Feasibility, Design and authorization of a zero-emission Geothermal Power Plant in Italy; Case Study: “Montenero” Project

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Social consensus is a condition precedent for any intervention having an impact on the territory, such as geothermal power plants. Therefore, private investors studied and proposed innovative solution for the exploitation of the medium enthalpy geothermal resource, with “zero emissions” in atmosphere, with the target of minimizing its environmental impact. “Montenero” project, developed by GESTO Italia, complies with this precondition.

The area covered by the exploration and exploitation permit is located on the northern edge of the great geothermal anomaly of Mt. Amiata (Tuscany), about 10 km north of the geothermal field of Bagnore, included in the homonymous Concession of Enel Green Power.

The geological - structural setting of the area around the inactive volcano of Mt. Amiata has been characterized by researches for the geothermal field of Bagnore, carried out by Enel Green Power over the years. The geothermal reservoir is present in the limestone and evaporitic rocks of the “Falda Toscana”, below which stands the Metamorphic Basement, as testified by the wells of geothermal field of Bagnore. The foreseen reservoir temperature at the target depth of 1.800 m is 140 °C, with an incondensable gas content of 1.8% by weight.

The project was presented to the authorities in 2013 and it is now undergoing exploitation authorization and features the construction of a 5 MW ORC (Organic Ranking Circle) binary power plant. The plant is fed by three production wells for a total mass flow rate of 700 t/h. The geothermal fluid is pumped by three ESPs (Electrical Submersible Pump) keeping the geothermal fluid in liquid state from the extraction through the heat exchangers to its final reinjection three wells.

The reinjection temperature is 70 °C and the circuit pressure is maintained above the incondensable gas bubble pressure, i.e. 40 bar, condition which prevents also the formation of calcium carbonate scaling. The confinement of the geothermal fluid in a “closed loop system” is an important advantage from the environmental point of view: possible pollutants presented inside the geothermal fluid are not released into the environment and are directly reinjected in geothermal reservoir.

The environmental authorization procedure (obtained) has taken into account all the environmental aspects concerning the natural matrices (air, water, ground, ...) potentially affected
by the activities needed for the development, construction and operation of “Montenero” ORC geothermal power plant. A numerical modeling was designed and applied in order to estimate the effect of the cultivation activity and to assess the reinjection overpressure (seismic effect evaluation). The project also follows the “best practices” implemented in Italy by the “Guidelines for the usage of medium and high enthalpy geothermal resources” prepared in cooperation between the Ministry of Economic Development and the Ministry of the Environment.