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INSURANCE SCHEME FOR INDONESIA'S GEOTHERMAL EXPLORATION AND DEVELOPMENT

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Abstract

The exploratory phases of a geothermal project are marked by not only high capital costs but also a chance of failure, due to the high temperatures found in geothermal reservoirs and uncertainties regarding reservoir geology. The combination of high risk and high capital costs can make financing geothermal projects difficult.

In some countries, such as France and Germany the governments are providing the support through some insurance schemes. In France, the program is intended to partially insure geothermal energy project promoters/ investors against (1) the short-term, up-front geological risk of exploration drilling, and/or (2) the long-term geological risk of developing and producing a geothermal reservoir with a lower than estimated temperature, higher than estimated mineralization, or difficulty with injection of geothermal fluids back into the subsurface. In the meantime, Also, the World Bank has established two programs for East African Rift Zone (the ARGeo Program in 2008) and for Europe and Central Asia region (the GeoFund Program in November 2006).

This paper discusses the possibility of setting up in Indonesia a similar insurance scheme in conjunction with local insurance market and international reinsurance supports, to cover risks in initial exploratory drilling. The intention is for the insurance coverage to cover multiple parties that have different tasks in the process. The main advantage of the risk mitigation scheme through insurance is that it combines both project financing via a credit and the mitigation of exploration risk in one program.

The risk coverage consists of a loan being for-given if the project is unsuccessful up to the available insurance limit provided. As insurance for geothermal development is still unknown in Indonesia's market, its introduction would require actuarial analysis to determining the appropriate insurance premium. The actuarial analysis has to be based on the prudent assumption and the generally applicable insurance practices, which would require reliable statistical data on the probability of success of a project at a specific site in certain area.

Based on the result of the study, it is recommended that INAGA updates a statistical study on the geothermal drilling results to be used in designing the insurance scheme for geothermal exploration and conduct capacity building for the insurance personnel.

Introduction

Despite improvements in the technology, geothermal project undertaking still contains significant element of risks and uncertainties. Occurring in nature in a variety of combination of geological, physical and chemical characteristics, a geothermal system has three main elements, namely heat source, reservoir and fluid. Therefore, the primary reason for the failure of exploration drilling projects is the fact that the anticipated temperature and/or flow rate is not encountered in the geothermal wells that have been drilled and tested.

Such risks for a failed geothermal well are particularly costly. Geothermal wells must be drilled and tested in order to determine the potential of high-temperature geothermal fluids and their possible flow rates for fueling a geothermal electrical power generation project. If the drilling and testing of a geothermal well does not verify the parameters assumed prior to drilling, the failed geothermal production well must be written off, or must be converted into an injection well, and an additional geothermal production well must be

drilled to provide the fuel necessary for the completion of the proposed geothermal power project.

To help mitigating the risk, a number of national governments have provided incentives to accelerate geothermal development as an alternative energy source. These include guaranteed loans, guaranteed cost sharing of unsuccessful drilling projects and insurance programs and incentive programs to help cover the upfront costs of exploration drilling and facility construction tax reduction programs and even mandated power purchase programs to provide a market for geothermal power.

This paper discusses the feasibility to have insurance coverage for geological risks in Indonesia's geothermal undertaking. This is in addition to insurance coverage for technical risks or lost in holes risks of the drilling phases which shall be covered by separate technical risk insurances and traditional risk management products that are totally available on the insurance market, including property damage, business interruption, machinery breakdown and construction all risks.

Geological Risk Insurance

As the geological risk is considered to be largest obstacle for the geothermal projects; the present of guarantee system will overcome the hesitations of bankers to offer loans. The following lists various insurance programs that have been introduced in several countries, to cover the risks in the exploration stage.

1) Iceland developed a fund for mitigation of geologic risk in geothermal energy development projects in approximately 1970. Prior to that time and beginning in the 1930s, the Icelandic government paid exploration costs. After 1980 the fund became available for grid-connected geothermal electrical development projects. The fund is primarily for exploration for geothermal reservoirs in rural areas, financing of small-scale geothermal district energy systems, small-scale exploration activities and distribution systems.

   Loans were provided by the government for up to 60% of exploration costs and exploratory drilling. Interest rates are normal commercial rates. The loan can be fully or partially for-given if the project is unsuccessful or only partially successful. The loan can cover geological studies, including geochemistry and geophysics. The amount of money available is set by the amount the government makes available through budget appropriation. They set aside 20-30% of the total fund to cover payment for failed projects; on average about 20% did fail.

