KOREA GLOBAL SERVICE

Generator Maintenance for LNG/C

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Specialized Service for LNG Ships

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1. Introduction

KGS team consists of ex-Hyundai specialists for large generator and motor, who worked for 30 years as designer & field service engineer in Hyundai Shipyard(HHI). Specially, KGS team has various work experiences for LNG carrier of Maran Gas & QGTC during new building in Hyundai Shipyard.

2. Service Scope – All Makers Serviceable

- Ship's dry dock maintenance
- Port trouble-shooting service
- Synchronous generator, Induction generator & Induction motor
- Installation, commission and supervision
- AVR Service / Retrofit (Analog → Digital)

3. Example of overhaul service (LNG/C Generator 4 sets)

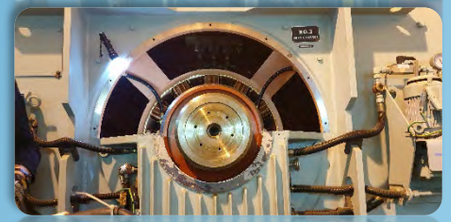
Generator type	Working Period	Daily Rate	Estimation (USD)
8,367KVA x 2 sets 1,254KVA x 2 sets	3 S/E X 8 Days	$900/Person	21,600

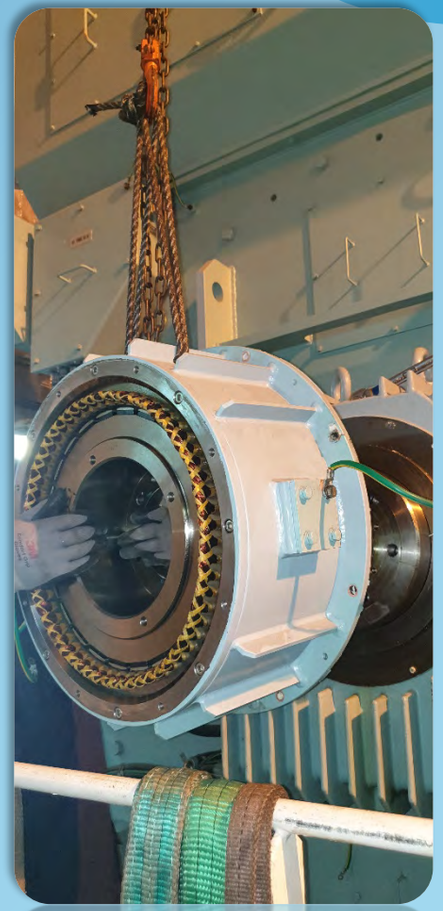
30% lower price than original maker

- All the required spares to be supplied by shipowner
- No extra cost for overtime until 20:00 on weekdays
  No extra cost for holidays & weekends to be applied
- Hotel & travel expenses & time to be added as per tariff

4. Dry dock maintenance work scope

	Inspection Item	5 Year	10 Years
1	Cleaning of frame inside	o	o
2	All windings	o	o
3	Inspection of power cable & auxiliary cable	o	o
4	Function check for all sensors	o	o
5	AVR & excitation equipment Inspection	o	o
6	Pressurized air cleaning for all windings	o	o
7	Rotating rectifiers & varistor	o	o
8	Air gap check of main & exciter machine	o	o
9	Bearing metal inspection of upper & lower bearing	o	o
10	Air cooler inspection & tube cleaning (*only for cooler type)	o	o
11	Chemical cleaning for end windings	o	o
12	Chemical cleaning with red varnish for complete windings	-	o
13	Impedance test for rotor winding	-	o





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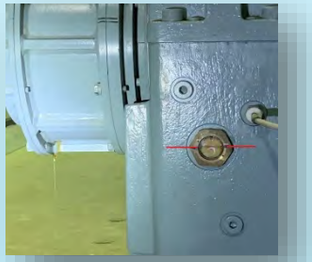
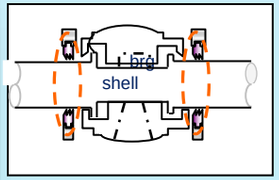
5. Maintenance Service

