

ORC Power Plant Neustadt - Glewe Operational Experience Since 2004

Electricity generation, combined heat and power
Strasbourg, September, 15th - 2006



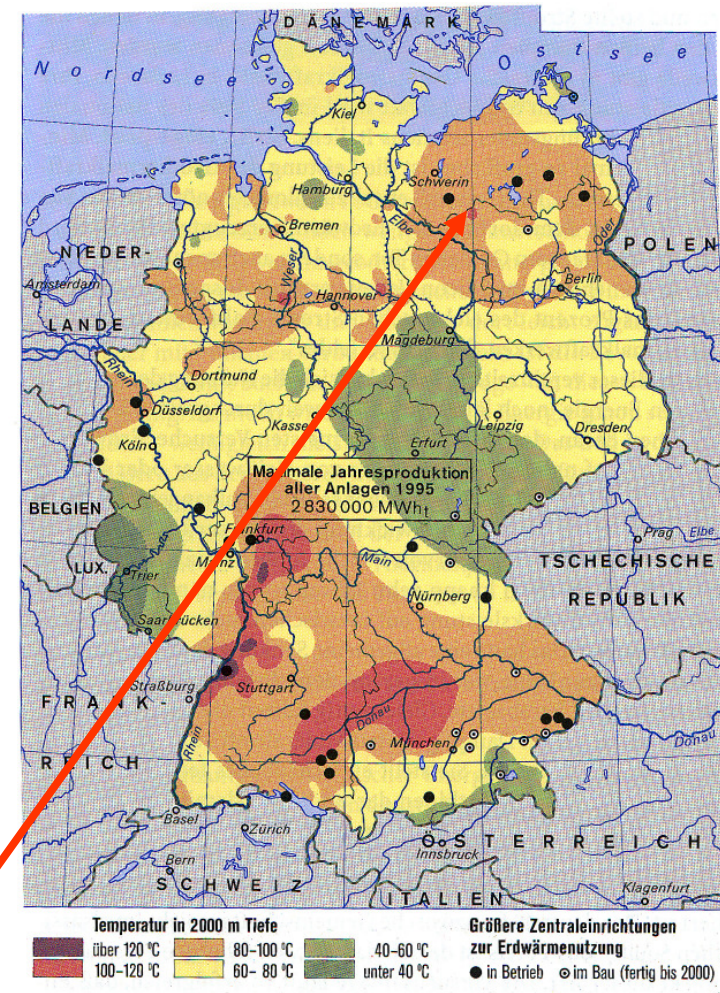
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A Vattenfall company

Location of Neustadt - Glewe

- ✗ Neustadt – Glewe is located in the Northeast of Germany (North German Basin)
- ✗ Land Mecklenburg-Vorpommern
- ✗ The existing heating station is in operation since 1994
- ✗ Less demand of heat during the summer gives the chance to produce electricity
- ✗ The complete plant is a combination of heat and electricity production - CHP



