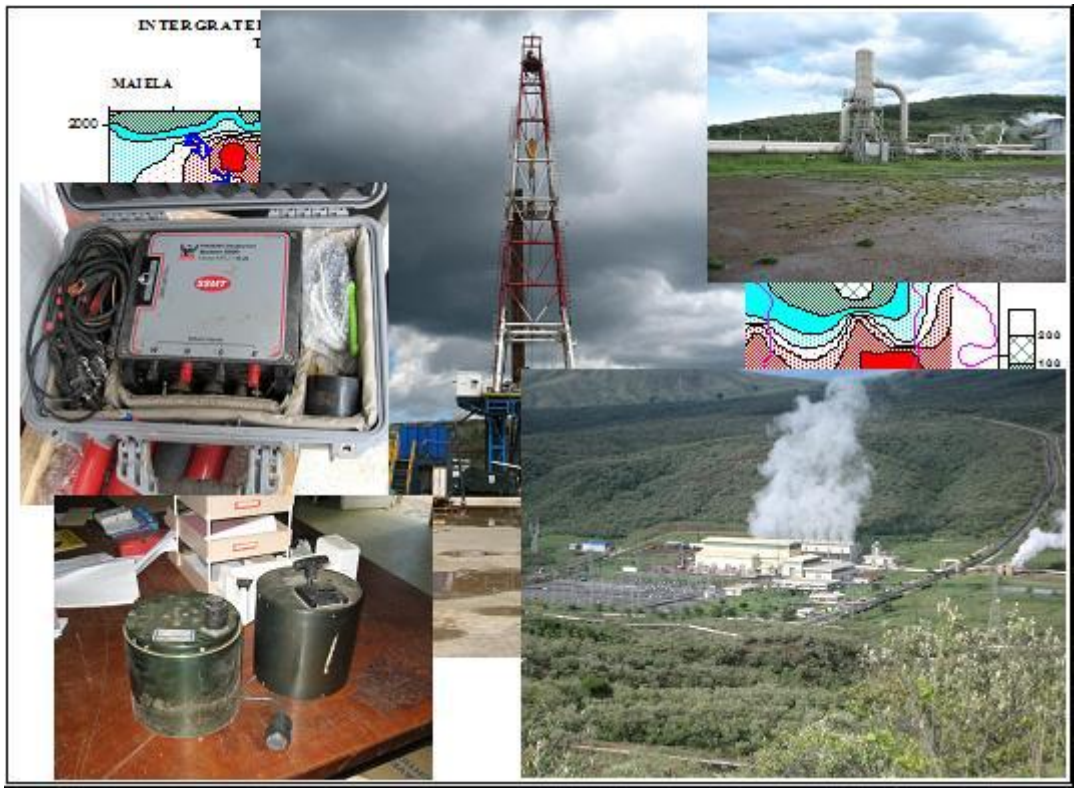
UNITED NATIONS ENVIRONMENT PROGRAMME

Terminal Evaluation of the UNEP/GEF
Project GF/4040-02-22 (4588)
"Joint Geophysical Imaging for Geothermal Reservoir Assessment (JGI)" - GFL/2721 -02-4588



EVALUATION AND OVERSIGHT UNIT

ALAIN BOISDET

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1 EXECUTIVE SUMMARY

The result of the present evaluation of the UNEP/GEF project is a rating of **moderately satisfactory**.

The main objective of the **Joint Geophysical Imaging for Geothermal Reservoir Assessment (JGI)** project was to increase the efficiency of the geophysical exploration of geothermal reservoirs, and by so doing to reduce the number of costly unproductive wells. The end result of the JGI was to decrease the cost of geothermal electricity as well as to increase its production. Both factors will contribute to reducing CO_2 emissions by the substitution of clean geothermal energy for polluting fossil-fuel energy. Emissions of equivalent CO_2 from geothermal electricity plants are 2000 times lower than those from equivalent fossil-fuel plants.

The implementing agency was KenGen with the collaboration of Duke University at Durham, North Carolina, USA. The total budget of the project was $2,733,323 (2002value) including a UNEP/DGEF contribution of $979,059 and co-financing of $1,754,264, mainly from KenGen ($1,220,000). The project, whose duration initially was 36 months in 2002, was completed on June 30 2008, after 72 months. However, the cost-effectiveness of the project is rather good if we consider the actual cost of one geothermal well that is now 4.5 M$. This means that the rate of KenGen participation today is much higher, from 45% before to 75% now.

