KEM Research Question (max. 4 pages + annex)

TITLE Risk assessment for Ultra Deep Geothermal Energy (UDG) and inventory of preventive and mitigation measures

Objective

Maximum 200 characters (short description of the objective of the research question, which knowledge gap is resolved)

Ultra-deep Geothermal Energy (UDG) as a source of heat and electricity are renewable energy resources promoted by the Ministry of Economic Affairs (MEA) and Energie Beheer Nederland (EBN). However, the various hazards and risks associated with UDG has not been thoroughly inventoried and no comprehensive guidelines exist in The Netherlands for quantifying them during all project phases. The State Secretariat of Mines (SS) foresees that these risks could become major concerns for UDG - projects in The Netherlands. Hence, as the responsible supervisory agency (SSM) considers it critical to obtain a good overview of the risks of UDG projects and strategies for risk management and mitigation.

State of the art, background

Maximum 400 characters (description of state of the art knowledge, practices and flaws, including link to references documents, data, models).

Like essentially all technologies, deep (> 400m) and ultra-deep >4 km) geothermal energy exploitation is not risk free. This applies to a variable degree to deep hydrothermal projects and Enhanced Geothermal Systems (EGS). Known risks are for example, induced seismicity, blowout, leakage, chemical spills, deformation or accidents. While for some of these risks extensive experience and empirical data exists from oil and gas production, others are more specific to geothermal energy exploitation and little experience exists, especially in the seismo-tectonic context of The Netherlands. While there are no existing guidelines in The Netherlands for classifying and quantifying the risks of UDG-projects in The Netherlands, such guidelines do in parts exist in other countries, and there is also a growing experience and modelling capability on geothermal processes worldwide that should be considered.

Research Question

Maximum 400 characters (what to be addressed and what not AND Link to KEM Research Agenda)

Task 1. Conduct a comprehensive review and ranking of surface and subsurface risks (in terms of Health, Safety and Environment, not economical or public acceptance) related to UDG-projects (both hydrothermal and EGS). This should contain a literature and accident database review of all risks, the identification of top events and the identification of causes and consequences. Expertt elicitation should also be used to identify and rank relevant risks. This review should focus specifically on the Dutch geological, technological and seismotectonic context, but should also discuss relevant analogues from around the world as well as possible/feasible preventive, management and mitigation measures.

Uncertainties, limitations and data needs, should be explicitly discussed. The overview should ideally be embedded in a bow-tie risk analysis of all risks involved, discussing as well the causes and consequences of these risks.

Task 2. Based on task 1, suggest a suitable framework for risk government of UDG-projects in The Netherlands. This framework would contain project classification scheme, monitoring requirements, risks assessment and risk mitigation strategies for those risks considered relevant and discuss relevant methodologies and software for facilitating hazard and risk assessment.

Deliverables expected

Maximum 400 characters (list of deliverables expected, way of publication and intended usage by client)

Report on Question 1 (month 3-6)
Report on Question 2 (month 6-12)

Timeline

Maximum 200 characters (phases, milestones, end of project dates)

Milestones: Technical progress meeting with team at the project onset, and after each phase. Start of project as soon as possible.

Expected use

Maximum 200 characters (general knowledge, contribution to risk instrument, contribution to risk assessment, benefit)

SSM will use these deliverables for their advices on licence applications and to policy makers as well as for supervising activities. The deliverables/reports will be open-access, publication of project results is encouraged.

Expertise and tools preferred for the team

Maximum 200 characters (lists of expertise and tool skills expected, required)

Preferably use bow-tie methodology, since it is used already in other technologies in The Netherlands, or discuss reasons why other frameworks are considered to be superior.

Quality assurance, Organisational and communication requirements

Maximum 200 characters qc process, (review level, location, collaboration and meeting schedule wishes)

Work breakdown structure, Gantt charts, three-months meetings, intermediate progress reports including critical issues and solution/management strategies, multidisciplinary approach and will to communicate and co-work with other experts.

Remarks and Suggestions

Maximum 200 characters (extra information concerning the Innovation/Research question)

None.

References

No limit (reference list of papers, tools and reports)

Fabroccino, G., Iervolino, I, Orlando F., Salzano, E. (2005) Quantitative risk analysis of oil storage facilities in seismic areas. Journal of Hazardous Materials, 123(1-3): 61-69.