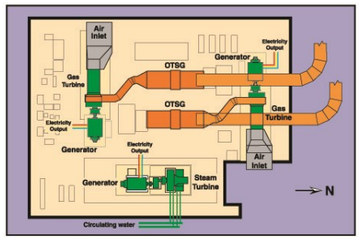
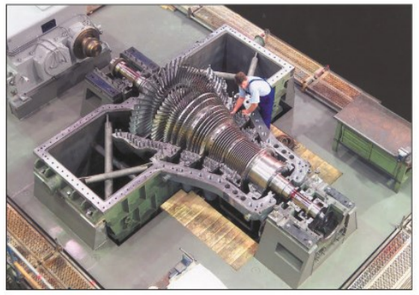
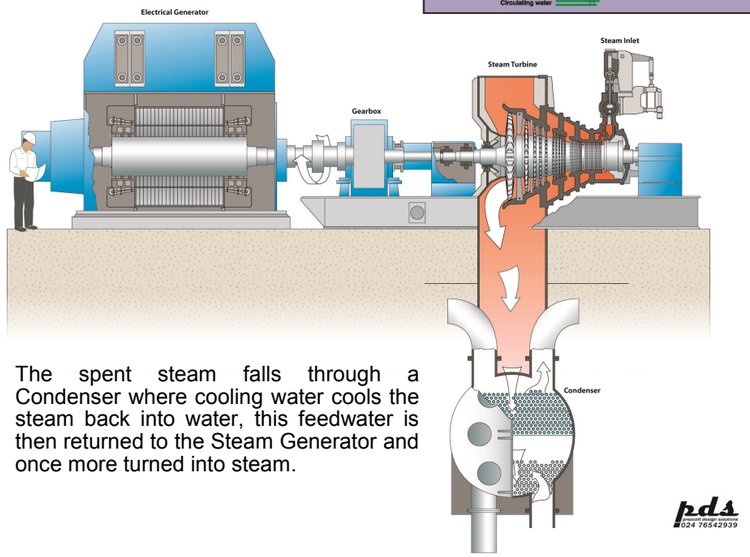
The Steam Turbine Generator

Manufactured by MAN Turbomaschinen AG, the steam turbine generator comprises of two combined assemblies operating at high and low pressures. Superheated steam produced in the “Once Through Steam Generator” (OTSG) is piped at high velocity to the turbines and strikes rows of blades causing the shaft to rotate (4818 rpm). This drive shaft is connected via a gearbox to the electrical generator adding a further 23MW to the overall power station output.







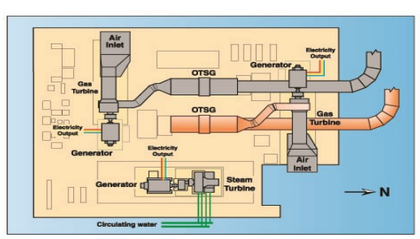
The spent steam falls through a Condenser where cooling water cools the steam back into water, this feedwater is then returned to the Steam Generator and once more turned into steam.

