

WARTSILA EQUIPMENT LIST

Engine type	6 x Wartsila 8L32
Max cont. rating (MCR).....	3840 kW,
Engine speed	720 rpm
Fuel type HFO.....	380 cSt (50°C)

1.0 Power generation machinery

1.1.1 Wartsila 8L32 6

1.2 Fuel oil system 1 for 3 x Wartsila 8L32

1.2.1 Feeder/Booster unit 1

1.2.2 Overflow valve (HFO/MDF) 1

1.2.3 Suction strainer (MDF) 1

1.2.4 Separator unit (HFO) common 1

1.2.5 Circulation pump 3

1.2.6 Safety filter (HFO) 3

1.3 Fuel oil system 2 for 3 x Wartsila 8L32

1.3.1 Feeder/Booster unit 1

1.3.2 Overflow valve (HFO/MDF) 1

1.3.3 Suction strainer (MDF) 1

1.3.4 Circulation pump 3

1.3.5 Safety filter (HFO) 3

1.4 Lubricating oil system

1.4.1 Separator unit (steam) 5

1.5 Compressed air systems 1 for 3 x Wartsila 8L32

1.5.1 Starting air vessel 2

1.5.2 Starting air compressor unit (water cooled) 1

1.6 Compressed air systems 2 for 3 x Wartsila 8L32

1.6.1 Starting air vessel 2

1.6.2 Starting air compressor unit (Water cooled) 1

1.7 Cooling water systems 1 for 3 x Wartsila 8L32

1.7.1 Temperature control valve (heat recovery) 1

1.7.2 Preheating unit 1

1.7.3 Central cooler 2

1.8 Cooling water systems 2 for 3 x Wartsila 8L32

1.8.1 Temperature control valve (heat recovery) 1

1.8.2 Preheating unit 1

1.8.3 Central cooler 2

1.9 Combustion air and exhaust gas systems

1.9.1 Turbocharger cleaning device 2

1.9.2 Exhaust gas bellows 6

1.9.3 Exhaust gas silencer with spark arrestor 6

1.9.4 Connection piece 6

1.10 Control and monitoring systems	
1.10.1 Power Unit	6
1.11 Electric motor starters	
1.11.1 Starters for electric motor driven pumps	12
1.11.2 Starter for engine turning gear	6
1.12 Foundation	
1.12.1 Flexible pipe connections spare set	1
1.12.2 Flexible pipe connections	6
1.12.3 Common base frame	6
1.13 Power transmission	
1.13.1 Flexible coupling (flywheel)	6
1.14 Tools and spare parts	
1.14.1 Tools (engine)	1
1.14.2 Spare parts (engine)	1
1.15 Packing and transportation	
1.15.1 VCI-coating	6
1.15.2 Tarpaulin	6
1.16 Technical documentation	
1.16.1 Engine manuals	6
1.17 Commissioning	
1.17.1 Start-up support 80 man-days in 6 trips	1

Terms of delivery

FCA Mantyluoto, Finland (Incoterms 2000).

Alternators ex works HHI Busan, S. Korea.

Time of delivery

Shipset 1 ready ex works.

Validity of quotation

This quotation is valid until 8 March 2013 subject to prior sale.

Terms of payment

To be agreed.

**TECHNICAL SPECIFICATION
WARTSILA GENSET PACKAGE**

DATE

8 January 2013

TABLE OF CONTENTS

1.0 Power Generation Machinery	3
General	3
1.1 Diesel Engine(s).....	4
1.2 Fuel oil system 1, for 3 x Wärtsilä 8L32.....	7
1.3 Fuel oil system 2, for 3 x Wärtsilä 8L32.....	8
1.4 Lubricating oil system.....	9
1.5 Compressed air systems 1, for 3 x Wärtsilä 8L32	9
1.6 Compressed air systems 2, for 3 x Wärtsilä 8L32	9
1.7 Cooling water systems 1, for 3 x Wärtsilä 8L32.....	10
1.8 Cooling water systems 2, for 3 x Wärtsilä 8L32.....	10
1.9 Combustion air and exhaust gas systems	10
1.10 Control and monitoring systems	11
1.11 Electric motor starters	11
1.12 Foundation.....	11
1.13 Power transmission.....	12
1.14 Tools and spare parts	12
1.15 Packing and transportation.....	12
1.16 Technical documentation	12
1.17 Commissioning	13
2.0 Additionally priced items 2	14
2.1 Compressed air systems.....	14

1.0 Power Generation Machinery

General

Ambient conditions

The equipment is designed for the following conditions:

Maximum ambient air temperature	45°C
Maximum LT cooling water temperature before engine	38°C
Maximum sea water temperature.....	32°C

Classification

The equipment meets the requirements of LR for unrestricted service at the date of quotation.

Warranty

As is. Buyer may obtain a guarantee from Wartsila for a certain price.

