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Geothermal Drilling Contract, Scope of Work, Risk and Cost Factors

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ABSTRACT

The complexity of planning and starting a drilling operation is very often underestimated. Same goes for cost budgeting, which is very often undervalued especially for exploration drilling in green field and remote areas.

Drilling a deep geothermal well requires not only an experienced drilling contractor but also a number of specialized service companies, and material supply companies. While the drilling contractor supplies the main equipment, the rig, crew and associated equipment, a number of other service companies are involved, such as drilling fluids, casing running, cementing, logging and directional drilling specialists. All of this need's procurement, logistic coordination and management in order to prevent expensive delays or longer rental time. By using one "lead contract" or an "integrated contract", the Employer will simplify the whole project management, gathering most of the responsibility and coordination on the shoulder of one contractor, in our experience usually the drilling contractor. This will ensure efficient execution of technical and operational objectives, ultimately leading to reduced cost.

Variations in an integrated drilling service contract, which diverge from the traditional scope and risk factors does occur, mainly due to bargaining power of the developer. Such deviations may involve the increased risk and responsibility usually taken by the developer but can now be transferred to the drilling contractor for example. One example of this is the transfer of geological risk to the drilling contractor, which may result in financial loss due to hole instability challenges. Further in recent drilling tenders, project owners are requesting for additional scope of work and risk sharing, which has very little to do with the drilling technology or drilling operations. This is for example, various civil works which is required prior to the start of a drilling project, such as water supply, installation of a camp, fencing and security service, and even permitting and licenses for the operation. It is questionable if this type of civil works would be economically advantageous when placed in the hands of the drilling contractor.

1. INTRODUCTION

Due to fact that drilling takes a on a very large portion of the overall project cost, an understanding and knowledge about the nature of the operation and different options when it comes to contracting is a key factor when preparing for the drilling project strategy.

This paper provides understanding in this respect and input to the preparation of a geothermal drilling campaign. The focus is mainly on the contractual options for the drilling services. It does not cover the first phase of a geothermal project planning, such as surface exploration, environmental and social study, and licensing, nor does it cover financing issue.

To understand the different variations of drilling contracts and their main characteristics, it is first necessary to understand the processes and activities around a single drilling project. Therefore, it covers only the second and third phase when the developer needs to prepare the drilling operations and start preparing a drilling tender. The Geothermal developer, who is the owner of a geothermal concession (Employer), does have various options on how to prepare and manage a drilling project. Due to the high cost of the drilling operation and the risk involved, it is fundamental to be aware of the options and try to make relevant decisions to mitigate the risk, and to secure the economics of the project.

The author of this paper has been involved in geothermal projects as director of business development for 14 years working mainly for Iceland Drilling Company and as a private consultant. He has prepared a substantial number of drilling bids and negotiated many drilling contracts in ten (10) countries around the world.

2. PREPARATION OF A SUCCESSFUL DRILLING OPERATION

Project planning and management of a drilling operation has been a routine procedure within the Oil & Gas sector for decades. Specific norms have been created, and "standard" drilling contracts been produced and published. The O&G companies usually have teams of experienced people working in the engineering and procurement departments preparing for a drilling campaign.

The same cannot be said about geothermal concession owners (with few exceptions) who in most cases need to engage outside expertise to prepare for the drilling campaign and to procure the necessary services and material. This preparation can be divided into 3 phases:

Phase 1. Preparation

Geological consulting, such as surface exploration, "Reservoir engineering", well targeting, well design and specification. It also includes environment and social study, water supply engineering and design and rig site engineering (not specifically addressed in this paper)

Phase 2 Civil work, service and material procurement

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Drilling material specification and procurement, Drilling service specification and tender preparation, civil work construction, Rig site preparation and access roads. , Installation of a water supply system

Phase 3 Well drilling, Engineering and supervision

Hiring a drilling specialist (company man / drilling manager). Submitting a tender for drilling operation. Awarding and negotiation of a drilling service contract/s for the provision of Drilling Rig, crew and equipment and other services and consumable material such as casing, wellheads, cement, etc. Requirements for rig equipment and drill pipe inspection.