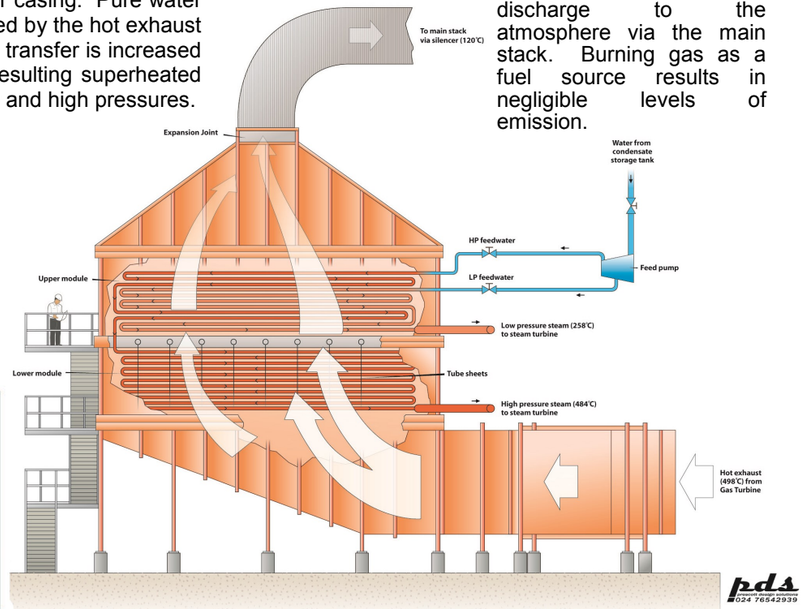
The Once Through Steam Generator

Manufactured by *Innovative Steam Technologies* the Once Through Steam Generator (Boiler) consists of rows of tubing arranged horizontally within the boiler outer casing. Pure water pumped down through these tubes is heated by the hot exhaust gas ducted from the Gas Turbine, the heat transfer is increased by “finning” attached to the tubes. The resulting superheated steam is piped to the Steam Turbine at low and high pressures.

The spent exhaust gas, now much reduced in temperature passes through a silencer before discharge to the atmosphere via the main stack. Burning gas as a fuel source results in negligible levels of emission.

This compact and efficient “once through” design enables the preheating, evaporation and superheating circuits to occur in one unit, unlike other boiler systems which require separate steam drums, water and blow-down systems.





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manxutilities
bun shirveishyn vannin

Welcome to Pulrose Power Station

Pulrose Power Station

An 84MW aero derivative combined cycle power plant

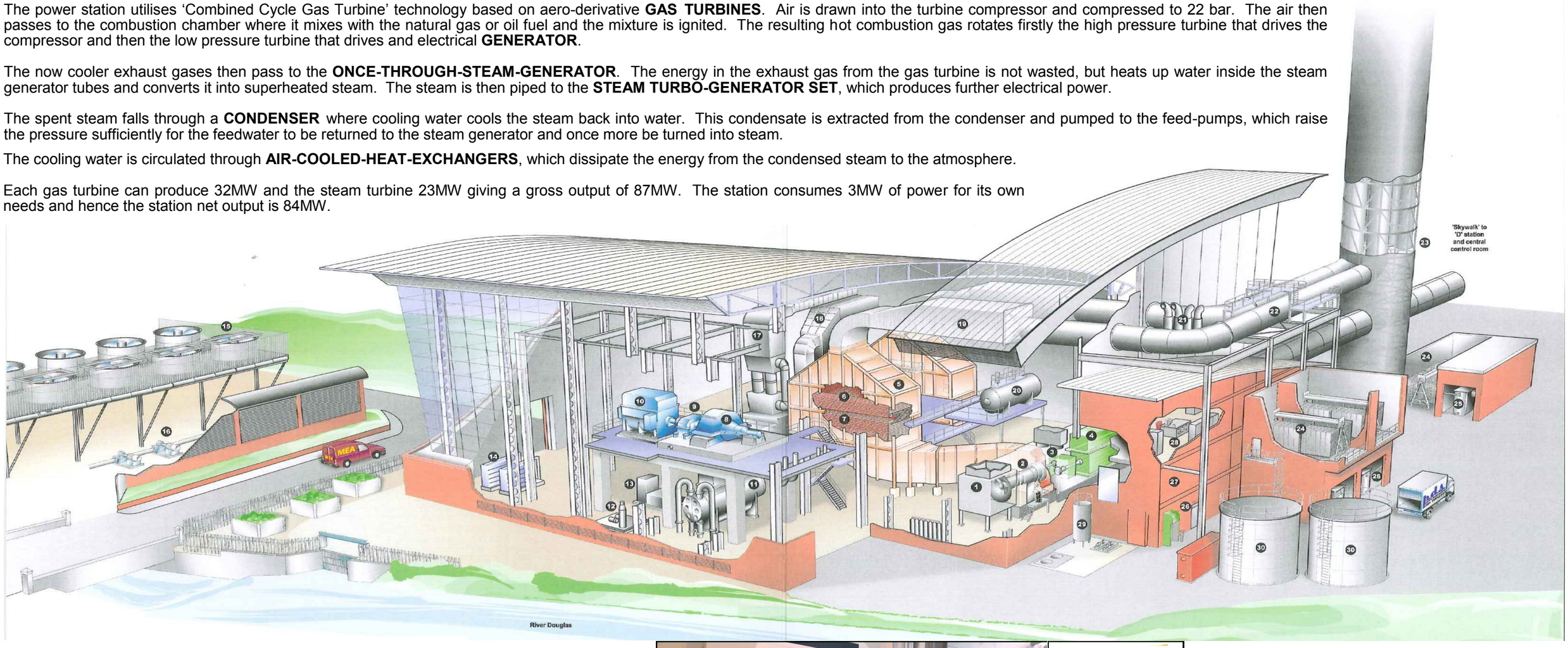
The power station utilises ‘Combined Cycle Gas Turbine’ technology based on aero-derivative **GAS TURBINES**. Air is drawn into the turbine compressor and compressed to 22 bar. The air then passes to the combustion chamber where it mixes with the natural gas or oil fuel and the mixture is ignited. The resulting hot combustion gas rotates firstly the high pressure turbine that drives the compressor and then the low pressure turbine that drives and electrical **GENERATOR**.