Validity of classification and other rules

The Equipment shall be delivered according to the valid edition of the mentioned rules, regulations and requirements of the Classification Society and Authority or Marine Organization as was applicable at the time of purchase.

Electric power supply

If not specially mentioned, all electrical equipment delivered with the engine is designed to operate with:

Main voltage	3x440V
Frequency	60Hz
Control voltage	24VDC

Fuel oil quality

The equipment is specified for fuel according to ISO 8217:2005 (E) with a viscosity of max. 380 cSt/50°C.

HFO

The following conditions, not specified in the ISO standard also apply:

Viscosity min., before injection pumps.....	16 cSt
Viscosity max., before injection pumps.....	24 cSt
CCAI, max.....	870
Water before engine, max.....	0.3 % volume
Sodium before engine, max	30 mg/kg
Aluminium + Silicon before engine, max.....	15 mg/kg
Asphaltenes, max.....	14 % mass

MDF

The following conditions, not specified in the ISO standard also apply:

Viscosity min., before injection pumps.....	2.0 cSt
Viscosity max., before injection pumps.....	24 cSt
Sodium before engine, max	30 mg/kg
Aluminium + Silicon before engine, max.....	15 mg/kg
Flash point (PMCC), min.....	60 °C
Pour point, max	0-6 °C

Water quality

Fresh cooling water shall be treated with approved products.

Lubricating oil quality

Only approved oils shall be used for the equipment.

1.1 Diesel Engine(s)

1.1.1 Wärtsilä 8L32

Application

Engine driving a generator at constant speed.

Main particulars

Max continuous rating (MCR)	3840 kW
Speed	720 rpm
Configuration	In-line engine
Number of cylinders	8
Cylinder bore.....	320 mm
Stroke	400 mm
Swept volume per cylinder	32.2 dm ³
Mean piston speed	9.6 m/s
Mean effective pressure	24.9 bar
Direction of rotation, looking at driving end	Clockwise

The max continuous rating (MCR) is valid at ambient conditions mentioned above.

Fuel oil consumption (SFOC)

Fuel consumption at shaft according to ISO 3046/1 without engine driven pumps using HFO and corrected to a net calorific value of 42,700 kJ/kg:

85 % load.....	176 g/kWh
Tolerance	□ 5 %

Lubricating oil consumption

85 % load	0.5 g/kWh
Tolerance	0.3 g/kWh

Lubricating oil consumption does not include treatment losses or oil changes.

NOx Emissions

The standard engine complies with the maximum permissible NOx emission according to MARPOL 73/78 ANNEX VI valid at the time of purchase.

Testing

The engines have been tested at the max continuous rating (MCR) in makers workshop in accordance with the requirements of the classification society and maker's own standard specification. The fuel oil used during the test run is closest to the actual specification. After test run the fuel rack position has been limited to 110 % MCR.

Engine specification

The engine is a four-stroke, turbocharged and intercooled diesel engine. The following equipment is mounted on the engine:

Fuel system

- One injection pump per cylinder
- Spring loaded control valve in the return pipe -
- Fuel oil pulse dampers (supply & return)

Lubricating oil system

- Direct driven lubricating oil pump with built-in safety valve and pressure regulating valve, without stand-by connections
- Electric motor driven pre-lubricating oil pump with built-in safety valve
- Automatic lubricating oil filter of back flushing type equipped with a differential pressure sensor
- Centrifugal filter mounted in the back flushing line
- Lubricating oil cooler of tube type
- Lubricating oil thermostatic valve
- Wet oil sump
- Separator connections including shut off valves

Starting air system

- Starting air master valve
- Blocking valve for turning gear
- Control air container
- None return valve
- Starting air distributor
- Starting air valve in each cylinder head
- Flame arrestor

Cooling water system

- Engine driven HT-cooling water pump without stand-by connection -
- HT thermostatic valve, direct acting type
- Engine driven LT-cooling water pump without stand-by connection -
- LT thermostatic valve, direct acting type

Combustion air and exhaust gas system

- Turbocharger(s) with air filter and silencer at free end of engine
- Exhaust gas outlet(s) orientation, 0° from vertical
- Single-stage charge air cooler(s)
- Connection(s) for cleaning device of turbine
- Cleaning device for compressor(s), manually operated
- Exhaust gas waste gate

Control and monitoring equipment on engine

- Fuel rack actuator for electronic speed control
- Two speed pickups for electronic speed control
- Electro-pneumatic shutdown system independent of the governor
- Microprocessor based distributed real time system for engine control and monitoring

Main components:

- Engine safety module for shutdown of engine acc. to class requirements
- Main control module for internal engine control functions
- Input /output modules for handling of sensor data

Main functions:

- shutdowns (e.g. lubricating oil pressure, overspeed)
- start blockings (e.g. lubricating oil pressure, turning gear)
- measuring of engine and turbocharger speed
- normal start and stop of the engine
- engine speed control
- other internal engine control functions as applicable
- signal processing of engine monitoring and alarm sensors
- data communication with ships alarm & monitoring system through Ethernet Modbus TCP/IP or RS-485 serial link/Modbus RTU
- hardwired interface with external systems for control functions such as remote start and stop

Operator interface

The operator interface consists of a local control panel (LCP) with backup indications, control switches and buttons, as well as a local display unit (LDU). Both are built on the engine. The local display unit shows all engine measurements (e.g. temperatures and pressures) and provides various engine status indications as well as an event history.

