

Rapid environmental assessment tool for the extended Berlin geothermal field project

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Abstract

Environmental Impact Assessment (EIA) is a tool used in the planning of development strategies and projects, and its use has been adopted into planning regulations in El Salvador. The historical development of EIA shows that a number of attempts have been made to improve the quality of the EIA analysis by seeking to improve the accuracy of the judgement, resulting in a number of formats being developed for EIA analyses in. In any the judgements will be subjective, either in whole or in part. This is a consequence of many factors: the lack or inadequacy of baseline data, the time frame provided for data acquisition and analysis, the terms of reference provided for the EIA, and the capacity of the assessors to cover a wide range of issues. Even where quantitative environmental data is available, the overall use of this data requires a subjective judgement of the possible impact, its spatial scale and potential magnitude. A new method for EIA to allow subjective judgements to be quantitatively recorded, thus providing both impact evaluation and a record that can be re-assessed with the passage of time, is the Rapid Impact Assessment Matrix (RIAM), which is applied in the Extended Berlin Geothermal Field Project. Geothermal development experts successfully applied this method making the environmental assessment easy and rapid with economical benefits for the company. It even resulted in an easy process for environmental legal evaluators.

Keywords: Rapid EIA tool, RIAM, environmental, evaluation, Berlin geothermal field.

1 Introduction

An extended Berlin geothermal field project was designed to increase installed capacity from 56 MW to 85 MW, which will cover national market electric power demand, through natural resources exploitation. The extent covers an area of 7.5 km² located in the southeast part of the Berlin Geothermal Power Plant area, which is planned to be implemented from 2003 to 2005. The project is designed in two phases:

PHASE - I: Technical (geoscientific) investigation in the southeast part of the geothermal field, through deep exploratory drilling of 3 wells in different pads for production and reinjection purposes. If the results are promising, then the drilling program will continue.

PHASE - II: The program will cover 12 drilling wells, pipelines and a surface equipment system and the third unit of 28 MW in order to complete the installed capacity of 85 MWe. Table 1 shows the zones and type of activities of the project.

Table 1: Characteristics of the project.

ZONE	PHASE 1	PHASE 2
Las Crucitas	1 production well	3 production wells
Los Cañales	1 production well	3 production wells
San Antonio Guallinac	1 reinjection well	2 reinjection well
Berlin Power Plant Existing		Unit 3, steam pipelines and reinjection well

2 Environmental analysis

As part of the strategy implemented by Geotérmica Salvadoreña (GESAL) environmental permission was obtained in order to get the resolution from El Salvador environmental authorities for the “Extended Berlin Geothermal Field Project”, which includes the following steps:

- Identification of main activities for the project execution (civil work and drilling wells)
- Characterization and inventory of the environmental factors for access roads and drilling well zones
- Identification of an Impact Matrix
- Preliminar Impact Assessment Matrix
- Using Rapid Impact Assessment Matrix (RIAM) to evaluate positive and negative impacts of the project according to the Environmental Impact Assessment (EIA)
- Results analysis using software applied to the project

A team of four experts covering the disciplines of geologist, biologist, sociologist and a chemist were involved in each of the developed stage. The environmental analysis was a success due to the data base fed to the software from the time of identification until the assessment matrixes, which provided environmental management plan in an easy and rapid manner with economical benefits for the company and the easy process for environmental legal evaluators, where available.

3 Methodology and procedure

The environmental assessment consists of four stages:

- a) Brain storm during a participative workshop session with specialist for impacts identification comparing scenarios with work project and significant impacts and those significant, positive, negative and the indifferent ones.
- b) A second participative workshop to prioritize positive and negative potential impacts, using a preliminary assessment matrix based on the environmental components designed in the RIAM. Table 2 shows the score given to each of the criteria in groups A and B weight of to each category.
- c) Rapid Impact Assessment Matrix (RIAM) Method is based on standard definition of the important assessment criteria as well as the means by which semi-quantitative values for each of these criteria can be collected to provide and accurate and independent score for each condition. The impacts of project activities are evaluated against the environmental components and for each component a score is determined, which provides a measure of the impact expected from the component. The important assessment criteria fall into two groups:

Group A: Criteria that are of importance to the condition, and which can individually change the score obtained.