   The program has moved in the direction of a risk guarantee with a requirement that the loan would have to come from a commercial source rather than directly from the fund or the government. The risk insurance thus provided covers both reservoir risk as well as drilling/geologic risk. The amount of the risk insurance available remained at 60% of the project cost. The remaining 40% could be made up on in-kind personal costs or equity. Applications are accepted at any time and processing of an application usually takes 6 months. The loan can be suspended for a period if a delay in the exploration program should be required.

2) In 1982 the France government established a system of risk guarantees to facilitate the development of geothermal energy. The program provides coverage for geological risks, based on two complementary mechanisms, namely the Short-term procedure (STR) and the Long-term procedure (LTR) on the sustainability of the resource and the risk against total or partial depletion during 15 years of operation.

   STR insurance is used to secure the project's profitability in spite of the geological model's uncertainties. The insurance scheme covers geological risk in the event of total or partial failure of the first drilling operation using Flow rate (Q) and Temperature (T) as representative parameters of the project's profitability or the success parameters that can be developed from general geological models. Any developer to subscript to the STR insurance are subject to prior acceptance of the project by the technical committee based on a complete economic, financial and juridical analysis at premium of 1,5 % of the sum insured. Maximum compensation payable under STR Insurance is 90% of the eligible claim (total cost of the first well – subsidies + over costs due to unforeseen or accidental events during drilling works). STR's insurance mechanism is based on success-failure curves. Different sums are granted according to the degree of success of the project. Success-failure economical curves are calculated on the basis of the project's economic sensitivity study whereby there be no compensation paid for a total success project, payment of partial compensation to reach profitability for partially success project and full compensation will be payable for totally failure project. The program has spurred the growth of geothermal energy to more than 100

wells completed by 1987 in the Paris Basin alone. [1]

Under the Long term risk (LTR) insurance, the geothermal characteristics are known but their long term behavior, as well as long term chemistry effects on wells and reservoir is not known. The mains risks are temperature and/or flow rate decrease and severe corrosion and/or scaling in wells. The LTR insurance essentially covers the risks of drilling exploitability's degradation, including for wells, materials and specific equipments, geothermal loop and quality of the geothermal resource (defined clearly at the origin). The duration of the insurance contracts is 15 years.

To subscribe to LTR insurance are subject to acceptance of rule of good technical management and respect of regulations, initial payment of 3.2 % of insured costs and payment of an annual contribution. As respect the level of claim compensation payable will depend on the drilling exploitability's degradation. For partial damage compensation is calculated according to the plant's lifetime and its power loss according to the contract reference. For total damage, compensation is calculated according to a contractual ceiling and the plant's residual value.

In order to manage the French guarantee system, the public authorities and ADEME created a private society called SAF Environment. ADEME is a State Agency, which owns the geothermal plants (public or private) and will make initial payment. Decision to make grant will be recommended by a technical committee, comprising of many parties. The balance of the fund is ensured by public funds:

The above scheme is for deep resource exploration. For shallow resource, French apply another guarantee system that has been created for geological risks due to uncertainties of the drilling results for shallows ground waters. This French guarantee system deals with plants using heat pumps of more than 30 kW (not for individual plants), based on two complementary mechanisms, namely Research guarantee to cover the risk of insufficient resource with regard to the expected one and failure of injection, and Long term productivity guarantee to cover the risk of decrease or deterioration of the resource during the exploitation. Maximum covered amount is € 115 000 for a duration of 10 years. The Fund is also managed by SAF-Environment (different fund than the deep resource fund). The decision of allocation is taken by the AQUAPAC committee compound of ADEME, EDF, BRGM and SAF Environment.

The failure rate was on the order of 20-25% depending upon the region where the project was undertaken. The 20-25% rate was the results of a conscience decision by the Technical Committee to approve high-risk drilling operations in areas not well know geologically. In more well know areas such as the Paris and Aquitaine Basins, the failure rate over a 15 year period (1982-1997) was less than 13% including partial failures.

