Combined Heat and Power Plant - 53 MW

- Gas turbine **LM6000 PB DLE, 40 MW**
- Steam turbine **Siemens ENK 40/56-3, 13 MW**
- Generator **Brush 10.5 kV**

The combined cycle plant consists of a gas turbine, waste heat recovery boiler, steam turbine and a generator mounted in a single shaft configuration.

The capacity of the installation (without steam delivery) is 53 MW (ISO conditions).

The efficiency (without steam delivery) is 48.3% (ISO conditions).

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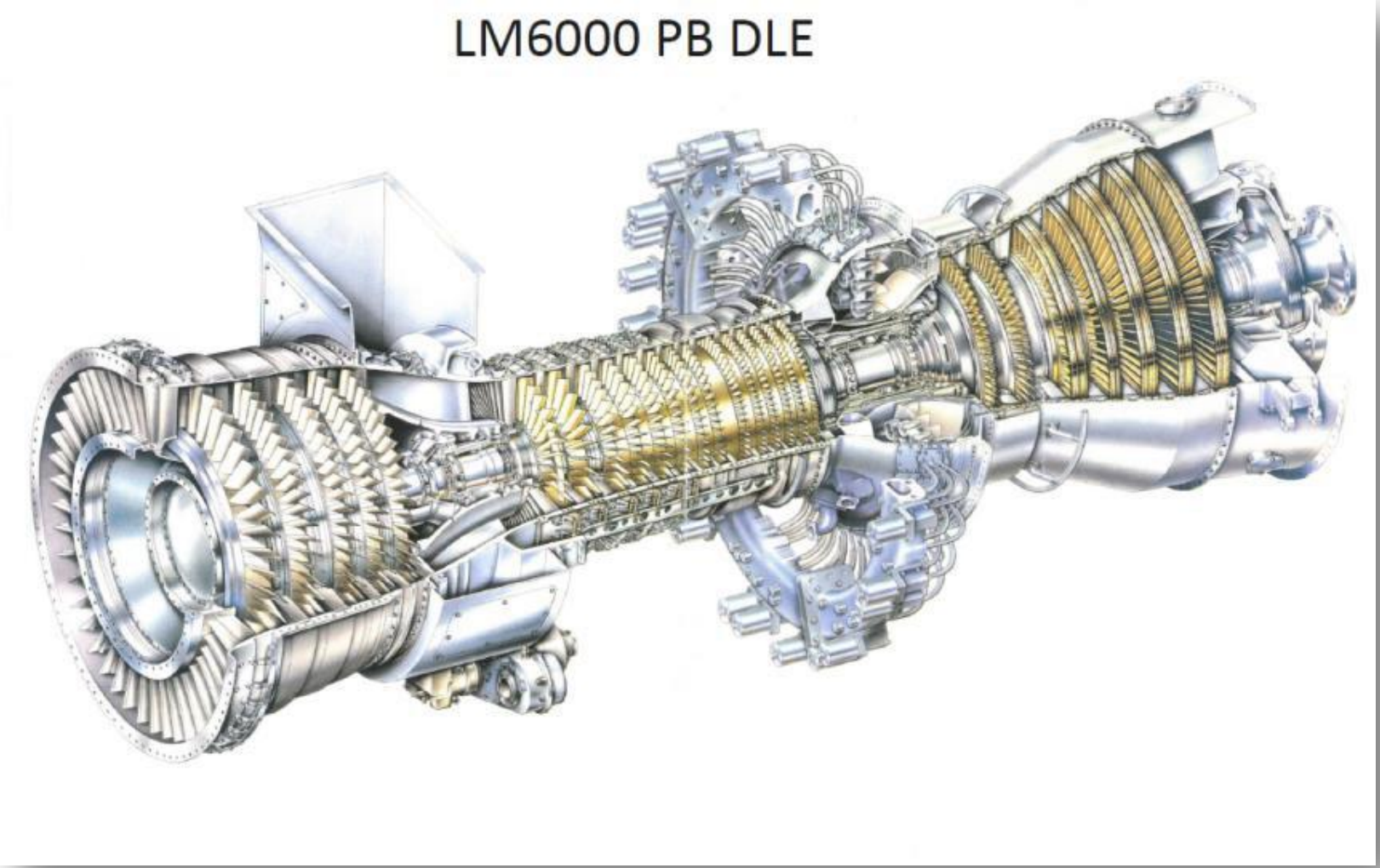
- Gas turbine M6000 PB DLE, 40 MW
- Steam turbine Siemens ENK 40/56-3, 13 MW
- Generator Brush 10.5 Kv
- Running hours 74 170 hours
- Starts 3 356 starts
- Steam turbine 75 832 hours
- Last overhaul GT 54 019 (major overhaul)

- Coming overhaul GT 79 019 hours (Hot Gas path)
- Coming overhaul GT 104 019 hours (major overhaul)

