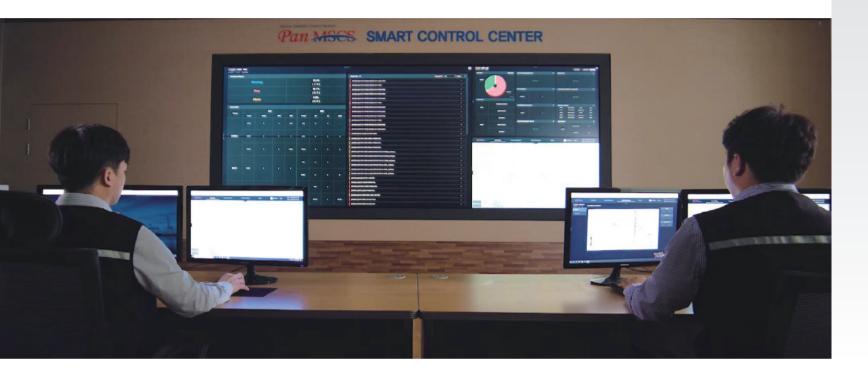
IBT (Internet Based Training Program)



Services — 26

MRO Service Integrated Control System

PANASIA's integrated control system is a customized ICT-based service available 24/7, which collects product data in real time and checks the system status remotely to provide customers with prompt and accurate solutions anytime, anywhere.



Pan-MSCS

Pan-MSCS is a Marine Satellite Control System. This solution monitors in real time, manages, and diagnoses the operating status of PANASIA's products (BWTS, Scrubber) installed on ships. If any problem occurs with any product, the system diagnoses the problem in advance, and notifies the ship of a solution to ensure safer operation.

Through big data analysis, it also notifies the ship of when to replace consumables, allowing the customer to operate the ship more efficiently. It helps us lead the way in creating a smart ship ecosystem.



Global Network

47 Global Service Networks in 37 Countries



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