Group B: Criteria that are of value to the situation, but individually should not be capable of changing the score obtained.

The value ascribed to each of these groups of criteria is determined by the use of a series of simple formulae. The scores for individual components may be determined on a defined basis by the use of these formulae. The process can be expressed:

$$(A1) * (A2) = AT$$

$$(B1) + (B2) + B3 = BT$$

$$(AT) * (BT) = ES \quad \text{is the assessment score for the condition.}$$

d) Complete Environmental Assessment

Table 2: Preliminary environmental assessment.

	A1	A2	B1	B2	B3	Environmental Score
PRIORITIZED IMPACTS						
Physical / Chemical						
Change in land uses	1	-1	3	2	1	-6
Levels noise increase	1	-1	2	2	2	-6
Change in soil permeability	1	-1	3	2	2	-7
Soil accidental spills pollution	2	-1	2	2	2	-12
Biological / Ecological						
Flora elimination	0	0	1	2	3	0
Fauna migration	0	0	1	2	3	0
Loss hábitat	0	0	1	2	3	0
Sociological / Cultural						
Employment	2	1	2	2	3	14
Traffic increase	2	1	2	2	3	14
Rural internal roads improvement	2	1	3	1	1	10
Landscape alteration	1	0	3	2	2	7
Safety labor and publics health	1	0	2	2	1	0
Crops and housing incidents	1	0	1	2	1	0
Extent services	1	1	2	2	3	7

Environmental Components: The RIAM requires a specific evaluation of the components to be defined through the process of “scoping” and these environmental components will be in one of the four categories that are described as follows:

- Physical / Chemical (PC): Covering all physical-chemical aspects of the environment
- Biological / Ecological (BE): Covering all biological aspects of the environment
- Sociological / Cultural (SC): Covering all human and cultural aspects of the environment
- Economic / Operational (EO): To qualitatively identify the economic consequences of the environment change, both temporary and permanent impacts.

For the analysis of the results, in the category of the component (SC) of the preliminary assessment matrix (Table 2), it was subdivided in components (SC) and (EO) as part of the requirement of RIAM.

Assessment criteria: The criteria should be defined for both groups, and be based on fundamental conditions that maybe affected by changes rather than be related with project activities (see Table 3).

Table 3: Assess criteria.

Category	SCALE	Description
A1: Importance of condition	4	Important to national / international Interest
	3	Important to Regional / national Interests
	2	Important to immediately outside the local condition
	1	Important only the local condition
	0	No importance
A2: Magnitude of change-effect	+3	Major positive benefit
	+2	Significant improvement in “status quo”
	+1	Improvement in “status quo”
	0	No change / “status quo”
	-1	Negative change to “status quo”
	-2	Significant negative dis – benefit or change
	-1	Major dis-benefit or change
B1: Permanence	1	No change / not applicable
	2	Temporary
	3	Permanent
B2: Reversibility	1	No change / not applicable
	2	Irreversible
	3	Irreversible
B3: Cumulative	1	No change / not applicable
	2	Non – cumulative /single
	3	Cumulative / synergistic

The method of the RIAM allows the carrying out of a global analysis of the results, based on the individual environmental score (ES) for each component, which are classified in ranges and can thus be compared to each other. Table 4 provides the established ranges for the conversion of scores obtained.

The enclosed Table 4, shows the 16 components analyzed for the project, individual score (punctuations) and equivalence in the band of ranges (RB), as well as a global summary of the total punctuation. Once these are classified, they are shown individually or contained according to the component type and presented numerically (see Table 5 at the end of the paper) or as histograms.

Table 4: Band of ranges.