1) Bearing oil leakage





Adjusting of gap between the shaft and sealing ring

Purpose of service

Protect the bearing from high bearing temp. caused by the oil leakage

Service Description

Measure the gap between shaft and sealing ring and adjust the gap. Assembling after gluing for contract surface

Working period

4~8 hours per bearing

2) Chemical cleaning Stator

Purpose of service

Prevent corrosion caused by salty water or insulation breakdown

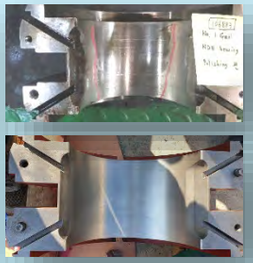
Service Description

Dismantle fan, air guide, bearing & end shields. Removing dust & foreign material on windings & core using a chemical cleaner

Working period

3~4 days per generator

3) Inspect Upper/Lower Bearing



Purpose of service

Improve poor contacts between low bearing and shaft to avoid bearing high temp.

Service Description

Dismantle PMG, bearing housing & lower bearing shell, polishing bearing surface and assemble

Working period

5~15 hours per bearing

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6. Trouble Shooting

1) Replace exciter rotor winding


Purpose of service

Damaged exciter rotor cause current unbalance or black out during parallel load operation.

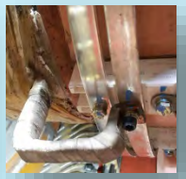
Service Description

Dismantle NDE bearing & end shield. Replacement of damage exciter rotor assembly

Working period

2~3 days per generator

2) Replace rectifier, leads & ring

Purpose of service

Switching surge at synchronizing or abnormal operation cause damage of varistor, rectifiers, leads and etc.

Service Description

Dismantle bearing, end shields and replace the rectifiers, leads & ring

Working period

3~4 days per generator

3) Replace exciter pole winding


Purpose of service

Oil mist & dust will stack on surface of the windings. This will cause winding damage by low insulation.

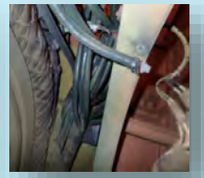
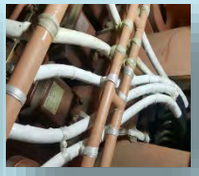
Service Description

Dismantle bearing, end shield and chemical cleaning. Replace the exciter pole windings

Working period

10~16 hours per generator

4) Replace power cable

Purpose of service

Main power cable can be damaged by rubbing and should be replaced with new stator.

Service Description

Dismantle bearing, end shield and repair damaged cable. Insulation, binding & curing of cable

Working period

24~32 hours per generator

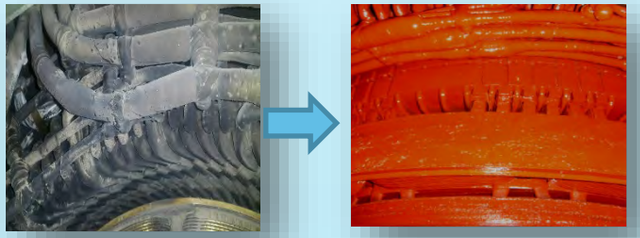
7. Retrofit & Improvement

1) Retrofit of AVR System

ANALOG AVR → DIGITAL AVR

Description	Analog AVR	Digital AVR
Components	Complicate	Simple
Setting Data	Visual check	By Computer
V- control	Normal (±2.5%)	Accurate (±0.5%)
T/shooting	Specialist	By Crew
Reliability	Normal	High
Cabling	Complicate	Simple
Fault history	No indication	Store in AVR

2) Improve insulation resistance



Purpose of service

To improve the winding insulation level by cleaning, varnishing the winding.

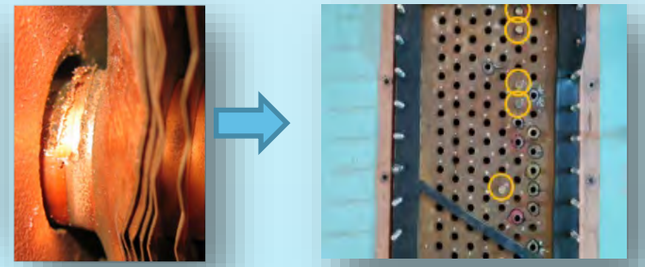
Service Description

Dismantle bearing, end shields and cleaning & red vanishing all windings.

