EIA CASE STUDY: Energy – Nicaragua

This case study is drawn from Inter-American Development Bank (2010).

Project name: "Technical Reconversion in San Jacinto-Tizate (Nicaragua) to generate 72MW of electric energy"
Sector: Energy
Date: 2008; Location: San Jacinto-Tizate, Leon, Nicaragua

Project Information

This project was originally operationalized in 1994 under declaration no. 18-94, Public Utility of the Construction of the Project "San Jacinto-Tizate." Concessions were awarded for a 20-year period to run a geothermal energy plant. The purpose of this project is to increase energy generation capacity to sell energy to the National interconnected system by amplifying the installed capacity from 10MW to 72MW through changes to more efficient technology. A secondary purpose is to grow in the market of Certified Carbon Emissions promoted by the mechanism for clean development of the Kyoto protocol through increasing the capacity of geothermal energy production. The main activities to be carried out in this project are to perforate 13 new production and reinjection ponds and to increase the installed capacity and the technological reconversion of counter pressure units (BPUs) by switching to modular condensation turbines (MCT) which are more efficient and cleaner.

Project Area

The project is located near the community of San Jacinto-Tizate, in the department of Leon, 100 km to the northwest of the capital, Managua. The community has 558 houses and approximately 4,715 inhabitants. Census data from 2005 showed that in the municipality, there was 10% immigration and 29% emigration related to searching for employment. Also, 95 percent of the population over 10 years participated in either paid or unpaid labour. The principal employment opportunities are in construction, agriculture and day and seasonal workers.

The area where the geothermal turbines are to be installed is a dry tropical forest. The forest is used by locals for construction and fire wood. Much of the surrounding area has been altered for agriculture purposes but there are still many important tree species, both native and introduced. Deforestation and slash and burn agriculture practices have significantly decreased the amount and types of wild animals in the area. The project is found within the "El Chorro" water basin; this is the main surface water drainage basin and is fed by many localized springs. One third of this project is located within the Telica-Rota protected area which is threatened by seismic activity, volcanoes, falling rocks, landslides and in some areas, flash flooding.

Because this project is located within a protected area, an EIA study must be carried out.

Screening

As a requirement for the screening process in Nicaragua, it is necessary to fill out an environmental form to assess all projects, works, activities and industries. All projects are classified into four categories, three of which require an EIA:

1. Special projects considered for their national or regional importance and high impact on the economy, social activity and the environment. These are subject to an EIA.
2. All projects that pose a potential high impact on the environment. These are subject to an EIA.
3. All projects that may cause a moderate amount of impact to the environment but may generate cumulative effects and so therefore require an environmental assessment, but not a full-blown EIA.
4. All projects with low potential impact are regulated by article 25 of the General Law on the Environment and Natural Resources. An environmental form must be filled out and submitted to local authorities and permissions be obtained. No EIA is necessary.

This project falls under Category 2 and is also located within a protected area. Under Nicaraguan law, an EIA is necessary in protected areas regardless of the impact of the project.

Scoping

Assessment Method Used Throughout the EIA

The Rapid Impact Assessment Matrix (RIAM) is a systematic approach using qualitative data that can be expressed in a semi-quantitative way. The process that RIAM follows is to identify significant changes (positive and negative) caused by the project, establish a baseline for the monitoring plan, identify mitigation strategies and design a monitoring and evaluation system to determine the effectiveness of the mitigation strategies. Using the RIAM method, public participation is carried out at the data collection and mitigation stages of the process. Both of these stages are directly followed by quality control measures during the analysis and program monitoring stages. The multidisciplinary team which allows data from different sectors to be analyzed at the same time in one common matrix, thus allowing for a rapid and clear evaluation of the most important impacts the project may have. Such a matrix also allows the team to compare different development options according to how the four aspects of the environment may react to an action.

Potential Project Impacts

The following table displays all the potential impacts of the project, categorized by the type of impact (physio-chemical, biological-ecological, sociocultural and economic-operational), the phase of the project and the impact level.

