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RISKS MITIGATION THROUGH INSURANCE SCHEME IN THE GEOTHERMAL ENERGY DEVELOPMENT PROJECT

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ABSTRACT

Geothermal exploration, development and operations are subject to uncertainties which vary among different geothermal reservoirs. Insurers and reinsurers have been providing many of the traditional risk management products for the petroleum industry to the geothermal industry, such as property damage, business interruption, machinery breakdown and construction – all risks. This paper discusses feasibility of extending the insurance coverage against non- traditional geothermal risks.

Some insurance schemes have been developed in the other parts of the world deal with the resource supply risk associated with the drilling of geothermal wells. For example, in order to promote the development of geothermal energy sources, World Bank has introduced Geothermal Energy Development Fund (GeoFund) for the Europe and Central Asia (ECA) region. As part of the program, the World Bank-GEF has created Partial Risk Guarantee Facilities (PRGF) which are 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.

This paper discusses the possibility of setting up in Indonesia a similar insurance scheme in conjunction with third party to cover risks in initial exploratory drilling. This may involve private as well as State Owned Enterprise (SOE) to provide a layer of coverage within the insurance scheme. The intention is for the insurance coverage to cover multiple parties that have different tasks in the process. Subsequently, there would be a need to define the criteria or parameter to determine the indemnified loss, extent of the guarantee, scope of coverage, amount of liability limit of risk carrier, types of risk carriers and risk transfer model. Various incentives may need to be developed to make the program attractive for the insurers and reinsurers to participate. If successful, the insurance scheme may stimulate other business activities in supporting Indonesia's geothermal development.

Introduction

Geothermal energy is abundant in Indonesia, thereby it has great potential as a substitute to coal and other polluting fuels. From a technological point of view, the geothermal technology is mature, robust, and can be commercially viable in an enabling regulatory and market environment. Also, as the operating cost of a geothermal system is relatively low, the costs of heat produced from a geothermal source are competitive once the basic infrastructure is in place. However, the initial up-front capital costs for both exploration and development often create a substantial first-cost barrier.

Geothermal exploration, development, and operations are also subject to uncertainties which vary among different geothermal reservoirs and are similar to those typically associated with oil and gas exploration and development; however, there are several significant differences. While potential oil and gas resources can be identified with much confidence prior to drilling through the utilization of available geophysical techniques, they are not as effective and do not provide the same level of confidence in defining geothermal reservoirs as they do in oil and gas exploration. The results of preliminary surveys often would still not be able to answer questions such as what is the size and temperature of resources and how does the quality of the reservoir. The depth of production wells and the

average production capacity are critical values in the design of a geothermal power plant, and business profitability depends largely on these values. These numbers are never the same for different geothermal power plant sites.

For this reason, as a key risk mitigation and management strategy, it is necessary for geothermal energy project investors to adopt a phased approach associated with their geothermal exploration and development activities with a clear decision point at the end of each phase before proceeding to the next phase. This paper discusses insurance schemes in conjunction with third parties to cover risks in initial exploratory drilling, and its possibility of setting up in Indonesia a similar program. The program should drive significant funding into the high risk period of geothermal development, when the limitations on capital sources currently impinge the number of sites being investigated and developed.

Risks Factors in Geothermal Project

Table 1 lists various types of risks in geothermal energy development project and their respective consequent.

Table 1
Type of Risks in Geothermal Energy Project *)

Type of Risks	Phase	Probability	Consequent
Geological/Reservoir			
Identification	Exploration	Frequent	Major
Field Survey	Exploration	Frequent	Major
Drilling (exploration/delineation)	Exploration	Frequent	Major
Development Drilling	Development	Frequent	Major
Reservoir Capacity & steam quality	Development	Frequent	Major
Higher Investment Cost	All phases	Frequent	Significant
Operational:			
Blowout & re-drilling	Drilling	Rare	Major
Pollution	All phases	Occasionally	Significant
Construction Permit	Development	Probable	Major
Construction Schedule	Development	Probable	Major
Reservoir Capacity & steam quality	Operation	Occasionally	Major
Equipment Breakdown	Operation	Probable	Significant
Prop. Damage/Business Interruption	All phases	Probable	Significant
Force Majeure	All phases	Rare	Major