Independent indications on the local control panel:

- Engine rpm
- Turbocharger rpm
- Running hours
- HT water temperature
- Lubricating oil pressure

Control switches and pushbuttons on the local control panel:

- BLOW/BLOCKED/LOCAL/REMOTE control mode switch -
Local START/STOP pushbuttons
- Shutdown RESET pushbutton
- Emergency stop pushbutton

Sensors

- Alarm, safety and measuring sensors according to maker and class requirements as per enclosed sensor list A01887215.

- Connections for testing of pressure sensors -
Additional FAKS sensors
- Sensors are wired to the engine mounted I/O- and control modules

Miscellaneous

- Flywheel with a gear ring for turning
- Electrical turning device
- Crankcase explosion valves
- Safety valve in each cylinder head
- Indicator valve in each cylinder head
- Nameplates in English
- Counter flanges, gaskets, bolts and nuts
- Torsional vibration damper or tuning mass in case needed

Painting

- The generating set will be painted with acrylic-based paint in colour Munsell no 7,5
BG 7/2

1.2 Fuel oil system 1, for 3 x Wärtsilä 8L32

1.2.1 Feeder/Booster unit

1

A self-contained skid equipped with a drip-tray comprising the following main components:

- Suction strainer
- Feed pumps, 2 pcs (duty and stand-by) of screw type with safety valves -
Pressure control valve
- An automatic filter with a manual by pass filter and differential pressure indicator with alarm contact.
- Flow meter with local indication
- Pressurized de-aeration tank provided with:
 - Level switch
 - Safety valve
 - Vent valve
- Circulating pumps. 2 pcs (duty and stand-by) of screw type with safety valves
- Steam heaters (2 pcs) with shut-off valves and safety valves
- Viscosity control system
- Starters with stand-by automatics
- Local control panels with individual alarm indications and group alarm contacts
- Pressure gauges and thermometers

The fuel pipes are equipped with steam trace heating, insulated and covered with steel plate.

1.2.2 Overflow valve (HFO/MDF)

1

Spring loaded overflow valve

1.2.3 Suction strainer (MDF)	1
Duplex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.	
1.2.4 Separator unit (HFO) common	1
The main components mounted on a steel frame are:	
- Two separator(s) of automatic discharge type	
- Suction strainer	
- Electrically driven separator feed pump	
- Steam heater with safety valve	
- Sludge tank with heating coils	
- Sludge pump	
- Motor starters	
Local control panel including temperature control, sequencing, individual alarm indication and group alarm contact	
1.2.5 Circulation pump	3
Electric motor driven screw pump with safety valve	
1.2.6 Safety filter (HFO)	3
Duplex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.	
1.3 Fuel oil system 2, for 3 x Wärtsilä 8L32	
1.3.1 Feeder/Booster unit	1
A self-contained skid equipped with a drip-tray comprising the following main components:	
- Suction strainer	
- Feed pumps, 2 pcs (duty and stand-by) of screw type with safety valves -	
Pressure control valve	
- An automatic filter with a manual by pass filter and differential pressure indicator with alarm contact.	
- Flow meter with local indication	
- Pressurized de-aeration tank provided with:	
- Level switch	
- Safety valve	
- Vent valve	
- Circulating pumps. 2 pcs (duty and stand-by) of screw type with safety valves	
- Steam heaters (2 pcs) with shut-off valves and safety valves	
- Viscosity control system	
- Starters with stand-by automatics	
- Local control panels with individual alarm indications and group alarm contacts	
- Pressure gauges and thermometers	
The fuel pipes are equipped with steam trace heating, insulated and covered with steel plate.	

