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DSME **GAS PRODUCTS**



DSME

DSME GAS PRODUCTS

DSME HISTORY



CONTENTS

About DSME	DSME History	_ 03
	DSME Prologue	_ 04
	Product Line-Up	_ 10
	Econology	_ 12
Products & Gas Technology	FLNG [Floating Liquefied Natural Gas]	_ 16
	DSME FLNG Process	_ 18
	LNGC	_ 20
	DSME GAS Technologies Re-Liquefaction System	_ 22
	Arctic Technologies	_ 23
	LNG FSRU	_ 24
	DSME GAS Technologies Re-Gasification System	_ 26
	LPGC / LEGC	_ 28
	FSPP	_ 29
	DSME GAS Technologies Cargo Containment System	_ 30
	DSME Gas Technologies LNG Fuel System	_ 31
R&D CENTER Energy System Research Center	R&D CENTER Energy System Research Center	_ 32
	R&D CENTER DSME R&D Complex	_ 33
	Okpo Yard Layout	_ 36
Appendix	DSME Global Network	_ 38

1973	_ Groundbreaking for Okpo Shipyard	2012	_ Awarded first export submarine order from South-East Asian Country
1978	_ Established Daewoo Shipbuilding & Heavy Machinery Co., Ltd. (DSHM)		_ Awarded first LNG-FPSO order from Petronas, to be installed in Malaysia
1981	_ Held topping out ceremony for completion of Okpo Shipyard		_ Completed construction of Novus II wind power plants installed in Nova Scotia, Canada
1982	_ Delivered first chemical carrier, 'Bow Pioneer'		_ Awarded most orders in the world, USD 14 billion, reached total of USD 10 billion in offshore plant orders for first time in global shipbuilding industry
1983	_ Delivered Korea's first Drilling Rig, 'Doo Sung'		2013
1994	_ Merged with Daewoo Heavy Industries Ltd.		_ Delivered world's largest 18,270 TEU containership
1995	_ Achieved aggregate export of USD 10 billion		_ Contracted for world's largest (263K) LNG-FSRU
1999	_ Autonomous Underwater Vehicle 'Okpo 6000' selected as one of Korea's TOP 100 Technologies in 20C		_ Awarded largest number of drillship newbuilding contracts (7 drillships)
2000	_ DHI's Shipbuilding Division became independent company		_ Awarded contract for high-spec Jack-Up Rig from Maersk Drilling
2001	_ Awarded most LNGC orders in the world and acquired OHSAS 18001 Certification for first time in Korean shipbuilding industry		2014
2002	_ Changed official corporate title to DSME and adopted corporate core values, 'Trust' and 'Passion'		_ Awarded the largest number of LNGC newbuilding contracts (37 LNGCs) which worth over USD 9 billion
2003	_ Named "World's Best Shipbuilder" by Maritime Asia's Lloyd's List		_ Awarded the world first Arc7 LNG Carriers
2004	_ Deployed first PI system in global shipbuilding industry		_ Reached the total of USD 10 billion in Gas Carrier (LNGC+LPGC) orders for the first time in the world shipbuilding industry
2005	_ Delivered world's first LNG-RV, which was selected as one of Korea's top 10 new technologies		_ FGSS was selected as 10 most outstanding mechanical engineering by the Korean Federation of Mechanical Engineers Societies
2006	_ Awarded orders worth over USD 10 billion		_ Steel cutting for the first 3,000 ton submarine which was developed entirely with domestic technology
2007	_ Received Transparent Management Award, USD 6 billion Export Tower Award at 44 th Trade Day Ceremony, and set new record with orders surpassing USD 20 billion		_ Awarded the mega size Contract of Modular Plant for Kazakhstan
2008	_ Received Korea IT Innovation Award and acquired ISO 27001 Certification		2015
	_ Achieved safety result of 10 million man-hours with IIF in Qatar LNGC project		_ Awarded first X-DF Propulsion LNGC
2009	_ Received USD 10 billion Export Tower Award and world's largest floating dock debuted at DSME shipyard		2017
2011	_ Delivered world's largest offshore Pazflor FPSO and installed in Angola		_ Delivered world's largest LNG-FSRU (263K) & world's first Arc7 LNGC
	_ Delivered world's largest Ro-Pax, "TANIT", to Tunisia Ferries		_ Delivered World First FLNG in operation (Petronas Satu)

Challenge

PRODUCTION & LIQUEFACTION



FLNG [Floating liquefied natural gas] _

DSME FLNG has become the technical solution for the development of stranded gas fields around the world. It adds significant value to the LNG value chain by means of optimizing the cost and the development timeline. Based on more than decades of LNG experience, DSME has developed various FLNG concept designs.



Adventure

TRANSPORTATION



GAS CARRIER _

DSME continues to lead the world's shipbuilding industry with expertise in Gas Carrier. DSME has contracted the LNG Carriers equipped with the reliable GTT-NO96 Cargo Containment System, Membrane Type. DSME's LNG Carriers have shown superior energy efficiency, excellent cargo handling and propulsion performance.



