TECHNICAL SPECIFICATION DIESEL DRIVEN GENERATOR SET 1000 KVA/ 900 kWe

Application

Kind of set	Emergency Generator set
Operation kind	Continuous operation, variable load (constant speed)
Classification	according to DNV rules and requirements

NOTES: * **Important:** classification indication (automation definition and cross notation) to be checked by the client for faults and in-completions (see also "documentation and certificates")

Engine Specification

Engine	: MTU/DDC Series 2000
Type	: 16V 2000 P82L
Engine rated power	: 980 kW (continuous duty)
Rated speed	: 1800 rpm
Norm	: ISO 3046
Max. / min. intake temperature	: + 45°C / - 20°C (relative humidity 70% at 45°C)
Design	: 4-stroke
Number of cylinders	: 16 in V
Total cylinder displacement	: 32 litres
Bore x stroke	: 130 x 150 mm
Flywheel housing	: SAE 0 (18")

Basic Engine

Grey cast-iron crankcase
Flywheel housing SAE 0, 18"
Oil pan
Forged crankshaft
Forged connecting rods
Four-valve, separate cylinder heads
Light-metal solid-skirt pistons
Piston cooling via oil spray nozzle
Water cooled exhaust manifolds
Vibration damper
All necessary on-engine air, exhaust, coolant, fuel and oil pipe work

Starting System

Redundant system with one (1) **Electric starter** (24VDC /9 kW / 2-pole), and one (1) **air starter** (7~8 bar), with electrical solenoid (24 VDC). 2 sets of starter batteries, with DNV Type Approval, and 2 battery charger with DNV Type Approval.
Engine coolant preheater (protection IP55) with circulation pump, check valve, thermostat and safety valve,690 VAC, 3-phase, 60 Hz, 9 kWe.

Cooling System

External Radiator *) cooling system, with an E-motor driven fan (power drawn from genset approx. 40 kWe) (loose delivery) Radiator built on a separate base frame and arrange outside covered by shipyard. (E-motor voltage is 690 V as requested by end user)
Coolant circulation pump and coolant thermostat for jacket water and charge air cooling circuit
Flexible connections (flame prove hoses in accordance to DNV requirements)
Electric motor for the fan drive Ex type, protection IP56 (with certificate)

*)**NOTE:** Radiator with HT and LT compartment including expansion reservoir and an E-motor driven fan.
Conservation for use in offshore environment (salty air). The Radiator is executed with a preheating unit (protection IP56). The Radiator and Fan are built in accordance of the Class Society DNV rules and requirements.

Fuel System

Suitable for fuel in accordance with the MTU fluids and lubricants specification (A001061/35E) *)
) Note: To be checked by customer
Fuel viscosity min. 1,5 mm2/s to be supplied by the customer
Direct fuel injection system, with low and high pressure fuel pumps, fuel pressure accumulator, double walled high pressure fuel lines and electronically controlled injection.
Fuel main filter (duplex filter with diverter valve)
Special fuel pre-filter with water separator and water level sensor
Engine version for exhaust optimized operation (IM02; according GL approval no. 40307-12HH)
Flexible connections (flame prove hoses in accordance to DNV requirements)

Lube Oil System

Forced-feed lubrication system with piston cooling
Lube oil circulation pump with safety valve
Lube oil heat exchanger
Oil filter neck and oil dipstick for measurement on non-running engine
Closed crankcase venting system
Lube oil multi-stage filter, switchable, engine mounted
Hand pump for lube oil extraction with flexible hose connected to the engine (flame prove hoses in accordance to DNV requirements)

NOTE: This scope of supply complies with Solos splash protection for fuel and oil pipes connections.

Combustion Air system

Exhaust turbocharger water cooled
Intercooler
Dry-type air filter with contamination indicator.
Shut-down air flaps with electrical actuator, 24VDC (control by IAS system)

Exhaust System

Triple walled, liquid cooled, on-engine exhaust manifolds
2 exhaust elbows with compensators, stainless steel 316 (90 dgr. upwards) with companion flange (loose delivery) for resilient connection of the ship side exhaust system to both exhaust gas turbochargers. Exhaust connection: vertical outlet

Exhaust gas Y-type junction (loose delivery)
1 Exhaust gas silencer in SS 316L, 45 dB(A), with spark arrestor (loose delivery)
Gaskets shall supply for connection points as above mentioned .

