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CONTRACTING OF GEOTHERMAL PROJECTS

José Antonio Rodríguez
Epsylon3, S.A. de C.V.
101 Av. Norte #4-109, Colonia Escalón
San Salvador
EL SALVADOR
tono.rodriguez.r@gmail.com

ABSTRACT

Geothermal projects can be very complex, and usually involve several contractors working simultaneously under a multidisciplinary team of supervisors. Care must be taken in the contracting procedures to ensure that each contractor is responsible for his own work, and also that the overall design and supervision are done in good coordination. A problem in one contract may cause delays and additional expenses in other components of the project, and this may impact the overall economics of the project.

But the contracts in the construction stage are not the only ones of importance. The geothermal developer must also be concerned with concession rights contracts, power sales contracts, insurance policies, loan agreements, certificates of emission reductions, among other obligations. This paper will concentrate on the contracting procedures and contents of concession rights contracts, construction-stage contracts, and power sales contracts.

1. CONCESSIONS

Merriam-Webster's online dictionary defines concession as "a right to undertake and profit by a specified activity". A geothermal concession is a contract, usually between the State and a developer, that describes in detail the rights and obligations of the developer in order to exploit a state-owned geothermal resource for profit. The concession must contain at least:

- Any fees owed to the State;
- Duration of the concession;
- The scope of work that the developer will execute;
- The time frame in which the work will be done;
- How the developer will sell power (or at least a reference to the relevant electricity market legislation); and
- References to other relevant legislation that mandates how the work shall proceed (i.e. environmental legislation and electricity system regulations).

In order for the Government to grant a concession, there is usually a process defined by law that must be followed. Legislation will define the requirements to qualify as a developer, and how a developer will be selected for a particular resource. Once a government embarks in this process, there is very

little margin for adjustment or negotiation, so consultants working for regulatory agencies have great responsibility in making the process simple, transparent, and effective.

It should also be observed that the right to exploit a state-owned subsurface resource in most cases does not automatically include the surface land rights. This situation depends on local legislation, but in most cases, the surface rights must be negotiated separately with the individual landowners.

2. CONTRACTING IN THE CONSTRUCTION STAGE

A complete development project will have at least eight major components in its construction stage, each with its own contractual arrangement: (i) design and supervision; (ii) drilling services; (iii) ancillary drilling services; (iv) civil works for drill pads and access roads; (v) power plant installations (EPC contract); (vi) gathering system materials supply; (vii) gathering system construction; and (viii) transmission line. General guidelines are discussed below.

2.1 Engineering

Perhaps the most critical contract (or contracts) for the construction stage is for engineering design and supervision. Though typically around 10% of the total cost of the geothermal project (percentage may vary significantly with size and complexity of each project), its scope impacts the entire project. Design and engineering problems may be very difficult to resolve, costly, and time-consuming, more so than problems in construction itself, and faulty designs may limit operability for the life of the project. Adequate engineering is ensured by (i) having knowledgeable and experienced personnel in-house, who either design and supervise themselves, and/or demand high quality from outside engineering contractors; and (ii) having special contracting procedures for engineering contractors, based not only on cost, but also on the firm's history of expertise, and the level of expertise of the people who will be assigned to the project. It is essential to have easy access to senior personnel who have experience developing resources of the kind that are in the concession area. It must be noted that ample experience in one kind of resource may be counterproductive when developing a different kind of resource, if the designs or equipment required for each are significantly different. For example, experience developing 100-MW flash steam power plants used on high-enthalpy fluid from deep volcanic rocks is not immediately transferrable to a 5-MW binary plant using low-enthalpy fluid from a shallow sedimentary aquifer.

This component of the project is the one responsible for the coordination of all the other contractors and suppliers, so that they all work together towards a common goal. Outsourcing of the engineering, and/or EPC contracting can reduce the developer´s headaches, but may be significantly more costly. In any case, the developer must always have high engineering standards in-house.

2.2 Equipment and materials

Materials are the most generic component of a project, and can be purchased in bulk to provide savings. The use of competitive reverse auction processes through the internet can help lower costs, as well as yield the most transparent selection method for suppliers. The downside of using this technology in developing countries is that local suppliers who are not familiar with online bidding may be at a disadvantage, and need to be educated. However, as a whole, online sourcing has become a very powerful tool in supply chain management, applicable in geothermal to drilling materials (cement, mud, casing, bits, etc.), gathering system materials (pipes, valves, accessories), and generic components of a power plant (cable, valves, relays, etc.). Another advantage of this technology is that the bidders compete directly with each other, with the developer observing the fruits of competition, instead of negotiating with each supplier.

The main equipment of the power plant (turbine, generator, transformer, control system, pumps, cooling system) should not be purchased through a generic supply chain, and instead are usually handled through a more traditional tender process that rewards quality and service as well as price. Of course, as always, competition between manufacturers/suppliers is key to obtaining a good quality product at a fair price. In fact, the entire power plant is commonly contracted through an engineering-procurement-construction contract, in order to concentrate the responsibility and assure quality through a single contractor. This is true even of experienced developers.

2.3 Drilling

An experienced geothermal drilling contractor is an important part of a team that develops geothermal fields. Though modern geothermal drilling technology is essentially derived from the oil and gas land drilling industry, there are certain key differences that make a substantial change in the drilling program and its cost. Geothermal wells use larger diameters, are drilled in higher temperature gradient areas, and drill through more abrasive material, but usually a geothermal developer does not have to deal with flammable fluids coming out of a well. Drilling decisions must be taken on the spot by qualified and experienced personnel in order to avoid excess costs and/or limited production.