Reliability

**SUPPLY &
SERVICES**



FSRU _

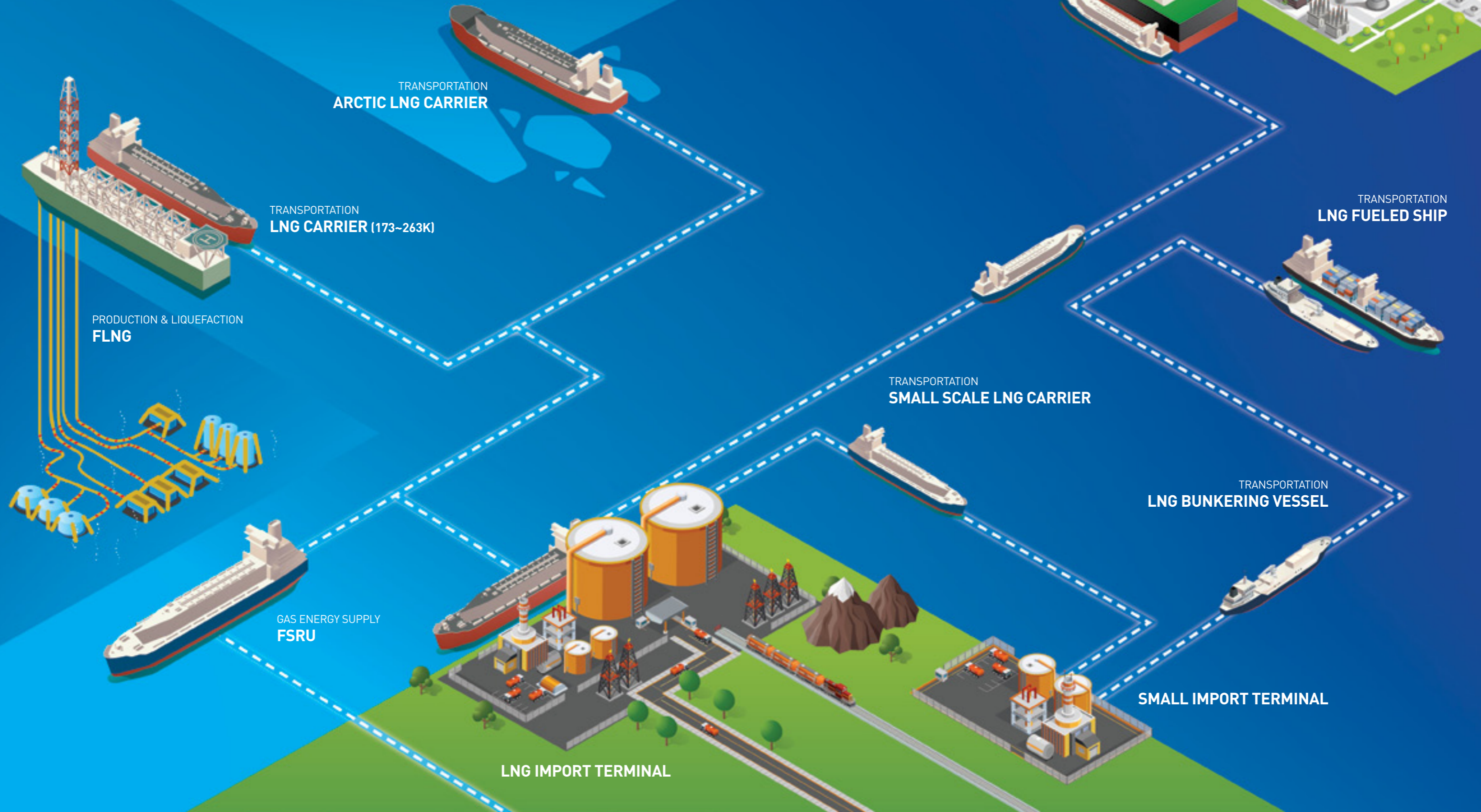
DSME's tailor-made LNG FSRU can be designed for a range of LNG storage capacities from 151K to 263K and various re-gasification capacity requirements, using proven and most advanced engineering technology.

FSPP _

DSME's FSPP includes of power generation, LNG storage, regasification and gas distribution. With this all-in-one solution, DSME's FSPP can supply electricity and natural gas to meet local demands.



PRODUCT LINE-UP



Promise

ECONOLOGY

Clean Fuel, LNG
Eliminating (Lowering) harmful emission



Environmental Effect

CO₂
Green House Gas

SO_x & NO_x
Acid Rain
Pollution

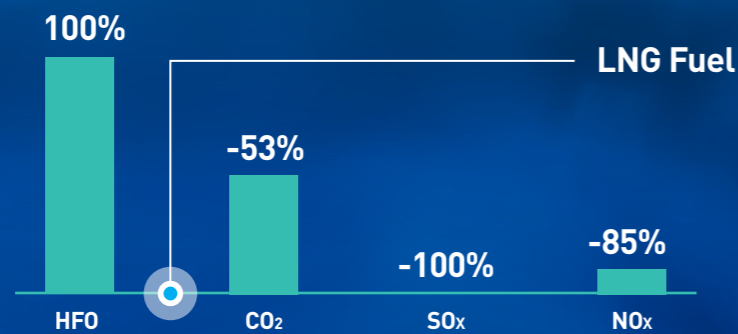
BLACK CARBON
Impact upon
Human Health

Regulations

EEDI Phase II
CO₂ **20%**

SO_x 0.5%
NO_x Tier III

BLACK CARBON



EEDI Phase II (CO₂ 20% ▼)
effective from 2020

CO₂ Monitoring Reporting and Verification System
effective from 2018

Carbon Pricing
requirements under review

SO_x Global Limit 0.5%
effective from 2020

NO_x Tier III
effective since 2016

Black Carbon
requirements under review

DSME GAS PRODUCTS

PRODUCTS & GAS TECHNOLOGY

FLNG [Floating Liquefied Natural Gas]

DSME FLNG Process

LNGC

DSME GAS Technologies Re-Liquefaction System

Arctic Technologies

LNG FSRU

DSME GAS Technologies Re-Gasification System

LPGC / LEGC

FSPP

DSME GAS Technologies Cargo Containment System

DSME GAS Technologies LNG Fuel System

R&D CENTER Energy System Research Center

R&D CENTER DSME R&D Complex



PRODUCTION & LIQUEFACTION

FLNG

Floating Liquefied Natural Gas

As one of the world's leading marine EPCIC contractors, DSME has distinguished itself as a premier supplier of offshore oil and gas PU (Production Unit). DSME's extensive track record for FPSOs includes the deliveries of more than five oil FPSOs and one FLNG. In addition, DSME has developed its own concept design for various FLNGs that are best suited for the development of mid-scale fields.