Neustadt - Glewe

Heating Station since 1994



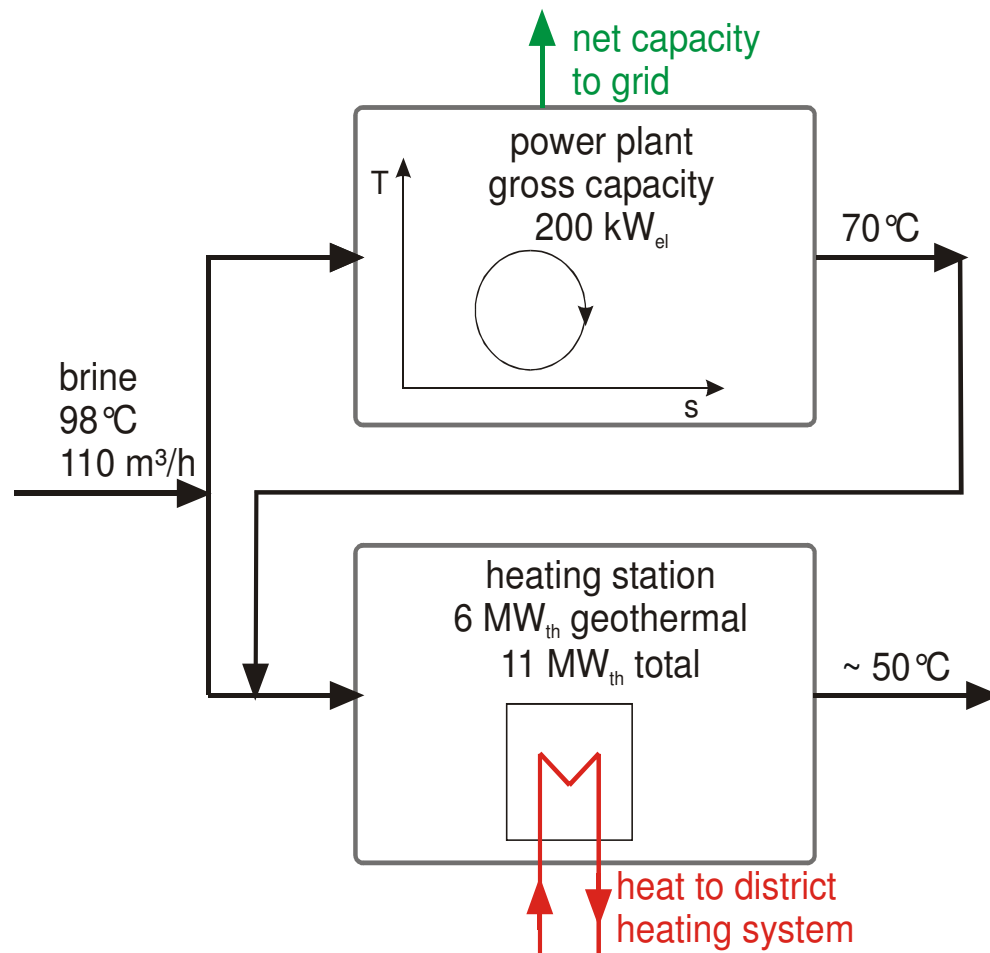
- ✗ Two Wells (production & reinjection) ~ 2250 m deep
- ✗ ca. 1400 customers
- ✗ Installed capacity: 16.4 MW_{th}
geothermal part : 6.5 MW_{th}
- ✗ Geothermal supplies 95 % of the total produced heat
- ✗ Very little heat demand during the summer months