Working period

3~4 days per generator

3) Water Cooler maintenance



Purpose of service

To improve cooling capacity by plugging the defective cooler tube.

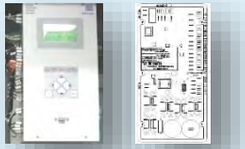
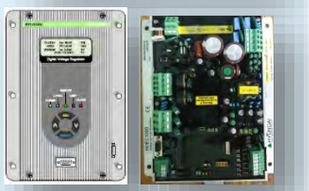
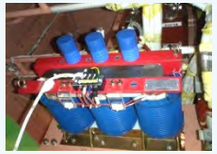
Service Description

Dismantle cooler & plugging for damaged tube.
Pressure test for the cooler.

Working period

1 day per generator

8. Spare list for sales (I)

Name	Figure	Description	Name	Figure	Description
Analog AVR (A1)		For Hyundai HFx5 Type Generator L/T 4 weeks	Digital AVR (A1)		DECS-100 DECS-250 L/T 6 weeks
		For Hyundai HFx6 Type Generator L/T 2 weeks	Reference Value Setter (90R)		Voltage Rheostat with handle for Analog AVR L/T 1 week
Digital AVR (A1)		For Hyundai HSX7 Type Generator HDEC-1000 HDEC-2000 L/T 5 weeks	Steady Rectifier (V1 or V29)		3 phase Rectifier for Analog AVR L/T 2 week
Control Transformer for High voltage (T9)		Step Down Transformer for Analog AVR L/T 2 weeks	Reactor (L1)		Power Supply for Analog AVR L/T 2 weeks

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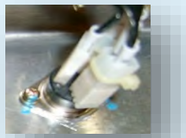
9. Spare list for sales (II)

Name	Figure	Description	Name	Figure	Description
Power CT for High Voltage (T1, T2, T3)		Power Supply for Analog AVR L/T 2 weeks	Rectifier Transformer (T6)		Power Supply for Analog AVR L/T 2 weeks
Power CTs for Low Voltage (T1, T2, T3)		Power Supply for Analog AVR L/T 2 weeks	Droop CT (T4)		CT for Droop characteristic L/T 2 weeks
Series Resistor (R1)		For Hyundai HFx5 Type Generator L/T 10 weeks	Rotating Rectifier (V2)		. SKKD81 L/T 1 week
By-pass Resistor (R48)		For Hyundai HFx6 Type Generator L/T 2 weeks			. SKKD162 L/T 1 week
Thyristor (V28)		For Hyundai HFx6 Type Generator L/T 2 weeks			. SKN380 L/T 1 week

10. Service Experience (2020 Dubai, LNG)

KOREA INTEGRATED MAINTENANCE PROVIDER
- MAIN ENGINE : ME & MC TYPE MAN HYUNDAI, DOOSAN, STX
- ELECTRIC SWITCHBOARD: 6600V, LOW VOLT, HIMAP/SYMAP
- D/G ENGINE : HIMSEN, MAN HOLEBY, WARTSILA
- RCS/BMS : NABTESCO, KONGSBERG, ACONIS AMS/PMS
- KOREA MKR : PUSNES DECK MC, HI-AIR A/C, KANGRIM BOILER
- GENERAL REPAIRS : HULL, OUTFITTING, VDR, GYRO, GMDSS

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Ship's Name : DYNA GAS / H2566

SPECIFICAITON OF GENERATOR : 8,367kVA 6,600V 6

Maintenance Report of DYNA GAS No.1

1. Working Period : 05/08/2020 ~ 06/08/2020
2. Company Name : Korea Global Service Co., Ltd
3. Equipment : No.1 Generator
4. Service Place : DUBAI / Dry Dock World

0	12-Aug-20	For Review	BD, LEE
Rev.	Issued date	Contents	Prepared by

Customer DYNA Gas
Project DYNA Gas / HHI H2566
Document Generator Inspection
File DD Maintenance Report

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1 Insulation Resistance of Windings