The now cooler exhaust gases then pass to the **ONCE-THROUGH-STEAM-GENERATOR**. The energy in the exhaust gas from the gas turbine is not wasted, but heats up water inside the steam generator tubes and converts it into superheated steam. The steam is then piped to the **STEAM TURBO-GENERATOR SET**, which produces further electrical power.

The spent steam falls through a **CONDENSER** where cooling water cools the steam back into water. This condensate is extracted from the condenser and pumped to the feed-pumps, which raise the pressure sufficiently for the feedwater to be returned to the steam generator and once more be turned into steam.

The cooling water is circulated through **AIR-COOLED-HEAT-EXCHANGERS**, which dissipate the energy from the condensed steam to the atmosphere.

Each gas turbine can produce 32MW and the steam turbine 23MW giving a gross output of 87MW. The station consumes 3MW of power for its own needs and hence the station net output is 84MW.



Operating Parameters

GAS TURBINE

Fuel:	Natural Gas/Light Oil
Output:	32 MW
Heat Rate:	9734 kJ/KWh
Power Turbine Speed:	6100 rpm
NOx:	61 ppm
Pressure ratio:	23.1
Air flow rate:	86.4 kg/s
Compressor Outlet Temp:	487 °C
Turbine Inlet Temp:	852 °C
Exh Mass flow:	89.1 kg/s
Turbine Exhaust Temp:	498 °C
Exhaust Specific Heat:	1.1626 kJ/kgK
NOx Suppression Water:	5.96 tonne/hr
Generator Efficiency:	98.24%

OTSG

Exhaust Mass Flow:	89.1 kg/s
Turbine Exhaust Temp:	498 °C
HP Steam flow:	9.58 kg/s
HP Steam Temp:	484 °C
HP Operating Pressure:	56.81 bar
HP pinch:	16 °C
IP Steam Flow:	2.25 kg/s
IP Steam Temp:	258 °C
IP Operating Pressure:	6.89 bar
IP pinch:	21 °C
Stack Exhaust Temp:	120 °C

STEAM TURBINE with 2 x GT’s @100%

Generator Output:	23MW
HP Stop Valve Pressure:	56.8 bar
HP Stop Valve Temp:	484 °C
HP Stop Valve Flow:	19.06 kg/s
LP Stop Valve Pressure:	6.89 bar
LP Stop Valve Temp:	258 °C
LP Stop Valve Pressure:	4.4 kg/s
Pressure after last blade:	0.06 bar a
Enthalpy after last blade:	2,286 kJ/kgK
Wetness:	11.7%

