BEOWAWE DOUBLE FLASH CYCLE GEOTHERMAL POWER PLANT

THE FIRST LARGE-CAPACITY MODULE TURBINE

MITSUBISHI HEAVY INDUSTRIES, LTD.

Nevada's First Flash Cycle Geothermal Plant

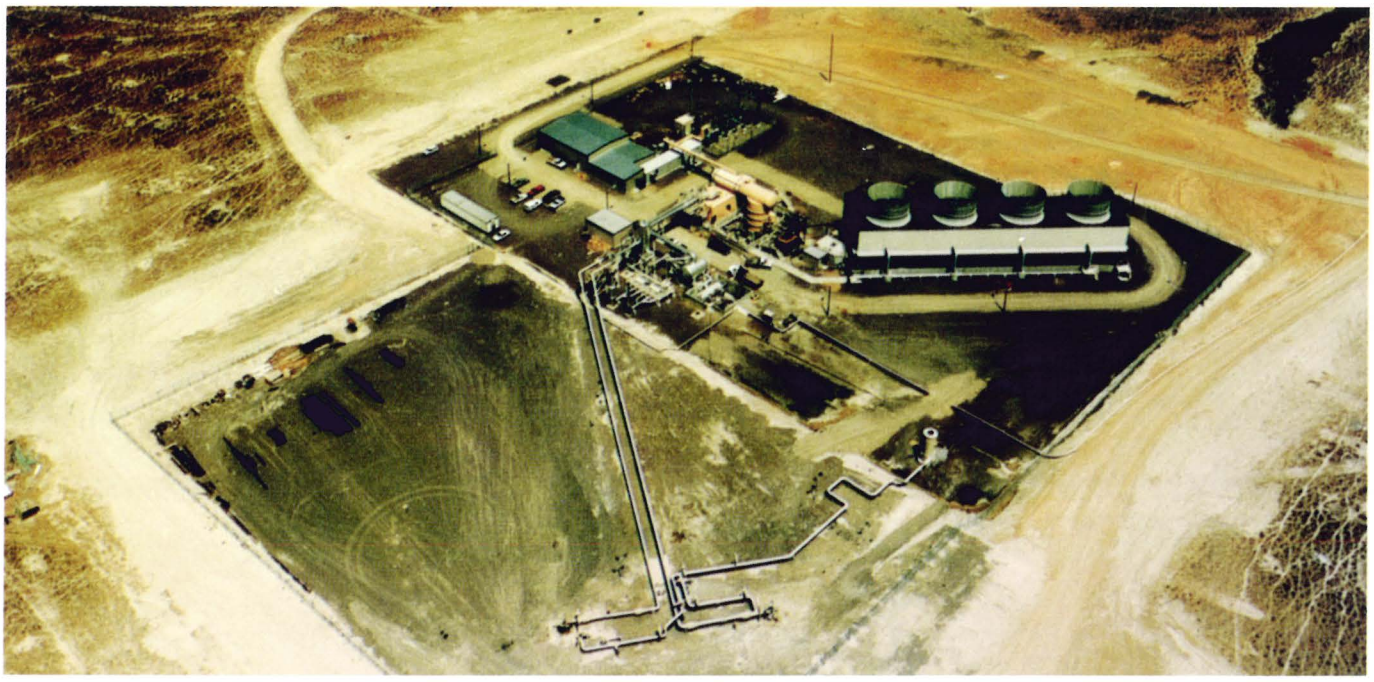
Mitsubishi completed the Beowawe 17MW double flash cycle geothermal power plant in Nevada in December 1985 and the plant has been operating successfully since that time.

The entire power plant including system engineering was designed by Mitsubishi which also manufactured and supplied all equipment, except the cooling tower. This full turnkey arrangement enabled drastic reductions in the engineering phase and realized the extremely short construction period of only 13 months.

Chevron is supplying 570T/H brine flow at 220℃ from two production wells and the generated power is sold to the Southern California Edison Co.

FEATURES

- *Adoption of large-capacity skid-mounted turbine module*
- *Adoption of high condenser vacuum*



Outline of System

Since the geothermal fluid at the Beowawe site is low temperature brine including very small amounts of noncondensible gas, the double flash cycle combined with the very high vacuum condenser was adopted to achieve higher efficiency and greater economical improvement.