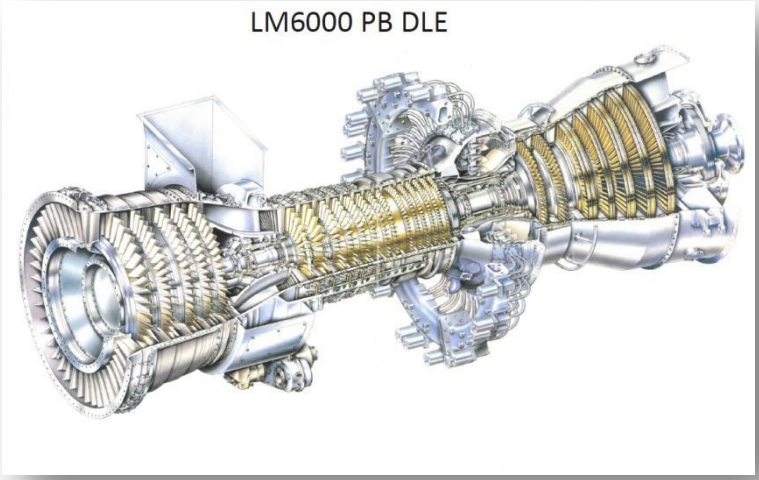
Gas Turbine



Gas Turbine

Main parts of the installation - Gas Turbine

- The prime mover of the installation is an aero derivative General Electric LM6000-PB-DLE.
- The GT is equipped with a Dry Low Emission combustion chamber which guarantees NOx emissions of 32 gr/GJ and CO2 emissions of 1,6 kg/h.
- The rated power of the GT is 40 MWe at an efficiency of 40%.
- The GT is equipped with a hydraulic starter make Hagglunds Drives.
- The GT has its own lubricating oil system. The GT is via a gearbox direct coupled to the generator.



Gas Turbine	General Electric
Type	LM6000 PB DLE
Serial number	190-204
Capacity	40 MW

Steam Turbine

Main parts of the installation - Steam Turbine

- The Steam Turbine is a SIEMENS ENK40/53-3, with a capacity of 13 MWe.
- The HP steam is led to the HP steam turbine. Via regulating valves the steam at the outlet of the HP turbine is mixed with the LP steam. The outlet steam has a pressure of 0.1 bar and is carried off the condenser.
- The Steam Turbine has two drains for the delivery of the heat. The HP drain has a pressure of 13 bar at 210°C. The maximum mass flow of the HP drain is 15 ton/h (4,2 kg/s). The LP drain, which is between the HP and the LP turbine has a pressure of 4 bar and a temperature of 149°C. The maximum mass flow of the LP drain is 50 ton/h (13,9 kg/s).
- The ST has its own lubricating and hydraulic system.
- The ST is coupled to the generator via a gearbox and a SSS clutch.

Steam Turbine	SIEMENS
Type	Extraction condensing turbine
Speed	7135 rpm
Capacity	12,3 MW
Extraction pressure 1	13 barg
Extraction temp 1	210 oC
Extraction pressure 2	3 barg
Extraction temp 2	160 oC

Generator

Main parts of the installation - Generator

- Make Brush
- Type Synchronous
- Speed 3000 rpm
- Voltage 10,5 kV
- Capacity 63,5 MVA
- The generator is equipped with a separate exciter

Exciter:

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Main parts of the installation

Air Cooled condenser

- Exhaust steam from the Steam Turbine goes to the air cooled condenser (make: GEA), mounted on the roof of the auxiliary boiler house. To create vacuum, the condenser is equipped with a hogging ejector. To hold the vacuum there is a redundant two stage holding ejector available.

Generator

- The generator mounted between the Gas Turbine and the Steam Turbine, is a 2 pole (3000 rpm) synchronous Brush generator, type BDAX8-355PRH. This air-cooled generator has a capacity of 64MVA at 10.5kV. The generator is equipped with its own lubricating oil system.

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Balance of the plant

The balance of the installation consists of all what is needed to keep the installation running.

Feedwater

- The feedwater is de-aerated in a feedwater tank. From there the water goes via a heat exchanger to the redundant LP and HP feedwater pumps. These pumps transport the water to the LP and HP economizers of the boiler.

Demi-installation

- The installed demi-installation is an ion exchanger installation, make Envitec. The installation consists of: a kathion ion exchanger, anion ion exchanger, mixed bed ion exchanger, intermediate and storage tanks, acid and caustic storage tanks and a neutralization tank. The ion exchangers are redundant, which means that the production of the demi-water continues when the other ion exchanger is regenerated. The capacity of the demi-installation is 60 ton/h continuous.

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Water quality

- The water quality supervision is concentrated on one rack in the water room. All necessary measurements are carried. The results of the measurements are presented in the DCS.

Closed cooling water

- For the cooling of the divers systems of the installation an internal closed cooling water system is installed. This system consists of a circulation system filled with 50% glycol and 50% demi-water. The cooling of the system takes place in the air coolers mounted next to the air-cooled condenser. Cooling water is used to cool the lubricating oil, the generator, the water quality, etc.

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Air compressors

- For the production of working air and instrument air two Atlas Copco air compressors are installed.