Engine Control Unit (ECU)

Engine control unit (ECU) in metal housing, wired and engine-mounted, with plugs for connection to the Local Operating Panel (LOP), with the following functions/subassemblies:

- Advanced engine speed control based on speed demand signal and fuel and speed limitations according to engine status and operating conditions
- Data processing logic for analog and binary signals
- Interface for data transfer to CAN field bus for remote control and monitoring
- Interface RS 232 for connection to MTU dialog unit
- Electronic "Speed governor", make MTU, Type MDEC, Power supply 24 VDC by separate batteries and charger
- EMU - Engine Monitoring Unit (required for classification)
  Monitoring of individual cylinder temperature, redundant sensors for lube oil pressure, coolant temperature and engine speed
- The engine speed can be set via the binary inputs on the ECU (BE5 for "Speed Up" and BE6 for "Speed Down").
- Standard droop settings
  droop setting 1: 4% for parallel operation (synchronous mode)
  droop setting 2: 0% for stand-alone operation (isochronous mode)
- Coolant level sensor with cable (25m) (magnetic/inductive Bedia sensor) for installation in coolant expansion tank

Interface (Include in signed original TA)
Modbus / RS485 /1 converter Modbus 485 to Profibus DP (RS485 to be checked)
(Data coupling and visualisation on display of all information MTU governor system (MDEC)

Potentiometer supply by MTU .

SAM - Basic

- with extensive customer interface (e.g. warnings, alarms, operating signals and fault codes), redundant data storage, possibility for web server access, remote control and life data storage
- 2 connecting cables (25m each) with on-engine connector for connecting the ECU/ to the switchgear cabinet terminal block and the ECU power supply
- 2 Connecting cables for fuel pre-filter water level sensor length: 15m

Note : MTU supply an alarm list for the package .

Local Operator Panel (LOP)

Main equipment list LOP Description	Type	Manufacture
Cabinet - Control	800x800x350	Rittal
Control system PLC	Simatic S7-	Siemens
Operator Panel	300 TP700	Siemens
Engine interface	SAM	MTU
Relays	Various	Phoenix Contact
Lineup terminals	Various	Phoenix Contact

The LOP is designed for interface with engine control system, control of start/display engine/ generator information. Profibus serial interface is included for data communication between MTU system and customer system. Roxtec cable transit (MCT)

LOP data:

Cabinet type:	Rittal 800x800x350(HxWxD)
Cabinet colure:	Stainless steel
Cabinet IP rating:	IP54
Cable entry:	Bottom - Undrilled space for gland or MCT

LOP PLC

The PLC is of Siemens make and the type S7-300.
CPU type is S7-314.
The LOP is equipped with 32 digital input signals, 32 digital output signal and 8 Analog input signals. 16 DO signals is connected to interface relays with one change over contact.
In LOP door an operator panel is mounted with readings and status of available signals from engine and generator. Switches, pushbuttons and lamps is placed below operator panel for easy control and safe operation.

The following is included as HW functions:

- Local/Off/ Remote key switch
- Emergency stop push button

-Start button
-stop button

- Acknowledge shutdown pushbutton.
- Genset not available lamp.

main switch board send a speed signal when harbour mode.(sync by YCRO)

Connected to the PLC is the HMI witch is front door mounted. Through the HMI the operator will have full access to all available information. The HMI also contains control functions for non-essential function, and back-up control for Hardwired door mounted control functions.
The PLC is equipped with communication interface to the SAM unit for receiving information from Diesel engine status and alarms. Communication protocol used is RK512
All alarm, process values and shutdown signals for the engine is sent through this link.
However, all critical alarms and functions is also connected through hardwired signals.
Generator is interfaced by 5 PT100 sensors. 3 winding temp. and 2 bearing temp.
No electrical values is included.
No protection of the generator is included.