1.3.2 Overflow valve (HFO/MDF)	1
Spring loaded overflow valve	
1.3.3 Suction strainer (MDF)	1
Duplex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.	
1.3.4 Circulation pump	3
Electric motor driven screw pump with safety valve	
1.3.5 Safety filter (HFO)	3
Duplex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.	
1.4 Lubricating oil system	
1.4.1 Separator unit	5
The main components mounted on a steel frame are:	
- Separator of automatic discharge type	
- Suction strainer	
- Electrically driven separator feed pump	
- Steam heater with safety valve	
- Operating water tank	
- Sludge tank with heating coils	
- Sludge pump	
- Motor starters	
- Local control panel including temperature control, sequencing, individual alarm indication and group alarm contact	
1.5 Compressed air systems 1, for 3 x Wärtsilä 8L32	
1.5.1 Starting air vessel	2
The total air volume of the starting air vessels are calculated for 12 starts (estimation).	
Starting air vessel (0.500 m ³) for vertical mounting with:	
- Valve head assembly with inlet, outlet, drain and safety valves	
- Counter flanges, gaskets, bolts and nuts	
Starting air vessel size to be confirmed by customer, since the approval discussions are carried out between system designer and classification society.	
1.6 Compressed air systems 2, for 3 x Wärtsilä 8L32	
1.6.1 Starting air vessel	2
The total air volume of the starting air vessels are calculated for 12 starts (estimation).	

- Starting air vessel (0.500 m³) for vertical mounting with:
- Valve head assembly with inlet, outlet, drain and safety valves
 - Counter flanges, gaskets, bolts and nuts

Starting air vessel size to be confirmed by customer, since the approval discussions are carried out between system designer and classification society.

1.7 Cooling water systems 1, for 3 x Wärtsilä 8L32

1.7.1 Temperature control valve (heat recovery) **1**
Temperature control valve of Direct type.

1.7.2 Preheating unit **1**
HT cooling water preheating unit with:

- Electric heater
- Circulating pump
- Control cabinet for heater and pump
- The unit is dimensioned to maintain a hot engine warm or to heat the engine block from 15 °C to 60 °C within 24 h, excluding losses in the external system

1.7.3 Central cooler **2**
Combined HT/LT fresh water central cooler of plate type for cooling of engines. Two coolers are designed for cooling of 3x Wärtsilä 8L32.

1.8 Cooling water systems 2, for 3 x Wärtsilä 8L32

1.8.1 Temperature control valve (heat recovery) **1**
Temperature control valve of Direct type.

1.8.2 Preheating unit **1**
HT cooling water preheating unit with:

- Electric heater
- Circulating pump
- Control cabinet for heater and pump
- The unit is dimensioned to maintain a hot engine warm or to heat the engine block from 15 °C to 60 °C within 24 h, excluding losses in the external system

1.8.3 Central cooler **2**
Combined HT/LT fresh water central cooler of plate type for cooling of engines. Two coolers are designed for cooling of 3x Wärtsilä 8L32.

1.9 Combustion air and exhaust gas systems

1.9.1 Turbocharger cleaning device **2**
Turbocharger water cleaning device for turbocharger turbine side:

- Dosing unit
- 10 meter hose with quick couplings

1.9.2 Exhaust gas bellows **6**

Flexible expansion bellows after turbocharger.

- Counter flanges, gaskets, bolts and nuts

1.9.3 Exhaust gas silencer, with spark arrestor **6**

Uninsulated exhaust gas silencer with spark arrestor with approximately 25 dB(A) noise reduction.

- Counter flanges, gaskets, bolts and nuts

1.9.4 Connection piece **6**

Conical transition piece after the exhaust gas bellows on the turbocharger.

1.10 Control and monitoring systems

1.10.1 Power Unit **6**

Power unit for supply of isolated and duplicated 24VDC to the engine.
Cabinet for bulkhead mounting, protection degree: IP44

Main components

- 230VAC/24VDC power supply converter
- 24VDC/24VDC power supply converter
- Miniature Circuit Breakers (MCBs) and terminals

The converters are dimensioned for 100% load and redundant. Failure of one supply will cause automatic takeover by the second supply.

Required power supply from ship's

system: - Main: 220VAC / abt. 150W

- Backup: 24VDC/ abt. 150W.

At least one of these must be connected to UPS or battery backup on ship's side.

1.11 Electric motor starters

1.11.1 Starters for electric motor driven pumps **12**

Motor starters included:

- engine built on pre lubricating oil pump (6 pcs)
- HFO/MDF Circulating pump (6 pcs)

Features of the starters:

- local start and stop control
- standby-, remote- or automatic mode as applicable

1.11.2 Starter for engine turning gear **6**

Starter for electric driven turning gear with a cable of 15 meters and handheld control unit.

1.12 Foundation

1.12.1 Flexible pipe connections, spare set **1**

Spare set of flexible hoses including one for each type of pipe connections on engine(s).

1.12.2 Flexible pipe connections **6**

Flexible hoses for the pipe connections on engine(s).

1.12.3 Common base frame **6**

Foundation for the engine and the alternator:

- Common base frame of welded steel
- Flexible mounts for common base frame
- The generator and engine will be mounted on the common base frame.
- Alternator fittings materials are included.
- Flywheel cover between engine and alternator

1.13 Power transmission

1.13.1 Flexible coupling (flywheel)

6

The final choice of flexible coupling will be based on the torsional vibration calculations (made after the order).

Bolts for connecting the coupling to the flywheel

1.14 Tools and spare parts

1.14.1 Tools (engine)

1

Tools for the engine according to enclosed tools list T01887215.