Fire detection and extinguishing

The fire detection installation is delivered by Siemens and covers the entire installation. Fire extinguishing is divided in two systems: inert gas and Micro-drop. The inert gas installation is used for:

- GT package
- Step-up transformer
- MCC room
- Auxiliary transformer room
- Control equipment room
- Operator room

The micro-drop extinguishing is driven by a special fire extinguishing pump in the demi-water room and is used for:

- Lub oil steam turbine
- Steam turbine
- Generator
- Lub oil generator
- Lub oil gas turbine

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Electrical installation

- The generator produces electricity at 10,5 kV. For own use two dry transformers are installed, one 10,5kV/400V and another 10,5kV/690V.
- In case of emergency (loss of grid connection) the installation is equipped with 110V = batteries for the emergency lub-oil pumps and 24V = batteries for the DCS.

Process automation

DCS

- The overall automation system for the installation is a Siemens TXP (T2000). This system holds the superior logic and all controls, alarms and trips for the complete installation. The separate automation systems (gas turbine, steam turbine) are controlled via T2000 system. Also all criteria in the separate automation systems (including events and alarms) are collected in the T2000.

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Overview

Gasturbine			
Make			General Electric
Type			LM6000-PB-NGD
Serial number			190-204
Fuel			Low caloric gas
NOx surpression			DLE comb. Chamber
Number of burners			90
Nominal fuel	m3n/h		12 000
Nominal capicity GT	Mwe		40.0
Efficiency GT	%		40.0
Gasgenerator			
Compressor end pressure	bar		29
Compressor end temperature	°C		500
Combustion temperature	°C		1 200
Stages HP	st		2
Powerturbine			
Stages LP	st		5
Inlet temperature	°C		1 180
Outlet temperature	°C		450
Mass flow	kg/s		127
Generator			Brush
Generator type			Synchroon
Number of poles			2
Capicity	MVA		64
Generator tension	kV		11
Type number			BDAX8-355PRH
Serial number			6199,A-16

Emissions			
NOx	gr/GJ		32.0
CO2	Ton/h		20.6
CO	kg/h		1.6

Steamturbine		
Make		Siemens
Type		ENK 40/56-3
Serial number		8 479
Speed	rpm	7 135
Nominal capicity	MWe	13.0
HP turbine		
Mass flow steam (no heat)	kg/s	13
Pressure	bar	61
Temperature	°C	445
LP turbine		
Mass flow steam (no heat)	kg/s	4.2
Pressure	bar	4.1
Temperature	°C	170
Exhaust		
Mass flow steam (no heat)	kg/s	17.4
Pressure	bar	-0.9
Temperature	°C	45
Discharge 1		
Pressure	bar	13.0
Temperature	°C	210.0
Mass flow (max)	kg/s	4.2
Discharge 2		
Pressure	bar	4.0
Temperature	°C	149
Mass flow (max)	kg/s	13.9
Rate heat /electricity	Ton/MWe	5.8
Condensor		
Type		Finned pipes (A frame)
Make		GEA
Cool medium		Air
Temperature coolmedium in	°C	15
Temperature coolmedium out	°C	25
Mass flow cool medium	kg/s	2 950
Nominaal cooling capicity	MW	35.2

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Weights and dimensio1

	Weight (ton)	Length (m)	Width (m)	Height (m)
Generator	137.50	10.70	3.60	4.70
Stator	71.10	5.80	3.60	3.10
Rotor (incl. Exciter rotor)	21.40	7.80	0.95	0.95
Exciter	1.90	0.75	1.20	1.20
Heat excanger (dry)	6.30	6.80	3.50	1.90
Bedplate	23.50	10.70	3.60	0.90
Bedplate incl. Stator, rotor, exciter and gear	134.00	10.70	3.60	3.20
Gasturbine				
Gasturbine	8.00	4.90	2.15	2.00
Package		9.05	4.20	4.40
Gear	13.00	2.80	1.55	1.80
Steamturbine				
Steam turbine (transport)	38.00	Appr. 6.00	Appr. 3.60	Appr. 4.50
Steamturbine rotor	3.15	Appr. 3.00	Appr. 1.00	Appr. 1.00
Bedplate	Appr. 25.00	Appr. 8.00	Appr. 3.60	Appr. 1.00
Gear	5.20	Appr. 3.00	Appr. 2.50	Appr. 2.00
Boiler				
Block 1 (HP superheater and HP evaporator)	Appr. 77.00	10.50	3.30	2.80
Block 2 (HP economiser 2, LP superheater and LP evaporator)	Appr. 94.00	10.50	3.30	3.40
Block 3 (HP economiser 1 and LP economiser)	Appr. 59.00	10.50	4.00	1.75
HP steamdrum	14.25	4.55	2.40	2.40
LP steamdrum	5.70	4.75	2.40	2.40
Feedwatertank	Appr. 9.50	7.80	3.00	3.00

CHP plant Total installed capacity 53 MW

CONDITION OF THE EQUIPMENT:

The unit during the lifecycle has received maintenance as advised/prescribed by the Original Equipment Manufacturer (OEM).

All inspections were performed by own maintenance crew assisted by a permanent site advisor of the Original Equipment Manufacturer (OEM).