

Geothermal Power Video answers for Thursday 2 March, 2006

1. t01-intro-to-the-wairakei-power-station

Chris Morris is a mechanical engineer at Wairakei and is responsible for steam turbines at the Power Station. Chris takes you on a quick tour of the power station from the outside.

- The steam pipe has a loop that goes up in the air before it heads into the power station. What is the loop called? Expansion loop
- How many turbines in Station A and how many Mega Watts (MW) does each produce? Six turbines each producing 11MW

2. t02-tour-through-station-a

Chris Morris takes Donald for a tour of the first power station to be built at Wairakei.

- What does the red represent on the turbine? Where the steam enters.
- What does the green represent? The generator.

3. t03-generator-rotor

Chris shows Donald a generator rotor taken out for maintenance.

- Where does the DC power come from? From the excitor
- What do the windings in the rotor produce? An electromagnet which produces the magnetic field which the stator windings cut when it rotates producing electricity.

4. t04-turbine-g11-under-maintenance

From high up on the side of the station you get a good look down into machine G11 with its casing taken off for maintenance. Mechanical Engineer Chris Morris talks you through the components.

- How long is this machine in length? 18m
- How much is the rotating mass? 80 tonnes

5. t05-turbine-g11-under-maintenance-2

Also from high up on the station wall Chris follows the path of high pressure steam as it enters and leaves this mixed pressure turbine. Steam enters the turbine in the middle of its length.

- What does the steam do as it travels through the diaphragms towards the front of the turbine? Expands
- What sits between each set of diaphragms? Turbine blades
- How many stages of diaphragms and turbine blades does the second steam input (through the back set of pipes) have to travel through? Seven

6. t06-turbine-g11-under-maintenance-3

The rotor has been taken out of the G11 turbine and is being serviced by two mechanics.

- How many stages of blades are in the front section of the rotor? eight

- How many in the rear section? Seven

Within the turbine the steam undergoes a pressure drop and a velocity drop.

- Where does the velocity drop? Across the rotating blades
- Where does the pressure drop? Across the diaphragm (of fixed blades)

7. t07-turbine-g11-under-maintenance-4

Chris gets right inside the turbine.

- What is the pressure and temperature of the steam when it first arrives in the turbine? 3.5 bar and 150 degrees C.
- What does the curved blade on the diaphragm do to the steam? Steam is directed at the right angle for the rotating blades.
- What is the pressure of the steam at the end of the first eight stages? Just over atmospheric pressure (ie 1 bar)

8. t08-turbine-g11-under-maintenance-4b

Chris is still inside turbine G11 and continues following the path of the geothermal steam. (IP stands for Intermediate Pressure)

- What happens to the water produced? Water is flung to the outside and drains away.
- How many stages are there in the final section? Seven
- What is the final pressure of steam that exits the turbine? 80 millibars

9. t09-turbine-g11-under-maintenance-5

You're at the front of G11 to see where the machine is controlled.

- What does the fly weight governor control? It regulates the speed and load.
- How much oil is circulated per minute? .5 tonnes
- What is the purpose of the oil? Lubricates the bearings, removes heat and is used as a control (hydraulic system).

10. t10-turbine-g11-under-maintenance-6

You're now looking at a large green box called the condenser that sits underneath G11 and the other Mixed Pressure Turbines.

- What is condensed into what? steam into water
- How much cooling water is used? 3.5 tonnes per second

11. t11-binary-plant-intro

You're at the binary plant – called binary because two liquids are used – water and pentane. Here electricity is created from waste hot water from the steam field.

- How many turbines are there? 4
- How many generators? 2
- How much electricity is produced? 14MW

12. t12-binary-plant-water-in-water-out

Pipes bring hot water from the geothermal field and cooler waste water is taken away.

- What is the temperature of water arriving and leaving at the plant? 127 and 87 degree.

13. t13-binary-plant-water-and-pentane

Chris explains why pentane is used in the binary plant.

- Why use pentane? Boils at a low temperature - 35 degrees C.

The turbines need high pressure and low temperature.

- What pressure is the pentane in the heat exchanger unit? 8 bar

14. t14-binary-plant-turbines-and-condensers

Chris shows you the double ended generators – with turbines at each end. A key part of the binary plant is the condenser which returns pentane gas to a liquid.

- What power is produced by each turbine? 4MW
- For each 8MW of electricity how much heat has to given off as low grade heat? 100MW
- What temperature is the pentane when it comes out of the turbine (on the way to the condenser) 40 degrees C.

15. t15-binary-plant-condensers-and-power-production

Underneath the condenser structure you get a clear look at the kilometers of tubing that carries the pentane to be cooled.

- What draws the air up through the tubes? Fans
- What is the output of the plant on a warm day? 14MW
- What is the output of the plant on a cold day? 20MW

16. t16-binary-plant-reusing-pentane

The binary plant uses a closed circuit of pentane.

- What does the 300KW pump do? Returns the pentane to about 12 bar pressure.
- How much pentane is used in the circuit? 5,000l

17. t17-audio-location-thursday-afternoon

Join Chris, Elizabeth and Donald after the audioconference.

- What does Chris Morris do here at Wairakei? Supervises the maintenance on the turbines.
- What does Elizabeth do here at Wairakei? Site visit Co-ordinator and Public Relations.