From a formal point of view, despite delays the project objectives were globally attained. However, at present the resignation of only one person (KenGen senior geophysicist post graduate student) has rendered impossible the transfer of competence to the advantage of KenGen.

The project's outcomes are consistent both with the UNEP/DGEF operational programme strategies, removing barriers and reducing implementation costs for the adoption of renewable energy, and with country priorities for developing geothermal energy. It is highly probable that the increase of fossil fuel costs as well as the clean development mechanism as part of the Kyoto Protocol, will boost geothermal energy development in Kenya. Today, KenGen and the Kenyan government are about to change organisation and functioning of KenGen, according to the recommendations of the society MCKINSEY in accordance with organizational concept "Good to Great" The progress due to JGI project should register in this new context.

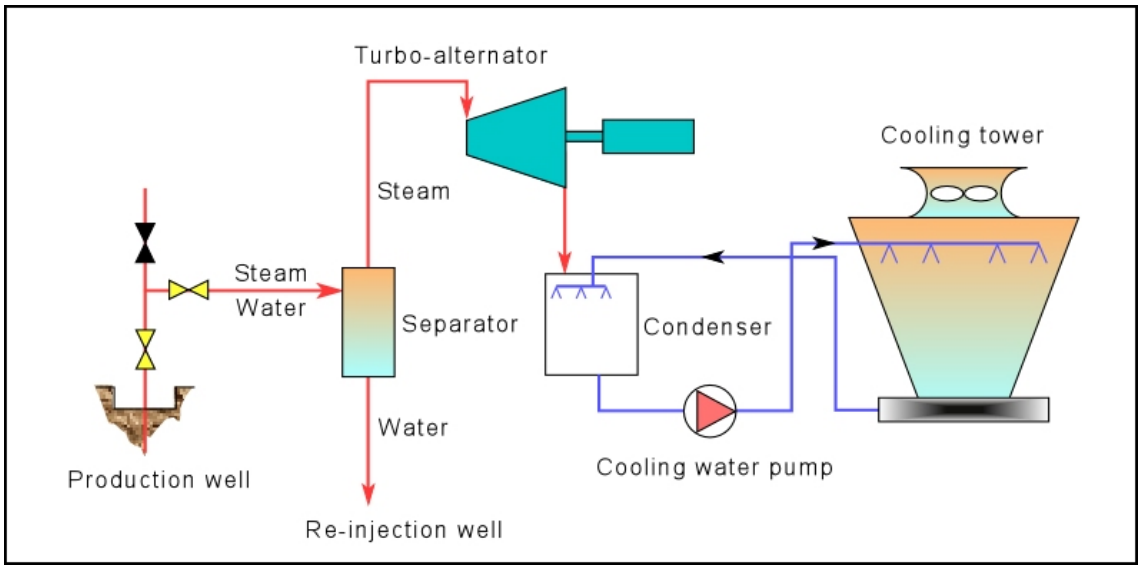
The clean development of geothermal electricity production in Kenya will have to resolve two main problems: the integration of connexion pipes of steam and water in remarkable wildlife landscapes and the impact of dangerous gases release, such as H_2S or CO_2, in the atmosphere. These aspects will require specific studies.

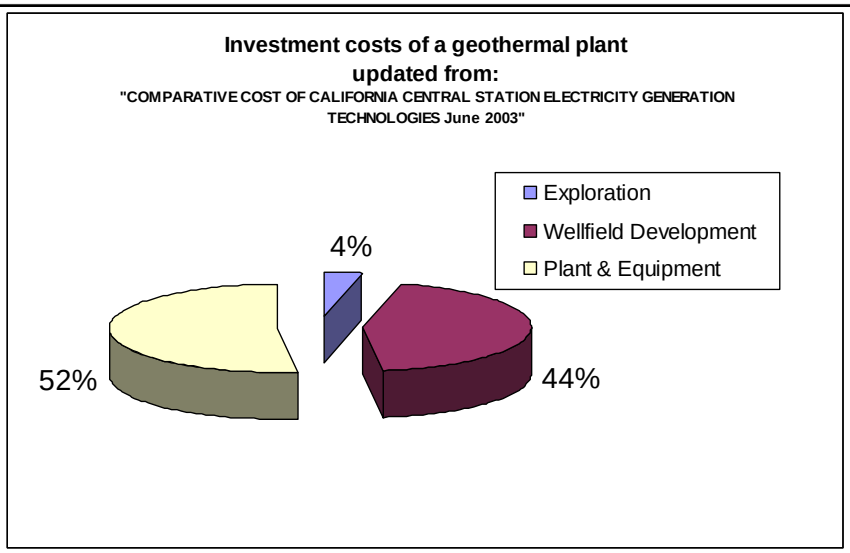
The JGI project gives an international visibility as well as an acknowledged authority to the geothermal energy program of Kenya. Since last year, KenGen scientists and technicians are teaching at the UN Geothermal Training Program. The project