1 PETRONAS FLNG (H.6302)

DIMENSIONS
 365m(L) X 60m(B) X 33m(D)

LNG PRODUCTION CAPACITY
 1.2 MTPA

CARGO CONTAINMENT SYSTEM
 GTT N096 MEMBRANE (TWO-ROW)

STORAGE CAPACITY
 LNG : 177,000 CBM
 NO LPG
 CONDENSATE : 20,000 CBM

LIQUEFACTION PROCESS
 APCI DUAL N2 EXPANSION

MOORING
 EXTERNAL TURRET MOORING
 (PERMANENT)

ELECTRIC POWER
 GAS TURBINE GENERATOR

LNG OFFLOADING
 SIDE BY SIDE WITH OFFLOADING
 ARMS

OPERATING FIELD
 - PHASE 1 (INITIAL 5 YEARS) :
 KUMANG KANOWIT GAS FIELD
 (MALAYSIA)
 - PHASE 2 (5 YEAR LATER) :
 WITHIN FILEDS IN THE OFFSHORE
 SARAWAK (MALAYSIA)



2 DSME 3.0 MTPA GENERIC FLNG

DIMENSIONS
 358m(L) X 65m(B) X 36.8m(D)

LNG PRODUCTION CAPACITY
 3.0 MTPA

CARGO CONTAINMENT SYSTEM
 GTT N096 MEMBRANE (TWO-ROW)

STORAGE CAPACITY
 LNG : 208,000 CBM
 LPG : 48,000 CBM
 CONDENSATE : 11,000 CBM

LIQUEFACTION PROCESS
 APCI SMR

MOORING
 EXTERNAL TURRET MOORING

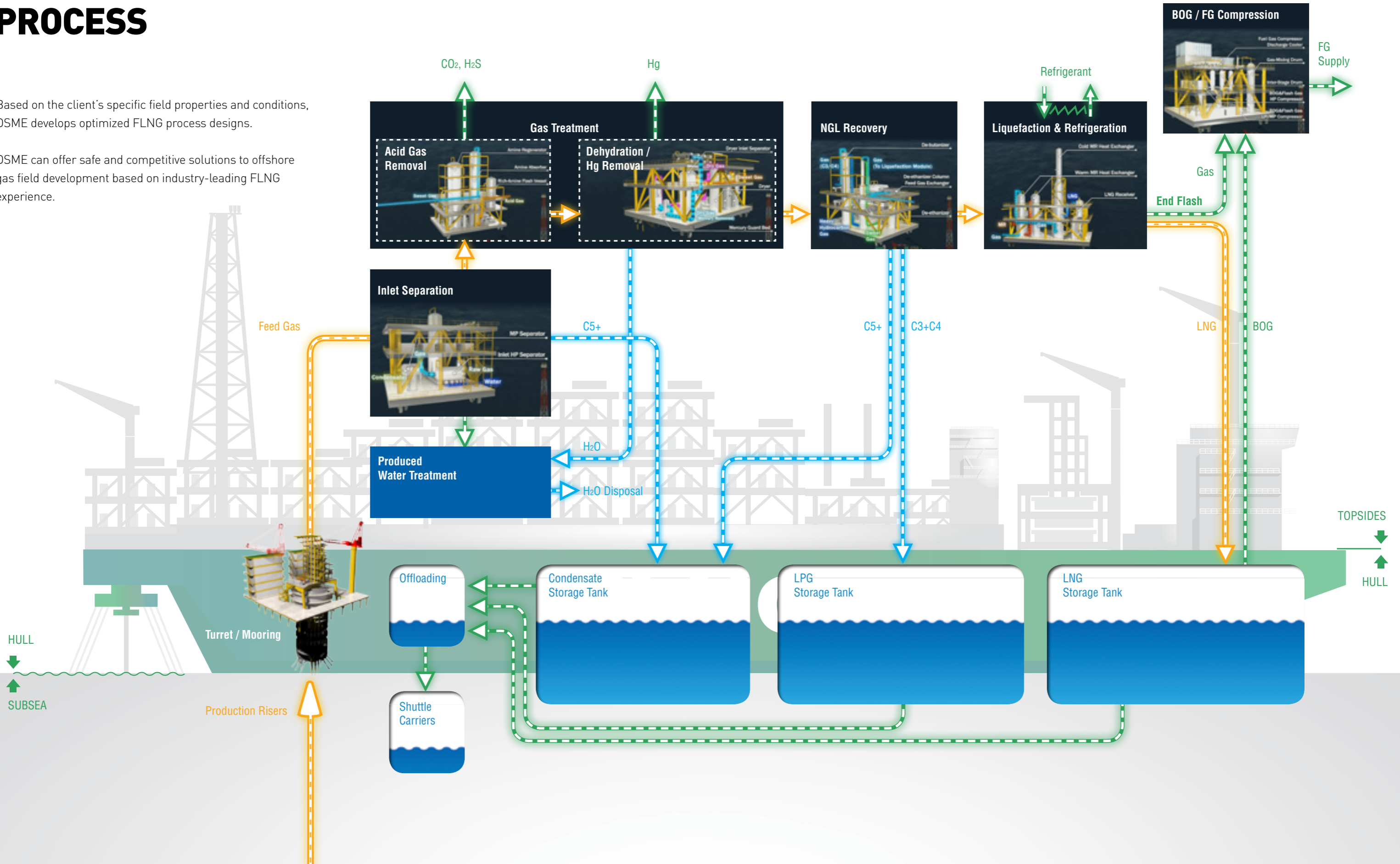
ELECTRIC POWER
 GAS TURBINE GENERATOR

LNG OFFLOADING
 SIDE BY SIDE

DSME FLNG PROCESS

Based on the client's specific field properties and conditions, DSME develops optimized FLNG process designs.

DSME can offer safe and competitive solutions to offshore gas field development based on industry-leading FLNG experience.



TRANSPORTATION

LNGC

1 BW 173.4K CBM ME-GI LNGC (H.2435)

DIMENSIONS
294.9m(L) X 46.4m(B) X 26.5m(D)