Anti-condensation heater 350W output, includes HW for supplying power to Anti-condensation heater including relay for On/ Off control and status.

Control System Data:

CPU:	1 x CPU314-2DP
Digital input:	1 x DI 32x24VDC
Digital output:	1 x DQ 32x24VDC/0,5A ST
Analog input:	1 x AI 8x0-4/20mA/PT100/PT1000
HMI:	Siemens TP700 (7" widescreen)

GENERATOR SPECIFICATION:

Make	: Newage Stamford self-regulating brushless generator
Type	: HCM634K2
Voltage control	: AVR MX 321 with manual back up control (manual adjustment included)
Classified power	: 900 kWe/1000 kVA, S1 type, (40 kW fan power is already taken in account)
Cos. Phi.	0,9
Voltage	: 690 VAC., 3 phase (690 V for E-motor driven fan)

Frequency	: 60 Hz
RPM	: 1800 rpm
Efficiency	: 95,8%
Isolation	: class H
Temperature rise 90°	: According class F
Protection	: IP 44 (on right side, seen from driven side)
SAE	: SAE 0 flange (18")
Built	: B20/B5 (double bearing)
Specification according	: VDE 0530 / IEC 34 / BS5000
Coolant type	: air

Included options:

- Anti-condensation heating element 230V 1-Ph, 350 W
- Stator Winding temperature detection by 2 (two) PT100, 2 per phase
- Bearing temperature detection by 1 PT100, 1 per bearing
- Droop transformer for parallel operation with other on board generator sets
- Cable entrance with MCT window including rubber elements (quantity and cable diameter to be advised by yard)
- 3 pieces of SPM measure connections 8mm, mounted above the bearings and on the side of the generator included mounted sensor type VIB6.127 from the company Moholt; in accordance to NORSOK Requirements (as discussed).

Assembly:

The double bearing generator will be connected to the engine by a SAE mounting flange ("monoblock" system) and a flex. coupling make Centa CM8000-SCA1 (shore hardness depending of the Torsion Vibration calculation)
The set will be resilient installed on a welded steel skid, The frame is ready for installation in the engine room. (single elastic system) The skid will be provided with lifting lugs (marked with SWL)
All rotating parts will be protected by steel guards.

Painting

The package will be painted in 2 component epoxy paint, Premium quality, in the by the customer required (industrial) RAL colour code. (RAL 5007 Brilliant Blue)

Engineering

Electrical diagrams, general arrangement drawings, in AutoCad, (main dimensions) and P&I D's, in AutoCad, will be provided after receipt of order.
Coding procedure to be according to SFI requirements according to owner, have to be advised. All documentation according MTU standard. (in accordance to Norsok Z-018)
Torsion vibration calculation and six degrees freedom calculation is included
Support to Yard for maximum two (2) interface meetings

Documentation and certificates

Instruction manual in 7 fold, (+3 CD) in the English language for:

- The engine (application installation)
- The generator
- Fluids and Lubricants A001061/35E

Parts- and tools manual in 7 fold in the English language for:

- The engine (3 CD)

Certificates in 1 fold (+ 5 hard copy):
Incl. Torsion vibration calculation report and 6 degrees freedom calculation
MTU-Benelux test certificate (local functional and performance test of the completed package)
Incl. certificate class DNV separate generator VDE 0530 / IEC 34
Incl. Certificate class DNV of the complete generator set
Incl. certificate class DNV separate Engine
Certificates, original stamped and signed by the surveyor in 1 original (+6 copy)

Generator Set MTU Benelux Acceptance Test

The package will be locally tested on the test bench at MTU Benelux, existing of a functional test and a performance test for generator set (at 25%, 50%, 75%, 100% and 110% output). The FAT will be carried out in presence of a DNV surveyor and owner. The FAT will be carried out with a power factor cos. phi = 1,0
This test is in accordance with our standard test procedure.

