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THE EFFECTIVE USE OF ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs) FOR GEOTHERMAL DEVELOPMENT PROJECTS

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ABSTRACT

Both the developed and developing nations of the world would like to move toward a position of sustainable geothermal development while paying attention to the restoration of natural resources, improving the environment, and improving the quality of life. The impacts of geothermal development projects are generally positive. It is important, however, that the environmental issues associated with development be addressed in a systematic fashion. Drafted early in the project planning stage, a well-prepared Environmental Impact Assessment (EIA) can significantly add to the quality of the overall project. An EIA customarily ends with the decision to proceed with the project. The environmental analysis process could be more effective if regular monitoring, detailed in the EIA, continues during project implementation. Geothermal development EIAs should be analytic rather than encyclopedic, emphasizing the impacts most closely associated with energy sector development. Air quality, water resources and quality, geologic factors, and socioeconomic issues will invariably be the most important factors. The purpose of an EIA should not be to generate paperwork, but to enable superb response. The EIA should be intended to help public officials make informed decisions that are based on an understanding of environmental consequences and take proper actions. The EIA process has been defined in different ways throughout the world. In fact, it appears that no two countries have defined it in exactly the same way. Going hand-in-hand with the different approaches to the process is the wide variety of formats available. It is recommended that the world geothermal community work towards the adoption of a standard for environmental impact assessment. The Latin America Energy Organization (OLADE) and the Inter-American Development Bank (IDB)(OLADE, 1993) prepared a guide that presents a comprehensive discussion of the environmental impacts and suggested mitigation alternatives associated with geothermal development projects. The OLADE guide is a good start for providing the geothermal community a standard EIA format. As decision makers may only read the Executive Summary of the EIA, this summary should be well written and present the significant impacts (in order of importance), clarifying which are unavoidable and which are irreversible; the measures which can be taken to mitigate them; the cumulative effects of impacts; and the requirements for monitoring and supervision. Quality plans and Public Participation plans should also be included as part of the environmental analysis process

1. INTRODUCTION

Geothermal power is a relatively benign source of energy. There are, however, certain negative impacts that this development could have if there are not appropriate mitigation actions and monitoring plans in place. With existing laws, the imminent passage of environmental laws and the strengthening of environmental agencies worldwide, it is becoming increasingly important that countries prepare to address environmental issues in a common, systematic manner.

The environmental assessment process has been defined differently everywhere. In fact, it appears that no two countries have defined it in exactly the same way. General blanket statements are often made that the developing countries are all behind the industrial countries in terms of environmental issues. It is interesting to note that the Philippines has required EIAs for certain projects since 1977. The Federal Republic of Germany started to do so nearly a decade later (Biawas, 1991). In addition to the different approaches to the process are the wide variety of formats for EIAs that are available. This paper presents the elements that should be included as part of a comprehensive geothermal development project EIA. The goal is the establishment of an international standard.

2. ENVIRONMENTAL IMPACT ASSESSMENTS (EIAs)

2.1 Purpose and Scope

The purpose of an EIA is to help public officials make informed decisions that are based on an understanding of environmental consequences and take proper actions. The intent should not be to generate paperwork, but to enable superb response. This requires that an EIA be analytic rather than encyclopedic. Not only should significant environmental issues deserving of study be identified, insignificant issues should be de-emphasized, narrowing the scope of the environmental impact assessment process accordingly (Shipley Associates, 1993).

The quality of EIAs could be improved with some relatively simple measures. There are examples of EIAs prepared in support of World Bank and Inter-American Development Bank projects in which large amounts of money and effort were expended in collecting and reporting data on every aspect of the environment and producing voluminous reports

in which there was more insignificant and irrelevant information than there were findings of significance (Goff, 1994). A first step in quality improvement is to be sure that EIA specifications are extremely clear as to the format and content of the expected document.

2.2 Quality EIAs

The EIA is commonly carried out fairly late in the project planning process (Goff, 1994). This often means that only single alternative impacts are identified. The EIA process mostly ends after the decision to proceed with the project has been taken. The environmental assessment process will only be effective if there is regular monitoring during project implementation and operation so that appropriate environmental impacts can be identified and measured. Unfortunately the EIA is often undertaken to satisfy the requirements of banks and donor agencies. Thus, the EIA gets done, but has only a minor role in improving environmental conditions of projects.

The US National Environmental Policy Act Regulations (DOE, 1986; EPA, 1985) state that procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality. Most important, documents must concentrate on issues that are truly significant to the action in question, rather than amassing needless detail. This requires that an analytic rather than encyclopedic environmental impact statement be prepared. Ultimately, of course, it is not better documents, but better decisions that count.

