3,000 kW SUGINOI HOTEL GEOTHERMAL POWER PLANT

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INTRODUCTION

The Suginoi Hotel is located, 200 m above sea level, in Beppu City, which is one of the largest hot spring resort area in Japan. In this hotel, there are some unique hot spring baths, which are interesting to visitors. In Beppu, there are numerous hot springs, some are call "Jigoku" (Hells). The main attraction in Beppu are the hell-like spots created by hot springs such as the Torando Hell, which erupt to a height of more than 50 meters, the Blood Pond Hell which is bloody red due to red clay content.

In yield, these hot springs rank second in the world next to those of Yellowstone National Park in the USA.

HOT SPRINGS

The hot springs in the Suginoi Hotel are colorless and transparent, and have a slight sulfur odor. They are at an ever constant 210°C. The ingredients in one kg of this mineral water are (mmg):

Chrome	2,174	Hydro carbonic acid	99,860
Sulfuric acid	71,660	Nitrium	31,350
Hydro acid	0.355	Calcium	48,870
Meta boric acid	6,552	Magnesium	13,190
Carbonic acid	36,210		

The Suginoi Hotel, consisting of two towers, has a capacity of 2,100 guests, 11 meeting rooms, 20 banquet halls, 4 restaurants, 4 cafeterias and a wedding ceremonial room. The hot springs are also used for Acquabeat (Figure 1), a facility that includes water slides, jacuzzi, dream bath (Ume-no Onsen), flower bath (Hana-no Onsen), outdoor hot spring baths, a wave pool, theater, bowling alley and restaurant.

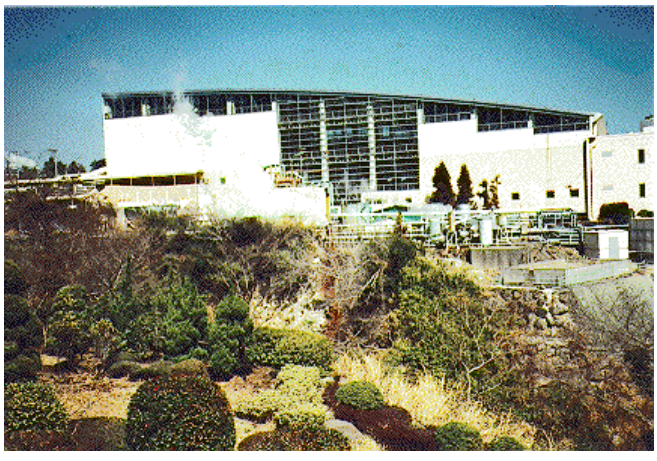

Figure 1. Acquabeat facility.

GEOTHERMAL POWER PLANT

A 3,000 kW geothermal power plant was put into commercial operation in November 1980 to supply electricity for the hotel use. The geothermal energy is utilized for many purposes such as baths, hot water supply, space heating and air conditioning as well as for power generation.

Figure 2. Steam separator.

OUTLINE OF THE 3,000 kW SUGINOI GEOTHERMAL POWER PLANT

Location	2272 Minamitateishi, Beppu City
Area	38,000 m^2
Rated output	3,000 kW
Construction start	October 1979
Operation start by back pressure	November 1980
Operation start by condensing	March 1981
Annual generation	18,000,000 kWh (approx.)

Steam Gathering Plant

Geothermal steam from the three wells is collected in a steam gathering plant located beside the power house through a two-phase flow transmission pipeline. The steam gathering plant consists of a cyclone separator and a moisture separator, and supplies clean steam to the turbine. Also, waste hot water from the steam gathering plant is utilized for public use such as baths in Beppu.