CARGO CAPACITY
173,400 CBM

PROPULSION
MAN B&W 5670ME-C9.5-GI X 2 SETS



2 MOL 180K CBM X-DF LNGC (H.2462)

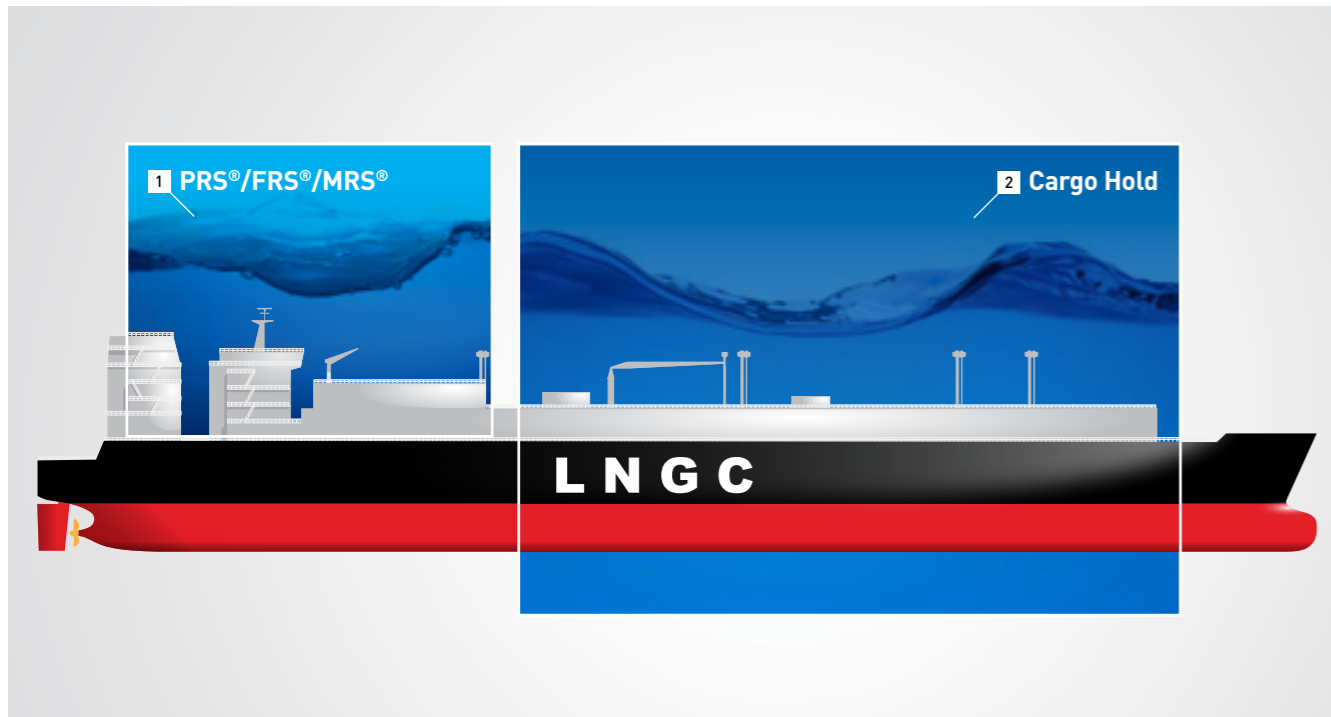
DIMENSIONS
297.9m(L) X 47.9m(B) X 26.5m(D)

CARGO CAPACITY
180,000 CBM

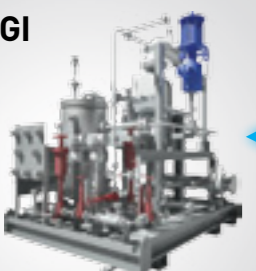
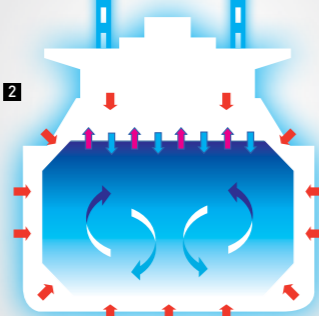
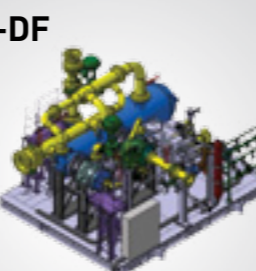
PROPULSION
WinGD 5X72DF X 2 SETS

DSME GAS TECHNOLOGIES

RE-LIQUEFACTION SYSTEM










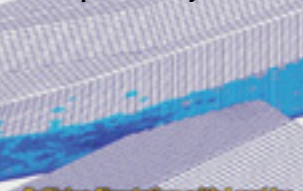
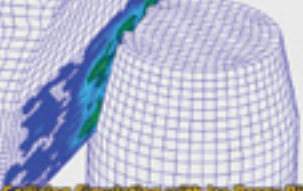
The Most Economic BOG Management (No GCU Operation)

<p>For MEG1</p>  <p>1</p>	<p>Cargo Hold</p>  <p>2</p>	<p>For X-DF</p>  <p>1</p>
<p>PRS®/FRS®</p> <ul style="list-style-type: none"> - BOR 0.075% / 0.030% - Most Economic - No Additional Rotating Machine - No Refrigerant Process - Robust & Simple Control - Partial or Full Re-liquefaction 		<p>MRS®</p> <ul style="list-style-type: none"> - BOR 0.075% / 0.030% - Methane Refrigerant System - Flexible & Economic Operation - Full Re-liquefaction - BOG As Refrigerant - FG Compressor Utilized For Refrigeration Process

ARCTIC TECHNOLOGIES

DSME's arctic technologies have proven to be the best by Yamal ARC7 LNG Carriers. DSME has developed high-end technologies for winterization, ice performance, strength and safety for harsh arctic environments.



<p>Winterization</p>	<p>Enclosed Bridge</p> 	<p>Heating</p> 	<p>Enclosed Mooring Space</p> 
<p>Ice Performance</p>	<p>Double Acting</p> 	<p>Stern Ice Breaking</p> 	<p>Bow Ice Breaking</p> 
<p>Strength and Safety</p>	<p>Structural Analysis</p>  <p>Non-linear FE Analysis for Ice Collision</p>	<p>Ice Impact Analysis</p>  <p>Collision Simulation with Level Ice</p>	<p>Ice Impact Analysis</p>  <p>Collision Simulation with Ice Bergs III</p>

SUPPLY & SERVICES

LNG FSRU

1 MOL 263K CBM LNG FSRU (H.2419)

DIMENSIONS
 345m(L) X 55m(B) X 27m(D)

CARGO CAPACITY
 263,000 CBM

PROPULSION
 MAN 9L51/60DF X 4 SETS

REGAS UNIT
 180 MMSCFD X 4 SKIDS

REGAS SYSTEM
 DSME SW DIRECT
 (OPEN & PARTIAL CLOSED MODE)



2 EXCELERATE 173.4K CBM LNG FSRU (H.2402)

DIMENSIONS
 294.5m(L) X 46.4m(B) X 26.5m(D)

CARGO CAPACITY
 173,400 CBM

PROPULSION
 WARTSILA 12V50DF X 2 SETS & WARTSILA 6L50DF X 2 SETS

REGAS UNIT
 200 MMSCFD X 4 SKIDS

REGAS SYSTEM
 DSME SW DIRECT
 (OPEN & CLOSED MODE)

