Engine Power Plant 5,2 MW
Stationary Dual Fuel (Diesel / Gas) Engine (12 VDS 48/42)

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1. General technical description

The engine power plant is a unit with gas and diesel fired engine of the type 12 VDS 48/42. The engine is directly connected with a self-starting, brushless three-phase alternator. The offer includes the complete power plant, consisting of the one dual fuel diesel / gas engine of the aforementioned type with the belonging alternators, the motor control boxes and speed control units, the foundation documents, spring elements, the specification of important parts, the nozzle heating modules, the elastic connecting elements between engines and pipe systems, engineering as well as deliveries of components concerning the lubricating oil system to be specified in detail.

The engine 12 VDS 48/42 AL works with diesel and gas.
The fuel oil used in diesel operation is light fuel or diesel oil. It is supplied to the engine from a storage tank by means of fuel oil system units.,
For reasons of operating safety, the engine unit have a own cooling system. The heat resulting from the cooling of the engine, jacket cooling water and charge air cooling 1st stage (intercooler), are carried away to the hot water system.
Moreover, the unit have its own lubricating oil system, with a pump supplying lubricating oil to the engine from a separate circulation tank.
The tank should be installed at a lower level nearby the engine. Filters for the cleaning of the oil should be installed between pump and engine. For treatment of the lubricating oil, separators should be used for each engine unit, which separate the lubricating oil in by-pass.

The emissions contained in the engine exhaust gas (pollutants and noise) must not be released uncontrolled to the environment. The pollutants, above all nitrogen oxides and carbon monoxide are therefore reduced in a SCR-catalyser with oxidation number.

Depending on the site, noise emissions have to be reduced to permissible values through an exhaust gas silencer and constructional project measures.
The exhaust gas is carried off through a chimney.

Compressed air (30 bar/10 bar) start the engine.

The total plant is controlled and regulated by a central process control technique which is in the scope of supply. The control system includes the engine protection and alternator protection. In case of emergency stop, the fuel supply to the engines will be cut off and the alternator switch will be opened.

The maximum output depends on the conditions on site. All data of engine and alternator referred to are based on standard conditions.

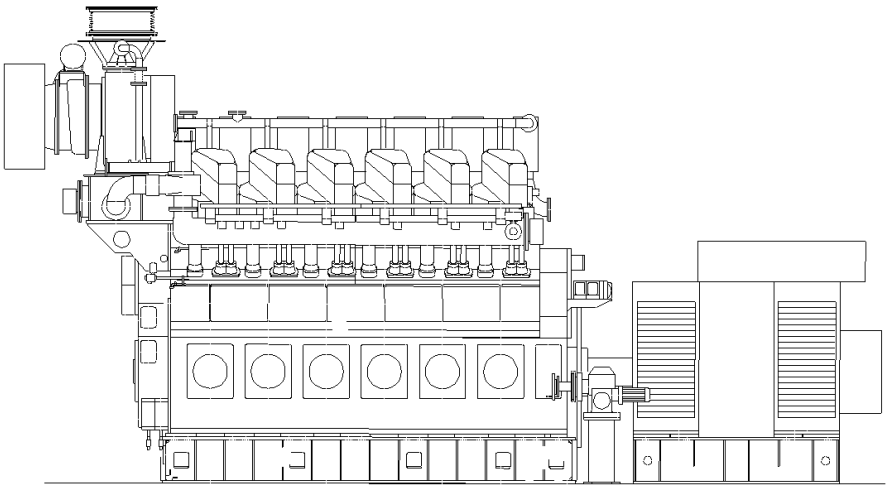
2. Description of the scope of supply of the MBH Engine-Generator Set

MBH Engine-Generator Sets

consisting of a MBH Engine 12 VDS 48/42 and a synchronous alternator.

Length:	**8.5 m**
Height:	**5.5 m**
Height with concrete block:	**8.0 m**
Width:	**4.0 m**

Engine and alternator coupled directly. Both, engine and alternator will be mounted with separate base frames on the top of a concrete block.



MBH Engine 12 VDS 48/42

2.1 **1** **engine**

12-cylinder, 4-stroke-system, V-engine, with direct fuel injection, exhaust gas turbo charger and 2-stage charge air cooling, equipped for operation with gas and oil.

Maximum nominal output:	**5300 kW**	
Nominal speed:		**500 1/min const.**
Cylinder bore:		**420 mm**
Piston stroke:		**480 mm**
Configuration:.....		**V-type engine**
Piston capacity:		**66,5 litre per cylinder**
Mean effective pressure:		**15,9 bar**
Mean piston speed:	**8 m/s**	
Weight:		**ca. 90 t**

2.2 Alternator

1 Synchronous Alternator

Apparent output:	**6400 kVA**
Effective output:	**5120 kW**
Power factor:	**cos phi = 0,8**
Frequency:	**50 Hz**
Voltage:	**10,5 kV**

2.3 Description of systems

2.3.1 Foundation work

The foundation consists of the static foundation (sub-foundation), the elastically bedded vibrating foundation, the foundation base frame – separate for engine and alternator - spring elements and fasteners. The engine/alternator set is screwed up on the vibrating foundation. In order to avoid the spreading of impact sound, the vibrating foundation is elastically bedded on spring elements. Dynamic forces are not passed on to the sub-foundation.