*) From various sources

Some of the above risks may be covered by standard insurance policies and these are:

1) Drilling risk, which is associated with the drilling process due to technical problems with the equipment. It includes e.g. the risks of losing equipment inside the borehole and the risk of a blocked drilling string. The risk also includes the costs of geothermal wells, which vary depending on the geological nature of the reservoirs, the depth of the wells to be drilled, the local regulatory authorities, and the available well drilling service industries involved. Since the geological environments associated with geothermal resources are typically characterized by high temperatures and somewhat corrosive geothermal fluids, as well as hard and abrasive reservoir formations found in geothermal environments, geothermal drilling is much more difficult and expensive than conventional hydrocarbon drilling.

   In addition to the drilling expense, the key risk issue associated with drilling is the "blow out". Based on data, less than one percent (<1%) of the drilled geothermal wells in the United States and other parts of the world have resulted in "blow outs". The risk associated with the drilling of hydrocarbon wells is much greater; in fact, some oil and gas blow outs have continued for periods of months and even years before they were controlled. In geothermal operation, there is indeed no risk of fire as with hydrocarbon wells, only the control of hot water. Nonetheless, such hazard of uncontrolled flow of hot water is

considered drilling risk and must be prevented to cause damage to environment.

2) Field development and construction risk, which is only present in the feasibility and the design and construction phase of the project development and very similar to the risk associated with all other power plant projects. While not all are insurable the risks include the traditional market risk, legal risks, cooperation with suppliers of equipment and services, environmental risk, risk of time schedule and budget as well as risks connected to site such as construction risk, geological risk for building, weather, for majeure and the findings of archeological remains or endangered species that could pose a risk to the time schedule. Like the drilling risks, insurance companies offer standard policies to cover the development and construction risks.

3) Geological hazards.

   This type of risk is associated with eruptions, seismic events, landslide and flooding. The volcano that is the heat source for the highly enthalpy geothermal system can be active, as the case with Indonesia where most of the high enthalpy areas are in connection with volcano activities. Therefore it is important to know the eruption history in order to assess the risk and have evacuation plans available during both development and operation.

   The earthquakes may change the reservoir and cause damages to subsurface and surface equipments. Consequently, many types of equipment today are designed to withstand the impact of earthquakes; also, there is design standards that were developed based on experiences.

Also, there are risks that are insurable but they are not covered by Standard Insurance Policy. These include the following:

1) Geological or Resource risk.

   Geological is an inherent element in any venture dealing with mineral resources. It consists of non-finding adequate resources (exploration risk), operational problems during the drilling (drilling risk), declining production capacity (reservoir risk) and geological hazards. The geological risks are present during all phases of the project development and throughout the project life time. The risk is obviously very different for each natural resource technology and the risks for a failed geothermal well are particularly costly. This may include that the anticipated temperature and/or flow rate is not encountered in the geothermal wells that have been drilled and tested.

2) Operational risks.

   The operational risks are found during the commercial operation. The risks are concerned with the geothermal resource management and the operation of power plant. The objective of resource management is to enable a continual delivery of adequate geothermal fluids, as the risk of interruption or changes to the geothermal fluid flow is present throughout the operation of the geothermal field. The need to monitor the resource is constant in order to succeed in a sustainable utilization of the renewable reservoir. This includes improving the natural productivity, or to recover lost productivity through various techniques. Considerable progress of well stimulation has been made for oil and gas industries however there is still a prominent need to develop technical expertise in areas directly related to geothermal well stimulation technologies. Finally, it is also important to monitor and survey the resource in the event of seismic activities in the area since they are known to affect the reservoir in positive or negative way or manner.

3) Economical risks.

   Such kind of risks becomes more significant after commitment is obtained for development and construction phase and may be present throughout the lifetime of the commercial phase. These may include price increases, reduced electricity tariff, etc.

