Swiss Centre of Competence for Deep Geothermal Energy for power and heat production



Seismic Risk Mitigation for the Haute-Sorne EGS pilot project

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The Haute-Sorne project

- Geothermal EGS project (multi-stage)
- □ 5 MW electric
- 2012 location decision and start of project development
- 2023 2D seismic
- 2024 drilling of the first well to 4km depth & 3D seismic
- 2025 stimulation test

GEO ENERGIE SUISSE







Source: The Federal Statistical Office

Introduction

The history of geothermal in Switzerland and the need for state of the art risk analysis & mitigation

□ Two deep geothermal projects at depths >4km

- Basel, 2006, petrothermal, Mw=3.2 stopped
- St. Gallen, 2013, hydrothermal, Mw=3.5 stopped
- significantly contributed to a better understanding of subsurface stimulation processes and associated risks
- also showed that a careful risk assessment beforehand and refined concepts to mitigate risks are necessary





Risk assessment

□ Faults and earthquake history



- Know where your (active) faults are
- Avoid large faults!
- Not all faults are problematic (slip tendency analysis, coulomb stress modeling)



risk assessment – deterministic scenarios - TLS

Earthquake scenarios – what groundmotion is acceptable?



- Vibration norm DIN 4150-3 or Swiss structure norms 260ff give a measure of acceptable ground motion
- Design your traffic light thresholds accordingly



Risk assessment – probabilistic risk

Risk tree



- 72 branches
- Calculations for damage, injuries & fatalities



Risk assessment – validation

 Validation with published data from re-insurances





Good agreement with reality

Risk assessment – probabilistic risk

Coupling earthquake scenarios with probabilities





Risk assessment – probabilistic risk

• What risk is acceptable?





Mitigation measures

 split the required area for an underground heat exchanger into many smaller engineered segments at a safe distance from larger faults.







Mitigation measure – stepwise realization process





Further mitigation measures

- □ 2D, 3D seismic VSP, ambient noise methods
- monitoring network
- □ Stimulation test
- □ Traffic light system (T_
- Adaptive traffic light system (ATLS)
- Bow-tie
- nultidisciplinary team, expert panel
- □ Fissure protocols

Stimulation test May 2025
Update of risk study