1.14.2 Spare parts (engine)

1

Spare parts according to the recommendations of the IACS, unrestricted service, for the engine(s) according to enclosed spare parts list S01887215.

1.15 Packing and transportation

1.15.1 VCI-coating

6

The engine is protected during transportation by a plastic VCI-film (Volatile Corrosion Inhibitor).

1.15.2 Tarpaulin

6

The engine is protected during transportation by a tarpaulin.

1.16 Technical documentation

Installation Planning Instructions

Delivery includes, in English, Installation Planning Instructions (IPI) necessary for Buyer's installation work of equipment in Wärtsilä scope of supply.

Classification drawings

Buyer shall prepare and submit to the relevant Classification Society and Authorities (class) all drawings necessary for certification and approval of the vessel unless otherwise specifically stated. Wärtsilä shall provide equipment certificates of equipment within the scope of supply.

1.16.1 Engine manuals

6

Set of engine Operating & Maintenance manuals (O & M manuals) and spare parts catalogues per ship set for the equipment included in Wärtsilä scope of supply.

Operating & Maintenance manuals

Operating & Maintenance manuals cover instructions and descriptions by text and pictures of the main actions and cautions needed when operating the delivered equipment. The engine Operating & Maintenance manual are made specific for the delivered engine(s).

Spare Parts Catalogues

Spare Parts Catalogues contain the needed pictures for identification of spare parts to be ordered, stored or installed. The Spare Parts Catalogue furthermore contains Wärtsilä specific Spare Part Numbers, which shall be used when ordering parts. The Spare Parts Numbers are connected to Wärtsilä's unique Code Resolution system, enhancing the precision of spare parts processing and minimizing the need for updating at the customer's side.

Type	Media	Language	Qty
O & M manual (Wärtsilä 8L32)	A4 binder	English	3
Spare parts catalogue (Wärtsilä 8L32)	A4 binder	English	3

1.17 Commissioning

1.17.1 Start-up support

1

Commissioning support

Support for pre-commissioning and commissioning of the installation and participation in sea trials including travelling and lodging costs. Commissioning support included for maximum:

- 80 man-days at yard during 6 visit(s)

Buyer shall notify Wärtsilä at least two (2) weeks before mobilization of personnel is required.

Commissioning support exceeding the contracted

If required commissioning support, due to reasons attributable to Buyer, exceeds the contractual amount based on a normal working week of sixty (60) hours and a normal working week of six (6) days, not exceeding ten (10) hours per day, Wärtsilä has the right to charge Buyer for overtime, man days and travel expenses exceeding the contractual amount according to the valid Wärtsilä Service Charges Price List.

Conditions related to commissioning

A commissioning kick-off meeting shall be held prior to starting commissioning activities to agree on a commissioning plan for the Wärtsilä scope of supply.

Wärtsilä personnel shall only be employed for consulting and supervising purposes in connection with commissioning work.

Technical documentation in form of drawings, specification etc. which might be necessary for the successful completion of commissioning work shall be supplied by Buyer.

Time required for checking the installation prior to start of engine(s) shall be reserved by Buyer. During this installation check, no other major jobs are allowed in the engine

room. No welding or spray painting may be done above or next to the engine(s), unless agreed in writing with Wärtsilä representative.

Wärtsilä personnel shall not assume responsibility for the engine room and other equipment in connection with sea trials. For this purpose a qualified chief engineer responsible for the vessel shall be present at the expense and initiative of the Buyer.

2.1 Compressed air systems

2.1.1 Starting air compressor unit (water cooled)

2

- Two stage, 1-cylinder compressor
- Air suction filter with silencer
- Air safety valve LP & HP
- Air pressure gauge LP & HP
- Water cooler
- Built-in inter- and aftercooler
- Direct driven cooling water pump

	Number	Date	Application Revision	Page
Ship Power	T01887215			1(3)