3) Similar risk mitigation measures were also taken by the German's government. The risk mitigation for geothermal projects is nationwide covered by the Renewable Energy Incentive Program MAP (*Marktanreiz-programm*). 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. The first exploration risk insurance in Germany was signed for the project *Unterhaching in the Molasse Basin.*

Since 2009, geothermal project developers in Germany can choose between two options of mitigating their exploration risk, namely the federal risk mitigation scheme administered by the KfW and private market-based insurance solutions. The KfW risk mitigation scheme combines both project financing via a credit and mitigation of exploration risk in one program. The risk coverage consists of a loan being forgiven if the project is unsuccessful. When a project is able to find a clearing bank willing to submit the application forms to the KfW, the fund will most likely be granted. The difficulty in finding such a bank however, is a serious pitfall for the program. Another problem of the KfW program is the uncertainty of interest rate prior to loan promise.

The private market sector for exploration risk insurances is covered by insurance companies acting as a direct, unique insurer on the one hand and insurance brokers distributing the risk between one leading and several contributing partners on the other hand. Both

[1] S. Bézèlgues-Courtade *The French Geothermal Risk Guarantee System*, Der Geothermie Kongress, Karslruhe, 11-13 November 2008.

individual insurance companies and the brokers offer coverage for singular projects as well as frame contracts to developers with several projects. 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.

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.

4) The World Bank has established two programs for East African Rift Zone (the ARGeo Program in 2008) and for Europe and Central Asia region (the GeoFund Program in November 2006). The two programs provide funding to complete feasibility studies, remove legal, institutional and regulatory barriers, develop in country and regional expertise and share much of the risks associated with exploration and reservoir confirmation drilling. The centerpiece of these programs is the geological risk mitigation instrument; i.e. Geological Risk Insurance (GRI) for the GeoFund Program and Risk Mitigation Fund (RMF) for the ARGeo Program. The GRI and RMF will provide an insurance-like contingent support to specifically assist in mitigating exploration and drilling risk and are thus expected to improve access to project funding for public and private developers and play a catalytic role in establishing geothermal energy as a strategic option.[2]

Geological Risk Insurance for Indonesia

From the preceding discussions, one may see that the insurance guarantee schemes in Iceland, France and Germany and East Africa proved to be successful to overcome many obstacles in the deployment of geothermal energy. In all of those countries, the role their respective government in risk transfer policy has been instrumental to their success. Needless to say, while the business sector in Indonesia will continue to find the solution to mitigate the risks associated with geothermal energy development, it will not be fair to leave the searching entirely to the private sector. As no standards have been established for this kind of insurance, the use of insurance scheme as risk mitigation would require co-operation between project developer and insurer. 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.

For Indonesia, the risks that may be transferred to the insurance market can be identified and they are as follows:

1) The risk of not finding the heat arising from error in zoning design, lack of data or data analysis error;

2) The risk of not finding the economically viable reserve of heat;

3) The risk of drilling in geologically dangerous zone such as when there is an error in classifying the rating of volcanic eruption exposures; and

4) Other geological risks when there is an error in analyzing the contents of dangerous elements in a geothermal field.

A recent study conducted by Agence Francaise Developpement (AFD) (based on data supplied by PENC) indicated that the insurance scheme has some advantages, including could help in attracting external capital thereby more projects could be covered in the same time and best option to secure the sustainability of the facility. The drawbacks are external financing are still needed and the system is complex to be administered.

Moreover, as insurance for geothermal development is still unknown in the local market, the objective is how to transfer what are known as non-insurable risks to insurance market or some other form of risk transfer mechanism. In order to find out the answer, we have to find out whether or not a risk is treatable or a non treatable risk. Non treatable risk would usually requires it be absorbed and finally be accepted. The treatable risk may be transferred or retained. When it is transferred or retained, the risk may be avoided, prevented, reduced or accept.

