169 MW WARTSILA POWER PLANT

SCOPE OF SUPPLY / SYSTEM DESCRIPTION

CIVIL

Buildings and civil structures that are feasible to dismantle.

MECHANICAL

All equipments, auxiliary units and modules.

ELECTRIC & CONTROL

All equipments, panels and cabling (feasible to dismantle). High voltage system is out of the scope.

GENSET EQUIPMENTS

The generating set consists of an engine and a generator, mounted on a common base frame. The base frame is flexibly mounted on the foundation using steel spring elements. A flexible coupling connects the engine and the generator.

The engine is a four-stroke diesel engine with direct fuel injection equipped with turbochargers and intercoolers. A small part of the auxiliary equipment, including the lubricating oil circulation system and the engine-driven cooling water pumps, is built on the engine.

The engine drives a synchronous three-phase generator.

The air-cooled generator has a shaft-mounted cooling fan and air filters. The generator is also equipped with an anticondensation heater. The excitation of the generator is controlled by an automatic voltage regulator, installed in the control cabinet of the generating set.

ENGINE-SPECIFIC MODULES

The engine-specific auxiliary equipment is mainly mounted on compact modules with connections to the common auxiliary units. The modules are connected directly to the engine or to other engine-specific modules.

Engine auxiliary module

The engine auxiliary module handles the flow of lubricating oil, cooling water and compressed air to and from the engine. Also the fuel lines go through the module. The module includes the necessary piping, valves and instrumentation.

The preheating unit and the temperature control valves of the cooling water system are located in the module.

Mixed cooling appendix

The appendix for mixed cooling is a pipe assembly connected to the cooling water circuits of the engine auxiliary module. In the appendix, the high temperature and low-temperature cooling water circuits are mixed. Depending on the temperatures in the water circuits, the water is directed to the cooling radiators or back to the engine.

Compact booster unit

The compact booster unit contains the complete fuel circulation system. The unit provides the engine with fuel and collects the return fuel for recirculation. It also collects leak fuel from the engine.

The compact booster unit includes piping, tanks, pumps, filters, valves and instrumentation. The lubricating oil separator is also mounted on the module.

The fuel pipes in the unit are equipped with steam trace heating.

Exhaust gas module

The exhaust gas module contains charge air and exhaust gas piping. The charge air silencers are located in the module.

The module includes an oil mist coalesces for the crankcase ventilation gas. An expansion vessel of the cooling water system is also mounted on the module.

BLACK START UNIT

To enable startup of the power plant when all engines are stopped and the grid is not energized, the plant includes a black start unit. The black start unit is a small generating set used to provide power for the auxiliaries needed when starting one of the main engines.

In addition to the engine and the generator, the black start unit contains the necessary auxiliary equipment, such as pumps and filters for fuel, lubricating oil and cooling water. The unit is cooled by a radiator with an engine-driven fan. A fuel tank is integrated in the unit.

The black start unit is equipped with an electric starting motor and a charging dynamo.

FUEL TREATMENT SYSTEM

Before the heavy fuel oil enters the day tank, it is treated in a separator unit, where impurities and water are removed.

The separator unit includes three separators, each of which is equipped with a feed pump and a heater. The electrically driven feed pump operates at constant flow. Together with an automatically operated three-way valve, the heater ensures that the oil entering the separator is at the correct temperature. The impurities removed from the oil are collected to a sludge tank in the separator unit. The sludge tank is emptied by an air-driven pump.

The separator unit has connections for compressed air and operating water. A control unit monitors and controls the operation of the separation system.

COMPRESSED AIR SYSTEM

Compressed air is used for starting the engine. The operation of pneumatic valves and air-driven pumps also requires a reliable supply of compressed air.

The compressed air system includes two subsystems with separate compressor units. The high-pressure air needed for starting the engine is provided by the starting air units, while the instrument air units supply air at lower pressure to pneumatically operated devices on the engine and in the auxiliary systems. The starting air units are connected to the instrument air system through pressure reducing lines. This enables the starting air units to be used as backup for the instrument air compressors.

Air vessels for storage of compressed air are installed in both the starting air system and the instrument air system. The engine is started by letting compressed air directly into the cylinders. The compressor units and the air vessels are shared by the engines in the power plant.

COOLING WATER SYSTEM

The cooling system of the engine uses chemically treated fresh water. The system is divided into a low-temperature (LT) and a high-temperature (HT) cooling water circuit. The cooling water is circulated in the system by directly driven centrifugal pumps mounted on the engine.

The LT cooling water circuit removes heat from the charge air and the lubricating oil. The HT water cools the engine jacket.