2.1 Risk factors

When preparing the tender documents or negotiating the drilling contract then it is the developer/employer who decides the level of responsibility they wish to take on. How can they simplify the whole operation and thereby better secure the economics, and is it worth moving some of the different services and material procurement related to a drilling project to only one contractor? Is it wise or possible to move some of the geological risk by applying meterage contracts, instead of day rate contract?

2.1.1 Operational risk

Operational risk may involve following situation during drilling operation:

- Cement plug / sidetrack
- Stuck pipe and unstable formation
- Fishing

If the Employer prefers to transfer the risk of the operation to the Contractor, then the Contractor needs to calculate that risk into the cost, based on a likelihood that challenges might occur. The contractor is then responsible for the operation and would make all effort to manage the operation successfully and avoid said challenges, turning the operational risk into a profit. However, if the employer takes full operational responsibility in a day rate contract he will have to bear the potential cost associated with the risk should challenges arise, or in other words additional rig time will be paid by the employer in the event of delays caused by unforeseen challenges.

It can easily be argued that a meter rate approach will not reduce the drilling cost, unless the contractor makes an error in the calculation. Further, a drilling contractor is reluctant to offer their service on a meter rate if the project is to take place in an unexplored green field area. This is due the difficulty and additionally risk of evaluating the drilling challenges without data from previous offset wells in the area.

A new trend has occurred in recent drilling tenders in Iceland, where Drilling contractor is asked to share defined downhole risk with the Employer. This is possible only due to the long drilling experience in certain fields, and therefore risk cost can be calculated based on the size of the contract. In normal market situations, the Drilling contractor is not able to take the risk unless adding the cost into his price schedule as explained in the paragraph above.

Moving other drilling services and material procurement on the shoulder of a one contractor will certainly reduce the operational risk for the developer. This approach which is called “Integrated Project Management” (IPM) or “Integrated Drilling Services” and is mostly chosen by companies who lack the in-house infrastructure and specific knowledge required. However this approach has and is still used in O&G industry today by several operators globally and so care should be taken to choose the right partner for the project type.

Drilling Service contracts should always have a clearly defined scope of work, not only in the main contract clauses but also in a very well defined appendixes named “Matrix of Responsibilities” which shows in a very simple format the split of responsibility between the Employer and the Contractor. The format of the matrix is very well defined, but the combination of the responsibility varies.

Just to take one example, the employer may prefer that the contractor maintain sufficient fuel on the rig site to ensure no interruptions of the drilling activity. This may be defined to be included in the day rate putting the risk of price fluctuations on the drilling contractor, or the employer may reimburse the fuel cost with an agreed mark-up. In the case the fuel is included in the day-rate, then the contractor usually has to calculate the risk depending on locations into his price structure. Furthermore, in remote areas for example, there might be supply challenges or certain difficulties transporting the fuel to the rig location. This also must be calculated in the cost structure.

It is often helpful to understand the complexity of a drilling project by comparing the operation with civil work or building a house which is based on a “blue print” and which involves visible and tangible solutions. Conversely drilling a well, all the construction happens below the surface where the contractor may encounter all kinds of unforeseen challenges in the geological formations encountered. Therefore, “day rate” contracts are more common with exceptions to locations where you have existing drilling history you can rely on.

2.1.2 Resource risk

While operational risk is related to risk factors during the drilling operation, the resource risk is related to the expected return of the well at the end of operation, which is the most critical factor. This is usually calculated in kilos of steam per hour (or enthalpy) in high temperature areas, and flow rate and temperature rate in lower temperature areas.

Downhole risk, whether it is operational or resource risk, is usually the responsibility of the developer. In the past drilling contractors never took on the resource risk. Nevertheless, in recent years, the developers have required the drilling contractor to share the risk in case of operational challenges. This is hardly achievable, unless the drilling field has track record of offset wells drilled, and secondly the number of wells in the contract should be in excess of about 15 wells. Therefore, in greenfield areas or unexploited areas the risk is still always on the developer. Exploratory wells in a new greenfield areas are more risky, and therefore likely to take more time to drill. They are often the most expensive wells in a drilling campaign. Production wells which follows the exploration phase should be less expensive as a result of increased experience in the field.