Geothermal Power Plant since 2003



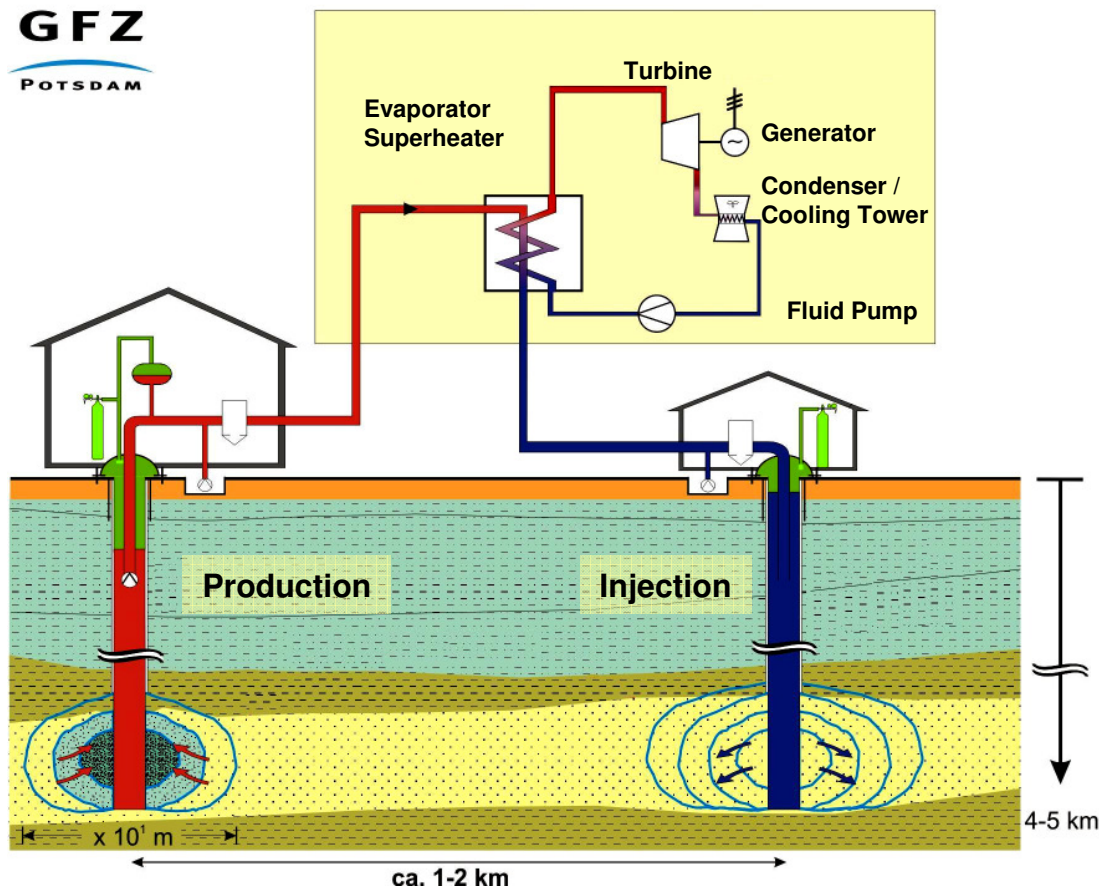
- ✖ First geothermal power plant in Germany
- ✖ Geothermal facility with very low brine temperature ($\sim 97^{\circ}\text{C}$) for an electric power station
- ✖ Gross capacity of 200 kW

Thermal water (brine) circuit



- ✗ Overall mass flow rate of brine 110 m³/h, divided in two streams, one for the heating station and one for the power plant
- ✗ The partial flow to the power plant is cooled down in a heat exchanger (evaporator) to a temperature of ~70°C
- ✗ Afterwards the cooled brine is mixed with the main brine stream and is transported to the heating station (500m)
- ✗ For the production of district heating the brine is finally cooled down to ~50°C
- ✗ Production of heat has the priority. Only the heat not needed by the heating station can be used in the power plant.
 - full load during summertime
 - out of service during wintertime

ORC - Process (Organic Rankine Cycle)



- ✗ Synthetic organic fluid (Perfluoropentane, C_5F_{12}) with a boiling point of $\sim 30^\circ C$
- ✗ This fluid is preheated and evaporated before the steam expands in the turbine
- ✗ After the turbine the steam is condensed in the condenser. The condenser is fed by cooling water which is cooled down in two cooling towers.
- ✗ To close the cycle the working fluid is pumped back to the boiler and evaporates again like in any other common power plant process.