Geothermal brine is initially led to the cyclone separator installed in the power station. Here the steam is separated and admitted to the turbine as high pressure steam through the demister in which the steam purity is further improved.

The discharged hot water from the separator is led to the flasher where low pressure steam is effectively flashed. The low pressure steam is then admitted to the intermediate stage of the turbine as mixed steam.

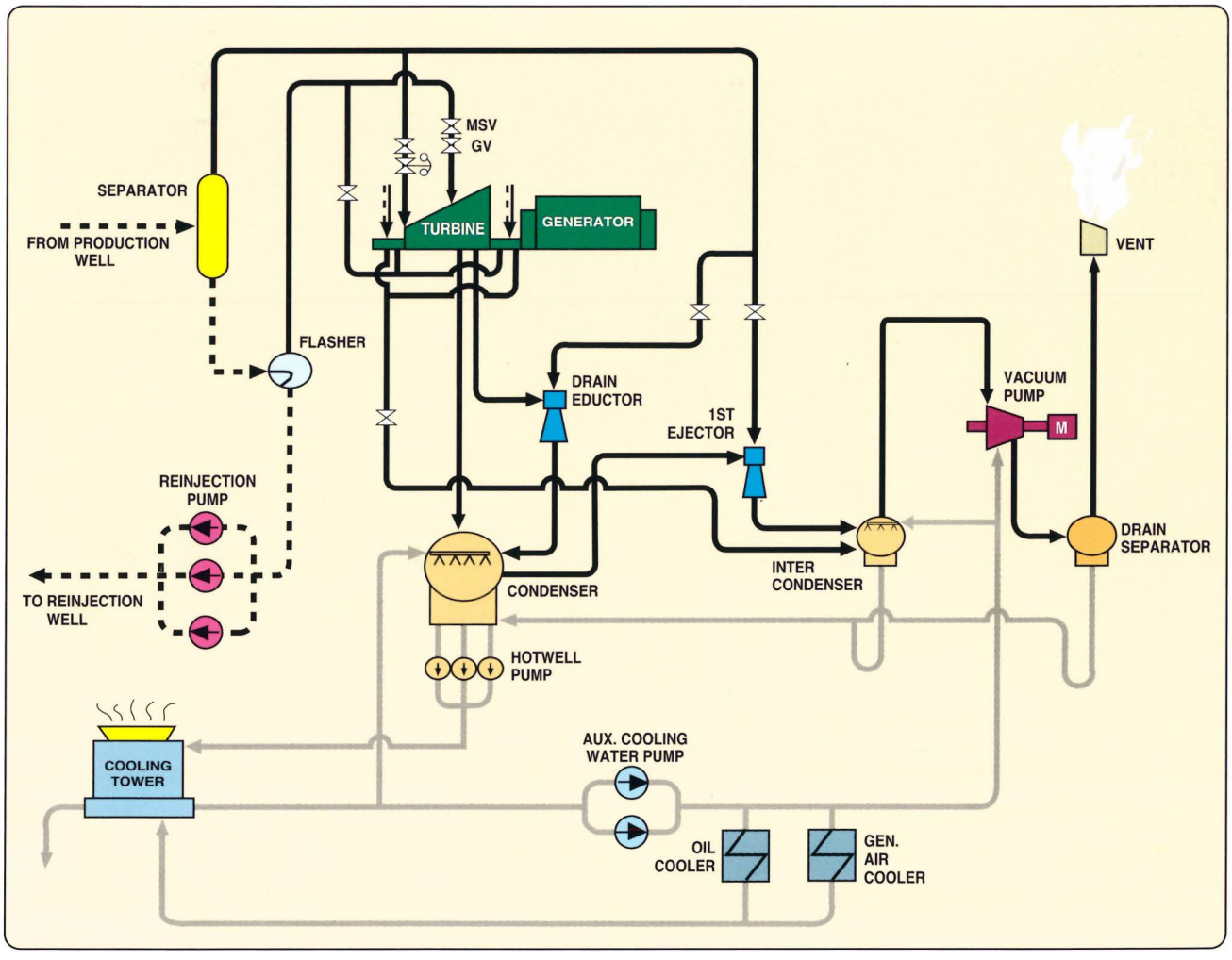
Exhaust steam from the turbine is condensated in the direct contact type condenser installed beside the turbine.

Cooling water and condensate in the condenser hotwell is discharged and transmitted to the cooling tower by the hotwell pumps.