2.3.2 Lubricating oil system

The lubricating oil system supplies lubricating oil to the engine and passes the heat of the engine contained in the oil on to the cooling water system.
It is required to use lubricating oil of the SAE class 40 with a maximum operating temperature of about 70°C behind the engine and a working pressure of about 4,5 bar before the engine. The lubricating oil pressure and temperature are being monitored.
The lubrication oil system of the engine is a circuit from the lubricating oil circulation tank over lubricating oil pump, lubricating oil cooler, lubricating oil automatic filter and indicating filter to the engine and back to the lubricating oil circulation tank.
The operation is monitored through motor-acted control. Monitored values are temperature (max) and pressure (min).
The lubricating oil is cleaned in the main circuit by means of the automatic filter and the indicator filter and in the bypass flow in a special circuit by means of the separator. The plant is designed with a separator for each engine/alternator set.
The residues resulting from the separation are collected in the lubricating oil sludge tank of the separator and pumped into the sludge tank of the fuel oil system.
From the joint lubricating oil tank and pump unit, lubricating oil is transported to the respective lubricating oil circulation tanks and to the internal cylinder lubrication systems of the engine.

2.3.3 Cooling water system

The cooling water system of the engine plant takes care of the carrying off of heat from the 2nd stage of the charge air cooler (intercooler) and of the lubrication oil system.
The secondary cooling water system is a closed circuit from the circulation pump over the heat exchanger to the air cooler and back to the pump.
The operation is monitored by motor control.
Monitored values are temperature and pressure.
The secondary cooling water system consists of the components circulation pump, dry coolers, cooling water service tank with refill/pressure maintaining pump and membrane expansion tank.

2.3.4 Charge air and exhaust gas system

The exhaust gas and charge air system of the engine serves to supply the engine with

charge air and to carry off exhaust gases of the engine.
Through direct engine suction from the power house, the charge air passes a silencer of the exhaust gas turbo charger. As alternative and when required by the local conditions, the charge air can be fetched through a filter, a silencer and a suction line from outside the power house.

The heat of compression resulting from the process of compression of the intake air in the exhaust gas turbo charger is carried off to the cooling water system by means of a charge air cooler (intercooler). The operation is monitored
by motor control. Monitored value is the temperature (max). This value is indicated through motor control.
The exhaust gas system consists of the pipes, the pipework equipment, silencer, exhaust gas cleaning system, exhaust gas boiler, chimney and various fixing devices.

2.3.5 Compressed air system

The compressed air system supplies the engine and the components of the plant with the necessary control and working air.
Two compressors fill two compressed-air bottles of 1000l each and with a working pressure of 30 bar. The compressed air with 30 bar is used as starting air for the diesel engines. In a second system, compressed air is reduced to 10 bar which serves to the control and monitoring systems of engine and plant components.
Compressors and compressed-air bottles are integrated in one system unit for both engine plant.

2.3.6 Ventilation system

The ventilation of the power house has to be designed in a way that the necessary charge air for the engines as well as the dissipation of the radiant heat from the particular units and system components guarantee a safe engine operation.

2.3.7 Measurement and control system of the engine alternator set

The engine control boxes, speed control (Heinzmann) as well as the cabling of the engine control boxes – Heinzmann controller belongs to the scope of supply .
Moreover, for the total plant, there have to be dimensioned and specified:

- **fire alarm system**
- **low voltage main distribution**
- **grounding and equipotent bonding**
- **For motor control:**
  - **all necessary control boxes and systems to operate the motor control (control, monitoring, 400V-drive distribution, etc.)**
  - **SPS**
  - **software for the monitoring and control of all engine systems**
  - **emergency shutdown circuit motive power unit**
  - **engine control (start, stop, charge, discharge, modification of operational mode) and monitoring**
  - **lubricating oil system, jacket cooling water system, fuel oil system, charge air and exhaust gas system, hot and secondary cooling water system with air cooler**
  - **protection and automatic synchronisation of the alternator**
  - **monitoring of the bearing temperature**
  - **monitoring of the winding temperature**
  - **differential protection**

- monitoring stator earth
- monitoring overload (graduated)
- monitoring short circuit (graduated)
- directional circuit breaking
- monitoring of voltage (+/-)
- monitoring of frequency (+/-)
- monitoring of short interruption
- processing of the signals from the exciting unit
- measurement, display, counting of the electric values

