„Assessment of accident risks and social acceptance for enhanced geothermal systems (EGS)”

Master Thesis

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Summary

After the nuclear disaster at Fukushima in 2011, Switzerland decided to gradually phase out nuclear power. To compensate the share of about 40% in its electricity-mix, the energy strategy of Switzerland needs to be changed. The Energy Strategy 2050 foresees an expansion of hydropower and new renewable energy sources as well as increasing energy efficiency. Therefore, deep geothermal energy should contribute 4.4 terawatt hours of electricity by 2050. The theoretical potential of petrothermal or enhanced geothermal systems (EGS) is significant, provided that on the one hand technical progress allows the specific use of the rock as a heat exchanger, and on the other hand possible risks, environmental impacts and social acceptance factors are comprehensively analyzed. At the time of this thesis, the "Technology Assessment" group at the Paul Scherrer Institute was involved in several projects on the risk assessment of deep geothermal energy. This master thesis was integrated into two of these projects, and had the goal of an objective assessment of the risks and benefits of petrothermal energy. For this purpose, a technical overview of petrothermal systems was carried out that takes into account the drilling phase including drilling technology as well as the operational phase to generate electricity. The chapters on pressure kicks and borehole breakouts (blowouts) include a detailed risk analysis of these phenomena. Pressure kicks and the penetration of geofluids into the borehole can eventually lead to loss of well control, and ultimately an uncontrolled blowout. Worldwide, there are few long-term time series data sets that are publicly available. An evaluation of kick data for the Canadian province of Alberta showed a frequency of 0.0229 Kicks / drilled well. The order of magnitude of the results should also be applicable to the anticipated risks in Switzerland. Such accidents can also lead to the release of environmentally hazardous substances. Therefore, the work also dealt with possible prevention and mitigation measures. Finally, the hydraulic stimulation operations of enhanced geothermal systems were considered because they may pose a problem for social acceptance, especially when induced seismic events occur.