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New Developments on the Geothermal Insurance Market

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ABSTRACT

The presence of sector-specific risks in deep geothermal projects significantly contributes to the continuing investment reluctance and the relatively slow development in the industry. By now, technical drilling risks can be insured on a standard basis. However, the conditions for an offer of exploration risk insurances are much more difficult. Based on practical experiences from insurance negotiation in Germany, international discussions and engagements in the setup of new risk mitigation schemes, the current developments on the private geothermal insurance market and new approaches of insurance negotiations are summarized. Within a growing and increasingly competitive market, terms and conditions are changed in favor of project developers. Against the background of more successful projects and more experienced data available to policy providers, exploration risk insurances will continuously become more affordable and more widely available. The current changes are expected to act as a market incentive and to contribute to an accelerated geothermal project development.

1. INTRODUCTION

The specific project risks associated with deep geothermal development can be classified into two main categories. The drilling risk comprises problems in 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 risk of not finding the economically viable temperature or flow rate in a geothermal reservoir is described as discovery or exploration risk. The risk of adverse chemical conditions also forms part of the exploration risk.

A number of countries like America, Iceland or France have developed governmental support or guarantee schemes mitigating these sector-specific risks. In Germany, in addition to the national support scheme, project developers also have the possibility to apply to private industry insurance providers for risk coverage.

While insurance policies for drilling risks are offered on a standard basis, private market-based policies covering the exploration risk are still 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). They require a mature project status and comprehensive project documentation. The opportunity of exploration risk coverage always depends on the individual case.

The following sections report on the positive new developments on the private insurance market over the last years. The changes include modified conditions for probability of success-studies, the regional focus of insurance offers in certain geothermal provinces and the enhanced co-operation between project developers and insurance companies during the negotiation of an insurance policy. Special attention is paid to the requirements regarding the geological background of the project documentation like exploration, drilling and stimulation concepts as well as the hydraulic test layout for determination of success or failure.

The practical aspects of the topic are reflected through examples and suggestions, mostly from a developer's point of view. They are based on a number of business cases negotiating risk coverage for geothermal projects in the Molasse Basin, the Upper Rhine Graben, but also from international discussions and contributions in setting up new risk mitigation schemes in Germany and worldwide.

2. HISTORY OF EXPLORATION RISK INSURANCES IN GERMANY

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 supported by the state of Bavaria. This first policy – from the Munich Re Group – remained a singular case for several years and was not repeated, despite the project being successful and part of the premium having been paid back.

Over the last years, other insurance companies and brokers entered the market. Several policies were offered to projects in the Molasse Basin. Some of them did not come into effect because of the developers preferring a multi-project structure for failure risk reduction and hence deciding to carry the risk on their own while saving the insurance premium. This was especially the case for bigger companies with a firm financial background. Other geothermal development companies owning exploration concessions for several projects signed frame contracts with insurance brokers with attractive contract terms. Smaller companies on the other hand didn't always succeed in the overall financing of their project, even though a contract covering the exploration risk of the wells was signed.

3. NEW DEVELOPMENTS ON THE GEOTHERMAL INSURANCE MARKET

The interest of the insurance market in the geothermal industry is increasing. In the light of a more and more competitive market, terms and conditions of insurance policies are modified in favor of the projects. The possibility of exploration risk coverage has now become available to a wider range of projects. Over the last months, several new policies have been negotiated, both in the Molasse Basin and in the Upper Rhine Valley.

During insurance negotiations for projects in different regions, it became obvious that the presentation of a geologically conclusive development concept demonstrating the project's chances of success is an

absolute necessity for the offer of risk coverage. Minimum requirements are the reprocessing or execution of a new 2D- and 3D-seismic survey including interpretation, the preparation of a feasibility-study including a development as well as a drilling and stimulation concept. It is suggested to also produce a layout of the test program used for the certification of results.

Given that still no standards have been established for exploration risk insurances yet, the co-operation between project developer and insurer during the preparation of the above-mentioned documents 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 (cf. Kreuter and Schrage 2008).