Special testing for noise and vibrations in accordance to NORSOK 5-002, will be carried out during the Factory Acceptance Test at MTU Benelux, the Netherlands.

Test Procedure Sound and Vibrations according Norsok S-002

A. Objectives of the Measurement

The objective is to determine the sound power level of the installation at maximum capacity and vibration levels at the base of the Unit. The average surface sound level at a distance of 1 meter has to be determined. This parameter has to be compared to the guaranteed level.
*Note: MTU to provide the yard an octave spectrum of the overall noise level (free field conditions)

B. Preconditions

B.1 General

The measurements will be carried out with an acoustic intensity sound meter in accordance with the standard ISO
9614-2. The sound meter has a traceable calibration certificate to IEC-61672 and 61260. The vibration analyzer to DIN- 45659 and ISO-5349.

B.2 Measurement uncertainty

It is expected that it is difficult to measure the exact noise level emitted by the installation itself. This is caused by the expected high noise level that is emitted by other noise sources.

The other uncertainties are:
According to ISO 9614-2, the uncertainty in the sound intensity measurements can vary from 1.5 up to 4 dB.
The measured noise level in the hall is different from a noise level in open space, the level is affected by the materials and the dimensions of the hall (reflections and absorption).
The uncertainties for the vibration measurements are 0.01 mm/s, the total uncertainties according to the ISO standards will be around 0.1 mm/s.

C Test day

C.1 The noise measurements will be carried out with an acoustic intensity sound meter in accordance with the
standard ISO 9614-2. The sound meter has a traceable calibration certificate.

C.2 The intensity meter is acoustically calibrated on location.

C.3 At first indicative measurements are made to define surfaces that are useful for the definite measurements.

C.4 On the floor of the hall the surfaces to be scanned are marked with tape or crayon.

C.5 The surfaces around the installation are scanned with the sound intensity probe in accordance with
ISO 9614-2. All surfaces are scanned twice; the two scanning paths are orthogonal.

C.6 During the measurements the field indicators are checked. If the field indicators are not in compliance with the
Standard ISO 9614-2 then a surface at another distance is chosen (in compliance with the standard).

C.7 The vibration measurements will be carried out on the same day as the sound intensity.

C.8 Calibration of the vibration analyzer will be done in the office of AV Consulting B.V.

C.9 The vibration measurements will be done on the base frame of the generator.

D. Calculation

The sound power level is calculated according to chapter 9 of ISO 9614-2. This calculation is carried out for the complete installation. The average surface noise level at a distance of 1 meter is compared to the guaranteed level. The vibration levels will be analyzed according to 150-2631 "Whole body combined" and 150-5349 "Hand/arm measurements".

E. Introduction of measurement uncertainties

The measured and calculated sound and vibration level is evaluated. If the level is strongly influenced by other installations or sources, a correction has to be made. An expert judgment is made to correct the calculated value.

F. Report Sound and Vibrations (5-002)

The Norsok data-sheets will be written in English. In the sheets the relevant issues are described. These issues are:

- Dimensions of the installation
- Measurement environment
- Instrumentation

- Measurement procedure

- Acoustical data, sound power levels in frequency bands
- Vibration data

Other
Cable glands to be suitable for yard armored cables (cable information to be supplied by yard)

Spare Parts
Commissioning spare parts and one year operation spare parts required by class and maker recommendation (Note : to be advised by Tognum Asia and MTU China).

Also required is a 3 years spare parts list (assuming approx.. 3000 operating hours per year).

Tools
Standard tools
(Note : to be advised by Tognum Asia and MTU China).

Additional:

Emergency sources of power shall be certified. In connection with the certification of the emergency sources of power

(generator with driving machinery), a prototype test shall be per- formed while it is heeling at least:

– 22.5 degrees combined with 10 degrees' trim for units of ship type.

This prototype test shall be pserformed with maximum load for at least 4 hours.

Certification for above mentioned shall be supplied by MTU.

NOTE:
COST IMPACT OF EURO 34,000 SHALL APPLY FOR PERFORMING INCLINATION TEST.

10/June/14