Often many developers have difficulties understanding these risk factors, and especially bankers who have extreme headaches to adopt their financing solutions for geothermal projects and not to mention understanding the dialect of various drilling contracts. They are more acquainted with big construction projects or civil works, building houses, bridges, or roads. Everything known from beginning, which involves visible and tangible parameters, while everything below surface in a drilling project is one big mystery until you crush the rock and create the hole.

2.2 Drilling operation, services and material

There is a wide range of activities and processes around one drilling project, all of which must be provided.

Table 1. Different services and material requirement

Services	Material, consumables
1. Mobilization and rig up service	
2. Drilling rig equipment and crew	Fuel – Diesel – Drill bits
3. Cementation equipment and services	Cement and additives materials
4. Casing Running Services	Tubulars, Casing & Tubing incl. Centralizer and float equipment
5. Mud engineering Service	Liner Hanger Equipment
6. Directional Drilling Services	Mud material, Bentonite and additives
7. Aerated drilling services	
8. Well Logging Services*	
9. Stimulation Services – Acidizing	Wellhead equipment
10. Production Tests (Pump, Cooling Units, Data Recording)*	Acid

* Not directly involved in drilling operation
Yellow marked= fixed cost

The drilling rig and equipment (marked green) only represents around 40-45% of the total drilling cost. It is highly misleading to compare day rates in different countries having different contract cultures, as some of the services or equipment may be charged separately and outside of the traditional day rate. Lower rig day rate does not necessary at the end represent higher or lower total cost.

2.2.1 Operational services

A Developer /Employer, who plan to drill a geothermal well, need to decide on what contractual basis each and every one of the different services and processes is to be provided. They can be provided under a large number of totally separate and discrete service contracts, or one can try to combine most of those processes under one integrated contract, or any mix between these two.

The choice of having many separate contracts, or just one integrated contract or some mix of both, will depend on the level of control, responsibility and risk that the Employer wishes to take.

Different services related to one drilling project can be seen in table 1.

2.2.2 Material procurement

As mentioned before, planning a geothermal drilling campaign is complex as it involves not only works and different services, but also material procurement of different material or consumables. This involves such as cementing material and related chemicals, various number of drilling fluid materials, casing material and accessories, wellheads, and drill bits for example.

Different material/consumables related to one drilling project can be seen in table 1.

2.3 Different type of drilling Contracts

On the market, we have three types of contracts:

1. Day rate contract
2. Meterage contract (or footage contract)
3. Integrated Service Contract (based on either day rate or meterage)
4. Turn key Contract (applies only for shallow water wells, and not covered here)

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What type of contract is chosen depends of what is realistic considering the concession conditions and what the employer prefers. The employer may be an established utility company having developed many geothermal projects keeping in house a large procurement team and drilling engineers with the necessary knowledge and experience, or the employer is a private company lacking all background and in-house profession in geothermal development. Using one "lead contract" or an "integrated contract" will certainly simplify the whole project planning, gathering most of the responsibility on the drilling contractor.

Even though drilling contracts in the geothermal sector can be categorized into 3 categories, then in reality the responsibility matrix may vary and any mix between those forms exists. The choice of having many separate contracts or just one integrated contract or some mix in between, will depend on the level of control, responsibility and risk that the Employer wishes to take.

2.3.1 Standard day rate contract

Majority of all deep drilling contracts (that means oil and gas and geothermal wells) are in the form of standard day rate contracts. Why is that? The biggest demand comes from oil and gas companies who have been performing exploration drilling for decades and have already big departments filled with technical engineers and procurement specialists in this field.

In a standard day rate contract, the service of a drilling company is actually limited to supplying only the rig equipment and safe operation of its crew. The handling of all other related services and material procurement is **then the obligation of the Employer**, who normally has enough staff of experienced drilling experts for management, planning, logistics and execution.