3.1 Definition of Project Success

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 capacity P which can be extracted from the brine. P is calculated employing the following formula 1:

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

in which 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.

The threshold value for exploration risk insurances (i.e. the parameter which defines project success or failure) is set individually for each project and is based on economical considerations. The project developer decides on the threshold value which forms part of the insurance request.

From a developer's point of view, P is the most important parameter. The combination of the individual factors is usually of minor importance. Therefore, it should be requested to insure the thermal capacity P instead of fixed parameter pairs for Q and T. Covering P rather than fixed pairs of parameters gives the insurance company a higher flexibility and therefore allows for a lower premium. Several insurance companies accept a threshold value for thermal capacity as the success criterion. A tested thermal capacity below the threshold value results in the full payment of the insurance sum. Values above the threshold define a successful well. In individual cases, it is also possible to define "partial success" thresholds in the transition zone, where only a certain part of the insurance sum is paid out.

3.2 Probability of Success (POS)

Most insurance providers require an external report quantifying the probability of success of a geothermal project. The so called POS-study plays an important role on the insurance market. These studies are based on an evaluation of reference well data and are currently mainly prepared by the independent LIAG (Leibniz Institute for Applied Geophysics) in Hannover. Some studies are also prepared by state institutes. In Germany, only state and federal geological surveys have access to all relevant reference data forming the basis of a POS-study, including those of the oil and gas industry.

If the calculation results in a probability of success above a certain threshold value (mostly 80 %), insurance companies submit an offer. Whether the threshold value for the probability of success can be reached mainly depends on the thermal capacity a client wishes to have insured. The higher the POS, the lower the insurance premium will be.

By now, a number of insurance companies and brokers have employed in-house experts for geothermal projects. These providers do not depend on a POS-value calculated by external geothermal experts, but judge the facts presented by the project developers, consultants and experts themselves. This is especially important for projects in regions with limited reference data from surrounding geothermal wells.

3.3 Regional Aspects of POS-Calculations

The three primary regions for the use of geothermal energy in Germany are the Upper Rhine Graben, the Molasse Basin and the North German Basin. 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 being drilled. In the last few years, many successful geothermal heat projects for direct use have also evolved in this region, using the karstified limestone reservoirs of the Upper Jura (Malm). With the number of tested and productive wells, it is now possible to perform statistical calculations on the basis of about 40 project results. This procedure allows the determination of the probability of success for a project in the Molasse Basin.

In the Upper Rhine Graben however, experience with the realization of geothermal projects is still limited. Only nine results from geothermal well testing are available, distributed over a range of three reservoir rocks and the whole graben area with a length of over 300 km from north to south. Seeing such limited data basis, no serious calculation of the probability of success (POS) is possible.

However, most insurance companies insist on a POS-value and are therefore not willing to insure projects in this region. Lately, individual providers accept an alternative procedure with special emphasis on the quality of project exploration (3D-seismics and a detailed, high quality structural analysis) plus an ongoing communication and co-operation between developer and insurance experts. In this way, it recently became possible to obtain insurance coverage also for projects in the Upper Rhine Graben.

Projects in the North German Basin have not been insured yet, the reasons being the lack of reference projects, the relatively large depth required for a sufficient temperature level and the necessity for EGS-components for most projects in this region. So far, exploration risk policies on the private market are only offered for hydrothermal projects. EGS-projects are still considered as too risk-prone because of lack of experience.

3.4 Stimulation Concept

Insurance companies require a stimulation concept coming into effect if the required flow rate cannot directly be extracted from the natural reservoir after successful completion of the drilling works. The possible stimulation measures include acidizing, hydraulic stimulations or side-tracks, depending on the local geology. Acidizing can be enhanced by hydraulic pressure.