DSME GAS TECHNOLOGIES

RE-GASIFICATION SYSTEM

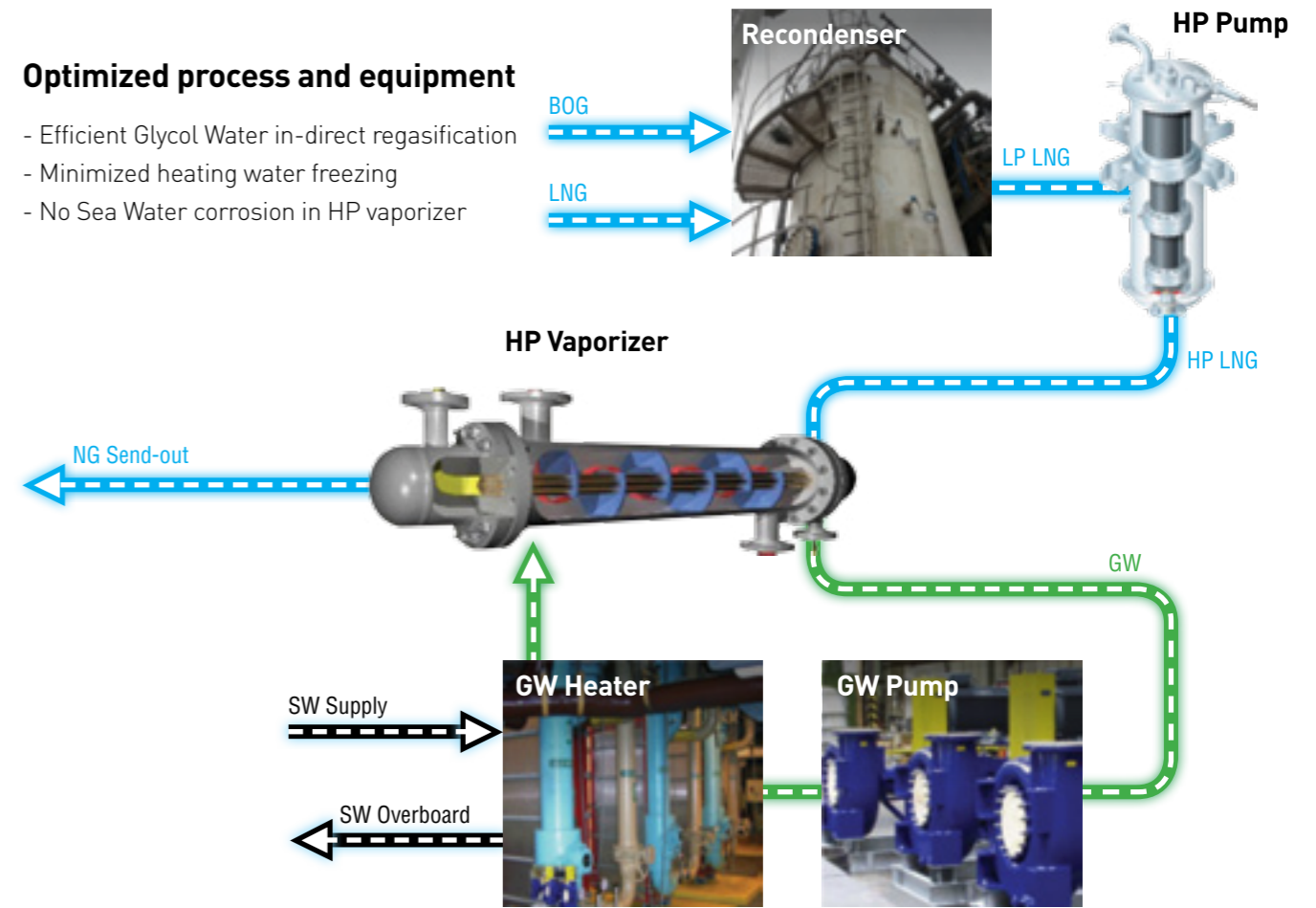
DSME Regasification Vessels

- World first LNG RV with SW(Sea Water) direct regas. system has been delivered since 2005.
- World first FSRU with GW(Glycol Water) in-direct regas. system will be delivered in 2019.

Ship Name	Client	Hull No.	Year	Storage Capacity	Regas. Capacity	Heating Medium
Excelsior	Excelerate Energy	H.2208	2005	138,000 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Excellence	Excelerate Energy	H.2218	2005	138,000 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Excelerate	Excelerate Energy	H.2237	2006	138,000 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Explorer	Excelerate Energy	H.2254	2008	150,900 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Express	Excelerate Energy	H.2263	2009	150,900 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Exquisite	Excelerate Energy	H.2270	2009	150,900 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Expedient	Excelerate Energy	H.2271	2010	150,900 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Exemplar	Excelerate Energy	H.2272	2010	150,900 m ³	600 mmscfd	SW direct (Open/Combined/Closed)
Experience	Excelerate Energy	H.2402	2014	173,400 m ³	800 mmscfd	SW direct (Open/Combined/Closed)
MOL FSRU CHALLENGER	Mitsui O.S.K Lines	H.2419	2017	263,000 m ³	720 mmscfd	SW direct (Open/Partial closed)
-	BW	H.2488	-2019	173,400 m ³	800 mmscfd	GW in-direct (Open)
-	MARAN	H.2477	-2020	173,400 m ³	750 mmscfd	GW in-direct (Open)

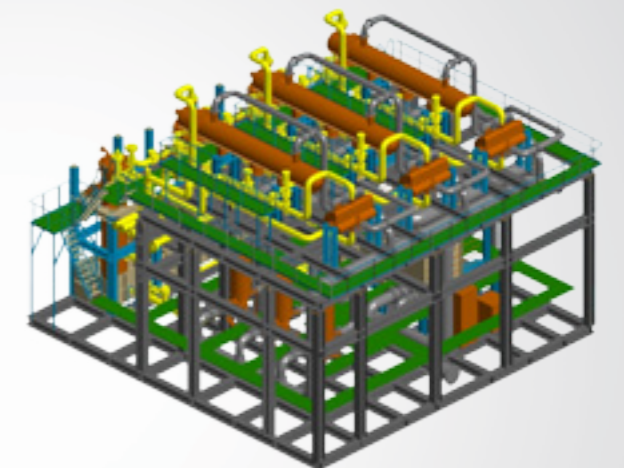
Optimized process and equipment

- Efficient Glycol Water in-direct regasification
- Minimized heating water freezing
- No Sea Water corrosion in HP vaporizer



