

## Geothermal Well Drilling Services Contracts

Hagen Hole

Geothermal Consultants NZ Ltd., Birkenhead, Auckland, New Zealand.

### ABSTRACT

The contract environments that are currently utilised by the geothermal well drilling industry range from unit time rate, unit metre rate, through to turnkey contracts. This paper reviews the associated benefits and drawbacks of these various contract formats.

*Keywords: geothermal, drilling, drilling services contract.*

### INTRODUCTION

Iceland's current geothermal drilling operations are being executed under drilling service contract structures which are predominantly metre-rate and 'turnkey' in nature. This is in contrast to the contract environments currently adopted in recent New Zealand, Kenyan and Indonesian geothermal drilling operations which are predominantly 'unit time rate' contracts.

### COMPONENTS OF A GEOTHERMAL DRILLING OPERATION

Any geothermal drilling operation includes a wide range of activities and processes all of which must be provided and executed. These activities and processes will include, but not necessarily be limited to:-

- Reservoir engineering and well targeting
- Well design and specification
- Drilling materials specification and procurement
- Well pad, access road civil design and engineering
- Water supply design and engineering
- Civil construction supervision
- Well drilling engineering and supervision
- Provision of drilling rig and equipment
- Provision of drilling personnel
- Provision of top drive unit and personnel
- Provision of cementing equipment, personnel and services
- Provision of directional drilling equipment and personnel
- Provision of mud engineering personnel
- Provision of aerated drilling equipment and personnel
- Provision of mud logging / geology equipment and personnel
- Drilling tool rental
- Drillpipe inspection
- Drillpipe hard-banding
- Provision of well measurements equipment and personnel

These activities and processes may be provided to an Owner under a large number of totally separate and discrete service contracts, or conversely under one lead contract, or any mix between these two extremes.

An Owner who desires to drill a geothermal well, will have to decide on what contractual basis each and every one of these activities and process is to be provided. The level of control, responsibility and risk that the Owner wishes to take, will determine the mix between having many separate contracts or just one lead contract.

### GEOTHERMAL OWNER RISKS

Owner risk could be defined as the 'potential cost to the Owner if the actual outcome of an operation does not match the planned and expected outcome'.

An Owner carrying out a geothermal drilling operation is faced with a number of risk components. Unlike a building or civil construction project, a drilling operation involves a significant 'unknown' factor.

A building or civil construction project is generally carried out on the basis of a 'blue-print' – a detailed plan of exactly how the construction process will occur and be completed. While the 'blue-print' can never totally eliminate all unknowns, the majority of the activities relate to 'visible' and tangible situations.

In comparison a drilling operation is based on a 'nominal' programme, which is based on 'best estimates' only, and deals with 'invisible' and 'interpreted' situations.

### RESPONSIBILITY, CONTROL AND RISK

The 'scope of work' of a drilling services contract will define clearly the split of responsibility between the Owner and the Contractor.

For example, the contract may define that the Contractor is responsible for maintaining sufficient fuel on the rig site to ensure no interruption in the drilling activities. The contract may define that the cost of the fuel is carried directly by the Owner, or by the Contractor who shall be reimbursed with an appropriate mark-up. The responsibilities, as defined, place control of ordering and procurement of fuel with the Contractor. The Contractor carries the operational risk that in the event that he fails to maintain sufficient fuel on site and drilling operations are effected then he will be penalised accordingly – most likely he will not be paid for the period of lost time.

June 2008

The Contractor will factor into his fee structure an amount to cover the possibility that he will be penalised at some stage.

Operational responsibility, control and risk are all interlinked. Operational responsibility implies operational control, but imposes operational risk, as depicted in Figure 1.

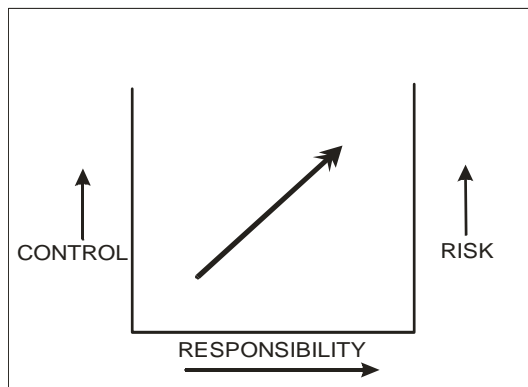


Figure 1. Responsibility, Control and Risk Matrix

An Owner who may decide to take technical and managerial responsibility, receives operational control but must accept the consequential risk.

This situation is implied when an Owner selects to enlist all, or a significant proportion, of the activities and process under separate and discrete contracts.

Typically an Owner may have within its own resources a geoscientific and engineering capability (or separately contracted these capabilities through a consultant). The reservoir engineering and well targeting; the well design, materials specification and procurement; the drilling pad and access road civil design and construction supervision; and finally the drilling engineering and drilling supervision, will all be provided by the Owner through his 'in-house' or consultant capabilities.

The drilling services contract in this scenario would typically be a simple unit day rate contract – the Owner is simply renting the drilling equipment and personnel required to operate it. The Owner is fully responsible for instructing the Contractor through each and every step of the operation, and has total control on how each step will be performed. The Owner carries all the operational responsibility, and of course all the operational risk. If there are some downhole problems and delays to progress, the Owner continues to pay the daily fee rate.

