Main results of a long-term monitoring of the Bouillante geothermal reservoir during its exploitation

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Titreenvisagé **:Main results of a long-term monitoring of the Bouillante geothermal reservoir during its exploitation**

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The Bouillante geothermal field is developed aroundthe BouillanteBayalong the western coast of Basse-Terre Island, Guadeloupe, F.W.I. It has been first surveyed in the 1960-1970's. Four vertical exploratory wells have been drilled during 1970-1977 from 350 to 2400 m deep. They evidenced a 250°C sodium chloride reservoir suitable for commercial exploitation. A first small double-flash turbine (4,5MWe gross capacity) feed by well BO-2 has been built and operated by the National electricity utility EDF between 1986-1992. Later the BRGM Group bought this plant and is operating it since 1996. In 1998, the poor producer well BO-4 has been stimulated by cold sea water injection and its capacity increased to about 2 MWe. In 2000-2001, three new deviated production wells (1200 to 1400 m deep) have been drilled close to the previous ones. Two of them (BO-5, BO-6) show high permeability conditions and are good producers. A second single-flash turbine (11 MWe gross capacity) has been installed and commissioned in 2005. The total field capacity is now 15 MWe. Reinjection of brine into the reservoir was first tested in 2010-2011 and should be put into operation late 2013. The steam field now includes two producers (BO-5, BO-6), one injector (BO-2) and two observation wells (BO-4, BO-7). All of the seven deep wells drilled since 1970 are located within an area of less than 1 km^2.

A detailed monitoring of the reservoir has been done since 2002. The main recorded parameters are: production and reinjection flow rates, dynamic wellhead pressures and static wellhead pressures. In addition, a geochemical monitoring of the fluids extracted from the reservoir is carried out regularly. P and T profiles have been done several times since 1998.No production-induced chemical change has been observed in Cl content, NCG content and other major elements after 15 years of exploitation. The temperature profiles show no temperature decline through time. This suggests that the nowadays exploited areais probably part of a larger reservoir with a rather uniform fluid chemical composition.

The pressure drawdown within the reservoir has been limited to about 5 bars. It appears to be closely related to the total mass of extracted fluid as shown by the lumped modeling of pressure decline using LUMPFIT. The best history matching is obtained by considering an open, double-tank reservoir with natural recharge. By analogy with this conceptual reservoir model, the exploited reservoir is ascribed to a main fractured zone (the Cocagne Fault) connected to(and feed by) a main deep reservoir located somewhere below the Bouillante Bay. Prediction model of reservoir pressure decline in response to fluid extraction is now used as a routine tool by the plant staff.

Benefits of brine reinjection in reservoir pressure support and enhancing energy extraction have not been assessed yet. In order to prevent silica scaling, the minimum reinjection temperature in well BO-2 has been set at 163°C corresponding to an ASSI Index of 0,9. This also reduces the risk of cold-front breakthrough and cooling of production wells which are

rather close to the injection well BO-2, due to localtopographicand environmental constraints. This situation requires close monitoring of the reinjection, tracer test and further modeling in order to secure the reservoir and to site new reinjection wellsat larger distance from the production wells.