Robust and Versatile

- Robust design with total engineering solution and technical guide
- Verification with pilot scaled test facility using LNG
- Modular design for retrofit and onshore project



TRANSPORTATION
LPGC / LEGC

1 PACIFIC GAS 84K CBM LPGC (H.2342)

DIMENSIONS
 226.0m(L) X 36.6m(B) X 22.2m(D)

CARGO CAPACITY
 84,000CBM

PROPULSION
 MAN B&W 6G60ME-C9.2 X 1 SET



2 DSME 93K CBM LEGC

DIMENSIONS
 230.0m(L) X 36.6m(B) X 23.4m(D) X 11.6m(T)

CARGO CAPACITY
 93,000 m³ (ETHANE, ETHYLENE, PROPANE, BUTANE)

PROPULSION
 MAN B&W 6G60ME

CARGO CONTAINMENT SYSTEM
 GTT N096, DSME MCTIB (IMO TYPE B)



SUPPLY & SERVICES

FSPP

Floating Storage Power Plant

LNG Storage + LNG Regasification + Power Generation

- Fast-Track Solution
- Eco-Friendly
- Movability & Asset Security
- All-In-One Solution

FSPP (FLOATING STORAGE POWER PLANT)

POWER RATE
 66MW ~ 750MW

CCS TYPE
 MEMBRANE

GENERATION TYPE
 ENGINE / COMBINED CYCLE

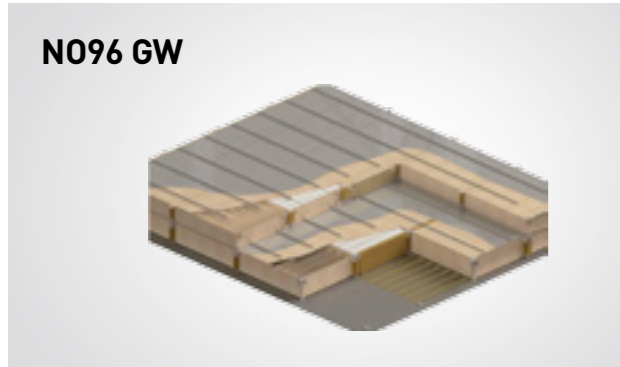
REGASIFICATION CAPACITY
 MADE TO ORDER

LNG STORAGE CAPACITY
 MADE TO ORDER



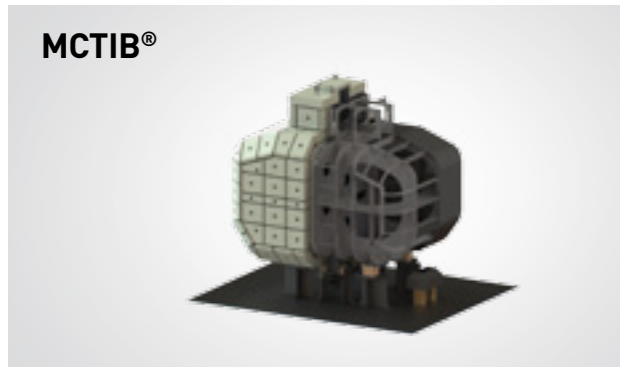
DSME GAS TECHNOLOGIES

CARGO CONTAINMENT SYSTEM



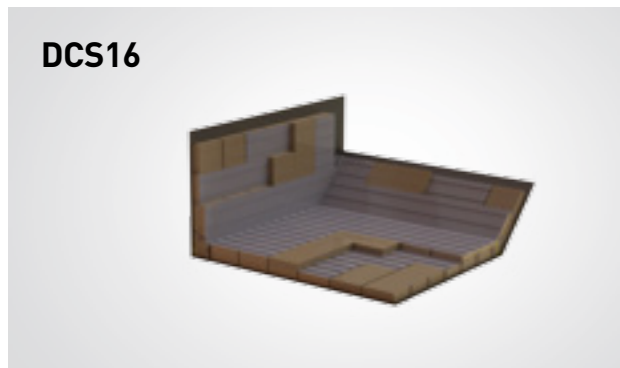
Widely Applied CCS

- GTT N096 CCS with widely applied BOR
- Application : LNG Carrier, FSRU



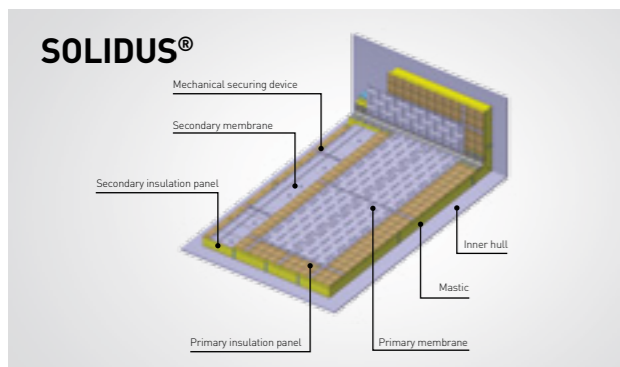
Cargo Free Filling CCS

- High Manganese Austenitic Steel
- Sloshing free solution with high volume efficiency
- Application : Shuttle LNG Carrier, FSRU, LNG Fuel Tank



Cost Effective CCS

- Based on the experiences over 100 LNG Carriers for more than 20 years
- Safer and more economic LNG cargo containment system
- Double INVAR membrane layers with wooden insulation boxes.
- Application : LNG Carrier, FSRU