Table 1. Potential Project Impacts

Type of Impact	Phase	Impact level	Details
Physio-chemical	Construction	Negative/ Moderate Moderate High Moderate/ negative Moderate/ negative Positive	**Residual solids:** Generation of residual solids from construction of buildings (can control and mitigate, national standards to be followed). **Residual Liquid:** All fluids coming from the project's reservoir after electricity is generated will not affect the surface environment as they will be reinjected into the subsoil. **Changes in soils and subsoils**: Wind and water erosion, and waste from the removal of vegetation, caused by the movement of soil for construction, contribute to the degradation of soils. Chemical elements that may be present include mercury, boron, and arsenic. This can cause problems for vegetation and agriculture in the area. The removal of trees and vegetation will increase the risk of erosion. Mitigation plan will be put in place. **Changes in noise levels**: Due to the use of heavy machinery, noise levels in the area will increase. This may have a negative effect on workers and the local community. **Changes in air quality**: An increased use of machinery and movement of soil will produce emissions. **Changes in quality and quantity of water:** There will be a temporary and localized change in the pattern of the stream surface drainage. However, as the work will be carried out during the dry season with strategic installations to improve drainage year round.
	Operation	Negative/ moderate Negative/ Moderate	**Residual Solids**: Waste from the perforation of the geothermal pools will generate mud and small rock fragments that will need to be brought to the surface. **Residual Liquid:** Grey water will be produced from the temporary construction, brine water from electricity generation and leaking of oil/gas from heavy machinery and transformers. **Changes in air quality:** Geothermal generators produce far less CO_2 than other thermal plants. The release of radon and mercury are estimated to be very minor based on the concentrations of vapour.
Biological-ecological		Positive	This project works within the Plan to Manage the Telica-Rota Protected Area and helps to reduce reliance on use of wood products for firewood and furniture. Most trees and vegetation have been altered by agricultural production. This project will not significantly impact the flora and fauna of the area.
Sociocultural		Positive Positive	There will not be any major differences in the sociocultural area at any stage of the project. While there are no negative impacts in this area: because the project is located within a risk zone, it will be integrated into the local plan of prevention, mitigation and attention to disasters. **Employment**: approximately 700 people will be employed in phases I and II of the project. **Access to basic services:** potable water is an issue in San Jacinto. The PRNSA helps part of the community by allowing them to use a tap on the outside of their offices and helped purchase tubes to install potable water in the rest of the community.

Economic-Operational		Negative/ low potential	**On-site Safety:** There is potential for work hazards if any tubes carrying vapour or reinjection water break. Potential for electrocution if individuals get too close to transmission lines.

Impact Assessment and Mitigation

The RIAM methodology described above was used in the identification, prediction and analysis of all potential direct and indirect impacts connected to the project. Using this model, the four major impact areas are analyzed: Physio-chemical, biological-ecological, sociocultural and economic-operational.

Project Alternatives

A: Without the project

In the analysis where the project is *not undertaken,* the most significant impacts are found in the economic arena in the form of lost job opportunities, dependence on fossil fuels, lost opportunities for carbon credits and an alliance to help manage the Telica-Rota protected area.

B: With the project

The most significant impacts found in the analysis *with* the project in place are in the physical-chemical environment. Most impacts will be felt during the construction phase and will therefore be temporary. Mitigations strategies were identified for all impacts throughout all stages of the project. Magnitude is estimated using experts' judgment based on the information collected in most cases. The EIA provides a detailed description of all the elements that may be affected by the construction and operations phases. These elements range from houses, schools and health centres to roads, agriculture land, forests and water sources among others. The report shows the number of units directly and indirectly affected by the project and other important observations such as town names, or water sources.

Using the RIAM method both direct and indirect impacts are identified. The group uses GIS to estimate a radius around the project identifying areas of direct and indirect influence at each stage of the project. The areas of impact were estimated using the principal transmission line where the principal risk—the hydro cables—is found.

Areas of influence are most greatly impacted by:

- Noise and gas emissions in the construction zone.
- Activities involving removal of vegetation where the platforms and access roads are situated.
- Moving equipment and materials.
- Contracting construction workers and services.

In the case of this EIA, all impacts, no matter their significance, are monitored and mitigated when necessary in order to avoid negative cumulative impacts. Because this is a project seeking to expand operations, ongoing monitoring and analysis previous to this assessment allow for more reliable data and predictions, allowing for some margin of error.