Insulation Resistance of Main Stator Winding	
8,367 KVA, 6600V, 14P	
No.1 Generator	
Phase to Ground	5.28 GΩ
Test Voltage	5,000Vdc
Result	Good
Criterion	>10MΩ
Inspection Date	05-Aug-20

Insulation Resistance of Main Rotor Winding	
8,367 KVA, 6600V, 14P	
No.1 Generator	
(+) Lead to Ground	∞ Ω
Test Voltage	500Vdc
Result	Good
Criterion	>5MΩ
Inspection Date	05-Aug-20

Insulation Resistance of Exciter Stator	
8,367 KVA, 6600V, 14P	
No.1 Generator	
+F1 or -F2 to GND	∞ Ω
Test Voltage	500Vdc
Result	Good
Criterion	>5MΩ
Inspection Date	05-Aug-20

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2 Measurement of Winding Resistance

Winding Resistance of Main Stator		
8,367 KVA, 6600V, 14P		
No.1 Generator		
U-V : 0.0795Ω	V-W : 0.0768Ω	U-W : 0.0799Ω
Result	Good	
Criterion	Within ±10% (Average of each line to line value)	
Inspection Date	05-Aug-20	

Winding Resistance of Main Rotor	
8,367 KVA, 6600V, 14P	
No.1 Generator	
Between (+) and (-) leads	0.5 Ω
Result	Good
Criterion	Reference only
Inspection Date	05-Aug-20

Winding Resistance of Exciter Stator	
8,367 KVA, 6600V, 14P	
No.1 Generator	
Between (+) and (-) leads	7.2 Ω
Result	Good
Criterion	Reference only
Inspection Date	05-Aug-20

Winding Resistance of PMG Stator		
8,367 KVA, 6600V, 14P		
No.1 Generator		
U-V : 1.0 Ω	V-W : 1.0 Ω	U-W : 1.0 Ω
Result	Good	
Criterion	Within ±10% (Average of each line to line value)	
Inspection Date	05-Aug-20	

Customer DYNA Gas
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3 PI Test for Main Stator Winding

PI measurement	
8,367 KVA, 6600V, 14P	
No.1 Generator	
Phase to Ground	
1 MIN : 5.28 GΩ	10 MIN : 30.1 GΩ
Result	5.7 (GOOD)
Applied Voltage	5,000 Vdc
Criterion	Above 2.0
Inspection Date	05-Aug-20

4 Air Gap Measurement

Air Gap between Exciter Stator and Rotor	
8,367 KVA, 6600V, 14P	
No.1 Generator	
Top : 2.0 mm	STBD : 1.9 mm
Bottom : 1.7 mm	PORT : 1.8 mm
Result	Good
Criterion	Reference only
Inspection Date	05-Aug-20

PMG Air Gap	
8,367 KVA, 6600V, 14P	
No.1 Generator	
Top : 1.8 mm	STBD : 1.6 mm
Bottom : 1.7 mm	PORT : 1.8 mm
Result	Good
Criterion	Reference only
Inspection Date	05-Aug-20

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11. Service Experience (Generator & Turbine)

Rotor and stator coil replacement for proportion motor ship

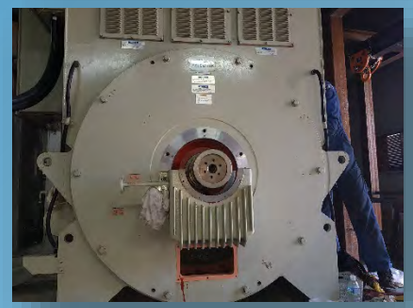
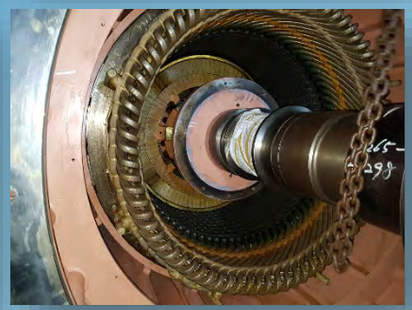



Generator overhaul for power plant in USA




E-mail: justinjang@kogios.com

Turbine generator overhaul

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12. KGS Technical Support

KGS Ulsan office

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MC/ME engine, general spares

PROMPT & POSITIVE SUPPORT