The costs for stimulation measures have to be included in the drilling budget. It is recommended to elaborate a detailed stimulation concept in form of a flow chart with definition of all likely scenarios and the corresponding stimulation measures along with the corresponding price estimates. This stimulation concept then forms part of the insurance policy. Based on the geology encountered, the

concept can be altered in consultation with the insurance provider. In principle however, an unsuccessful well can only be attested when the entire flow chart has been run through. Figure 1 shows an example of such a stimulation concept, where 75 l/s are defined as the threshold value of a productive well.

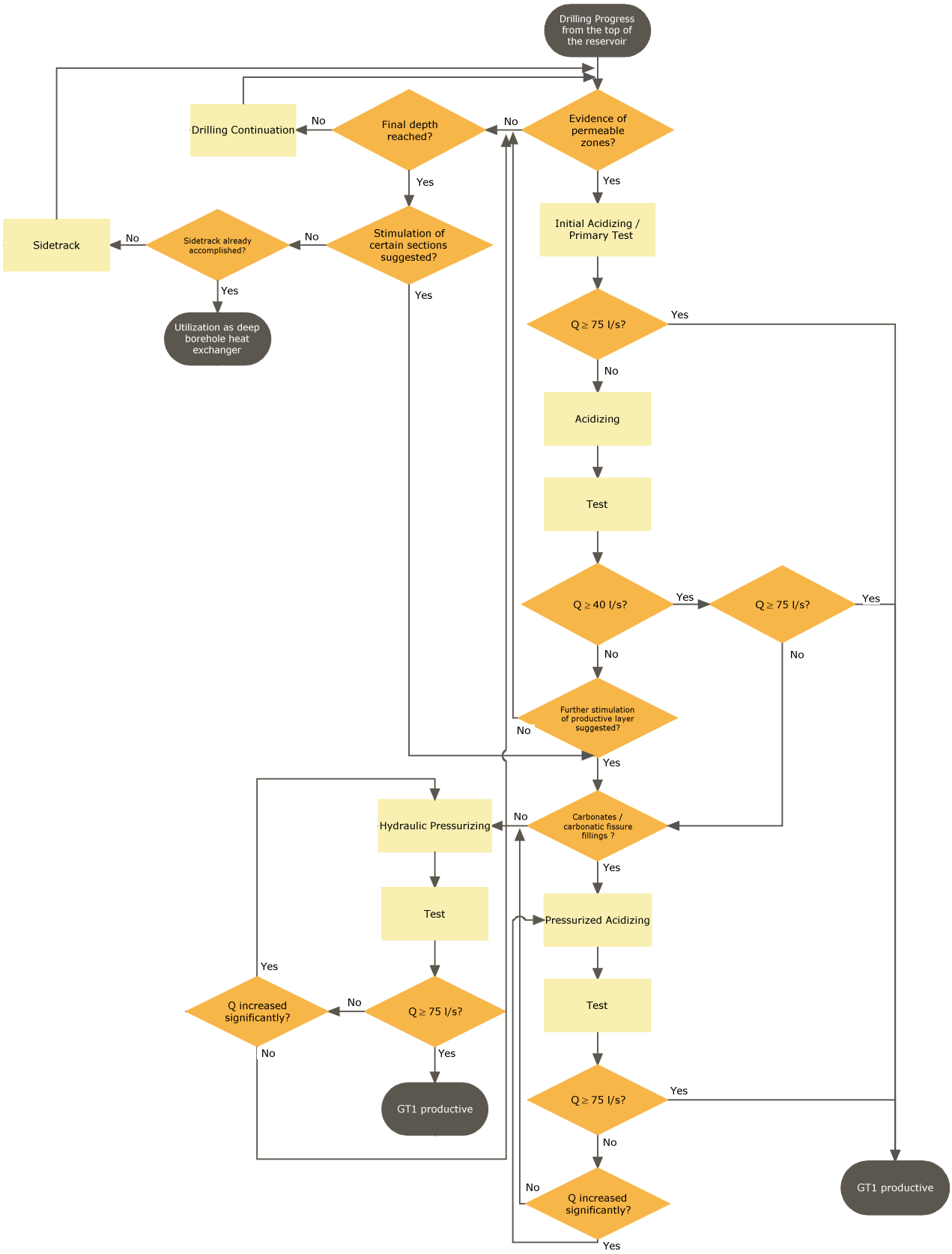

Figure 1: Example of a Stimulation Concept Flowchart

3.5 Certification of Results

The decision over project success or failure is determined by means of hydraulic production or injection tests. Ideally, a well is tested for its purpose (production or injection). Due to the high mineralization and temperature of the brine however, long discharge tests lead to storage and disposal problems of the water when no injection well is available yet. In most cases, it is therefore not possible to conduct a full, steady-state discharge test. The alternative is an injection test with several pressure phases and with subsequent pressure recovery measurement. The layout, procedure and measurement parameters for the hydraulic test need to be specified in advance. A concrete test program should be elaborated and form part of the insurance policy. The results are evaluated by the project developer in consultation with the insurer. If the results lie in a transition zone between "definitely successful" and "definitely unsuccessful", only a full-size steady-state discharge test can clear the ambiguity.

3.6 Financial Aspects

In the past, due to the lack of experience with the probability of success of a geothermal project, a considerable premium of up to 25 % of the drilling costs was charged for exploration risk policies. Given the first successful projects, more experience and more competition on the insurance market, the premium has now become significantly lower. Selected companies also offer to cover the premium in case of project failure. Currently, a premium of around 1 Mio. € for an insured sum of around 10 Mio. € plus an own risk share (deductible) of approximately 1 Mio. € are a common example. However, the insurance costs are still determined specifically for each individual project.

One option to further 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 a thermal capacity just below the insurance threshold value, a smaller or different project might still be possible. Therefore some insurance companies define a project, which is "partly successful". In this case, not the total insurance sum, but a reduced amount is paid out. This procedure should be defined beforehand in the contract negotiations.