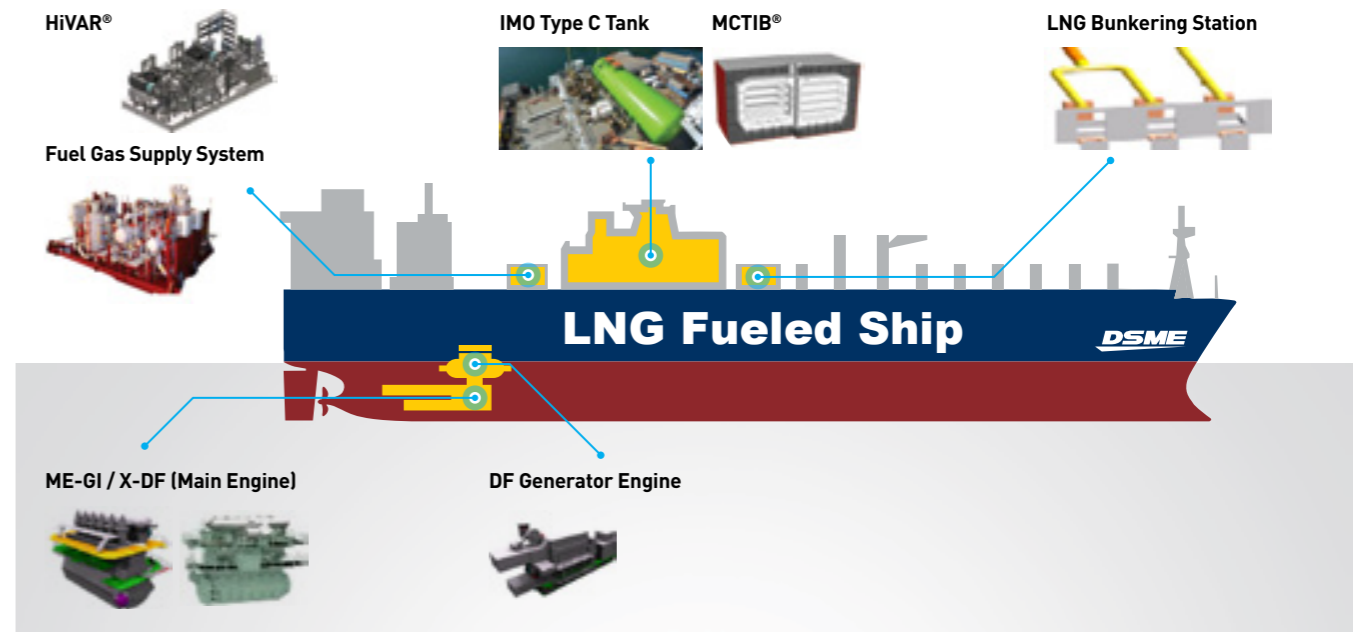
High Performance CCS

- Solution to meet the needs for "Low BOR" of the market and customer
- Double metal membrane layers with R-PUF panel
- Application : LNG Carrier, FSRU, LNG Fuel Tank

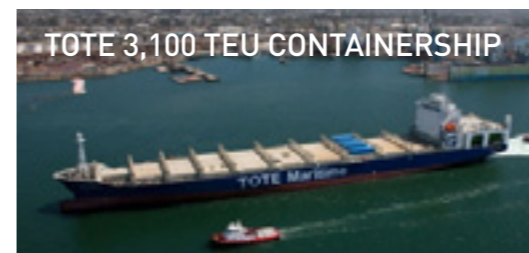
DSME GAS TECHNOLOGIES

LNG FUEL SYSTEM

DSME HiVAR®, The most efficient fuel gas supply system



Applications : The World 1st LNG Fueled Containership



DSME HiVAR® applications:

- The World 1st LNG Fueled Containership delivered on October, 2015.
- Widely adopted by new generation LNG carriers and proven advanced energy efficiency.

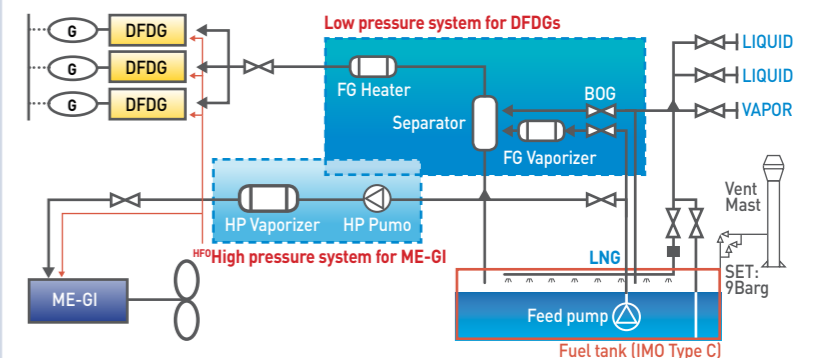
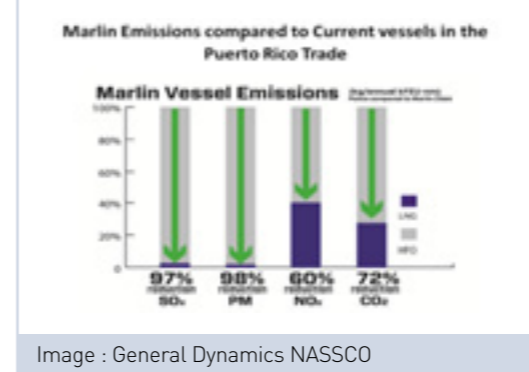


Image : General Dynamics NASSCO

R&D CENTER

ENERGY SYSTEM RESEARCH CENTER



Energy System Research Center is specialized in conducting full-scale tests with cryogenic liquids such as LNG and LN2 for prototype systems, which helps assurance of the performance prior to ship application. Various LNG systems such as LNG CCS, fuel gas supply skid, regasification skid, and re-liquefaction skid have been tested at the laboratory.



- 1 LNG/LN2 Storage
- 2 Regasification SKid
- 3 Fuel Gas Supply Skid
- 4 Reliquefaction Skid