Geothermal power plant Neustadt-Glewe

ORC-Container

Cooling towers

Chemical
Water treatment



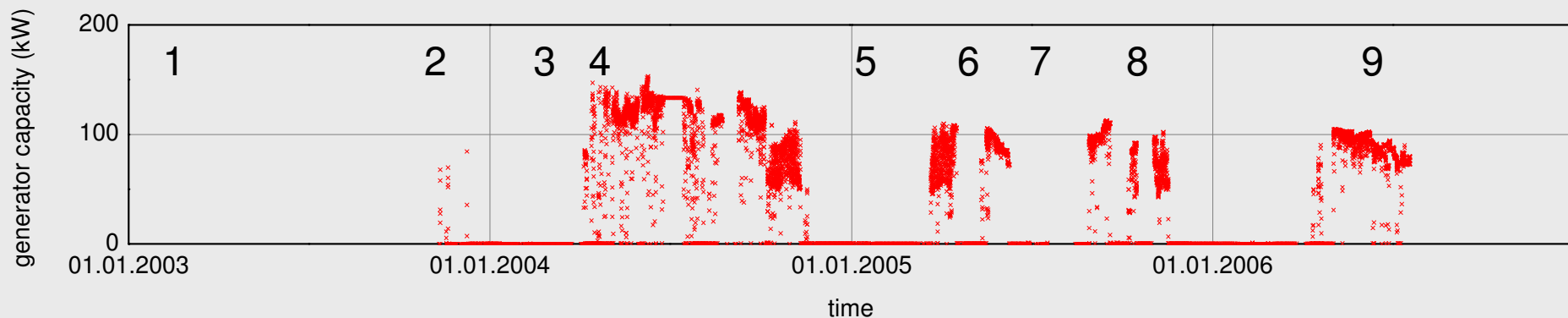
- ✗ The unit is installed in a 12 m container close to the production well
- ✗ The electric switching station is installed on the same site. It connects the plant to the 20 kV grid.
- ✗ The power plant runs automatically with checks every three days. Starts and unplanned stops were supported manually.

Technical data ORC - Thermal Heat Power Plant

- ✗ Electrical output 200 kW (installed)
- ✗ Electrical production 1.400 – 1.600 MWh/a max. theoretical (annual demand of ~ 500 households)
- ✗ ORC-Turbine axial inflow, single stage with three nozzles
- ✗ Turbine efficiency, 70 %
- ✗ Preheater and evaporator made out of titanium
- ✗ Live steam temperature ~ 75 °C, pressure ~ 4 bar
- ✗ Pressure condenser ca. 1 bar
- ✗ Total efficiency ~ 7.4 %
- ✗ Total investment costs ~ 950,000 €

The Story of Neustadt - Glewe

- | | |
|--|---------------------|
| 1. Technical and organizational preparations | 2002 – 2003 |
| 2. Start up | Nov 2003 |
| 3. First modifications | Mar 2004 |
| 4. Start continuous production | Aug 2004 |
| 5. First winter shut down | Nov 2004 – Mar 2005 |
| 6. Bearing damage – generator | Apr – May 2005 |
| 7. Leakage – ORC valves | Jun – Aug 2005 |
| 8. Damage brine pump | Oct – Nov 2005 |
| 9. In operation with unsatisfying load | since Apr 2006 |



Problems to Solve

- ✘ Since the first start up the plant doesn't reach the full load
- ✘ Investigations were started – in close cooperation with GFZ
- ✘ Possible reasons are numerous (heat exchange – feed pump – turbine)
- ✘ [We expect first results and improvements this autumn](#)
- ✘ Depending on the investment costs we will try to modify some components
- ✘ Less output affects also the economics. The revenues are much smaller than planned
- ✘ Although the price of the produced electricity is government-funded under the so-called Renewable Energies Act the situation is unsatisfying: Only the combined production of heat and electricity will allow successful operation!