Cooling water is cooled again in the cooling tower and collected in the basin. This water is induced into the condenser without pumps.

Noncondensible gas in the condenser is extracted by the gas extraction system and exhausted through the fan stack of the cooling tower.

Chemical dosing is carried out continuously to neutralize the cooling water system.

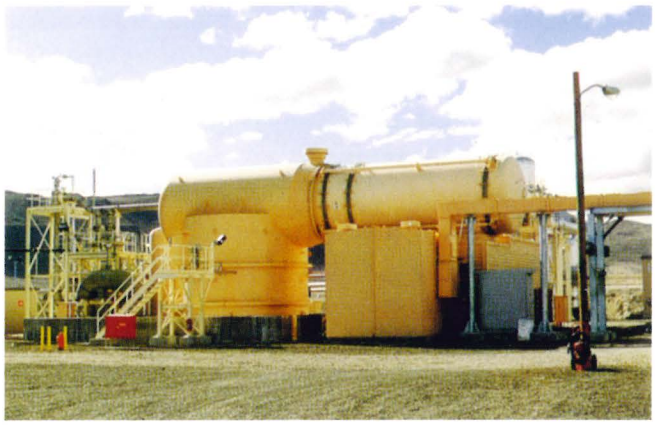


MODULAR-25 Steam Turbine

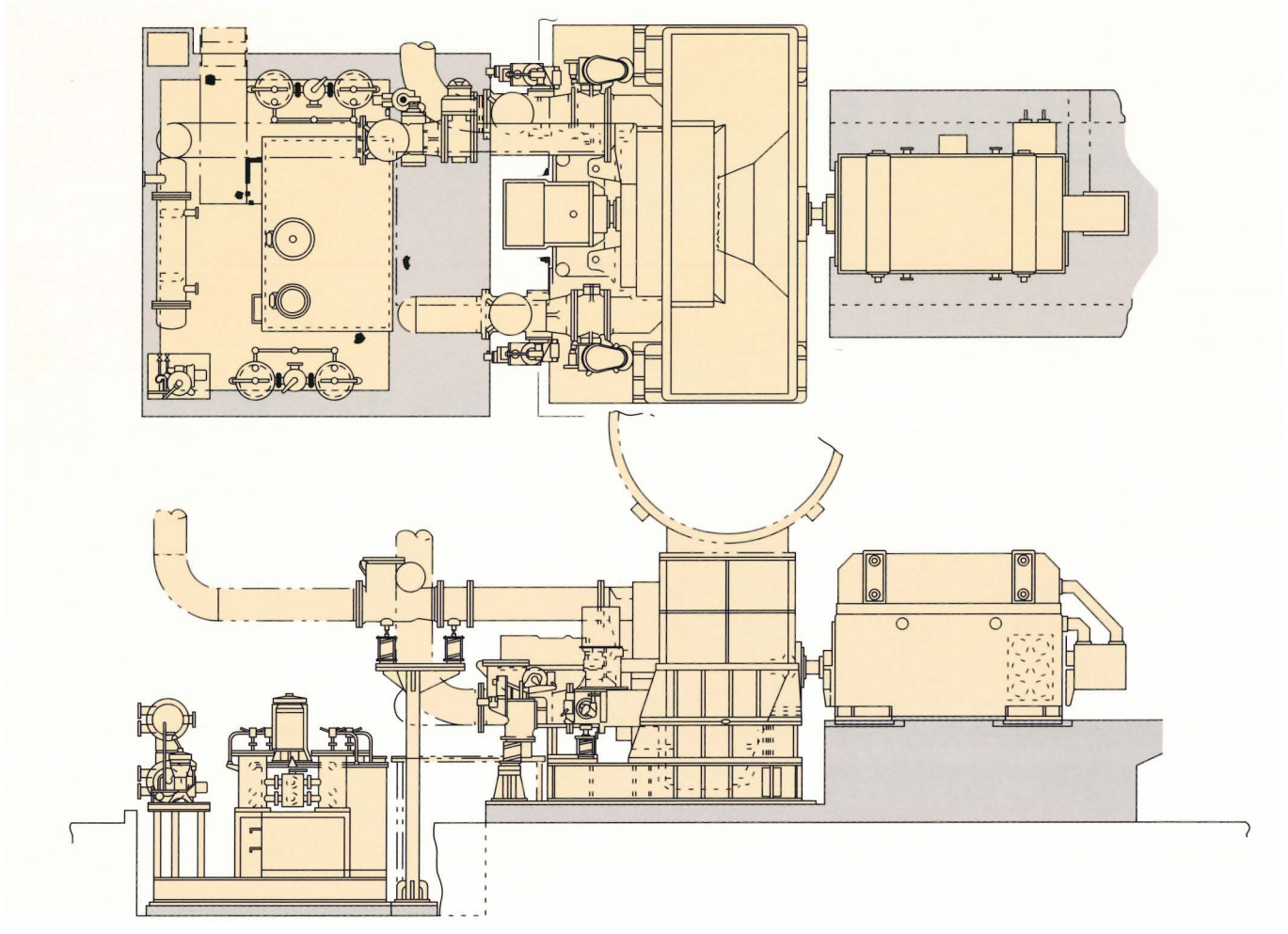
The steam turbine is a top exhaust skid-mounted type called MODULAR-25 and uses 25-inch last blades.