In addition, there are Political Risks, which is associated with possible negative events such as expropriation of assets, changes in tax policy, restrictions on the exchange of foreign currency, or other changes in the business climate (labor unrest, land matters, securing permits). They may also deal with the regulatory and environmental and social risks associated with investments, which can add to the uncertainties of doing business in geothermal energy development. The regulatory changes and inconsistencies in the Government's policy have caused legal uncertainties that inhibited the geothermal resource development. The example includes delays in obtaining land clearing, causing delays in the commencement of geothermal projects in a number of new WKP's.

Note that for Indonesia's IPP projects prior to the monetary crisis (1997) such "insurance

coverage" was issued in the form of the Government's support letters. To provide comforts for the lenders, the project owner received two Support Letters issued by the Government of Republic of Indonesia. The letters guarantee that the Government will cause PLN, its successors and assignees, to discharge PLN's payment obligations as due and payable and unsatisfied by PLN and to ensure that PERTAMINA, its successors and assignees, will continue to perform its obligations under the terms and conditions as set out in the JOC.

Role of Government in Risks Mitigation

As the geological risk is considered to be the largest obstacle for the geothermal projects and are not covered by the Standard Insurance Policy, Government in some countries provide support in the development of their geothermal resources by taking over the risks in the exploration stage. Table 2 lists various geothermal risk mitigation measures or programs in various countries.

Table 2
Risk Mitigation Measures

Country	Programs
New Zealand	Government conducted early exploration (1950's)
Philippines	State Owned Enterprise (PNOC) conducted initial exploration (1970's).
Iceland	Establish Energy Fund to promote geothermal resource utilization
Japan	NEDO (semi-government agency) is carrying out advanced studies in areas selected from across Japan likely to hold geothermal resources, included preliminary survey, geology, geochemistry and geophysical surveys and drilling.
France	Provide Guarantee Facilities (since 1981 and reactivated in 2006). The system is a financing fund to cover the geological risks, based on two complementary mechanisms (Short-Term Risk for exploration and Long-Term Risk during exploitation) and addressed to deep geothermal drilling for direct heating and/or electricity generation.
Germany	Drilling Insurance facilities (2009) by Federal Government and Private (for over 400 meter depth).
Switzerland	1987-1997: Risk guaranteed system for geothermal drilling up to CHF 10 million. In 2008 it was replaced by Governmental risk coverage system. It is applicable only to pure geothermal The maximum guarantee is 50% of the subsurface costs (drill site, well drilling and completion, pumping tests and reservoir stimulation;
World Bank	Geothermal Energy Development Fund (GeoFund) for the Europe and Central Asia (ECA) region. As part of the program the World Bank-GEF has created Partial Risk Guarantee Facilities (PRGF), which were primarily designed to encourage entities in the ECA region to explore for and drill geothermal exploration wells to develop geothermal resources for electrical generation and/or direct use applications.[1]

[1] World Bank, *GEF Geothermal Energy Development Project in Europe and Central Asia and its Geothermal Energy Development Fund (GeoFund)*, Global Environment Facility, 2003

The World Bank's PRGF is a partial risk facility with well-defined (covenanted) risk coverage. The facility will earn interest while no covenanted event occurs, thus compensating in part against outlays occurring when a covenanted risk materializes. The PRGF will apply to the specific geological risks associated with the drilling of the initial exploratory well at a geothermal prospect. However, the facility will not be applicable to preliminary works, including the geothermal resource study, field reconnaissance survey and exploration surveys.

For commercially successful geothermal projects, the PRGF cover should be repaid to the GeoFund with interest to maximize the financial sustainability of the PRG portfolio in the GeoFund. With this approach there will be a continual replenishment of the funds to apply to geological risk associated with additional geothermal electrical generation, and/or direct use, projects.

Each of these geological risks associated with exploratory well drilling must be evaluated by designing and completing measurements, during a geothermal well test program. The determination of success and failure of the exploration drilling activities will be based on the ability of the geothermal well to produce the necessary quantity and quality of geothermal fluids to fuel the proposed geothermal electrical generation project and/or the proposed direct use application. The guarantee coverage will be defined against the key parameters of the geothermal energy production such as reservoir temperature, wellhead pressure, wellhead flow rate, geothermal fluid chemistry, etc.

