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GEOTHERMAL MARKET BASED INSURANCE SCHEMES

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SUMMARY

This report summarizes the experiences with risk mitigation for deep geothermal projects in Germany. Both technical drilling and exploration risks are addressed. To overcome the main obstacle developing geothermal projects, the exploration risk, private insurance companies and insurance brokers entered the market. The paper reports on insurance solutions in the private market sector. Basic terms and conditions are introduced and their further development with experience in a growing competitive market is described.

In the framework of the national renewable energy incentive program, the German federal risk mitigation program was started in 2008 and will be available on the German geothermal market in the first months of 2009. The author's practical experiences from different insurance negotiations give some insight into the current use of those insurance solutions.

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.

The main obstacle for the development of geothermal projects, however is the exploration risk. 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.

The first exploration risk insurance in Germany was signed in 2003 for the project Unterhaching in the Molasse Basin. The concept was not purely private, but was supported by the state of Bavaria. This first policy remained a singular case for several years and was not repeated, even though the project was successful and the premium was partly paid back.

Over the last years, other insurance companies and insurance brokers entered the market and insurance policies were offered to projects in the Molasse Basin. Some of them were not accepted because the developers had a multi project structure, hence reduced the risk of failure and decided to carry the risk on their own. This was especially the case for bigger companies with a firm financial background. Smaller companies sometimes didn't succeed in the overall financing of their project, even though the exploration risk of the wells was covered.

In the past, due to the lag of experience on probabilities of success of a geothermal project, a high premium of up to 25 % of the drilling costs was charged for exploration risk policies.
With the first successful projects, more experience and more competition on the insurance market, the premium is now lower and terms and conditions were modified in favour of the projects.
Geothermal development companies owning exploration concessions for several projects signed frame contracts with insurance brokers with attractive contract terms.

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1. GEOLOGICAL AND GEOTHERMAL PRINCIPLES OF RISK MITIGATION IN GERMANY

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 decades, thermal spas were the reason for many geothermal wells in the Molasse Basin. In the last few years, many successful geothermal heat projects for direct use have also evolved there. With the number of tested and productive wells, it is now possible to perform statistical calculations on the basis of about 40 data. This procedure allows the calculation of the probability of success of a project at a specific site.

In the Upper Rhine Graben, on the other hand, not much experience exists with the realization of geothermal projects. Only nine measurements are available, distributed over a range of three reservoir rocks and the whole graben area. Thus no serious calculation of the probability of success is possible and it is much more challenging – both for a project developer and for an insurance company – to negotiate an exploration risk insurance in this geothermal province.

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.

2. INSURANCE MARKET

The insurance companies active on the German geothermal market include Munich Re, Swiss Re, Axa, Gothaer, R&V and others. Insurance brokers on the market include Marsh and Willis.
Both individual insurance companies and the brokers offer frame contracts for developers with several projects. The broker solutions divide the risk among several insurance companies under the contract. Usually, one company takes the leading role, evaluating the project and negotiating the terms and conditions.
This reduces the risk for the insurance companies. In Germany, the insurance companies sometimes form the leading partner in one project and a secondary partner in another one.

3. BASIC CONDITIONS OF INSURANCE CONTRACTS

The threshold values for exploration risk insurances (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.

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:

$$(1) \qquad P = \rho_F \, c_F \, Q \, (T_i - T_o),$$

where ρ_F stands for density, c_F for the heat capacity, Q for the flow rate and $T_i - T_o$ for the temperature spread between inflow and outflow of the power plant cycle.

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. Some insurance companies accept such a fixed threshold value. Tested P values below this threshold result in the full payment of the insurance sum. Values above the threshold mean a successful exploration well.

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 probability of success study plays a leading role in the insurance market. In Germany, a federal institute and its members elaborate most of these studies. Some of the studies are also elaborated by state

institutes. In Germany, only state and federal geological institutes can access all relevant reference data, including those of the oil and gas industry.

Especially in the Upper Rhine Graben with only a few experiences and data, calculating a probability of success value is impossible. Some insurance companies insist on a value and are not willing to insure projects in the Upper Rhine Graben. If the calculation shows a probability of success above a threshold value, often 80 %, insurance companies submit an offer. Whether the threshold value for the probability of success can be reached also depends of the temperature and flow rate the customer wants to insure. With a high value for the probability of success, premiums are lower.

Some insurance companies and brokers by now have in house experts for geothermal projects. They do not depend on a value given by independent federal or state geothermal experts, but judge the facts presented by the project developers, consultants and experts themselves.

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. With P values just below the threshold, a smaller or different project can still be carried out. Therefore some insurance companies define a project, which is "partly successful". In this case, not the total insurance sum, but a smaller sum is paid out. This sum can be defined beforehand in the contract negotiations.

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.

Technical drilling risks can be insured on a standard basis. However, the conditions for an offer of discovery or exploration 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.

4. THE GERMAN RENEWABLE ENERGY INCENTIVE PROGRAM (MAP)

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

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.

4.1. Drilling Risk

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. Part of this program covers the drilling risk (excess of the anticipated costs). 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. €.

4.2. 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 in 2009.

It is planned to set up a revolving fund of 40 Mio. € by the German Government with additional 20 Mio. by the private insurance sector. 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 %.

5. FURTHER READING

Kreuter, H. & Schrage, Ch. (2008): Geologischer Hintergrund von Fündigkeitsversicherungen. Geothermische Vereinigung e. V., Kongressband, Der Geothermiekongress, p. 40-49, Karlsruhe.

Dr.-Ing. **Horst Kreuter** is member of the board of the International Geothermal Association. He is also president of the section “Deep Geothermal Applications” within the German Geothermal Society (Geothermische Vereinigung – Bundesverband Geothermie e.V.). His experience covers wide rang of geothermal problematics beginning 1996-1998 as Geotechnical Consultant of an engineering company in Halle/Saale, Germany, then 1998-1999 as Geotechnical Consultant of an engineering company in Düsseldorf, Germany working on soil mechanical and foundation engineering for building and infrastructure projects in Germany, airfield foundation engineering in Canuan Island, Caribbean and road rehabilitation project in Tukuyu, Tanzania. From 1999 – 2005 he works in HotRock Group, Karlsruhe on acquisition of mining rights in the Upper Rhine valley, project development of several geothermal projects, seismic surveys in the Upper Rhine Valley area, project engineering and project management of geothermal power projects including the drilling of deep wells, application and realization of scientific programs funded by the German Government (R&D), funding of geothermal projects and technical and commercial assessment of power generation plants for geothermal applications. Since 2005 he is in Geothermal Engineering GmbH.