

Wairakei Geothermal Power Station in New Zealand

By Lloyd Butler VK5BR

As a small group touring New Zealand, we visited the Geothermal Power Station at Wairakei in the North Island. It is unique in that it uses a system of operation duplicated in few other places in the world. Placing wells deep into the volcanic earth, steam is extracted and used to drive turbines which produce electrical power. Our guided tour through a power unit was difficult in the presence of high background noise. But much of what was missed has been described in the technical detail of the article.

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In January 1979, our group consisting of myself and wife Margaret with sailing friends, Pam and Ray, toured New Zealand by self drive vehicle. Part of our touring included a visit to the Wairakei Geothermal Power Station in the North Island. The Power Station field covers between 20 and 25Km² and lies 8 km north of Taupo along State Highway 1. Wairakei and its power station is part of the Taupo Volcanic Zone which features several natural geysers and hot pools and also its many power stations.

The Wairakei power station was commissioned in 1958. The station operates from geothermal steam with 55 wells dug to the to a depth of up to 660 metres. There are six power generation units of 11.2 MW, 3 of 30 MW, a single unit of 4 MW and a single unit of 14 MW, making a total of 175.2 MW maximum output. The annual power generated has been quoted as 1365 GWh.

The Wairakei Power Station is the world's second geothermal power station, and the first to utilise flash steam from geothermal water as an energy source. Geothermal energy from the power stations in the Waikato region provides about 16 per cent of the national New Zealand electricity supply.



**The Field of Wairakei Geothermal Power Station
(On site photo by the Author)**

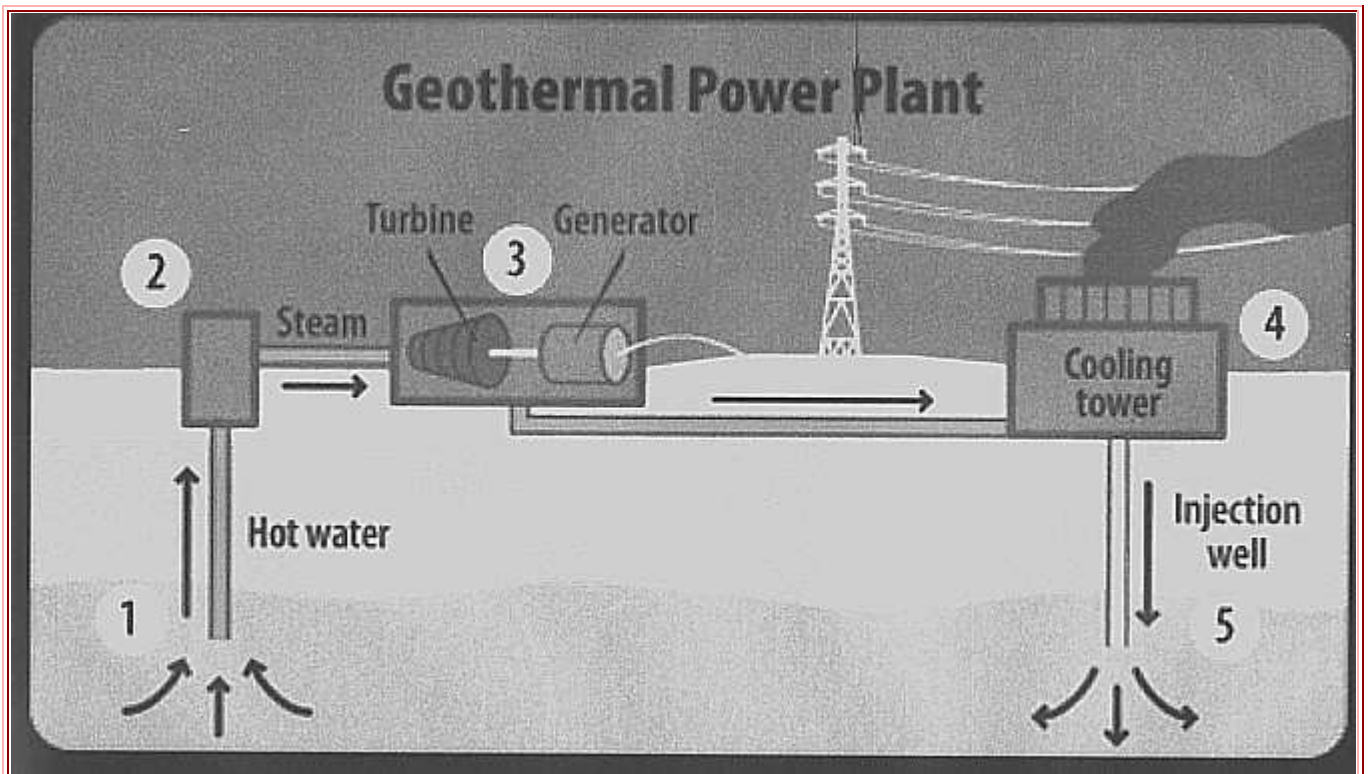
A guide from the power station gave us a tour through one of the power generation units. The noise generated was overpowering and it was difficult to resolve exactly what the guide was telling us in the environment of the high noise level. This can be a problem in touring some factories and other noisy environments where there is machinery or large scale water exchange. But there are ways to deal with the problem. Later on in a different tour location in which I was one of a party, headphones were provided with pre-recorded information.