CONDENSER

Exhaust Steam Pressure:	60 mbar a
Exhaust Steam Flow:	84.43 tonne/hr
Condensate Outlet Temp:	36°C
Condenser heat load:	50,700 kJ/s
Cooling-water Inlet Temp:	19 °C

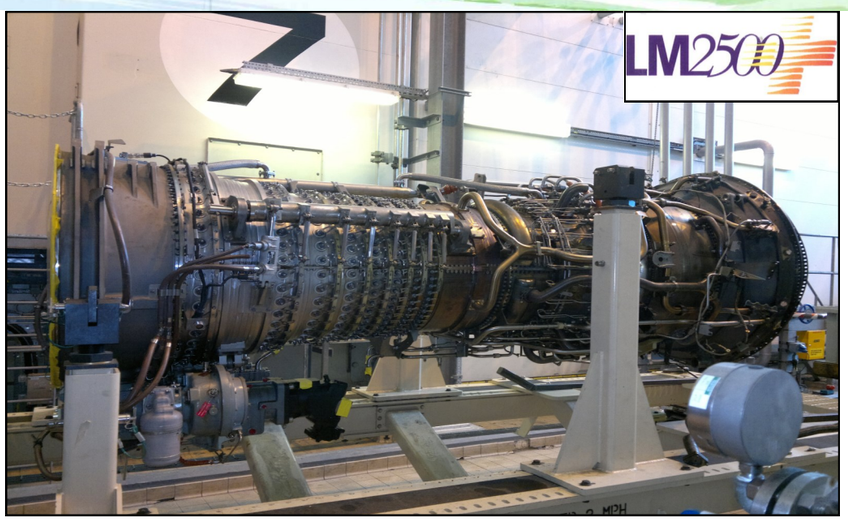
CCGT

Total Output:	87 MW
Parasitic Load:	3 MW
Nett Output:	84 MW
Heatrate:	7340 kJ/kWh
Efficiency:	49%

GAS TURBINES
GE LM2500+ PV—MDW
General Electric Company
Land & Marine
2500—Engine family
PV—type code Gas Turbine with HSPT
MDW—Marinised;Duel-Fuel;Water;
NOx suppression

STEAM TURBINE
MAN Turbomaschinnen AG (MAN Turbo)
Type: DK080/250RZ1
Output: 23020 kW
Speed: 4818 rpm
Stages: 1;12;7;5;5

ELECTRICAL MACHINERY
GT Alternators: 41.250 MVA
> ABB type AMS-1250-LK
ST Alternator: 31.625 MVA
> LDW (Loyd dynamowerke) S5E11 20 M66-42P
Unit Transformer: Alstom
Switchgear: Siemens 8DA10
> 1250A rating: 25kA; upto 36kV



Key to Annotations

1	Air inlet	18	Air inlet
2	Gas turbine	19	Silencers
3	Gearbox	20	Condensate storage tank
4	Generator	21	Stem vents
5	“Once through” steam generator (OTSG)	22	OTSG exhaust ducts
6	Upper module	23	Multi-flue stack
7	Lower module	24	Radiators
8	Steam turbine	25	Transformers
9	Gearbox	26	Water treatment plant room
10	Generator	27	CCGT equipment room
11	Condenser	28	Control room
12	Vacuum system	29	RW break tank
13	Lub oil module	30	Raw water/firewater tank
14	Close circuit coolers	31	Distillate oil storage tanks
15	Air-cooled heat exchanger (ACHE)	32	Firewater storage tanks
16	Cooling water pumps	33	33kV switch house
17	GT enclosure vent exhaust duct and anti-icing	34	415V substation