Pursuant to item (1) of Article 21 of the Government Regulation No. 73/1992 on Implementation of the Insurance Business,

[2] Bloomquist, R.G.; Petty, S; and Wagner, Roger; *Geothermal Risk Mitigation Instrument and Incentive Program*, World Bank, September 2007.

insurance premium rate is set based on a healthy risk calculation. Also, under Article 19 of the Finance Minister's Decree No. 422/KMK.06/2003 concerning Insurance Companies and Reinsurance Companies, the calculation of the insurance premium has to be based on the prudent assumption and the generally applicable insurance practice. The decree also governs that setting of the general insurance rate has to take into account at least the following:

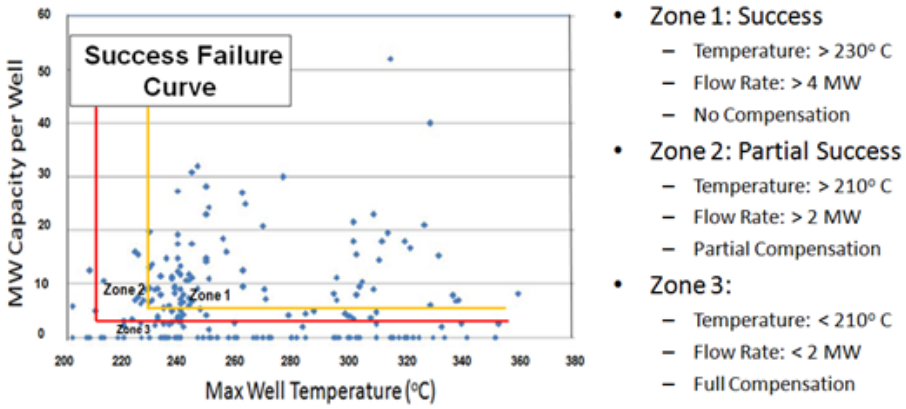
1) Basic (pure) premium calculated based on risk and loss profile of the respective insurance line for at least 5 consecutive years;

2) Acquisition costs, administration costs and other general expenses.

Furthermore, the appropriate premium rate for geothermal exploration risks may be determined by the statistical calculations on the probability of success of a project at a specific site in certain area. Based on Subir Sanyal's study the success rate of drilling has been in the range of 63% to 73%. Figure 1 shows the result of drilling in Indonesia plotted as wellhead temperature versus capacity.

Note that the Sanyal' study relies on the resource base estimates for nearly 100 sites, and productivity data on 215 wells in the country, representing some 80% of the production wells drilled in Indonesia.[3] The majority of data came from drilling results in Java and Sumatra thereby it is not applicable for low enthalpy geothermal sources in East Indonesia.

Figure 1



Indonesian insurance market is familiar with setting up pool to overcome lack of insurance and reinsurance capacity especially for undesirable risks or catastrophic risks such as the earthquake and volcanic eruption risks or traditional market (pasar) risk and an insurance pool for tree crop and industrial forest. It has proven that pool set up has been able to increase local insurance market capacity and provide better stability to the availability of capacity and price albeit without any financial support of the government. However, the failure of oil and gas insurance pool that would cover more attractive risks compared to unknown and hence perceived as being higher geothermal exploration risks may indicate the importance of government's financial commitment and direction to ensure that should an insurance pool would be selected as a solution to providing insurance capacity to cover geothermal exploration risks. The small limit of each insurance pool currently in operation of US$ 2.5 million and approximately US$ 5 million respectively for earthquake and volcanic eruption insurance and pasar risk are clearly small for the magnitude of exploration costs to be incurred for each exploration work.

Moreover, Item (2) of Article 8 of the Law No. 2/1992 concerning Insurance Business dictates that placement of insurance objects in Indonesia has to take into account the local capacity and local reinsurance companies. Under the Government Regulation No. 73/1992, it is further regulated that any insurance object in Indonesia must be insured with insurance companies licensed to operate in Indonesia except when there is no insurance company, acting alone or in conjunction with other, having the capacity to retain the insurance risk, there is no insurer prepared to insure such insurance object or the insurance object does not belong to Indonesia citizen or entity founded under the Indonesian law. Without an insurance pool or any other form of actions that would provide insurance or reinsurance capacity for geothermal exploration risks in Indonesia, it will be permissible to insure such risks directly overseas that regrettably would prevent the local market to learn and experience and accumulate technical

[3] Subir K. Sanyal, et. al., *Geothermal Resource Risk in Indonesia – A statistical Inquiry*, 36th Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, 2011.

knowledge in providing insurance cover for the risks in addition to contributing further to the ever increasing flow of reinsurance premium overseas.

Success Criteria

In introducing the risk insurance scheme for geothermal activities in Indonesia, it is important to establish prerequisites of first exploration drilling and success criteria of the first exploration well, which will be as follows.

