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ENVIRONMENTAL MANAGEMENT IN GEOTHERMAL DEVELOPMENT: CASE HISTORY FROM EL SALVADOR

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ABSTRACT

Regulatory framework applied by LaGeo to the geothermal projects in execution has been through the Ministry of Environment and Natural Resources (MARN), which guarantees the environmental law and the fulfilment of the regulations in El Salvador. For geothermal projects, it takes more than 6 months to obtain an environmental permit for the construction stage. Included in the Environmental Management Plan are the re-injection strategy, adopted as the primary disposal method for the brines and the rehabilitation on land disturbances through slope stability, terraces and roadsides. During well test, barriers in the silencers, rock mufflers and fresh water injected steam outlets are installed to mitigate the noise level on communities and for the safety of the workers, among others. Quality air, water and soil monitoring programme as part of the risk analysis on geothermal activities is a tool for the environmental management operation that guarantees the fulfilment of both the Environmental Law and LaGeo´s company policies.

Although LaGeo is not directly responsible for the local development where operations and development are held, it is conscious in making strategic alliances with local inhabitants concerning the productive, educational and health facilities and human development projects. Projects with high impacts in the communities around the Ahuachapan and Berlin geothermal fields consist in helping in the unemployment crisis in those areas and the youth development programme through computer training and sports events.

The Environmental Management and Social Investment Plans are integral part of any geothermal project executed, with investment up to a half million dollars per year. At the present, LaGeo is in the process of constructing the Enterprise Management System (EMS) that includes all the social and environmental responsibilities, an initiative since the 90`s when the geothermal development began.

1. INTRODUCTION

LaGeo S.A. de C.V., a company dedicated to the production and commercialization of electricity generated from geothermal energy, has worked as a private entity since its creation in November 1999, and became an exemplary company in the national development.

In El Salvador, areas with geothermal potential are situated in the middle of very poor communities, which may resent the impact of constructing access roads, well pads, pipelines, and power plants. It requires some research, understanding, and negotiation, to be able to address their legitimate concerns – beyond strict legal compliance – before a project can move ahead without problems.

In the case of LaGeo, this requirement is part of the Corporate Social Responsibility policy, which requires the company to become actively involved in the local development plans, both in elaboration and execution.

2. LEGAL FRAMEWORK

In 1997, the Ministry of Environment and Natural Resources of El Salvador (MARN) was created as a governing institution for environmental matters to ensure compliance with the Agreements, Conventions and Protocols of the United Nations, endorsed by the Republic of El Salvador. The vision of this institution is "to direct an effective environmental management through policies and norms and facilitate the sustainable development of Salvadoran society."

The environmental law in El Salvador was passed in 1998, while the national environment policy and benefits of the natural resources (water, air, biodiversity, etc.) were approved in 2000. All of these became instruments for the public sector that defined a legal framework for environmental matters.

All projects must be submitted to MARN for prior approval before construction begins. The request for approval must contain an environmental impact assessment (EIA), and the project is submitted to a public hearing process if MARN sees that the environmental impact will be significant. The concerns expressed in public hearing are documented by MARN, and they may require modifications in project design before final approval. If the concerns expressed at the public hearing are not properly addressed by the developer, project approval may be denied. In actual practice, several permits have been denied by the environmental authorities, but all clean energy projects have been approved. It must be observed, however, that most of the opposition to geothermal projects may not be channelled through official procedures, and may come out after the start of the construction, even when the developer is in possession of all the necessary permits.

When a developer obtains a permit, he must submit an environmental bond guarantee to MARN that he will execute all the environmental mitigation/compensation measures that are stated in the permit. Failure to comply will result in MARN cashing the bond.

The office in charge of awarding concessions of geothermal areas for production of electricity is SIGET. In order to obtain a concession, the interested developer must apply to SIGET with a feasibility study and the approved environmental impact assessment document. SIGET then holds a public hearing for opposition to the project (separate from MARN), competing projects, and/or other parties interested in developing the resource. If there is no significant opposition or competing projects, SIGET holds a public bidding process to award the concession, and awards it to the highest bidder.

3. ENVIRONMENTAL AND SOCIAL MANAGEMENT IN LAGEO

In practice, the first group to do the reconnaissance work in a new geothermal prospect is the one in charge of environmental and social issues (even before the geologist sets foot on the site!). The first duty is to establish an environmental and social baseline in the project area, and identify the potential points of conflict for the early exploration phases. This involves holding discussions with local leaders and organisations, and compiling existing information on the socioeconomic status of the neighbouring communities. Local leaders are thus informed of the exploration program, and educated about the basics of geothermal development.