3.7 International Developments

Exploration risk mitigation schemes not only exist in Germany, but also for example in the USA, Iceland or France. However, these programs mainly rely on publicly funded, governmental resources and are not private market-based. Insurance cover is usually granted on a competitive basis including a cost and risk share of the developer of about 10-20 % in order to avoid "gamesmanship" from the side of the developer. This is either achieved by increased interest rates during the high risk period of a credit or by the payment of a premium plus own share in case of project failure.

Currently, a number of new risk mitigation schemes is discussed and implemented in various countries worldwide. Some of them, as for example the proposed risk mitigation schemes for Chile or Djibouti, are funded by national or international bodies like the KfW or the World Bank. German consultancy expertise and experience with private market-based insurance solutions is drawn upon in order to structure some of these programs. Furthermore, the international geothermal industry also offers promising expansion possibilities to German insurance providers with experience in the negotiation of private-sector risk mitigation policies.

CONCLUSIONS

More and more insurance providers are interested in meeting the desire of the geothermal industry to mitigate the sector-specific exploration risk with a private market-based insurance solution. After the realization of several successful projects and a more comprehensive data basis regarding the local geology and geothermal conditions, exploration risk policies have become available not only to projects in the Molasse Basin, but also in the Upper Rhine Graben. Terms and conditions have become much more favorable to project developers, and premiums are a lot more affordable than in the past.

Practical experiences from insurance negotiations have shown the importance of producing a geologically conclusive development and exploitation concept, demonstrating a project's chances of success. Co-operation and consultation between project developer and the insurance provider, a consensus in the project assessment and written agreements on procedures, scenarios and measures form the basis of a successful and transparent insurance policy.

Germany is the first country to offer private-market based insurance solutions mitigation the exploration risk of geothermal projects. Based on a growing experience in Germany, the private market-based risk mitigation concept is expected to become available in other countries worldwide.

REFERENCES

Kreuter, H. and Schrage, Ch: Geologischer Hintergrund von Fündigkeitsversicherungen, *Proceedings*, German Geothermal Congress 2008, Karlsruhe, Germany (2008), 40-49.