In contrast to this model, the Owner may decide that the operational responsibility and control should lie totally with the Contractor, a contractual model generally termed 'Turnkey'. In essence the scope of work given to the Contractor could be – "drill me a geothermal well in this particular place into this particular reservoir – come back and tell me when it is finished". The Owner may have no 'in-house' technical capability, and may not have the required

managerial resources. The Contractor in this case, is totally responsible, has full control of how and when activities occur, and carries all of the operational risk.

The price the Contractor will charge the Owner will include an amount to cover the equipment rental and personnel, a management component, and an operational risk component – these management and risk components can be significant.

### THE COST OF OPERATIONAL RISK

In comparing these two extreme contract models the costs of the equipment rental and personnel components should be the same.

The cost of the management component should be similar, either the Owner pays for his own resources or he contracts them in either through a consultant hired directly by the Owner, or through the Contractor.

It is the cost of the operational risk component that will be significantly different. In the case where the Owner takes full responsibility, he will incur costs associated with risk only in the event that a problem occurs. The Owner will pay for additional rig time only in the event that there is a problem causing a delay.

In the Turnkey contractual model, the Contractor will have to assess the likelihood of problems occurring, and will build into his price a component to cover such an occurrence. Of course his objective will be that he will 'manage' the operation successfully and avoid problems, turning the operational risk component of the price into a pure profit component.

The difference to the Owner is that he will pay the operational risk component whether a problem occurs or not.

### DOWNHOLE RISK

A significant sub-set of geothermal drilling operational risk is the downhole risk – the risk of losing drilling equipment down the hole, and the risk of losing the hole itself in part or in full. Typically, drilling contracts pass the downhole risk, in full, to the Owner. That is, any damage to or loss of equipment that occurs below ground level, and any damage to or loss of the hole itself is generally always to the full account of the Owner. The only exception will be when proven negligence by the Contractor can be shown to the cause of the loss.

In Turnkey type contracts there is often a proportional responsibility, where even though the Contractor has full responsibility and control of the operation, some proportion of the cost of covering the downhole loss or damage will be borne by the Owner.

## RESOURCE RISK

Perhaps the most significant Owner risk is the production (or reinjection) success of the completed well, generally termed the resource risk. This form of risk is obviously extreme in the case of exploration and green-field wells, and will be inversely proportional to quantity and quality of the geoscientific survey work carried out. The resource diminishes as understanding of the reservoir structure and the nature of the resource and formation increases. With each well drilled and completed comes a better understanding of the formations and the resource, resulting in the lowering the resource risk.

It is extremely uncommon that an Owner can pass the resource risk to others through a contract structure. One example where this can occur, is a steam production based drilling contract – where the Contractor is paid for drilling a well on the basis of the mass flow or the Megawatts of electricity produced from the completed well. This type of contract was used for a short period in New Zealand, but as far as the author is aware, with unsatisfactory results.

## CONSEQUENTIAL RISK

In the event that some significant drilling delay occurs or the productivity of a well or wells is not as expected, delays to commencement of planned generating may occur. The lost revenue, and possibly penalties for non-supply may be a result, and would fall into the category of a consequential loss. This type of loss is typically covered by insurance, but unless negligence can be proven, must be to the account of the Owner.

## FINANCIAL RISK

The Owner of a geothermal drilling operation will usually be constrained to a financial budget of some form while executing the operation.

If an Owner desires full technical control of a drilling operation and accepts the associated responsibilities and risks, this normally leads to some form of a unit time rate contract, which will impose a financial risk with respect to the budget. By definition a unit time rate contract is unlikely to be completed 'on-budget', there is a chance that the well be completed 'under-budget', and there is a financial risk that the cost of completing the well will exceed the budget.

The only way an Owner can minimise the financial risk is by converting all or part of the drilling operation to a fixed or 'lump sum' contract. Any 'conversion' to a fixed fee, shifts responsibility and therefore control back to the Contractor and away from the Owner.

## AN OWNER'S CHOICE

The Owner of a geothermal drilling operation is faced with balancing the level of technical and managerial control of the drilling operation he desires, against the level of operational and financial risk he is willing to accept.

## OBSERVATIONS

The trend observed recently in operations in New Zealand, Kenya and Indonesia, has been toward unit time rate contracting with owners demanding full technical and managerial control, with a willingness to accept the operational and financial risks.

The upswing in demand from the oil industry over the past five years has created a shortage of available drilling rigs and suitably qualified personnel, which has in turn hardened the market and reduced the willingness of drilling Contractors to accept risk unless significantly higher levels of compensation are offered.

As stated in the Introduction, this situation is in clear contrast to the current practice in Iceland, where it is evident that a unit metre rate contract structure that places significant operational risk with the Contractor is practiced and accepted by both Owners and Contractors.

The drilling Contractors that are, or were, operating in New Zealand, Kenya and Indonesia are without exception Contractors that operate predominantly in the Oil industry, with only relatively small involvement in the geothermal industry. It is evident that the reverse is the case for the Iceland based drilling Contractors.

## REFERENCES

Hole, H M., 2001, "Geothermal Drilling", Geothermal Institute, University of Auckland, Auckland New Zealand, Paper 665.620.