Tools for 6 x Wärtsilä 8L32

Description	Qty/inst.	Part No.
Tools for main bearings		
Turning tool for main bearing shell	1	800004
Turning tool for thrust bearing shell	1	800005
Tools for cylinder liner		
Lifting tool for cylinder liner	1	800007
Honing equipment for cylinder liner	1	800008
Dismounting tool for anti polishing ring	1	800009
Assembly tool for piston	1	800103
Fastening tool for cylinder liner	4	800123
Tools for piston		
Lifting tool	1	800012
Piston rings pliers	1	800001
Clamp device for piston rings	1	800013
Pliers for securing ring	1	800002
Screwing tap F-M12-6H	1	802000
Assembly tool for connecting rod		
Locking device for connecting rod big end (only L-eng.)	1	800015
Mounting and dismounting tool for connecting rod	1	800016
Guiding plug for connecting rod (only L-eng.)	2	800017
Limiter for piston	1	800018
Hydraulic tightening tools for connecting rod		
Hydraulic tools M27x2	2	800020
Mounting device for M27x2 stud	1	800021
Pin for tightening of nuts M27x2	1	800022
Assembly tool for intermediate gear		
Extractor plate for intermediate gear bearing	1	800024
Tools for cylinder head		
Lifting tool for cylinder head	1	800026
Presser for valve springs	1	800027
Turning tool for grinding of valves	1	800028
Removing device for injection valve	1	800029
Cleaning tool for seal surface for injection valve	1	800075
Extraction mandrel for valve guide	1	800126
Valve clearance gauge feeler	1	800030
T-wrench for indicator valve	1	800031
Tools for injection equipment		
Dismounting tool for injection pump	1	800033
Lifting tool for injection pump	1	800073
Testing device for injection valve	1	800034
Socket wrench 36 mm.	1	800035
Tool for connecting piece flange screws	1	800127
Wrench for tightening of injection pipes, 41mm.	1	800036
Socket wrench for injection nozzle, 55mm.	1	800037
Limiter for fuel rack movements	1	800038

	Number	Date	Application Revision	Page
Ship Power	T01887215			2(3)

Description	Qty/inst.	Part No.
Moving tool for fuel pipe sleeves	1	800039
Measure gauge for injection tappet	1	800111
Extractor tool for injection pump tappet	1	800140
Tools for hydraulically tensioned M42 screw connection		
Hydraulic cylinder	2	800041
Distance sleeves	2	800042
Distance sleeves	2	861055
Pin for tightening of nuts M42	1	800043
Mounting device for M42 stud	1	800044
Tools for hydraulically tensioned M56 screw connection		
Hydraulic cylinder (for main bearings)	2	800046
Hydraulic cylinder (for cylinder heads)	4	800047
Mounting device for M56 stud	1	800048
Pin for tightening of nuts M56	1	800049
Lifting tool for hydraulic cylinders	1	800050
Lifting tool for hydraulic cylinder	1	800051
Tools for hydraulically tensioned M80 screw connection		
Hydraulic tool	1	800112
Support for hydraulic tool	1	800113
Mounting device for M80 stud	1	800114
Fastening arm	1	800125
High pressure pump (1000 bar)		
Hand pump	1	800053
Sign plate	1	800054
Flexible hose 838 mm.	3	800055
Flexible hose 3090 mm.	2	800056
Low pressure pump (150 bar)		
Low pressure pump	1	800059
Flexible hose 3000 mm.	2	800060
Male part B5602-4-4	1	860076
Miscellaneous tools		
Mounting and removing device for camshaft bearing bush	1	800062
Hydraulic extractor	1	800063
Checking device for cylinder / valves tightness	1	800064
Deflection indicator	1	800065
Locking plate for IP-tappet	8	800066
Securing pin for valve tappet	16	800067
Lifting eye bolt M12	1	800068
Lifting eye bolt M16	1	800069
Wrench for centrifugal filter	1	800074
Hexagon socket screw Bit (17 mm.), 3/4" square drive	1	806032
Box wrench head 24	1	800094
Extractor plate for holder of thermostat element	1	800122
Extractor for impeller of water pump	1	837055
Tool for cylinder liner temperature sensor	1	800141



Tools list

	Number	Date	Application Revision	Page
Ship Power	T01887215		-	3(3)

Tools for Engine Automation		
Description	Qty/inst.	Part No.
Speed simulator	1	848113
Crimp tool, Variocrimp	1	846622
Cable stripping tool 6-14 mm	1	846623
Cable stripping tool 4-8 mm	1	846624
Tools for turbocharger		
Tools for turbocharger	1	800070

Spare parts for 6 x Wärtsilä 8L32

Description	Qty/inst.	Remark	Part No.
Side screw	2		100013
Round nut M42 for side screw	2		100097
Main bearing screw	2		100017
Round nut M56 for main bearing screw	2		100010
Main bearing shell, lower	1		100008
Main bearing shell, upper	1		100007
Thrust bearing rail	4		100028
Cylinder liner	1		100110
Anti polishing ring	1		100003
Sealing set for cylinder liner	1		100204
Cylinder head, equipped with valves	1		120025
Cylinder head screw	2		100024
Round nut M56 for cylinder head screw	2		100010
Sealing set for cylinder head overhaul	2		120054
Sealing set for cylinder head replacement	2		120015
Exhaust valve, complete	4		121001
Exhaust valve seat ring	4		120022
Inlet valve, complete	2		121007
Inlet valve seat ring	2		120021
Starting air valve, complete	1		123001
Safety valve, complete	1		125010
Injection valve complete	8		167005
Sealing set for injection valve	8		167044
Big end bearing shell lower	1		111005
Big end bearing shell upper	1		111006
Big end bearing screw	4		111004
Big end bearing nut	4		111003
Connecting rod screw	4		111012
Connecting rod nut	4		111003
Shim	1		111015
Gudgeon pin bearing bush	1		111002
Piston	1		113001
Gudgeon pin	1		113010
Securing ring	2		113009
Connecting rod complete	1		111001
Piston ring set	2		113012
Injection pump, complete	1		165001
Sealing set for injection pump	1		165080
High pressure fuel pipe	1		167012
High pressure connection	1		167003
Bearing bush for intermediate gear	2		100194
Thrust bearing for intermediate gear	1		131026

