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Risk Mitigation in Deep Geothermal Projects – Experience in Germany

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SUMMARY/ABSTRACT

This report summarizes the experiences with risk mitigation for deep geothermal projects in Germany. Both technical drilling and exploration risks are addressed. Based on the history of geothermal project development in Germany, the national renewable energy incentive program is introduced. The paper reports on insurance solutions on the private market sector as well as on the German federal risk mitigation program started in 2008. The author's practical experiences from different insurance negotiations give some insight on the current use of those insurance solutions.

1 INTRODUCTION

The risks in geothermal projects can be classified in two different types. The drilling risk comprises problems with the drilling process due to unexpected geology or technical problems with the equipment. It includes e.g. the risks of loosing equipment inside the borehole and the risk of a blocked drilling string. On the other hand, the exploration risk stands for the risk of not finding the economically viable temperature or flow rate in a geothermal reservoir. Also, the risk of adverse chemical conditions is part of the exploration risk. At the moment, insurance companies offer standard policies to cover the drilling risks. However, policies covering the exploration risk are currently only offered for projects located in one of the two main geothermal provinces in Germany (the Molasse Basin north of the Alps and the Upper Rhine Graben) and depending on the individual case.

Especially in the initial phases of a geothermal project development, when the risk of project failure is particularly high, many project owners communicate the desire for an exploration risk insurance. The threshold values for this insurance (e.g. the temperature and flow rate which define project success or failure) are set individually for each single project and are based on economical considerations. The values are set and requested by the project developers. So far, exploration risk policies are only offered for hydrothermal projects. EGS projects are still considered as too risk-prone because of lack of experience.

2 THE GERMAN EXPERIENCE

Geothermal energy in Germany has the generation potential to cover up to 50 % of the gross power generation of Germany in 2006. The three primary regions for the use of geothermal energy are the Upper Rhine Graben, the Molasse Basin and the North German Basin. Whereas the Upper Rhine Valley is characterized by a positive thermal anomaly in the subsurface plus a narrow network of faults and fractures in the underground, the Molasse Basin shows the advantage of the widely distributed karstified and productive aquifer "Malm" at varying depths (depending on the site's position on a North-South axis). In general, geothermal projects in Germany are mainly bound to hydraulically active and productive faults and fracture zones.

Over the last few years, many successful geothermal heat projects have evolved in the Molasse Basin. Therefore, it is now possible to perform statistical calculations on the probability of success of a project at a specific site in the Molasse Basin. This procedure facilitates the offer of an exploration risk insurance. In the Upper Rhine Graben, on the other hand, not many experience exist with the realization of geothermal projects. Thus, it is much more challenging – both for a project developer and for an insurance company – to negotiate and exploration risk insurance in this geothermal province.

The first exploration risk insurance in Germany was signed for the project Unterhaching in the Molasse Basin. It remained a singular case for several years. Only in the latest past, other policies have been negotiated, both for the Molasse Basin and for the Upper Rhine Valley. Projects in the North German Basin have not been insured yet, because electrical power projects have to use EGS to be commercially successful there.

The insurance companies active on the German geothermal market include the Munich Re, Swiss Re, Axa, Gothaer, R&V and others. Insurance brokers on the market include Marsh and Willis. In

addition to the private insurance market, the federal and state governments in Germany also offer risk mitigation programs.

3 THE GERMAN RENEWABLE ENERGY INCENTIVE PROGRAM (MAP)

In Germany, the risk mitigation for geothermal projects is nationwide covered by the Renewable Energy Incentive Program MAP („Marktanreizprogramm"). The guidelines are specified in the "Richtlinien zur Förderung von Maßnahmen zur Nutzung erneuerbarer Energien im Wärmemarkt" (Guidelines for the support of measures to use renewable energies in the heat market). The program is administered by the German Reconstruction Loan Corporation "Kreditanstalt für Wiederaufbau" (KfW). Only deep geothermal projects (more than 400 m depth) in Germany are eligible for this program.

The MAP consists of a project promotion via subsidized long-term loans with low interest rates. It also contains two different risk mitigation modules, the first one covering the technical drilling risks, the second one covering the exploration and discovery risk. The subsidies are only available for geothermal heat projects. The risk mitigation components are available for both heat and power projects.