Impact Management

The Socio-Environmental Management Plan laid out in this project was developed using observations and studies in the area of influence, site visits and public consultations within the municipality of Telica.

The impact management plan has five objectives:

- Strengthen all the components that make up the social and environmental areas of influences throughout all phases of the project.
- Establish mitigation measures and a monitoring plan to prevent and reduce any significant negative impacts to acceptable levels and strengthen all positive impacts caused as a result of the project.
- Define the responsibilities of all the different actors to properly implement the mitigation measures during all phases of the project.
- Comply with the established environmental and social regulations in order to obtain environmental licence.
- Protect the health and safety of all the workers and citizens living in the project area.

The plan includes sections to address mitigation measures, monitoring, a contingency plan, a waste management plan, a reforestation plan and an implementation plan.

Table 2. List of Mitigation Measures

Impact Details	Standards	Mitigation Methods	Residual Impact
Physio-chemical **Residual solids:** Generation of residual solids from construction of buildings can potentially cause erosion and loss of topsoil as well as possible contamination.	None indicated	• Plant bushes on slopes and embankments to reduce erosion risk • Build gutters and energy sinks for storm and rain water • Build gabion walls for areas with moderate slopes • Irrigate the access roads in the dry season • Reforestation of native species • Monitor seismic activity • Continual lab analysis to test toxicity in muds • Muds will remain in an impermeable tank until total dry • Use water based chemicals mixed with the drilling sludge • Treat the sludge with bio-remediation • Build emergency pools to avoid overflow of sludge in the case of extreme storms	*Impact Reduction* • Along with reforestation, mitigation efforts for all physio-chemical impacts will help to control and reduce impacts to acceptable levels
Residual Liquid: The project could be affected by its own activities, either by sediment or residual liquids and solids.	Decree 33-95: Provisions for the control of pollution from domestic, industrial and agricultural discharges and wastewater	• Implement a Toxic Waste Management Plan • Reinject the drilling fluids to maintain hydrothermal balance in the aquafer • Monitor pressure and temperature • Avoid overflow of residual waters into surface drainage by using reinjection methods • No run-off or dumping sites for final wastes within 200 m of any streams near the project • All maintenance done in shops, off-site • No dumping grey waters directly into water sources • Discharge and run-off from construction will be reduced using sediment traps • Residual waters reinjected directly into the reservoir for production ponds • Impermeable lagoons built to avoid seepage of waste water • Build drainage system able to capture and reinject water from vapour drainage lines and cooling towers into cold water • Hydrological study to determine the configuration of the aquafer to decide where the ponds will be drilled • Precautions will be taken during the drilling period to not contaminate the aquafer with chemicals • Monitoring of temperature and pressure in all production ponds • Reinject all residual waters into the reservoir • Build emergency run-off pools to avoid overflow of storm water	
Changes in noise levels: Due to the use of heavy machinery, noise levels in the area will increase. This may have a negative effect on workers and the local community.	None indicated		
Changes in air quality: A minor amount of	None indicated		

Impact Details	Standards	Mitigation Methods	Residual Impact
CO_2, radon and mercury may be emitted		• Build sewers to avoid residual water contact with soils while passing to the emergency lagoons • Ensure machinery is working properly • Install sound barriers to reduce noise around generating plants • Ensure use of safety equipment for all workers on site at all phases of the project • Use silencers for the blowers in the entrance of the turbine • H_2S detectors installed to detect 500 parts per billion (ppb) within 15 seconds • Periodically monitor CO_2 and H_2S emissions in the proximity of areas of emission potential • No burning wastes of any kind. All waste to be deposited in municipal garbage sites	
Bio-Ecological Because of overall human interventions in the area, ecosystems are fragmented and vulnerable	None indicated	• Reforestation plan	*Positive impact:* increased numbers of migratory birds, improved connection of the Pacific Biological Corridor, positive changes in the migratory patterns of land and air fauna.
Sociocultural and Economic-Operational **Health issues**: contact with escaping vapour from pipes, accidents dealing with the transmission lines, fires that could affect the plant and infrastructure	None indicated	• Occupational health standards and risk mitigation on-site • Undertake studies to promote the economic production of some local species (i.e., iguana) to substitute hunting over harvesting • Finance forest rangers and co-manage a program with government agencies, the municipality, local communities • Control and preventive measures for all activities that are significantly damaging the potential in the area especially deforestation, fires and poaching	*Positive impact:* Reforestation efforts in the area will help the community qualify for carbon sequestration credits and government agencies can sell carbon credits for having reduced emissions. Part of the money raised will go to a conservation fund for wild flora and fauna and an environmental education plan for the area.