Description	Qty/inst.	Remark	Part No.
Camshaft thrust bearing	1		223019
ESM10	1		516387
PDM-20	1		516495
Camshaft speed sensor (for ESM)	1		ST173/174
Flywheel speed sensor (governing)	1		SE167/168
LT/HT/CA pressure sensor 6 bar	1		PT601/PT471
LO pressure sensor 10 bar	1		PTZ201
FO pressure sensor 16 bar	1		PT101
SA pressure sensor 40 bar	1		PT301/PT311
Pt100 63 mm	1		TE471
Pt100 113 mm	1		TE601
Exhaust gas temperature sensor	1		TE511
FO Leak switch, capacitive	1		LS103A/LS108A
Spare parts for turbocharger	1		929001

Technical Specification

for

Three Phase Synchronous Generator



1. Technical Specification

1.1 General

1) Maker/Model	: HHI/HSJ7 809-10
2) Quantity	: 6set / Ship
3) Type of excitation	: Brushless and self excited with AVR, rotating field, with damper winding
4) Parallel operation	: Yes
5) Ambient temperature	: 45°C
6) Applicable standards	: IEC, VDE AND DIN
7) Class Society	: DNV certificates included
8) Quality system	: ISO 9001

1.2 Rating

1) Time rating	: Continuous
2) Rated output	: 4,600KVA / 3,680KW
3) Rated voltage	: 6,600V
4) Rated speed	: 720RPM
5) Rated frequency	: 60 HZ
6) Winding connection	: Star (Y)
7) Number of phase	: Three (3)
8) Number of poles	: Ten (10)
9) Power factor	: 0.8 Lagging

1.3 Specifications

- 1) Insulation class : F Class
- 2) Temperature rise : F Class
- 3) Construction : B 3
- 4) Protection degree : IP44
- 5) Radio interference suppr. : "N" ACC. TO VDE0875
- 6) Voltage regulation : Within $\pm 2.5\%$ From no Load to rated full load
- 7) Voltage adjustment : $\pm 5\%$ of the rated of voltage
- 8) Anti condensation heater : AC230V single phase
- 9) Cooling method : Air to cooler with double tube type cooler
- 10) Type of bearing & lub : Bracket type, single sleeve bearing & self lubraction.
- 11) Accessories (per 1set)
 - Automatic voltage regulator
 - Reference value setter
 - Space heater
 - Rod type thermometer for bearing
 - Stator winding temp. detector of pt100ohm(2ea/phase)
 - Bearing temp. detector of pt100ohm(1ea/bearing)
 - Double tube type cooler
 - Water leakage detector for cooler
 - Diff. C/T shall be supplied by the alternator maker (6ea/gen)
- 12) Spare parts (per ship)
 - Rotating rectifier 1set
 - Steady diode 1ea

SIEMENS EQUIPMENT LIST

A Summary		
Item	Qty.	Specification
B1	1	Switchboards and Power management
81.1	1	6600V Main switchboard including neutral earthing transformers
81.2	1	Power management system PMA 300
B1.3	1	Siemens GPA System
81.4	1	Power Plant Protection system
B2		Parts for Multidrive P
B2.1		8 pcs. Inverter Module 1200kW – 6SL3325-1TG41-3AA0 5 pcs. Inverter Module 800Kw – 6SL3325-1TG38-1AA0 6 pcs. Inverter Module 560Kw - 6SL3325-1TG35-8AA0 5 pcs. Inverter Module 315kW - 6SL3325--TG33-3AA0 1 pcs. Inverter Module 200kW - 6SL3325-1TG32-2AA0 11 pcs. Inverter Module 90kW - 6SL3325-1TG38-1AA0
B2.2	4	Converter transformer, 5200kVA, three winding type, 12/Q24-pulse, fresh water cooled
B3		Distribution Transformers
		2 pcs. 6600/450V, 3,500kVA Distribution Transformers 2 pcs. 6600/450V, 3000kVA Distribution Transformers 2 pcs. 450/230V, 220kVA Distribution Transformers.
B4	1	Standard documentation, 4 sets
B5	1	DNV certification

B SCOPE OF SUPPLY

B.1 Switchboards and Power Management system

- B.1.1 1 off Main Switchboard 6600V type NX Plus C - SF₆-insulated - for marine application, is divided into two separate busbar sections, and consist of the following panels :
- 6 off Panels for generator control
 - 1 off EMPTY panel for FUTURE generator
 - 1 off Panels for bus-tie breaker
 - 4 off Panels for feeders to multi-drive 1 to 4 — 5200kVA each
 - 2 off Panels for feeders to Distr. Transformers — 1250 A Breakers
 - 2 off Spare Panels for future use
 - 2 off Spare Panels for future power export
 - 2 off Panels for feeders to earth transformers (transformers are included)
 - 2 off UPS for Main Switchboard

The switchboard is constructed for continues parallel operation between all six generators with the bustle breakers closed.