Very often, some of the necessary rig equipment is quoted separately, and therefore not included in the day rate. Example of this is for example the BOP's, top drive, and drill strings. Again, it is very difficult to compare day rate unless having full understanding of the responsibility of the contractor and what is included.

2.3.2 Meterage contracts

Most of the contracts in Geothermal drilling in Iceland, Mexico, and Turkey are meter rate contracts, while for example, New Zealand, Kenya, Indonesia and USA are predominantly day rate contracts. Drilling on meter rate means less operational risk for the employer. A fixed price for drilling the different sections of the well is applied, but at the same time, the employer's control of the drilling procedure is reduced and almost negligible, unless for example unusual unforeseen geological situation occurs due to formation challenges, moving the contractor suddenly on day rate. Day rate may for example apply when the contractor encounters operational difficulties as explained in section 2.1.1;

Drilling companies are reluctant to take on the geological risk, even in meterage contracts. In some cases, a mix of day rate and meter rate contracts exists. (sometimes referred as hybrid drilling contracts)

This form of contracts is possible when there is sufficient knowledge about the expected drilling conditions for the contractor. In green field areas then this form of contract is usually not practical. If the Employer is offering a long-term contract (3 to 7 years) then the contractor would be more willing to accept the risk by calculating and spread the risk cost over longer period.

Here, the contractor takes the risk of slower drilling time, but is rewarded if the time consumed is in average less than expected.

2.3.3 Integrated drilling service solutions

In this type of contract, one contractor provides multiple services and sometime also material procurement under a single integrated contract

If the Employer decides to procure all the services and material needed for one drilling project to different suppliers then he will end up negotiating and signing at least 7 to 9 contracts, depending on the setup.

For employers or developers of geothermal drilling projects not having their own infrastructure and expertise for handling all the procurements and tendering involved in a drilling operation, the best option is to source these services out to a professional Drilling Contractor.

What is considered to be the benefits?

- By integrating multiple services, which are needed in the drilling operation, into a single contract, the process will be **simplified,** by making it easier and more economical for the developer to start the drilling operations without the need of assembling number of players into the planning phase and operation. One contractor will act on behalf of the Employer.

- Better workflow means **reduced risk of onsite challenges**.

- **Reduced risk of delays in the drilling time plan**. The contractor will be responsible for supplying all the material before the operations starts, which means that they will strive for delivering all supplies at the right time. In the case that they are unsuccessful, they simply will not be able to operate the rig, and therefore not entitled to a "daily rig rate"**.** This would not be the case with an external IPM company and hence why the drilling contractor should take on this role directly.

- The Employer has a "one stop shop" for information and communication. **Increased quality of communication,** due to fewer people involved. The drilling contractor is directly in communication with all parties involved and able to report directly with the employer rather that via an external IPM company.

- **Easier monitoring of processes,** which should lead to higher quality of work.

- Due to **reduced cost** because of less overhead, you will have better economy in the whole project.
- **Improved security** because you need less people on site.

3. CONCLUSION

A good understanding of the contract options for drilling operations is important. Geothermal developers have in recent years increasingly chosen to use integrated type of contracts. Few service companies on the market have been able to offer this type of service using the name such as "Integrated Project Management" or IPM. In those cases then larger service companies hire the drilling contractor as subcontractor, only as one element in the whole project execution.

There are few companies committed to geothermal project development and dedicated to the success of the projects in the same way as a drilling contractor, that are also independent of major services providers to be able to review, compare and offer and best technical solution from the market without being tied to inhouse services and equipment as with many of larger IPM service companies. Drilling Companies are also able to offer this type of extended services. Then the drilling contractor is the lead contractor, but handling all the material procurement, and managing all the other services needed. . Of the three type of drilling contracts, then integrated type of drilling contract is being offered by an increasing number of drilling contractors who have experience offering a wide array of services under one contract as "Integrated Drilling Services" or IDS.

For new developers and smaller concession owners not having the in-house expertise, then the integrated contract solution is an interesting approach which is getting increased attention due to its simplified setup, less risk involved and improved performance

REFERENCES

Drilling contracts; Landsvirkjun

ON

Dominica

St. Vincent

Azores

New Zealand

Djibouti