The EIA document submitted to MARN must contain the observations of the environmental and social teams, plus the baseline studies, and the impact of mitigation/compensation measures that the company sees necessary and adequate for the first stages of the project. At this time, LaGeo becomes involved only in small projects to assist local population, in order to demonstrate the good will, but no long-term commitments are made until it is certain that a project will be developed, after the exploration/confirmation stage.

The social and environmental teams are in charge of internal follow-up and evaluation of LaGeo´s compliance with the obligations acquired with both MARN and the local communities. Obligations acquired with SIGET are supervised by teams under the Projects and Production managers.

After the exploration/confirmation stage is completed and if it is feasible to develop an area economically, a development project will be defined, which will have its own, separate, EIA, permitting process, and discussion with neighbouring communities. At this stage, more significant resources are committed to improve the environmental and social conditions in the scope of the influence of the project. Typically, 2-3% of the project budget is set aside for these issues, though the amount committed depends on the conditions found in the baseline study of each field.

Geothermal projects in El Salvador are situated around volcanic areas with communities living in extreme poverty. There is widespread unemployment, and roughly half of the younger generation migrate to North America in search of better opportunities, even if it means to risk going illegally into the United States. Incomes are as low as $6/day for a farmer/labourer. Social services, such as access to clean water and health and education services, are scarce. There is a very serious problem with delinquency, especially among gang members that are deported from the U.S. In areas around the Berlin power plant, there are also very serious seismic and landslide risks, which the local population associates with geothermal development.

The aim of the social programs and the environmental mitigation/compensation programs are often to help alleviate poverty and reduce the geological risk of the neighbouring communities. This is seen in LaGeo as more than a legal obligation, a moral imperative, corporate social responsibility, and a fair business practice.

4. SOCIAL AND ENVIRONMENTAL PROJECTS

The social and environmental projects associated with a large-scale geothermal development project are defined in the EIA in part, and also negotiated with the local communities. They can be quite varied, and target the physical, chemical, and biological environmental impacts, as well as socioeconomic and cultural aspects.

4.1 Physical environment.

The construction of well pads, pipelines, access roads, and a power plant impacts the natural flow of rainwater, and can cause disturbances from where the infrastructure is built (erosion, flooding, etc.). The design of the civil works must take these impacts into consideration, and measures to solve any potential problem. In fact, LaGeo has assisted in construction of dam structures and slope stabilisations in areas where there is no geothermal infrastructure, in order to protect the neighbouring communities from potential damage. The noise levels are a nuisance to neighbours, especially during drilling, well tests, and pipe blow-outs. Care must be taken in the project construction stage to build adequate sound barriers and mufflers to minimise the impact. All of LaGeo´s projects include reforestation, that actually improves the environment around the wells and power plant before construction begins.

4.2 Chemical environment.

The main impacts come from emanation during well tests and power plant operation. The H_2S levels are monitored to ensure they are held below acceptable levels, as defined by MARN. Well discharges are announced publicly days before, and programmed jointly with neighbours, when there are people living near the well. This gives people a chance to get away if they are bothered by the sound or odours. Other impacts come from possible brine or mud spills. These must be foreseen during the design stage, and there must be monitoring of contaminants to ensure the compliance, usually with legal and moral obligations. Adequate disposal of drilling mud and adequate reinjection infrastructure should ensure that all effluents are properly contained.

4.3 Biological environment.

The impacts to the local flora and fauna come from cutting trees and reducing wildlife habitat to make way for infrastructure. However, as El Salvador has very little original forest cover left as a result of centuries of subsistence-level agriculture, geothermal projects can actually help improve conditions from what was found in the baseline study. Native species of trees have been planted along pipelines and around well pads and power plants. Where the ground is too hot for other species, and over filled mud sumps, eucalyptus is usually planted. There is now denser tree cover in the area of influence of the Ahuachapan and Berlin projects than there was ten years ago. The main threat to wildlife is the local population, who hunt species to extinction. In order to address this, an employee awareness program for wildlife conservation has been maintained for several years, and agreements have been worked out with MARN and the Zoology Foundation to construct and maintain a large animal shelter around the geothermal installations. This has become a small tourist attraction.