EIAs should be prepared using an inter-disciplinary approach to insure the integrated use of the natural and social sciences and the environmental design arts. The disciplines of the preparers must be appropriate to the scope and the issues identified in the scoping process. The EIA should list the names and qualifications of the persons primarily responsible for preparing the EIA or significant background papers. Where possible the persons who are responsible for a particular analysis, including analyses in background papers, are to be identified. Following these guidelines will insure that appropriate standards will be applied and carried out with reasonable safeguards. This is particularly important to ensure quality, especially when consultants and contractors subcontract out the work.

Another quality improvement for EIA preparation is that any methodologies used should be referenced, by explicit reference, to the scientific and other sources relied upon for conclusions in the EIA. Discussions of the methodology should appear in the appendix. Failure to do so reflects poorly on scientific integrity.

In addition, the EIA should contain an executive summary which adequately and accurately summarizes the EIA. Often decisions makers may read only this summary, therefore it must present the significant impacts (in order of importance), clarifying which are unavoidable and which are irreversible; the measures which can be taken to mitigate them; the cumulative effect of the impacts; and the requirements for monitoring and supervision.

2.3 Transmission Lines and Substations

There is public concern about living near high-voltage transmission lines. This concern stems from questions about possible health effects from long-term exposure to the extremely low frequency electric and magnetic fields (ELF-EMF). In 1992, the US Congress authorized a program of research and analysis aimed at providing scientific evidence to clarify the potential for health risks from exposure to ELF-EMF. The report on this work (NIEHS, 1999) concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard in occupationally exposed adults. The report points out that the lack of connection between the human data and the experimental data as well as the complicated nature of the interaction of humans with ELF-EMF is insufficient to warrant aggressive regulatory concern (NIEHS, 1999). Many public commissions have endorsed a concept called "prudent avoidance" which means that exposure to magnetic fields should be reduced as much as possible.

2.4 Public Participation

Public opinion is a powerful force and, if unanticipated and unchecked, can delay or cancel otherwise sound projects. Meaningful public participation requires that information be available to every group that wants it or has an interest in a project. This kind of participation has not been found to hurt projects. In fact, excluding the public may actually cause more frequent delays. It can also result in poorer quality projects.

EIAs provide numerous opportunities for coordinating environmental work in a country, and should be linked to other environmental strategies, action plans, and freestanding projects. EIAs provide a formal mechanism for interagency coordination and for addressing the concerns of affected groups and local nongovernmental organizations (NGOs). The concerns of communities affected by the project and of local NGOs with environmental issues also should be covered in the EIA. These groups can provide information useful for the EIA. In fact, sometimes they are the only source of detailed knowledge about the local study area.

After initial scoping of the environmental assessment, a summary or outline should be circulated to known concerned groups and individuals for comment to "flesh out" concerns. It is better to uncover concerns and potential problems early in the project development than to prepare detailed analyses on non-critical issues or to omit key areas from the analysis.

2.5 Community Relations Program Plan.

A Community Relations Program plan is also useful. The plan can include a brief description of the energy project; a background on the developer and its environmental programs; description of the affected community; and concerns about environmental issues**.**

Designated Coordinator

It is a good idea to have a designated coordinator to assist the public in locating the information it needs on the EIA and the

EIA process. This person could also act as the primary contact for the public on a number of other issues.

Public Participation Scheme

A scheme for public participation opportunities in the EIA process is presented in Figure 1. It provides for public comment during the preparation of the final draft of the EIA, and during the preparation of the monitoring and mitigation work plan and final report**.**

Quality Plan

Quality assurance serves as both a guideline and a management tool to ensure that all activities are performed under a program plan in an appropriate, well-regulated manner that generates reliable, scientifically valid, and thoroughly documented data. It is largely an institutional concern. Quality control is a technical concern. It is a process for measuring the actual quality performance of a product against an applicable standard or specifications. The ability to provide data whose quality is sufficient to meet program goals is a concern that falls within quality control. Both quality assurance and quality control are important parts of a "Quality Plan."

The Quality Plan implementation method is like the scientific method and comprises certain basic steps that include: Plan what you do; Do what you plan; Document what you do; Assess the results; Improve the process.

These steps are all essential to the good management and effective conduct of operations, processes and activities in industry, business and science. The plan is a documented description of the environmental and monitoring activities and how they are to be conducted. The Quality Plan and accompanying procedures describe what is actually done, or what is intended to be done. Figure 2 presents a sample "Quality Program Plan Outline."