equipment is also used for exploration in ARGEO countries, giving KenGen a leadership position in some aspects of the project.

If the project's objectives were clear, the means to achieve the objectives were evidently not sufficiently analysed and evaluated. Due to this lack of project management and rules to be applied, there was a constitutive weakness of the project. These are the main reasons for the delay of the JGI project. Delays are linked to technical aspects (definition, order and reception of sensors by DUKE University) as in financial aspects (financing, not envisaged at first by KenGen, of taxes of importation of equipments).. At the beginning of the project, UNEP/DGEF staff did not fully realise the complexity of this R&D project and had no precise idea of the necessary means for reaching its objectives, nor how this kind of project should be designed. It would seem that UNEP/DGEF did not understand that, for this kind of project, its role was more partnership than only control.

Despite the delays in document transfer, from KenGen to DGEF, the project has the appropriate financial controls, both in KenGen and in UNEP/DGEF.





LESSONS LEARNED

The project planning has to take into account administrative procedures and corresponding durations (calls for tenders, terms of payment, etc.).

Before the beginning of a project, it is very important to verify (possibly by an independent expert) the project's organisation and dedicated means.

During the project, impose periodical meetings of the Steering Committee.

It is necessary to have specific management rules for R&D projects, especially the possibility to add additional funding. Because this kind of project has to attain uncertain results with limited resources. In some cases, it is necessary to stop the project or to increase its duration or its means.

The contract documents must present the concrete tasks to be accomplished to reach the objectives and the corresponding resources. A precise definition of the means lead automatically to a good definition of the planning and of the budget.

RECOMMENDATIONS

Considering the remaining objectives of the JGI project, the technical evaluator has proposed to postpone the completion the project in order to allow KenGen to utilise the rest of the budget to proceed to technician training and purchase of an interpretation software.

Dedicate a specific budget to evaluate the project structure according to its various levels: organizational, technical, legal, financial aspects and general planning.

2 INTRODUCTION, BACKGROUND AND OVERVIEW

2.1 Introduction

The project falls under UNEP/DGEF Operational Program 6: Removing Barriers and Reducing Implementation Costs to Adoption of Renewable Energy.

Kenya is recognized as one of around thirty countries in the world that could meet its electrical-power needs through the harnessing of its non-atmosphere-polluting geothermal resources. It has an estimated capacity of over 2000 MW and simulation studies indicate that it is the Least Cost option of base-load power development.

The main objective of the **Joint Geophysical Imaging for Geothermal Reservoir Assessment (JGI)** project is to increase the efficiency of geothermal geophysical prospecting, and in so doing to reduce the CO_2 emissions of Kenya and, at a later stage, all East African Rift countries. Geothermal resources in Kenya are sufficient to meet the country's entire electricity requirements.

The implementing agency was Kenya electricity generating company Ltd, hereafter called KenGen, with the collaboration of Duke University at Durham, North Carolina, USA. The total budget of the project was $2,733,323 (2002 value) including a UNEP/DGEF contribution of $979,059 and a co-financing of $1,754,264, mainly from KenGen ($1,220,000).

At the beginning, in 2002, the project duration was 36 months, this duration has been extended to 72 months, with a completion on June 30 2008.

Over the years, KenGen has improved on the methodology of locating geothermal wells. For example, for the Olkaria 1 power station built in the 1980s, 33 wells were drilled for an installed capacity of 45 MW (average of 1.36 MW per well). For Olkaria 2 built in of the early 2000s, only 25 wells were drilled for an installed capacity of 71 MW, or an average of 2.84 MW per well.