In addition to short-term, the facility also cover 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. The coverage is linked with geothermal performance of the guaranteed production and/or injection well, a scoring model needs to be established based on the estimated (i.e., predicted) and actual geothermal data such as wellhead temperature, wellhead flow rate, estimate of permeability, geochemical analyses of geothermal fluid and non-condensable gasses.

Like World Bank's PGRF, in France the Government has also established financing system to cover geological risks, which is based on two complementary mechanisms, namely:

1) Short Term Risk Procedure (STR) involving the guaranteeing the results of the first well drilled, namely flow rate and temperature. The exploration drilling results may be divided into three zones based on temperature and reservoir capacity, as shown in the Figure 1 (SRT Risk Principle). 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.

2) Long Term Risk Procedure (LTR), which begins at the starting-up of the facilities and guarantees the sustainability of the resource and the risk of total or partial depletion during 15 years of operation.[2] The level of compensation depends on the drilling exploitability's degradation, namely:

   a) Partial damage (the exploitation is still economically viable after repairing), in which the compensation is calculated according to the plant's lifetime and its power loss according to the contract reference;

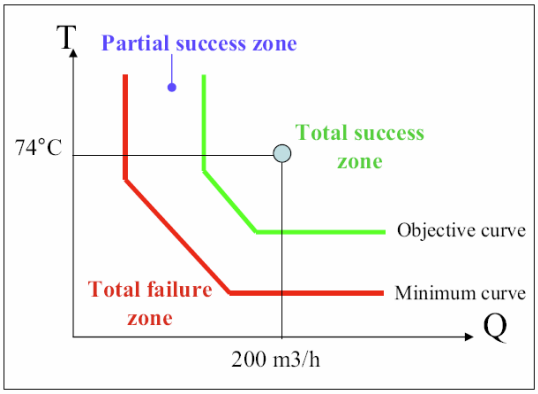
   b) Total damage (non repairable damages or accidents – the exploitation is no more economically viable), in which the compensation is calculated according to a contractual ceiling and the plant's residual value.

In order to manage the risk fund the French Government established SAF – Environment. In addition to public funds, the balance of the fund is ensured by owners of geothermal plants (public or private) through initial payment and annual contribution and financial products of investments. The schemes proved to be successful, overcoming many obstacles for the deployment of geothermal energy. The guarantee system overcomes the hesitations of bankers to offer loans.

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

Figure 1

Short-Term Risk Principle



Insurance Scheme for Indonesia's Venture

From the preceding discussions it may be concluded that there are essentially two conceptual approaches that the Government of Indonesia (GOI) may consider in mitigating the risks in geothermal resource in order to accelerate the development. The first approach is through the funding mechanism by establishing a revolving fund to support direct participation in the initial exploration activities. Such an approach is being executed in Indonesia by the Government's decision to allocate annually USD 125 million in the State Budget for the next five years for financing the initial geothermal exploration activities (Geothermal Fund/GF).

Under the Ministry of Finance Regulation Nr. 1 Nr. 01/PMK.011/2012, the GF will be managed by Pusat Investasi Pemerintah (PIP) or Government Investment Centre. The initial exploration includes geological, geophysical and geochemistry surveys and drilling initial exploration well(s). The purpose of the fund is to enhance the existing geological data in a pre-selected area, before being offered for tendering of the Geothermal Working Area (*Wilayah Kuasa Pertambangan* or WKP).

The enhanced data should make the geothermal risks more defined and manageable when the WKP is offered for tender, which could result in obtaining better and affordable electricity price. The costs of conducting the survey and initial exploration would be recovered, in the various forms, including data compensation to be paid by the participants in the tender process and reimbursement of the drilling costs by the winner.

The GF expended for the field data acquisition is expected to be incrementally offset with the proceeds from the sale of data acquired, so the fund to be at least self-sustaining. The GF shall be made available to support the GOI's program on Public Private Partnership as stated in the Presidential Regulation Number 13 of 2010. The GF will also be made available as a loan for exploration (including drilling wells) of geothermal resources that have been listed in the GOI's accelerating project.