The temperature in the LT and HT circuits is controlled by three-way valves. The temperature control valves direct the water to the cooling radiators or back to the engine, depending on the temperature of the water.

An expansion vessel is installed in the system. The expansion vessel is connected to the cooling water circuits on the engine by vent pipes.

The cooling water circuits include equipment for monitoring the pressure and temperature in the system.

CHARGE AIR SYSTEM

The charge air system supplies the engine with clean combustion air.

The charge air to the engine is taken from outside the power house. The air passes through the filter and silencer units into the turbochargers installed on the engine. Before entering the charge air receiver of the engine, the compressed charge air flows through the charge air coolers, where it is cooled in two stages by water from the cooling water system of the engine.

EXHAUST GAS SYSTEM

The exhaust gas system leads the exhaust gases out of the power house and reduces the noise.

After leaving the turbochargers, the exhaust gases from the engine flow through an exhaust gas boiler for recovering heat. The exhaust gases enter the stack by way of a stack-integrated silencer.

STEAM GENERATION SYSTEM

Steam is produced in the power plant by recovering heat from the exhaust gas of the engines. The steam is used for heating purposes in the power plant.

A feed water pump unit transfers water from the feed water tank to the exhaust gas boilers where water is evaporated. A feed water control unit regulates the flow of water to the boiler. A bypass damper system working according to the pressure in the boiler controls the capacity of the boiler.

From the exhaust gas boiler the saturated steam flows to a steam header. From the steam header the steam is led to the consumers in the power plant. Part of the steam is led to the feed water tank, where it is used for heating the water.

In addition to the exhaust gas boilers, the system includes an auxiliary boiler that may be used for steam production in startup situations and as backup. When used as backup for the exhaust gas boilers, the auxiliary boiler is automatically started if the steam production of the exhaust gas boilers does not cover the steam demand. The exhaust gas boilers and the auxiliary boiler are supplied by the same feed water pump unit.

CONTROL SYSTEM

The control system of the power plant includes a central control panel for control of the generating sets and a number of local control panels for control of auxiliary equipment.

The control panel includes a double frequency meter, a double voltage meter, a synchronoscope and a synchronizing control unit that are used when synchronizing breakers in manual mode. The control cabinet also contains an automatic synchronizer.

The positions of the circuit breakers in the power distribution system are indicated in the mimic diagram on the front panel of the control cabinet. The switches in the mimic diagram allow the operator to open or close breakers and select breakers for synchronization.

A power plant shutdown can be initiated with an emergency stop button on the control panel. Pushing the button causes an immediate shutdown of all engines in the power plant.

Local control panels

The auxiliary units in the power plant are mainly operated from local control panels. Part of the engine-specific auxiliaries are controlled from the control panel in the engine auxiliary module. Common auxiliary units are mainly controlled from control panels mounted close to the equipment.

The control panel in the engine auxiliary module is used for controlling part of the engine-specific auxiliaries, including equipment installed on the generating set and in other locations outside the module.

The electrical system of the power plant uses high voltage (HV), medium voltage (MV) and low voltage (LV).

In addition, there are supporting systems with restricted distribution for specific use, for instance the DC power supply to the PLC system.

High voltage

The HV system of the power plant is connected to the regional HV grid. The system extends from the step-up transformers to the grid connection.

HV is not within the scope of this proposal.

Medium voltage

The medium voltage switchgear distributes the power supplied by the generators. Each generator is connected to the MV system through a circuit breaker.

The MV switchgear is of air-insulated type, and it consists of a number of cubicles that are bolted together and connected to the MV busbar. The switchgear includes cubicles for the generator and transformer connections, outgoing feeders and busbar measurements.

Station service transformers for supplying power to low voltage system are connected to the MV switchgear.

Generator cubicle

The medium voltage switchgear includes a generator cubicle for each generator. The generator supplies power to the busbar through a connection in the generator cubicle.

The generator cubicle contains the generator breaker and equipment for measurement and protection.

Auxiliary transformer cubicle

The auxiliary transformer cubicle provides a connection from the MV busbar to the station service transformer. The MV system supplies power to the LV system through the transformer.

The auxiliary transformer cubicle contains a circuit breaker, current transformers for measurement and protection, and an earthing switch. In addition, the cubicle includes equipment for monitoring the power and the current, as well as relays for overcurrent and earth fault protection.

Outgoing feeder cubicle

The outgoing feeder cubicle provides a connection for feeding the power generated to the receiving network.

The outgoing feeder cubicle contains a circuit breaker, current and voltage transformers for measurement and protection, a cable transformer for earth fault protection, an earthing switch and lightning arresters. The cubicle also includes protection relays, and meters for monitoring the power, current and voltage.