1) Prerequisites of First Exploration Drilling

Before the first deep full size exploration well to target depth is drilled the following information should presumably be available, as part of normal geothermal exploration, and form the basis for the risk mitigation scheme for the first exploration well.

a) Results of literature review, including regional geology, regional tectonic, structural geology and aerial photographs and satellite images;

b) Results from geological field work, showing mapping of important geological features, such as geothermal surface manifestation, fluid chemistry and temperatures profile.

c) Results from geophysical exploration activities, including resistivity measurements (Magneto Telluric - MT) and seismic profiling covering the geothermal; reservoir rocks.

d) Results from shallow exploration drilling, including temperature gradient well.

2) Success Criteria of the First Exploration Drilling

The purpose of the first deep full size well is to prove the existence exploitable geothermal and to determine if the geothermal field can be utilized in a power plant. The three parameters that may be used as success criteria for the first deep full size exploration well are the temperature, flow rate and fluid acidity:

a) The minimum temperature for steam power plan to run efficiently is about 200^{o}C;

b) The MW benchmark has to be determined on a case by case basis and based on available information on the geothermal reservoir before the drilling of the well. For example, first exploration well drilled in a geothermal system might for example be considered successful if it provides 3 MW of electrical power with 15 bar well head pressure.

c) Fluid with pH value of less than 5 is considered corrosive and could be considered as a benchmark for fluid acidity.

The other parameters, scaling and the presence of non-condensable gases does not impose significant constraints on geothermal development, but will impact operation and maintenance cost of geothermal project. The reservoir temperature and the well power output can be estimated quantitatively easily, but the chemical parameters can only be estimated qualitatively at this stage.

Figure 2

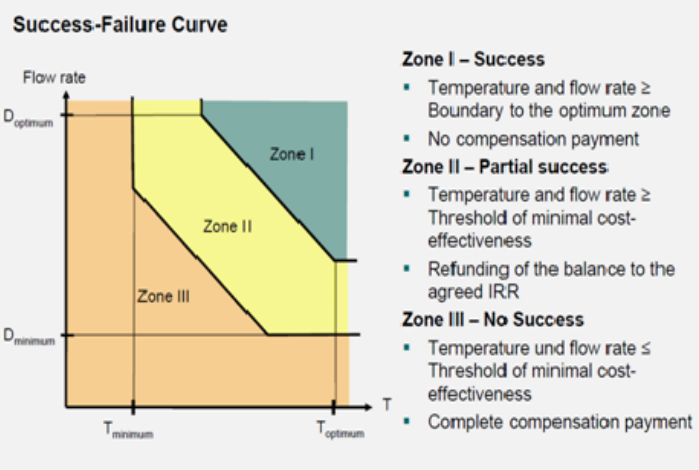


Figure 2 shows the success-failure curves as used in the Short-Term Risk (STR) insurance mechanism in France's Partial Risk Guarantee

Program for Geothermal. The exploration drilling results may be divided into three zones based on temperature and reservoir capacity. They are calculated on the basis of the project's economic sensitivity study, i.e. no compensation for total success, partial compensation to reach profitability for partial success and full compensation for total failure.

Conclusions and Recommendations

The risks associated with geothermal development have served to severely limit the availability of conventional financing to conduct exploration and development activities. In order to accelerate the use of geothermal energy, Indonesia shall establish programs aimed at minimizing or at least substantially reducing the financial risks of exploration and development. Insurance programs have been the centerpiece of risk reduction programs in some countries. Its capacity will grow as the exploration activities in Indonesia's geothermal development increases and shows acceptable level of proven success.

As insurance coverage for geothermal exploration and development is still unknown in Indonesia's market, its introduction would require actuarial techniques to assist in determining the calculation of the insurance premium. Such actuarial calculation will have to be based on the prudent assumption and the generally applicable insurance practices, and will require reliable statistical data on the probability of success of a geothermal project at a specific site in certain area.

It is recommended that INAGA updates a statistical study on the geothermal drilling results to be used in designing the insurance scheme for geothermal exploration and conducts capacity building for the insurance industry. Keeping in mind that in all countries that have been successfully developed geothermal energy resources, their respective government have been actively involved in providing incentive policies including insurance or other kinds of risk transfer and given the critical need for Indonesia to find alternative energy, it is strongly recommended for INAGA to discuss the Indonesian Government to set a policy that would expedite the geothermal energy development in Indonesia.

References:

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