The second approach is through insurance mechanism by creating Partial Risk Guarantee Facilities (PRGF) to cover the geological risks, such as those applied in the United Nation's PRGF or insurance program from France and Germany. The insurance program would be designed to provide a vital enhancement on private capital mobilization into geothermal energy development projects by mitigating the geological risks during exploration well drilling and during operation of geothermal wells for the initial years of the project.

The risks and scope of guarantee or Insurance Coverage to include the following:

1) Failure to find heat, due to lack of data and inaccurate setting of prospective zones and inaccurate data analysis.

2) Failure to find reserves capable to produce required heat for the planned capacity.

3) Encounter technical difficulties during the drilling, such as volcanic eruption, dangerous gas, and other geological hazards.

The above parameters need to be determined before an occurrence can be classified as an insured loss or damage. Also, some risks that may not need to be insured under the program; these include the ordinary coverage available in the insurance market (such as loss of or damage to equipment used for the

exploratory drilling), insurer's liability limitation (to be agreed by the parties) and risk retention (the company will bear as its own risk certain percentage or monetary sum on any claim lodged with the Insurer).

Insurance coverage for geothermal 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. The actuarial techniques will require reliable statistical data on the probability of success of a geothermal project at a specific site in certain area.

Given that substantial geothermal wells have been drilled in Indonesia, such statistical well data should be available. However, such statistical data may not be readily available and need to be compiled for actuarial analysis. Also, while this would probably be true for Java and Sumatra; especially in regions with only few experiences and data, like the East Indonesia, calculating a reliable statistical possible of success in the conventional way will be difficult or impossible.

It is equally important to study the possibility of setting a risk sharing mechanism among the stakeholders to carry the risks such as the set up of an insurance pool that can be combined with the support from the reinsurance market. It is noted that 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 risks 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 its viability should an insurance pool would be selected as a solution to providing insurance capacity to cover geothermal exploration risks. This may include providing some forms of incentives to be made available to any insurers or reinsurers participating the program. The insurance program will involve searching for a number of strategies such as the possibility of having a national insurance pool, either in coinsurance or reinsurance form or combination of both forms. Either one may be structured to be on proportional or non proportional basis depending on the appetite of the insurance and reinsurance market toward the geothermal exploratory drilling risks. Insurance capacity will grow as the exploration actitivities in geothermal development in Indonesia increases and shows acceptable level of proven success.

In order to provide higher assurance to prospective investors toward the reliability of the enhanced data reports, government can also turn to Professional Indemnity (PI) insurance market to provide coverage against loss or damage that the investors using the reports may suffer during the exploitation phase arising out of errors and omissions by the surveyors preparing the reports. This insurance type is commonly available in the local market for non geothermal risks albeit most likely would still require reinsurance supports from the international market depending on the limit of liability to be effected. PI policy is suitable to insure the risks of professional negligence (errors and omissions) for the like of engineers, surveyors, architects, lawyers, public accountants, doctors, insurance brokers, stock brokers and even for commercial banks.

Political Risks

Another type of risks that may be faced by investors in the geothermal energy development is the issue of political risk involving regulatory changes and inconsistencies in the government's policy. To foreign investors his may be associated with possible negative events such as expropriation of assets, changes in tax policy, restrictions on the exchange of foreign currency, or other changes in the business climate. Political risks insurance is commonly available to protect the interest of foreign investors. Regulatory changes and inconsistencies have caused delays in the program execution. However, to the domestic investors, the regulatory and environmental and social risks associated with investments that can add to the uncertainties of doing business in geothermal energy development have yet to be addressed".

Conclusions

The preceding discussions may be summarized by the following conclusions:

1) The development of geothermal resources may be accelerated by providing exploration risk insurance, which will provide the developer with financial security for the venture capital needed until the completion of drilling works

and successful well testing. Proof of risk coverage also facilitates the acquisition of loan capital.

2) 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 forgiven if the project is unsuccessful up to the available insurance limit provided.

3) As insurance for geothermal development is still unknown in Indonesia's market; its introduction would require actuarial analysis to determining the 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.

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