The oil unit is also designed as a skid-mounted package.

The turbine module and oil unit were completely shop assembled and were delivered as separate unit.



Type	Double pressure, impulse-reaction, single flow condensing portable turbine	
Rated Output	16,660 kW	
Speed	3,600 rpm	
Steam Condition	Pressure 4.3/0.95 kg/cm^2 abs.	Temperature 146/99℃
Exhaust Pressure	0.045 kg/cm^2 abs. (1.3 in Hg abs.)	



Steam Gathering Equipment

A separator, flasher and demister constitute the steam gathering system. Since steam purity affects reliability of the power plant, the demister was adopted in addition to the separator and flasher.

Waste brine from the flasher is collected in the brine surge tank and injected into the reinjection well by pumps.

Condenser

The condenser consists of a jet spray main condensing vessel and three-stage tray gas cooling vessel.

Exhaust steam from the turbine is led into the condenser through a crossover pipe.

Type	Direct contact jet spray type
Design Vacuum	0.43 kg/cm^2 (1.25 in Hg abs.)
Cooling Water	Temperature 16 ℃
	Quantity 5,300 m^3/hr

Hotwell Pump

Three sets of 50% capacity hotwell pumps are installed in the lower level pit beside the condenser.

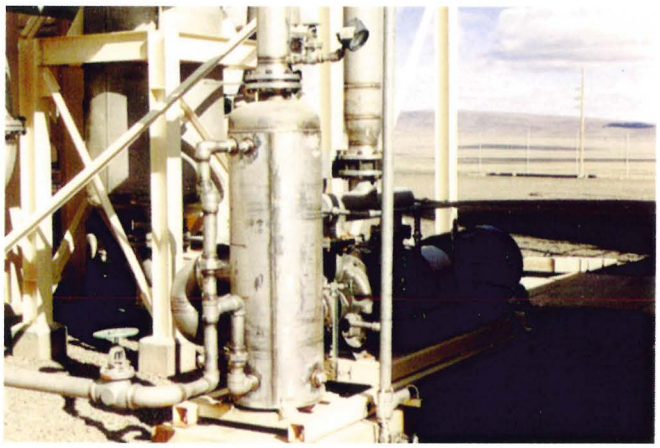
Two sets are usually operated while one set is reserved for standby.

Type	Vertical canned type
Capacity	2,900 m^3/hr
Delivery Water Head	30 m
Speed	900 rpm

Gas Extractor

The 100% capacity combined system of the first stage steam ejector and the second stage vacuum pump operate under very high vacuum conditions.

Suction Pressure	0.04 kg/cm^2 abs.
Suction Temperature	26 ℃
Capacity	1,340 kg/hr
Gas	570 kg/hr
Steam	770 kg/hr



The original three-stage gas ejector system is changed to standby.

Cooling Tower

The cooling tower is counterflow mechanical draft type.

Number of Cells	4
Hot Water Flow	5,500 m^3/hr
Design Temperature	Inlet water 28 ℃
	Outlet water 16.1 ℃
	Wet bulb 12.2 ℃

Plant Control Module and Electrical Package House

The plant control module and the electrical package house are installed adjacent to one another.

All testing and assembling of equipment and wiring cables were factory completed prior to shipping.

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THE FIRST LARGE CAPACITY MODULE TURBINE

Oil Unit Module

Turbine Module

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