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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
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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 dm³
- 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
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)
Spring loaded overflow valve
1.2.3 Suction strainer (MDF)
Duempex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.

1.2.4 Separator unit (HFO) common
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
Electric motor driven screw pump with safety valve

1.2.6 Safety filter (HFO)
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
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)
Spring loaded overflow valve

1.3.3 Suction strainer (MDF)
Duplex filter with differential pressure indicator with alarm contact. The inserts can be exchanged with engine running.

1.3.4 Circulation pump
Electric motor driven screw pump with safety valve

1.3.5 Safety filter (HFO)
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
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
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
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)
Temperature control valve of Direct type.

1.7.2 Preheating unit
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
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)
Temperature control valve of Direct type.

1.8.2 Preheating unit
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
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
Turbocharger water cleaning device for turbocharger turbine side:
- Dosing unit
- 10 meter hose with quick couplings

1.9.2 Exhaust gas bellows
Flexible expansion bellows after turbocharger.
- Counter flanges, gaskets, bolts and nuts

1.9.3 Exhaust gas silencer, with spark arrestor
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
Conical transition piece after the exhaust gas bellows on the turbocharger.

1.10 Control and monitoring systems

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

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

1.12.3 Common base frame
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)

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)
Tools for the engine according to enclosed tools list T01887215.

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

1.15.2 Tarpaulin
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
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.

<table>
<thead>
<tr>
<th>Type</th>
<th>Media</th>
<th>Language</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>O &amp; M manual (Wärtsilä 8L32)</td>
<td>A4 binder</td>
<td>English</td>
<td>3</td>
</tr>
<tr>
<td>Spare parts catalogue (Wärtsilä 8L32)</td>
<td>A4 binder</td>
<td>English</td>
<td>3</td>
</tr>
</tbody>
</table>

### 1.17 Commissioning

#### 1.17.1 Start-up support

**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)

- 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
## Tools list

### Tools for 6 x Wärtsilä 8L32

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty/inst.</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tools for main bearings</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turning tool for main bearing shell</td>
<td>1</td>
<td>800004</td>
</tr>
<tr>
<td>Turning tool for thrust bearing shell</td>
<td>1</td>
<td>800005</td>
</tr>
<tr>
<td><strong>Tools for cylinder liner</strong></td>
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<td>Lifting tool for cylinder liner</td>
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<td>Honing equipment for cylinder liner</td>
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<td>Dismounting tool for anti polishing ring</td>
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<td><strong>Tools for piston</strong></td>
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<td>Lifting tool</td>
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<td>Piston rings pliers</td>
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<tr>
<td>Clamp device for piston rings</td>
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<td>Pliers for securing ring</td>
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<td>800002</td>
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<td>Screwing tap F-M12-6H</td>
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<tr>
<td><strong>Assembly tool for connecting rod</strong></td>
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<td>Locking device for connecting rod big end (only L-eng.)</td>
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<td>Mounting and dismounting tool for connecting rod</td>
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<td>Guiding plug for connecting rod (only L-eng.)</td>
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<td>Limiter for piston</td>
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<td><strong>Hydraulic tightening tools for connecting rod</strong></td>
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<td>Mounting device for M27x2 stud</td>
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<td>Pin for tightening of nuts M27x2</td>
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<td><strong>Assembly tool for intermediate gear</strong></td>
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<td>Extractor plate for intermediate gear bearing</td>
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<td><strong>Tools for cylinder head</strong></td>
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<tr>
<td>Presser for valve springs</td>
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<td>Turning tool for grinding of valves</td>
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## Spare parts list

### Spare parts for 6 x Wärtsilä 8L32

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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 ± 2.5% From no Load to rated full load
7) Voltage adjustment : ± 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 lubrication.

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
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<td>5 pcs. Inverter Module 800Kw – 6SL3325-1TG38-1AA0</td>
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<td>11 pcs. Inverter Module 90kW - 6SL3325-1TG38-1AA0</td>
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| B2.2  | 4    | Converter transformer, 5200kVA, three winding type, 12/Q24-pulse, fresh water cooled |

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<th><strong>Distribution Transformers</strong></th>
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<td>2 pcs. 6600/450V, 3,500kVA Distribution Transformers</td>
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<td>3 pcs. 6600/450V, 3000kVA Distribution Transformers</td>
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<td>2 pcs. 450/230V, 220kVA Distribution Transformers.</td>
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| **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 mechanical 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 bustle 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.