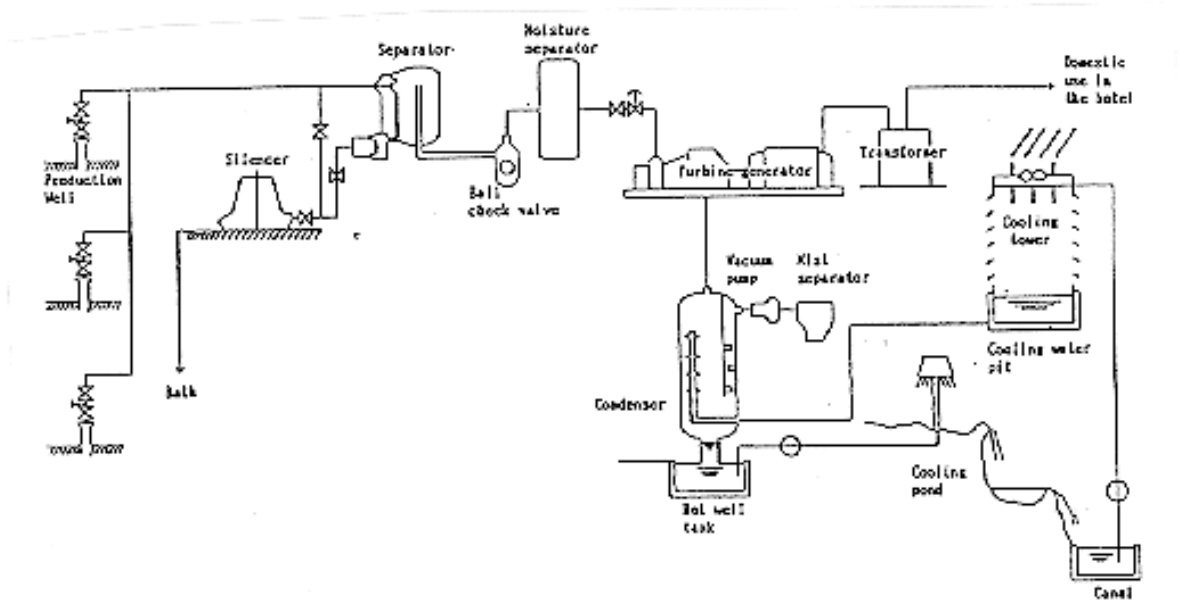

Figure 3. Schematic diagram of 3,000 kW Suginoi geothermal power plant.

Steam Turbine

Type	Condensing turbine
Output	3,000 kW
Steam condition	(main stop valve inlet)
Pressure	4.0 kg/cm^2 abs
Temperature	142.9°C (saturated)
Exhaust pressure	0.3 kg/cm^2 abs
Steam consumption	40,000 kg/hr

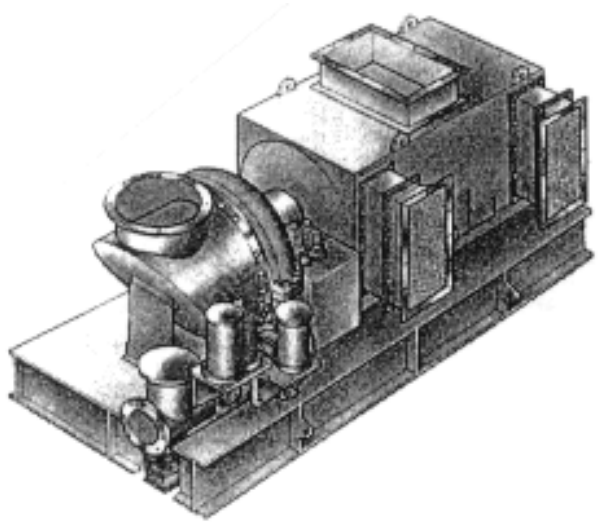

Figure 4. The Mitsubishi portable turbine generator.

Generator

Type	Open-circuit, air-cooled generator
Capacity	3,530 KVA

Condenser

Type	Spray-tray, barometric-type jet condenser
Vacuum	0.3 kg/cm^2 abs
Cooling water	Recirculating water
Temperature	32°C
Quantity	600 m^3/hr

Gas Extractor (22 kW x 2, 37 kW x 1)

Type	SONIT-TV
Diameter	100 mm (150 mm)
Vacuum	547 mm Hg
Quantity of gas	10(20) m^3/min

Cooling Tower

Type	Mechanical draft counter flow type
Capacity of cooling	21,000,000 Kcal/h
In/Out temperature	32 ~ 67°C
Wet bulb temperature	27°C
Circulation water quantity	600 t/h
Cooling tower fan	1 kW x 4

Warm water from the condenser is first cooled at the cascade cooling pond, which also serves as a sightseeing spot, and is further cooled in the cooling tower. Then, the cooled water is reused for cooling water.