- hardware locking circuit for engine protection
- 24V USV unit for engine plant
- 24V – supply for the motor control unit with charging set and battery unit
- general control
all necessary switch boxes and systems to operate the general system (control, monitoring, 400V drive distribution, 24V-distribution etc.)
- SPS
- software for monitoring and control of the following systems

- medium voltage unit
- low voltage distribution
- 24V USV-unit
- compressed air system with compressors
- emergency shutdown for the engine unit
- separator unit
- tank unit, fuel oil system units

2.3.8 Medium voltage unit 10,5 kV

Consisting of:

- alternator feeding field
- cable outlet field
- cable outlet field to the existing unit
- cabling

3. Consumption figures per engine

Natural Gas:	**230 cubic meter/MW +/- 10 %**
Lubricating oil:	**approx. 400 t/a**

4. Technical marginal conditions

4.1 Ambient conditions

4.1.1 Design data

air intake temperature (power house, min.)	**10 °C**
air intake temperature (power house, max.)	**40 °C**
Relative humidity, normal	**70 %**
installation altitude	**< 500 m above M.S.L.**
Dust concentration in the air	**< 10 mg/m³**

4.2 Process materials

4.2.1 Electrical Power

Network	**AC**
	3-phase (3PNE)

Voltage	**230/400V +/-2%**
Frequency	**50 Hz**

4.2.2 Medium voltage

Type	**3-conductors**
Frequency	**50 Hz**
Voltage	**10,5 KV**

4.2.3 Fuel

4.2.3.1 Gas or diesel fuel oil

Net calorific value Hu	**42 700**	**kJ/kg**
Viscosity 40°C ca.	**2 – 6**	**cSt**
Density 15°C ca.	**0,81 – 0,85**	**g/ml**
Flash point (according to Pensky-Martens)	**>60**	**°C**
Pour point	**-9**	**°C**
Sediment	**< 0,30**	**% w/w**
Water	**< 0,20**	**% w/w**
Sulphur	**< 1,0**	**% w/w**
Ash	**< 0,01**	**% w/w**
Cetane number	**> 45**	
Specification	**DIN 51601 DIN 51603**	

4.2.4 Lubricating oil

The specification of the lubricating oil has to be specifically selected for the prevailing engine operating conditions.
The quality and type of the lubricating oil to be used are subject to prior approval by MBH.

Viscosity class			**SAE 40**	
Viscosity	**40°C**	**ca.**	**145**	**cSt**
	100°C	**ca.**	**14.5**	**cSt**
Density at	**15°C**	**ca.**	**890**	**kg/m³**
Flash point			**> 220**	**°C**
Pour point			**- 15**	**°C**
TBN diesel oil			**10 - 20**	**mg KOH/g**
Ash (as sulphatees)			**< 0.75**	**% w/w**
Ash (as oxides)			**< 0.02**	**% w/w**

Possible suppliers:

Shell	**Argina 40**
Esso	**Exmar 40**
Texaco	**Taro 40**
Mobil	**Mobilgard**
Fina	**Stellano**
Castrol	**TLX**

<u>Water quality</u>
according to the special prescriptions of the tank manufacturer

4.2.5 Fresh water

Fresh water is required for producing internal cooling water, for turbine washing, in the separator etc.

Limits:

PH (25°C)	**6,5 – 7,5**	
Conductivity 25°C	**< 1000**	**µS/m**
Total hardness (Ca^{2+} , Mg^{2+})	**< 20**	**°dH**
Silicate (as SiO2)	**< 15**	**mg/l**
Chloride Cl-	**< 50**	**mg/l**
Sulphate ($SO4^{2-}$)	**< 50**	**mg/l**
Fe	**< 0.02**	**mg/l**
Appearance	**clear, colourless, free from un-dissolved matter**	

4.2.6 Cooling water / jacket cooling water

The cooling water and jacket cooling water have to be treated according to the below requirements.

The cooling water system forms a closed circle together with the jacket cooling water system.
This cooling circuit must be treated with the corrosion preventive CWT Diesel/QC2.
Before using a different corrosion preventive, it is necessary to consult the engine manufacturer.
Only those reagents may be used, which prevent corrosion and cavitations during the operation and stop period of the plant and which do not act upon material and seals in the cooling system.

Water quality

Water type :	**fresh water, free from solid foreign substances**	
Total hardness :	**max. 8**	**°dH**
Permanent hardness:	**max. 3**	**°dH**
pH – value of the untreated water at 20°C	**7 – 8**	
pH – value of the water in the cooling circuit at 20°C	**8 – 9**	
level of chlorides and sulphates	**max. 50**	**mg/dm³**
level of cilicic acid	**max. 30**	**mg/dm³**

5. Documentation

The following documents in German or English language are part of this plant documentation:

- **installation drawing engine**
- **Specifications of operating material and possible components (MBH scope of supply)**
- **key plans and flow chart (proposal)**
- **foundation documents**