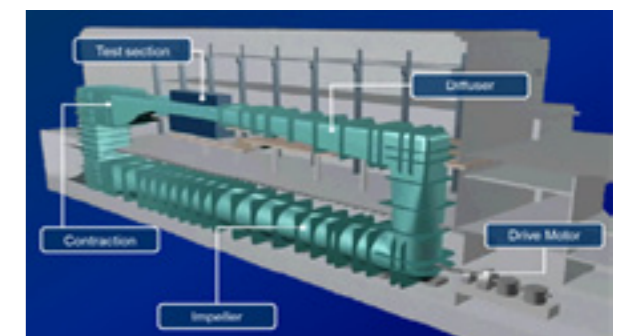
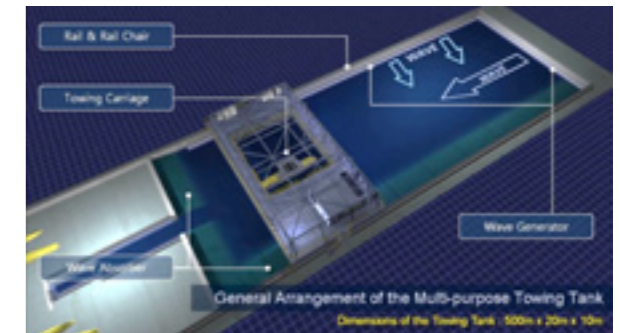
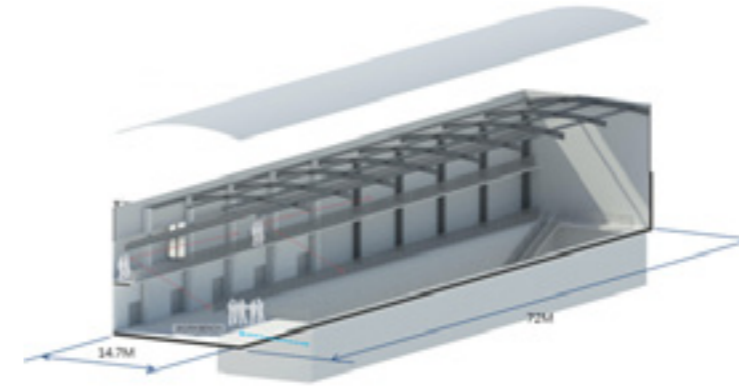
R&D CENTER

DSME R&D COMPLEX

DSME R&D complex, co-located with Seoul National University, is set to open in August 2018 and to be the heart of DSME's technological innovation. It will accommodate various facilities for the R&D in the fields of ship, offshore, and defense industries. The complex will also be the hub for collaborations with government institutions, universities, and enterprises.



Formal Opening : August 2018



- Towing Tank
- Cavitation Tunnel
- Model Workshop
- Defense industry Laboratory
- Gas / Energy Laboratory (LBTS)
- Acoustic Laboratory

DSME GAS PRODUCTS

APPENDIX

OKPO YARD LAYOUT
DSME GLOBAL NETWORK



OKPO YARD LAYOUT

YARD SIZE

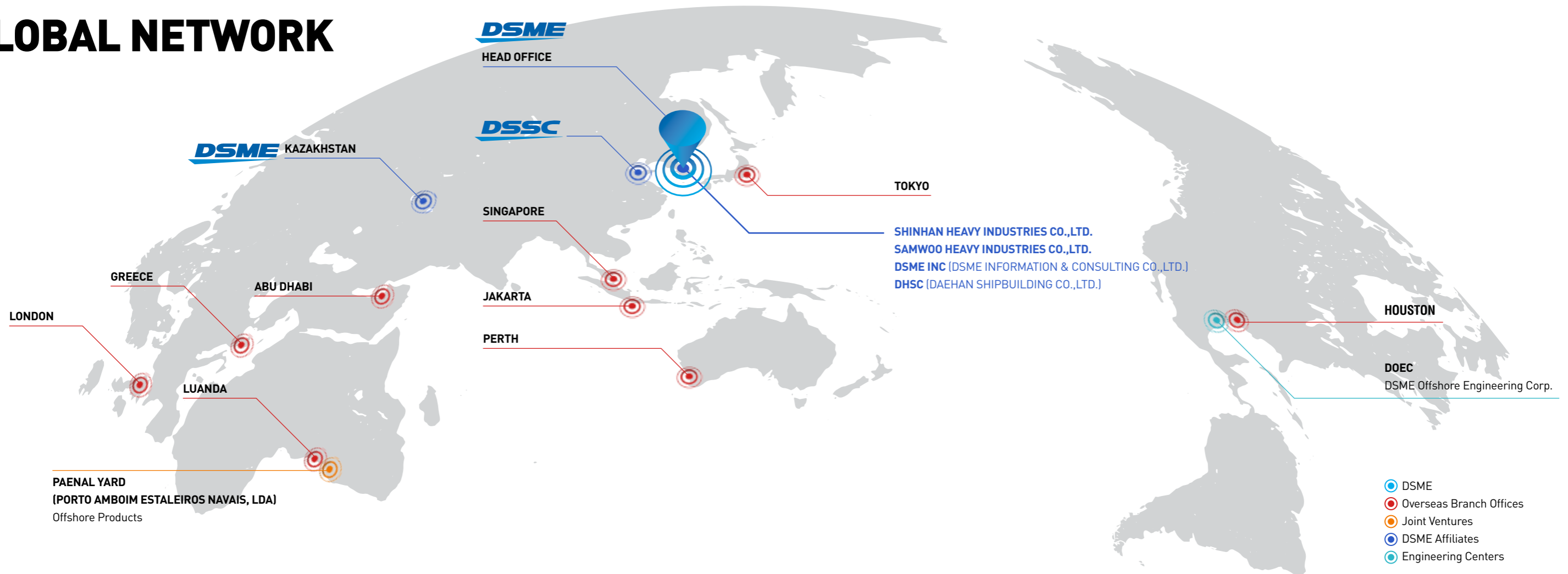
Total Area : **4,900,000 m²**
 Covered Shop : 560,000 m²
 Open Working Area : 1,470,600 m²
 Total Outfitting Quay : 8,766.7 m

- 1** Drydock 1 **4** RD-3 **7** Launching Barge
- 2** Drydock 2 **5** RD-4 **8** Floating Crane
- 3** Heavy Zone **6** RD-5

	DRY DOCKS		HEAVY ZONE		FLOATING DOCKS				FLOATING CRANES
	No.1	No. 2	G1	G2	RD-3	RD-4	RD-5	L/B	
Capacity (ton)	1,000,000	630,000	-	-	80,000	120,000	150,000	26,000	2 x 3,600 tons
Length(m)	529	540	320	313.5	336	408	408	221.5	
Width(m)	131	81	80	205	59.2	66.6	68.2	47.9	
Depth(m)	14.5	14.5	-	-	21.0	23.5	25.3	20.5	
Crane	G1 x 900 tons J1 x 200 tons J4 x 50 tons T1 x 60 tons		G1 x 900 tons	G1 x 900 tons	J 2 x 35 tons	J 2 x 50 tons	J 2 x 50 tons	J1 x 50 tons	



DSME GLOBAL NETWORK



DSME

HEAD OFFICE (OKPO)

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DOEC

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SAMWOO HEAVY INDUSTRIES CO., LTD.

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BRANCH OFFICES

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Fax : + 30 210 422 6788

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Tel : + 65 6336 0930 (Rep : 0940)
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JAKARTA

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