THE CONCEPT OF HYBRID POWER PLANTS IN GEOTHERMAL APPLICATIONS

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Geothermal power plant Unterhaching (Siemens I+S).

CONCEPT OF HYBRID POWER

In many regions in Germany, the temperature of geothermal brine that can be tapped in natural reservoirs generally stays below 120°C. The production of electricity is economically not feasible in most of these areas, because with low temperatures the degree of efficiency and thus the amount of produced power is small. With the new hybrid concept, it is now possible to feed in energy from a second renewable energy source into the geothermal power cycle while raising the temperature at the same time.

Electricity generation out of a geothermal energy source depends on the local geological situation. Reservoir temperatures lower than 120°C are usually found if reservoir rocks are not deep enough or if the temperature gradient is too low.

The hybrid concept was developed to help a community in the Upper Rhine Valley realize a geothermal power project in spite of these unfavorable circumstances. There, the geothermal power plant will be coupled with a biogas power plant. This project is now being implemented in the village of Neuried for the first time worldwide.

In a fermentation process, methane is produced and then combusted in gas engines. These engines drive a generator which feeds electricity into the grid. With the help of a heat exchanger, the heat of both the mufflers and the cooling system of the engines are fed into the power-producing cycle of the geothermal power plant. If the temperature of the geothermal power cycle amounts to e.g. 105°C, the cycle can be heated up to about 120°C, depending on the size of the biogas plant. This increase of efficiency is calculated for a power plant built under the local conditions of the Upper Rhine Valley. A temperature rise of more than 10°C results in increasing the gross degree of efficiency of the geothermal power production by 0.8%. In addition, up to 2.4 MW of heat can be supplied for the geothermal power process. Thus, by the hybrid concept, the geothermal plant will generate about 500 kW more power leading to an increase of 10% compared to the common stand-alone solution.

In addition to this improvement of efficiency, more synergy effects arise: The waste heat from the thermal power process can be sold to neighboring customers. The heat

Biogas power plant (Schmack Biogas).

can be used in many different ways: for example for private or office heating, swimming pools or even for vegetable production in greenhouses. Heat is mainly needed during winter time. In contrast to this seasonal usage, the waste heat of the biogas plant is fed into the geothermal power plant year round. The waste heat of the geothermal power plant is available for the customers.

Geothermal power plant detail (exorka).

To guarantee a constant heat supply, back-up systems need to be installed, usually basing on conventional heat sources like oil and gas. By combining two renewable energy sources, there will always be a renewable back-up system available in case one of the two sources should be out of order, e.g. in case of servicing. Hence, there is no more need for a conventional back-up system. If the geothermal power plant is down, the biogas waste heat, which is normally being fed into the geothermal cycle, can then be used for direct heating. The waste heat of the geothermal power plant itself suffices for the direct heat use system.

Both renewable energy systems produce base load electricity. An uptime of more than 8,000 hours a year is possible (91% load factor). Therefore, a complex control system is necessary which has to adjust the geothermal power circuit to the variation in load of the biogas system, of the direct heat use system and to the variation of the ambient temperature.

The hybrid plant in the Upper Rhine Valley will generate up to 44,000 MWh of power per year supplying up to 28,000 people with electric power. In comparison to a conventional natural gas power station, the emission of CO_2 can be reduced by up to 18,000 tons per year.

By combining a geothermal power plant with another renewable energy source, the generation of geothermal energy can be extended regionally. Geothermal reservoirs with temperatures below 120°C can thus be made profitable. This doesn‘t only apply to parts of the geothermically favored Upper Rhine Valley but even more so to other regions in Germany. Especially in the Molasse Basin in Bavaria, where the temperatures of the brines in the Malm Karst reservoir average between 80°C and 120°C, the hybrid concept provides a high potential. Hence, projects, that wouldn't be profitable being based on geothermal energy only, can now be realized by using the hybrid concept.

Biogas power plant (Schmack Biogas).

Geothermal power plant Husavik, Iceland (exorka).

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