Contingency Plan

The Security and Emergency plan includes security policies, a plan for notification in case of an emergency, responsibilities for supervisors and workers, functions and duties for the health and safety committee, emergency training, rules and practices for workers relative to materials handling, transportation, work with electricity, soldering, using tools and machinery, anti-fire protection and handling chemicals. Here details are provided as to what each of these items entails, methodology for

evaluation and follow-up of the contingency plan and recuperation activities for all parties and elements affected. Included within the contingency plan are:

- Occupational health and safety plan
- Plan for prevention, mitigation and attention to disasters
- Waste management plan
- Hydrocarbon management plan

All plans identify measures taken to date and all regulations they are obligated to follow under national and local law.

Reforestation plan

While the impact analysis does not emphasize any significant impact to the natural landscape, the project has dedicated an effort to reverse the negative effects of human interaction in the area. As such, a reforestation and management plan is included in this document. This is done to strengthen the positive impacts the project has on the area.

Implementation plan

This plan outlines who is responsible for all aspects of the Socio-Environmental Management Plan to ensure that all mitigation measures are being implemented. It states that MARENA and other authorized bodies are responsible for monitoring compliance with the environmental management and monitoring plan and that all people contracted under the company, PENSA, must follow all policies outlined in this document including:

- Environmental monitoring programs.
- Health and safety plans.
- A continuation with the process of public consultation and participation when needed.
- Depositing of residual wastes in an adequate manner, meeting the needs of local authorities.

Budget

A brief budget is included, in U.S. dollars, to outline the costs for the construction and operation phases and monitoring programs.

Monitoring Plan

Under the terms of the monitoring plan, experts are employed in their specific areas on a permanent basis: results are verified by a panel of consultants who convene every 18 months to ensure quality standards in data analysis. Detailed plans are in place to monitor air, water, soil, pH levels in rainwater, and geothermal activities as a result of all energy production operations. Each plan is written in detail, with specific elements being monitored, standards followed and how long monitoring has been carried out. As well, the existing baseline for all air, water and soil factors is updated on a regular basis. Because these monitoring plans have been in place for some time, a detailed description is not included in the report; however, some general information about what indicators are monitored is available:

Monitoring plan

Monitoring Plan	Indicator
Air quality	H_2S levels 0-500 ppb
Water quality	Concentration level of liquid effluent in the water source- specifically boric acid, arsenic and chlorides
Soil	Presence of micro-seismic incidents
Thermo-hydraulic evaluation of ponds	Temperature Flow Pressure % gas in vapor state

The EIA Report

The EIA report consists of the following main sections:

- Introduction.
- Objectives and justification for the project.
- Project description, including location orientation, characteristics of the existing structures, reconversion of technology, phases of the project in general and stages of this phase of the project.
- Legal aspects including all existing environmental licences.
- The initial diagnostic (Screening).
- Prediction and evaluation of impacts, including the assessment methodology used, comparison of the project with and without the project in place, impacts listed by category.
- The Socio-Environmental Management program including, objectives, structure, mitigation measures for each impact category, monitoring plans, contingency plans, waste management plans, reforestation and implementation plans and the cost of the overall management plan.
- Conclusions of the EIA.
- Bibliography.
- List of illustrations.
- List of abbreviations.
- Glossary.

References

Inter-American Development Bank (2010). San Jacinto-Tizate Geothermal Power Project. Retrieved from http://www.iadb.org/en/projects/project-description-title,1303.html?id=NI-L1057

Source: EIA Online Learning Platform - http://www.iisd.org/learning/eia