**The Geothermal Power unit visited
(On site photo by the Author)**

However, I have put together some information on how this type of thermal power station operates.

Geothermal Power Plants work by piping hot steam from underground reservoirs directly into turbines from geothermal reservoirs, to power the generators which provide electricity. Following powering of the turbines, the steam condenses into water and is piped back into the earth via an injection well. The following diagram gives more detail:



**Schematic Diagram of a basic Geothermal Power System
(Diagram from Student Courses EPA Victoria)**

Hot water is pumped from deep underground through a well under high pressure.(1) When the water reaches the surface, the pressure is dropped, which causes the water to turn into steam.(2) The steam spins a turbine, which is connected to a generator that produces electricity.(3) The steam cools off in a cooling tower and condenses back to water.(4) The cooled water is pumped back into the Earth to begin the process again.(5)



**Geothermal Wells in Wairakei Power Station Field
(On site photo by the Author)**

Geothermal reservoirs are pools of water heated by magma deep below the surface. Water or steam can escape from cracks in the earth in the form of geysers (or sometimes as magna from a volcano). Wairakei reservoir is partially connected to the adjacent Tauhara Field. The Waikato River marks the boundary between Wairakei and Tauhara fields.

As a visitor to New Zealand, we could not miss the spectacular Huka Falls on the Waikato River narrows which are formed from a width of around 100 metres across into a canyon only 15 metres across.



**With Lake Taupo in the background, water turbulence
in the narrow canyon creates rapids in the Waikato River.
(Photo from a New Zealand travel document)**

The Waikato River is the longest river in New Zealand, running for 425 kilometres through the North Island. The Waikato River flows out of Lake Taupo at the town of Taupo in Tapuaeharuru Bay at the northeast end of the lake. It flows northeast past the town, alongside State Highway 1, via the canyon to the Huka Falls. The ring of lakes, tunnels and canals are used to generate hydroelectric power along the way including the Wairakei Geothermal power station.



**Huka Falls, following the turbulent rapids created in the narrow canyon.
(On site photo by the Author)**

The geothermal techniques, as used in the Waikato Power Station, are unique in the world and unlikely to be seen again in our touring around. So it was pleasing to have seen this system on site. But for someone with my interests, I would have been happy to have visited some of the other types of power units in the country. But it was a group decision, no more noisy power stations. But indeed! New Zealand is an interesting country on how they have applied their natural resources to power engineering.

References

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