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Baden Arena Kongress 1 – Tiefe Geothermie

Friday, 1 March 2024, 2.40 pm
Baden Arena Congress 1 – Deep Geothermal Energy

Optimizing power generation in EGS reservoir with Organic Rankine Cycle based on Radial Outflow Turbine technology: The United Downs Deep Geothermal Project

Optimierung der Stromerzeugung in EGS-Reservoiren mit Organic Rankine Cycle auf der Grundlage der Radial Outflow Turbine-Technologie: Das United Downs Deep Geothermal Project

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This paper presents the application of Organic Rankine Cycle based on the Radial Outflow Turbine technology to harness the geothermal resource from the first deep geothermal project in UK. Located in Cornwall this geothermal field is an Enhanced Geothermal System based on a Hot Dry Rock geothermal reservoir extracting the heat from the hot granite rocks beneath the United Downs site, near Redruth. To create the geothermal reservoir two deep directional wells were drilled and tested by GEL Geothermal Engineering Ltd in 2019 and 2020. The production well is the deepest in the UK at 5275 m depth while the injection well is at a depth of 2393 m. Thanks to the deployment of an Organic Rankine Cycle power plant, now under development, the geothermal field will produce by 2024 approximately 2.5 MWe net of carbon free electricity. The project also involves the exploitation of the geothermal heat to deliver 10 MWth of zero carbon heat for a large housing development at Langarth Garden Village, a project being developed by Cornwall Council.

The EPC project for the binary power plant is being developed by Exergy International and employs the proprietary Radial Outflow Turbine technology to produce power from the geothermal brine of the reservoir entering the ORC cycle at a temperature of 170°C. The thermal power extracted from the brine is used first to preheat and then to evaporate and superheat the organic fluid typically adopted in ORC geothermal applications. In the cycle configuration designed by Exergy, the organic fluid enters in the Radial Outflow Turbine in superheated conditions and is expanded down to the condensation pressure. The condenser is an induced air-cooled condenser. After the condenser, two feed-pumps are used to increase the pressure up to the maximum value, to close the loop. After the last ORC heat exchanger is sent to the reinjection system where two multistage centrifugal pumps give the geothermal fluid the necessary head to be reinjected.

The design of the cycle and choice of the working fluid were totally customized by Exergy to optimize geothermal resource exploitation thus enhancing the overall efficiency of the power plant. The system is a closed loop with a total reinjection of the resource in the reservoir so the power plant will have minimal impact on the environment and a small footprint.

The system will be delivered in 18 months, with commissioning of the plant expected by late 2024. Once in operation, this installation will save more than 6,500 tonnes of CO2 emissions per year compared to the production of conventional fossil fuel power.