4.4 Integration with communities.

If the relationship with local communities is not managed properly, the local people will see the geothermal developers as invaders who will exploit their land for profit, give nothing in return to the community, and damage the environment. News of bad experiences with a project by another developer in a neighbouring country will spread quickly, and provoke resistance to all geothermal developments. In LaGeo, helping the local communities with their development is therefore seen not only as a fair and just action, but also as good business practice to ensure sustainability.

Initially, when LaGeo was created, projects with neighbouring communities were mainly for minor problems such as paving parts of roads, supporting local sports teams, etc. With time, working with the communities has become more focussed, and much more effective. The basis for the support programs has been the local´s own development plan, where major problems are identified, and actions are planned to resolve these issues. LaGeo can contribute to the development of these areas by

supporting these local plans. Small assistance projects are still carried out, but the main focus now is for serious solutions for health and education programs, and self-sustaining productive projects. Because the needs are so many, the social assistance projects now arise to approximately 150 around Ahuachapan and Berlin. The funds are taken from both the investment budget and the operating budget.

One example of a successful project in education is called "Window to the World". Children from neighbouring communities that have very limited access to education are provided with English language education to a basic level, and taught computer skills, including internet navigation. This opens young minds and gives new opportunities in a globalised world. As El Salvador has opted to open its economy to trade and commerce, these skills may prove useful for many young people in the near future. LaGeo provides the teachers, the computers that are already out of the company´s inventory, the physical space for the classroom, and the internet server (with filters).

An example of a successful productive project in Ahuachapan is the harvest of bananas. Some local people have invaded LaGeo´s lands in Ahuachapan, and started setting up cardboard houses and planting subsistence-level crops (corn and sorghum). This posed a threat to LaGeo's legal tenure of the land, and assumed that these people would continue living in extreme poverty conditions for many years. A negotiation committee was set up jointly with the local municipality, and found a solution: LaGeo would keep legal tenure of the land; the locals would be allowed to plant and harvest non-subsistence level crops (bananas) on LaGeo's land at no additional cost, which would allow them to raise their quality of life in the future. Condensate waters were used to irrigate the crops. The Government provided an agricultural engineer to supervise the crops. The result was that thirteen families raised their standard of living from extreme poverty to non-poverty conditions. Their children can now attend school. The people in charge have learned how to manage a small business. And, finally, the Ahuachapan power plant is seen as a source of wealth for the neighbours, and not an invader.

5. CLEAN DEVELOPMENT MECHANISM

El Salvador has subscribed to the UN Kyoto Protocol to reduce greenhouse gas emissions, and so the clean-energy projects that displace other fossil-fuel projects are candidates to be certified for emission reductions (CER's) within the framework of the Clean Development Mechanism (CDM) of the Kyoto Protocol. Industrialised countries seeking to reduce their emissions may meet their targets in part by financing clean energy projects in developing countries by purchasing CER's from these projects. Geothermal developments are natural candidates to sell CER's (1 CER = 1 ton of CO_2 avoided) to interested buyers, as the energy produced is both clean and stable.

LaGeo has one certified project, the 44-MW Berlin Third Unit, and another project, the 9.3-MW Berlin Binary Cycle has been validated and is awaiting for the certification of the UN. Both projects are already contracted until 2012 (when the Kyoto Protocol ends), the Berlin Third Unit to the Government of Holland, and Berlin Binary Cycle to the Government of Belgium. The sale of CER's adds about 3% to the IRR of a geothermal project in El Salvador.

As sustainable developing plan coming from LaGeo CDM contract signed with the Government of Belgium, the following indicators were created:

a) **Economic**
- Company CER´s Annual incomes
- Quality of life of the communities

b) **Social**
- Company recognition at world level
- No. of fixed employments /year
- No. of temporary employments /year
- No. of Visitors to the park
- No. of training courses carried out

c) **Environmental**
- CO_2 ton avoided
- conservation park and reception of wild life.
- reforested area (M^2)
-% native species
-% fruit-bearing species
- No. of Animals preserved in the park
- No. of entering animals

6. CONCLUSIONS

The environmental and social impacts of geothermal projects must not be overlooked, and indeed should be considered as an integral part of project design, in order to ensure that the facility can comply with legislation and is accepted by the neighbouring communities. This kind of development is seen in LaGeo as both a moral imperative and fair business practice. The economic rewards of the Corporate Social Responsibility Policy are possible, but are not the driving force behind the policy.

7. REFERENCES

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