3. OLADE GUIDE REVIEW

OLADE and the IDB (OLADE, 1993) prepared a guide with the purpose of providing tools for integrating environmental factors into the plan, design and operation of energy projects. The guide presents comprehensive discussions of the environmental impacts associated with geothermal development projects and suggested mitigation alternatives. The guide is more useful to geothermal professionals than to environmental scientists and regulators. There are some improvements that could be made to the guide to make it a more valuable tool. For example, discussions of environmental successes and failures associated with geothermal development projects would improve the guide's effectiveness in training and extension activities. Details for formulating an effective Executive Summary would also improve the usefulness of the guide as a training manual.

From a technical perspective, the OLADE/IBD guide does not adequately address landslide hazards. Geothermal sites and volcanic regions often exhibit significant landslide hazard. Such sites are typically characterized by sloping, hydrothermally-weakened, saturated ground, and substantial volcanic activity. Engineering works associated with geothermal sites, including wells, pipeline networks, and modification of ground by cuts and fills, may also contribute to landsliding. Significant hazard is not restricted to extreme events. Fatalities and damage can occur with landslides of modest size, as illustrated by slump-and-debris flow of ordinary proportions that in 1991 caused 23 fatalities at the Zunil geothermal field in Guatemala (Flynn et al, 1991) (Figure 3). For most geothermal areas it is the small or moderate-sized landslide that is of most concern, providing the higher-probability of a hazard (Voight, 1992). It is imperative that a standard EIA format include some discussion of the impacts of landslides and suggested mitigation options for landslide hazards.

4. RECOMMENDATIONS

A standard EIA format for geothermal development projects would benefit the international geothermal community. A well-prepared EIA can add significantly to the quality of the overall project and a standard format should be a required part of an energy development bid package.

Utility company representatives (or appropriate governmental personnel) should understand the essence of an EIA. This requires learning how to do a comprehensive review; having the team putting the EIA together spend adequate time in the field assessing the environmental conditions at the development project; knowing the qualifications of those preparing the document and the disciplines that will be represented; spending time with the team preparing the EIA; and requiring status reports as part of the overall bid specifications.

Countries should consider assembling a local team to prepare EIAs by "twinning" or "teaming" with other organizations such as universities, other ministries, and private companies. It might also make sense to consider the possibility of teaming with the electric utilities of neighboring countries to achieve the same effect. Environmental issues seldom have borders. (The Río Paz for example is on the border with Guatemala and there is a water quality treaty in place between El Salvador and Guatemala to address common water quality issues.)

The suggested "standard" should allow for EIAs that are analytic not encyclopedic. The EIAs should concentrate on impacts most closely associated with energy sector development. Air quality, water resources and quality, geologic factors, and socioeconomic issues will consistently be among the most important factors. If working near protected wildlife or natural resource areas, biological/ecological factors will increase in importance. The positive impacts that energy development projects could have on ecological issues could be stressed by including a reforestation, revegetation program affiliated with the development component. This will not necessarily be costly and will add to the overall improvement of environmental quality in the country.

In countries with no formal air emission and air quality standards or water quality standards, the utility or respective government agency should adopt as early as possible its own "Energy Sector Guidelines" for air emissions, air quality, and water quality. This will make monitoring programs more meaningful and address the issue of not taking action because there are no standards in place. It is also essential to establish environmental control procedures and standards to ensure that program activities are carried out with reasonable environmental safeguards. To accomplish this a Quality Plan must be developed. Many environmental problem definitions and mitigation plans rely heavily on physical and quantitative sciences of chemistry, geology, and engineering.

The purpose of an EIA should not be to generate paperwork, but to foster informed decisions. The process should be intended to help public officials make decisions that are based on understanding of environmental consequences and take proper actions.

Implementation of a meaningful public participation plan should be part of an energy sector development program. For the plan to be meaningful, information must reach those that will be affected by the project and all of those interested in the project. It is important that governments not be secretive with the details of its project plans, potential environmental impacts, and mitigation alternatives. It is especially important that public opinion be taken into consideration. The US nuclear power industry is an example of the adverse consequences that can result when the public isn't consulted or taken seriously during energy development projects.