ENVIRONMENTAL SCORE (ES)	BAND OF RANGES	DESCRIPTION
+72 at +108	+E	Changes / Major positive Impacts
+36 at +71	+D	Changes / significant positive Impacts
+19 at +35	+C	Changes / moderate positive Impacts
+10 at +18	+B	Changes / positive Impacts
+1 to + 9	+A	Changes / lightly positive Impacts
0	N	Non changes / “status quo” / not applicable
-1 to – 9	-A	Changes / lightly negative impacts
-10 at –18	-B	Changes / negative impacts
-19 at –35	-C	Changes / moderate negative impacts
-36 at –71	-D	Changes / significant negative impacts
-72 at –108	-AND	Changes / Major negative impacts

4 Analysis of results

The summary of the total marks given (Table 5), as well as the histograms of Figure 1 (at the end of the paper), which contains all the components, and the comparison of the data of Table 4, the actions adopted by the Extended Berlin Geothermal Field Project, prevents the following environmental aspects:

- ↳ Changes in environment for negative impacts due to soil spill pollution (-12 / -B); changes slightly negative impacts due to increase in noise level or the use of machinery (-6 / -A), both inside the category of the physico chemical factors. See Figure 1.
- ↳ There won't be changes in the natural state ("status quo") for 7 impacts foreseen in the 4 analyzed categories.
- ↳ There will be positive socio-economic changes from the operation (Ranges from +1 up to +35, equivalent to the bands A, B and C), according to the results of the graph.

5 Conclusions

A key aspect of the project is that it has considered measures of environmental control in each of the activities and will be incorporated in the final designs of civil works and drilling of wells. Also to improve the access roads and opportunity of temporary employments in the area, reason for which the realization of the project helps sustain good employment prospects for the communities.

The Rapid Impact Assessment Matrix (RIAM) method, including project activities and the influence area knowledge of environmental team were important to environmental analysis. The last studies took from 4 to 5 months, whereas only 1.5 months were needed for the same studies in this case saving the company US\$ 60,000 in cost.

6 References

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Table 5: Total analysis for component.

Significant impacts		ES	RB	A1	A2	B1	B2	B3
FQ1	Land use changes	8	A	1	1	3	3	2
FQ2	Level noise increase	-6	-A	1	-1	2	2	2
FQ3	Soil permeability changes	0	N	1	0	1	1	1
FQ4	Soil uncertainty changes	0	N	0	0	1	1	1
FQ5	Soil pollution spills	-12	-B	2	-1	2	2	2

Biological and ecological component (BE)

Significant impacts		ES	RB	A1	A2	B1	B2	B3
BE6	Flora elimination	0	N	0	0	1	2	3
BE7	Habitat loss	0	N	0	0	1	2	3

Sociological and Cultural component (SC)

Significant impacts		ES	RB	A1	A2	B1	B2	B3
SC8	Geosciences research	27	C	3	3	1	1	1
SC9	Landscape alteration	0	N	1	0	3	2	2
SC10	Labor and public accidents	0	N	1	0	2	2	1
SC11	Rural roads improvement and zone risk lessen	10	B	2	1	3	1	1

Economic and operational component (EO)

Significant impacts		ES	RB	A2	B1	B2	B3
EO12	Tourism opportunity	14	B	1	2	2	3
EO13	Access roads improvement	10	B	1	3	1	1
EO14	Extend services	7	A	1	2	2	3
EO15	Land Acquisition	0	N	0	3	3	3
EO16	Employment opportunity	14	B	1	2	2	3

SUMMARY OF PUNCTUATION

Range	-108	-71	-35	-18	-9	0	1	10	19	36	72
	-72	-36	-19	-10	-1	0	9	18	35	71	108
Class	-E	-D	-C	-B	-A	N	A	B	C	D	E
FQ	0	0	0	1	1	2	1	0	0	0	0
BE	0	0	0	0	0	2	0	0	0	0	0
SC	0	0	0	0	0	2	0	1	1	0	0
EO	0	0	0	0	0	1	1	3	0	0	0
Total	0	0	0	1	1	7	2	4	1	0	0

Figure 1: Project Global Grafic Analysis.