Summary

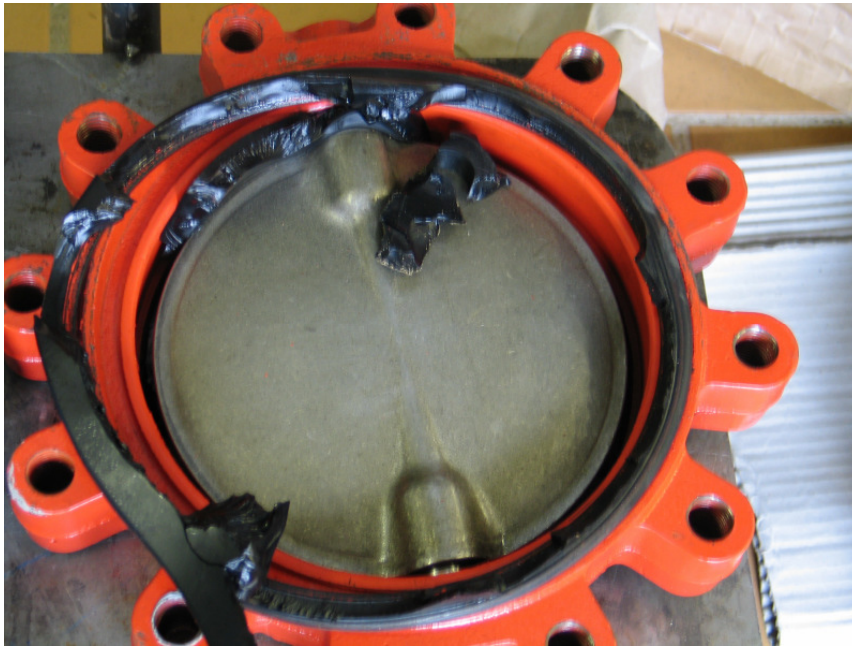
- ✗ The geothermal power plant of Neustadt – Glewe is an important project to gain experiences under the special geologic conditions of Germany (low temperatures).
- ✗ It supports the next project of GFZ-Potsdam and Vattenfall in Groß Schönebeck.
- ✗ The technique on the surface is not so easy as it might look like although we've heard different things yesterday
- ✗ More experiences in low-temperature power plant operation are necessary.
- ✗ With better thermal conditions the efficiency of new projects will increase – but:

Without the combination of heat production (CHP process) it would be difficult to operate a power plant for electricity production with success.