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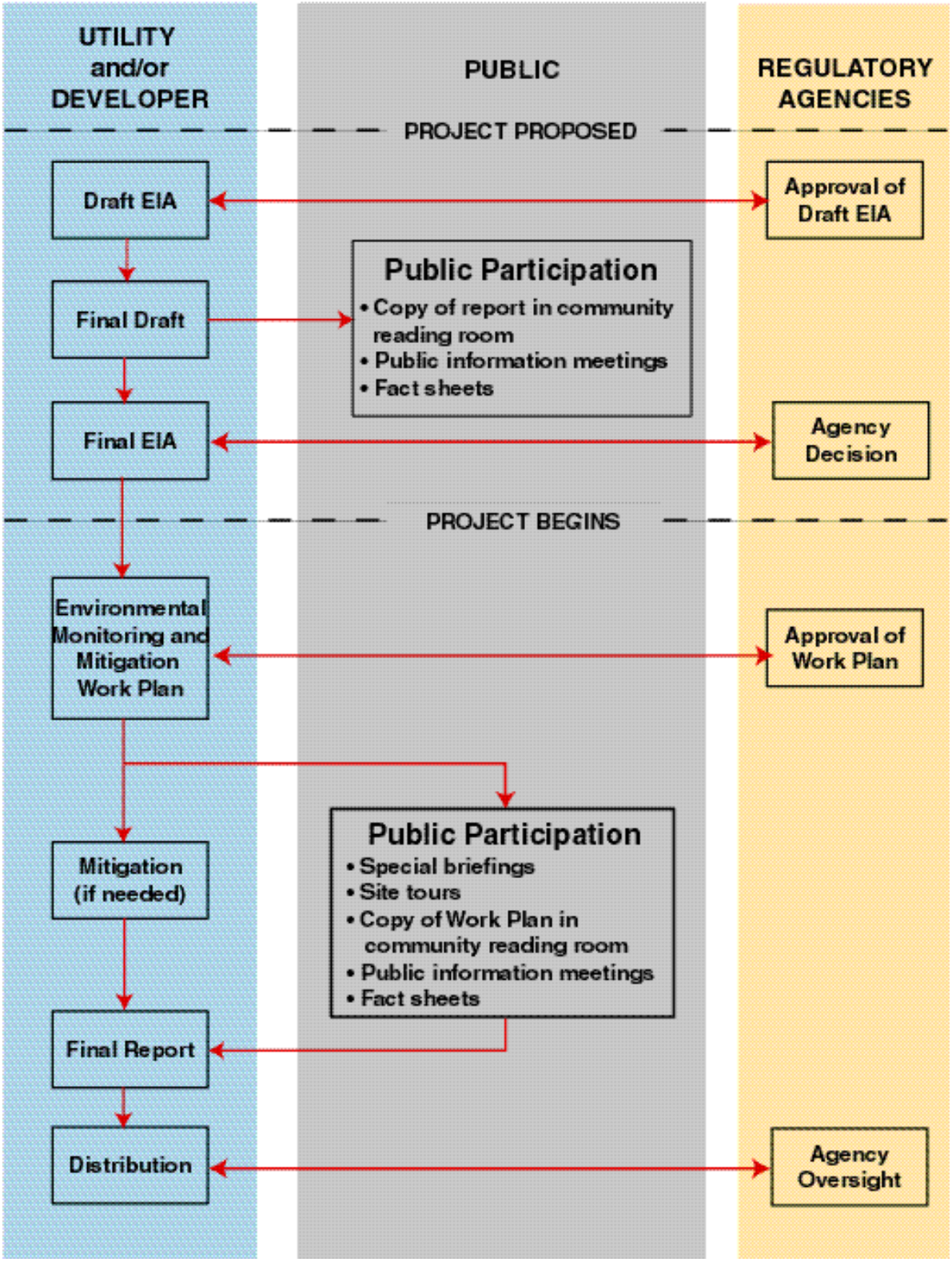

Figure 1. Suggested scheme for public participation opportunities.

QUALITY PROGRAM PLAN
Outline

1. INTRODUCTION
   1.1 Scope
   1.2 Policy Statement
2. ORGANIZATION
   2.1 Responsibilities
   2.2 Design
3. QUALITY ASSURANCE PROGRAM
   3.1 Personnel Qualifications and Training
   3.2 Data Quality Objectives
   3.3 Assessment of Data Quality
      3.3.1 Precision
         3.3.1.1 Standard Reference Materials
         3.3.1.2 Instrument Checks
      3.3.2 Accuracy
         3.3.2.1 Traceability of Instruments
         3.3.2.2 Traceability of Standards
         3.3.2.3 Traceability of Samples
         3.3.2.4 Traceability of Data
         3.3.2.5 Reference, Spiked, or Blind Samples
4. CONTROL OF PURCHASED ITEMS AND SERVICES
5. STANDARD OPERATING PROCEDURES
6. DOCUMENT CONTROL
7. CONTROL OF MEASURING AND TEST EQUIPMENT
   7.1 Identification of Equipment
   7.2 Maintenance and Calibration of Measuring and Test Equipment
8. CORRECTIVE ACTION
9. RECORDS
10. QUALITY IMPROVEMENT

Figure 2. Quality Program Plan Outline

Figure 3. Photo looking west at catastrophic landslide that killed 23 people on January 5, 1991 at the Zunil I geothermal field, Guatemala. The area is heavily cultivated from terraced fields. Because of its fluidized character, many local inhabitants mistakenly thought the slide was a white lava flow. Note the steam near the headwall of the slide from damaged well ZCQ-4.