3.1 Basic Regulations

The risk mitigation is incorporated into the KfW incentive program for renewable energy where a credit (max. 10 Mio. •) is granted for the investment costs of a geothermal project exceeding the costs for a comparable conventional heat plant. Funds exist for subsidizing the repayment of the loan. The funds can be granted in three different modules. All components are independent modules, which can be applied for individually or as a package:

1. Plant promotion (200 • per kW thermal capacity, max. 2 Mio. •)
2. Drilling promotion (375 • - 750 • per m, unit amount depending on depth, max. 2.5 Mio. • per well, max. two wells)
3. Drilling risk (excess of the anticipated costs)

3.2 Technical drilling risk

Both geothermal heat and power projects are eligible for the drilling risk module. This module partly underwrites the risk of higher drilling costs compared to the originally planned expenses. It assumes the risk of additional work and expenses exceeding the original planning costs, for example in the case of technical drilling problems. It covers a maximum of 50 % of the original planning costs of drilling, and a maximum of 1.25 Mio. •.

3.3 Exploration risk

In addition to the drilling risk mitigation program, the MAP is also supposed to cover the risk of not reaching the economically viable values for temperature and flow rate in a deep geothermal heat or power project. This part of the risk mitigation scheme has not been put into effect by the KfW yet. The guidelines are currently being developed and formulated and it is expected that the program can start next year.

It is planned to set up a revolving fund of 20 Mio. •. The risk mitigation module then consists of a loan for the drilling costs and a credit indemnification clause. Part of the loan does not need to be repaid if the project fails. More precisely, the fund will cover 80 % of the drilling costs, if the well is not successful. Hence, the own contribution (deductible) is 20 % of the drilling costs. The necessary risk surcharge (loading) is represented by an interest rate increase during the high risk credit period until the termination of the drilling works and the hydraulic tests. The increased interest rate is expected to be set between 10 % and 20 %.

4 PRIVATE INSURANCE SECTOR

As the government fund schemes need a long time to be implemented, the private insurance sector meanwhile offers an attractive alternative for risk mitigation for geothermal projects in Germany.

Technical drilling risks can be insured on a standard basis. However, the conditions for an offer of discovery risk insurances on the private market are a mature project preparation and a substantiated geological-technical exploration and development concept of the geothermal project. In addition, the financial strength and the technical ability and know-how of the project developer needs to be proven.

The minimum requirements for an offer of an exploration risk insurance include a project description with a geological feasibility study, seismic investigations including interpretation, a development concept, the drilling path and well design as well as a stimulation and hydraulic test program, the power plant and heat use concept, all necessary permits, information on contractors and key personnel plus a business plan and insurance. In addition, an independent expert's report on the conclusiveness of all data and an estimate on the probability of success to generate the requested thermal capacity (flow rate and temperature) are required.

As no standards have been established for this kind of insurance yet, the co-operation between project developer and insurer is of major importance. The clear definition of scenarios, best- and worst-cases, measures and procedures is crucial in order to produce a reliable and transparent policy. Both the stimulation concept and the layout of the test program for the certification of results should be specified in advance and form part of the insurance policy.

5 PRACTICAL EXPERIENCE

The exploration risk is defined as the risk of not being able to exploit a geothermal reservoir with sufficient quality or quantity, whereas the quantity is defined by the thermal output P which can be extracted from the brine. P is calculated with the following formula 1:

(1) $P = \tilde{n}_F \, c_F \, Q \, (T_i - T_o)$,

where $\tilde{n}_F$ stands for density, c_F for the heat capacity, Q for the flow rate and $T_i - T_o$ for the temperature spread.

From the developer's point of view, P is the most important parameter. The combination of the individual factors is usually not of major importance. Therefore, it should be aimed at insuring the thermal output and capacity P instead of fixed parameter pairs for Q and T. Covering P instead of fixed pairs of parameters leaves the insurance company with a higher flexibility and therefore allows for a lower premium.

Insurance companies require a stimulation concept which comes into effect if the required flow rate cannot be directly extracted from the natural reservoir after drilling. The costs have to be included in the project budget. A hydraulic test program to determine success or failure of the well also has to be agreed upon within the insurance negotiations.

The general concept of the private insurance solutions is to let the customer choose the desired insurance sum according to the expected investment costs. The own risk share (deductible) also needs to be negotiated. Usually, all proven costs spent on drilling, stimulation, test program can be insured. Individual companies offer to cover costs like seismic investigation or the drilling site construction as well.

A cap for individual cost items should be avoided, as it reduces the flexibility of a project developer. A further measure to reduce the premium is the inclusion of a residual value concept, where – in case of project failure – a reduced insurance payment is made depending on the achievable flow rate and the possible alternative use scenarios of the well.