The switchboard and circuit breakers are designed for a sub transient short circuit value of max 31,5 kA and a peak value of max 80 kA.

The low-voltage compartments accommodate our standard marine solution for protection, control and monitoring equipment, including the SIPROTEC multifunction protection relay.

The degree of protection of the switchboard — IP 31

The switchboard will be delivered divided in transport sections. The necessary mehanical and electrical completion onboard to be done by the yard.

- B.1.2 1 off Power Management System (PMS)
Siemens Power Management System PMA300. The PMS will, for each of the four generator panels, perform normal generator control functions such as:
- load-dependent (and fault dependent) start and stop of generators
 - individual selection of standby sequence
 - automatic synchronising (separate synchroniser for each generator)
 - automatic synchronising of bustie breaker
 - automatic load shedding
 - handling of heavy consumers
 - power plant control with status and alarm presentation on the touch screen panel located in Main Switchboard or Machine Control Room
 - Profibus communication to IAS for indication Power Plant status and status and alarm presentation

As a standard Siemens recommend that the active load sharing are taken care of by an iso synchronous load sharing system type Woodward 723+ or similar. This part to be supplied by the diesel engine supplier.

B.1.3 1 off Generator Power Adaptation system (GPA)
GPA - Generator Power Adapter is a ultra fast control system preventing generators from being overloaded even during sudden load changes (i.e. generator breakdown). The GPA is measuring and detecting generator overload. As soon as overload is detected the GPA will via the RO HP Feed Pump frequency converters automatically reduce and limit pump speed keeping consumed power below available power. The GPA is a fast acting system that prevents any overload doing any harm to the network stability.

B.1.4 1 off Power Plant Protection System (P³)
The P3 system is a generator set supervision system that analyzes any abnormal system situation that can occur related to unacceptable and;
- Sudden uneven reactive load sharing (AVR failure)
- sudden uneven active load sharing (engine load sharing failure) - long term (more than 150-200 ms elapse time) uneven active load sharing (engine load sharing failure or drifting)
- over/under frequency
The main means of the P3 is to analyze the gensets as single sets and as common power station to;
- do a selective trip of the correct genset in situations related to above AVR problems
give alarm in special fault situations without tripping gensets

B.2 **Multidrive**

B.2.1 Parts for Bluedrive Multidrive Pump Control Frequency Converter
8 pcs. Inverter Module 1200kW – 6SL3325-1TG41-3AA0
5 pcs. Inverter Module 800Kw – 6SL3325-1TG38-1AA0
6 pcs. Inverter Module 560Kw-6SL3325-1TG35-8AA0
5 pcs. Inverter Module 315kW-6SL3325--TG33-3AA0
1 pcs. Inverter Module 200kW- 6SL3325-1TG32-2AA0
11 pcs. Inverter Module 90kW - 6SL3325-1TG38-1AA0

B.2.2 4 off Converter Transformer
5200 kVA, 3AC6600V/720V/720V, freshwater cooled AFWF, IP44, phase shift between the two pairs of transformers give a quasi-24-pulse network feedback max. 38 deg C inlet temperature, water leakage indication, insulation class F and utilized to F, 3 PT100 in each secondary winding, space heater 230V. Top cable entry for the 6.6 kV incoming cables and bottom cable exit for 690V cables to **Multidrives**.

B.3 **Distribution Transformers**

2 pcs. 6000/450V, 3,500kVA Distribution Transformers
2 pcs. 6600/450V, 3000kVA Distribution Transformers
2 pcs. 450/230V, 220kVA Distribution Transformers.

B.4**Documentation**

1 set of standard documentation for engineering and 4 sets of standard as-built documentation in English.

B.5**Classification**

DnV-certificates for item B1 is included. The equipment is based on 45°C ambient temperature and 38°C fresh water temperature. No additional tests or requirements for the equipment are included.

C. The following terms apply.**DELIVERY**

Unless otherwise stated, delivery of the equipment shall take place upon receipt of payment in full.

PRICES

Unless explicitly stated otherwise, the following applies to the prices:

All prices are based on:

FOB ex works European Port according to Incoterms 2000

Unloading, erection and installation as well as material (including cables, cabling glands i.e.) and equipment necessary in order to perform such work are not included in the price.

TERMS OF PAYMENT

The payment plan is to be agreed.