Most drilling contractors, including geothermal drillers, will insist on contracting based on an IADC (International Association of Drilling Contractors) standard contract. The IADC standard allows the contractor to charge an hourly rate for the use of the rig, depending on the activity. Different activities (actual drilling, standby, repair time, etc.) are billed at different rates. The developer must tell the contractor what to do at every moment (within certain boundaries), and the driller operates the equipment to reach the developer´s goal safely and in as little time as possible. Under these contractual terms, the drilling contractor is not responsible for problems encountered while following the developer's instructions (blowouts, sticking, wellbore collapse, etc.). The drilling contractor is responsible only for maintaining and operating the rig in the best possible conditions, and following the developer's instructions. The developer's supervisor (called the "company man") issues the instructions following a predetermined well plan, which is defined previously with the participation of the drilling contractor.

In most cases, geothermal wells require other services (cementing, directional drilling, logging, aerated fluid) that are contracted separately from the drilling services contract. These other contractors must work closely with the "company man" and the drilling contractor in order for the well to be completed properly.

2.4 Construction services

Civil works and electromechanical erection are also an important part of a geothermal project, though these contractors do not need to be as specialised or experienced as drilling contractors or main equipment suppliers. Qualifies local contractors, with experience in industrial civil and electromechanical work, can do a good job with adequate direction and supervision from the engineering group. In fact, small civil and electromechanical contractors can do the work at a lower cost, though they may demand more involvement from the supervisors. Experience from several projects in Central America shows that these contractors may be selected through an online bidding process to ensure the best price, and adequate supervision will ensure work quality.

There are benchmarks published for the geothermal cost per kW installed that can guide a developer in budgeting and contracting specific projects. Some of these are, for instance, Dolor (2006), Liguori (1995), California Energy Commission (2003), Hiriart and Andaluz (2000), and others. Care must be taken to consider that development costs are influenced by a variety of factors:

- Geographic location of the field (closeness and ease of transport to the manufacturer). For example, in Central America, equipment and materials usually cost more than in California;

- Temperature and depth of the resource;
- Geologic complexity of the resource;
- Topographic relief;
- Environmental and/or social sensitivity of the project; and
- Prior knowledge of the geothermal field.

Reported costs for a medium-sized flash-steam development (~50 MW) in 2007 around the world ranged from $2,400 to $3,400/kW installed, including everything but the exploration stage. Recent, rapid rise in the price of steel and diesel fuel used for drilling put additional upward pressure in the development cost.

3. POWER SALES CONTRACTS

Financial institutions willing to fund geothermal power projects will insist on knowing how the cash flows from a project will be used to repay the debt, before approving any financing scheme. If the geothermal project will operate in an open electricity market, the bankers' concerns may be satisfied by demonstrating that geothermal power will be dispatched, and that the price required is competitive with all foreseeable electricity supply alternatives in the future. This requires the developer to contract an independent consultant to study all possible electricity supply alternatives in the market, select several plausible scenarios, and analyse how geothermal can compete in each scenario. In some parts of the world, where geothermal's main competition for dispatch comes from low-speed generators driven by internal combustion engines burning fuel oil, or from other, higher cost renewable, it can be readily demonstrated that geothermal is the preferred option, and financing can be obtained readily, once a project is proven feasible.

In places where there is little experience with geothermal, or where competing supply alternatives are large fossil fuel plants with little environmental limitations, financial institutions may require a power sales contract to be in place before a project begins construction. Power purchase agreements, or PPAs, are usually negotiated with a distribution company, or large wholesale purchaser of power. International environmental pressures on energy producers and distributors (like renewable portfolio standards, or pressure to reduce CO_2 emissions) have motivated large distribution companies to purchase large blocks of clean energy, like what geothermal can offer, sometimes even at prices above those of other alternatives. On the whole, the rise in international prices of fossil fuels, together with international environmental concerns, have made power markets in the 21st century friendly to geothermal power.

There are issues other than price that must also be defined in a power sales contract that may be equally important to the financial survival of the project. Since the competitiveness of geothermal is highly dependent on a high plant factor needed to amortise the high cost per kW installed over a large number of kWh produced, it is necessary to ensure that all geothermal electricity that can be produced will be dispatched. In a competitive market structure, geothermal electricity is demonstrated to have zero or near-zero variable cost, and so geothermal plants are operated on a must-run basis (similar to nuclear power plants). A similar case can be made for non-market based dispatch. Also important are issues regarding minimum availabilities, reserve capacity, quality standards, guarantees and penalties, and so on.

The inherent complexity of a geothermal project, and the fact that it operates on an equally complex electricity system, and also that it utilises a state-owned resource, make geothermal a challenge to develop and operate. The relationships with other entities and organisations require clear, well-defined responsibilities in contractual clauses. The economic, social, and environmental benefits of such projects make this technology a worthwhile pursuit in many countries throughout the world.

REFERENCES

Dolor, F.M., 2006; Phases of Geothermal Development in the Philippines, UNU-GTP Workshop for Decision Makers on Geothermal Projects in Central America, 2006

Liguori, P.E., 1995; Economics of Geothermal Energy, Proceedings of the World Geothermal Congress, 1995

California Energy Commission, Comparative Cost of California Central Station Electricity Generation Technologies, 2003

Hiriart, G., and Andaluz, J.I., 2000; Strategies and Economics of Geothermal Power Development in Mexico, Proceedings of the World Geothermal Congress, 2000

Ministry of Economic Development of New Zealand, 2005; Availabilities and Costs of Renewable Sources of Energy for Electricity and Heat