Thank you for your attention



Pictures



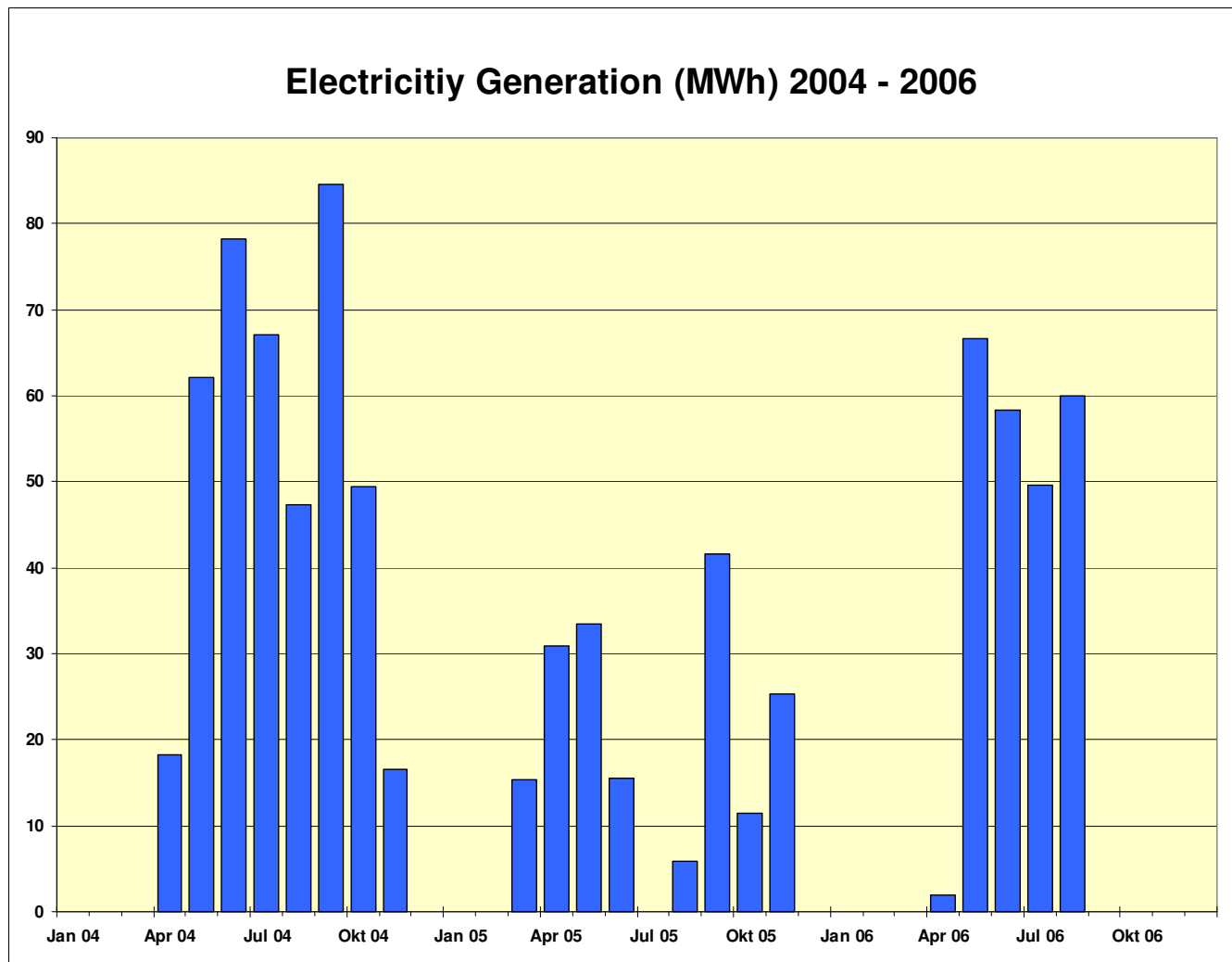
Valve with damaged rubber lining



Pieces of rubber found in turbine

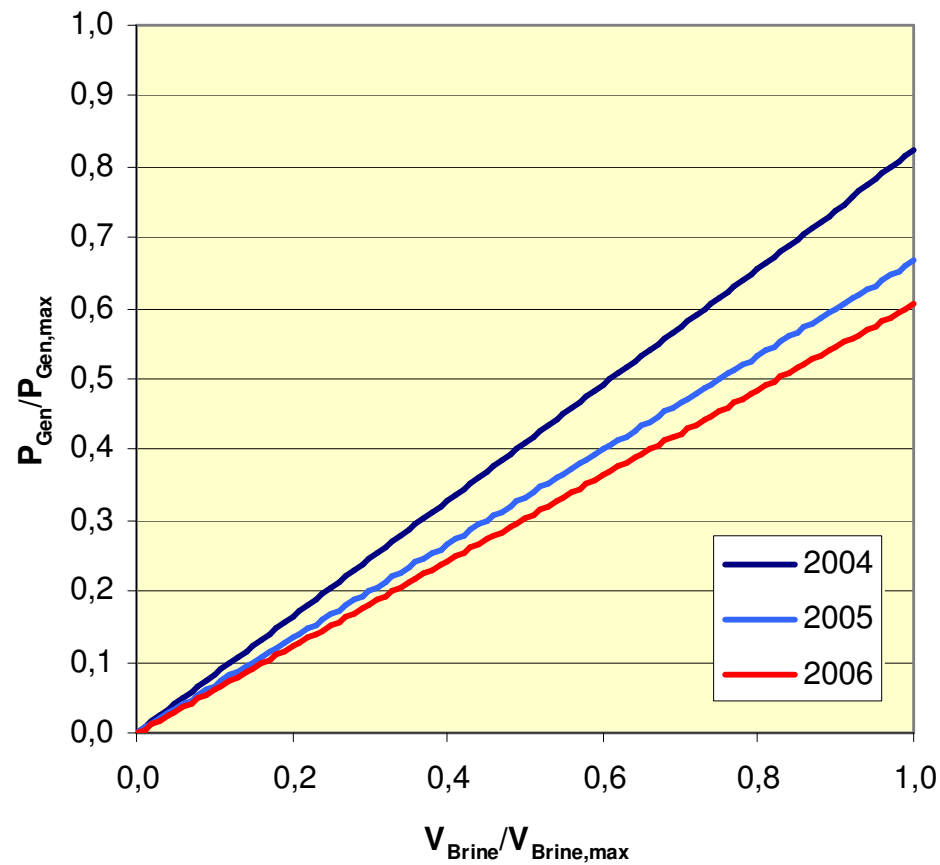


Charts I



Charts II

Electric Output / Brine



Electric generation decreased within the last years