However, there is still need for a further reduction in the total number of wells drilled for a single power station and for finding the most productive area at the start of a project. In the case of Olkaria, the power for one well varies from 1 MW up to 19 MW. The question was thus: how to find the most productive wells at the start of a project?

2.2 The objectives

The project had three main objectives, on three different levels:

(i) R&D development;

(ii) Transfer of technology;

(iii) Field validation.

The R&D objectives were, first, to develop a new and efficient type of geophysical probe for evaluating a high-enthalpy geothermal reservoir, including the construction of dedicated seismic probes and, second, to develop a new interpretation method and the associate software.

The dedicated probes are portable seismographic MEQ, electrical resistance MT/TEM, and se1f-potential SP instruments.

Combined, or "joint geophysical imaging", methods for micro-earthquake, electrical, and self-potential data collection, analysis, and interpretation methods required specific development. This activity aims at joint "inversion" of the three data types for improved understanding of subsurface geothermal conditions.

Geophysical surveys are directed at obtaining indirectly, from the surface or from depth intervals near the surface, the physical parameters of deep geological formations. These physical parameters include:

- Temperature (thermal survey),
- Electrical conductivity (electrical and electromagnetic methods),
- Propagation velocity of elastic waves (seismic survey),
- Density (gravity survey),
- Magnetic susceptibility (magnetic survey).

Some of these techniques, such as seismic, gravity and magnetic ones that are traditionally used in oil-and-gas exploration, can give valuable information on the shape, size, depth and other important characteristics of the deep geological structures that might constitute a geothermal reservoir, but they give little or no indication as to whether these structures actually contain the fluids that are the primary objective of the research. Such methods are, therefore, more suited to defining details during the final stages of exploration, before the exploratory wells are sited. Information on the existence of geothermal fluids in the geological structures can be obtained by electrical and electromagnetic prospecting, which are more sensitive than the other surveys to the presence of these fluids and to variations in temperature; both techniques have been applied widely with satisfactory results. The magneto-telluric method, which exploits the electromagnetic waves generated by solar storms, has been greatly improved over the last few years, and now offers a vast spectrum of possible applications, despite the fact that it requires sophisticated instrumentation and is sensitive to background noise in urbanized areas. The main advantage of the magneto-telluric method is that it can be used for defining deeper structures than are attainable with electric and other electro-magnetic techniques. The recently developed Controlled Source AudioMagneto-Tellurics method (CSAMT), uses artificially induced waves instead of natural electro-magnetic waves. The penetration depth is shallower with this technique, but it is quicker, cheaper, and provides far more detail than the classic MT method.

…All geophysical techniques are expensive, although some more than others. Nor

can they be used indiscriminately in any situation or condition, as a method that produces excellent results in a determinate geological environment may give very unsatisfactory results in another. In order to reduce costs, it is therefore very important that the geophysical method(s) be selected very carefully beforehand by geophysicists working in close collaboration with geologists (Meidav, 1998).

Drilling of *exploratory wells* represents the final phase of any geothermal exploration programme and is the only means of determining the real characteristics of the geothermal reservoir and thus of assessing its potential (Combs and Muffler, 1973). The data provided by exploratory wells should be capable of verifying all the hypotheses and models elaborated from the results of surface exploration and of confirming that the reservoir is productive and that it contains enough fluids of adequate characteristics for the utilisation for which it is intended. Siting of the exploratory wells is therefore a very delicate operation.

Mary H. Dickson and Mario Fanelli

Istituto di Geoscienze e Georisorse, CNR , Pisa, Italy

Prepared on February 2004

The second main objective of technology transfer had two aspects. The first was the training of Mr S. Onocha of KenGen who enrolled in graduate studies at Duke University. His PhD program involved field-data collection in Kenya and development of new software. The second aspect was the training of technicians of KenGen in the utilisation of the new modern pool of instruments.

The third main objective was the validation of the JGI methodology. This was to be achieved by drilling a highly productive well whose target, in the geothermal reservoir, was to be determined by the JGI methodology. This well location had to be selected as part of the development of the Longonot geothermal field, the next KenGen priority after completing the current set of appraisal wells in Olkaria Domes.

2.3 Means and capacities

The weakness of the project lies in the means and capacities, probably the reason of the delays and the present unsatisfactory feeling both in KenGen and in UNEP/DGEF.

Analysis of the means needed for achieving the project as well as the capacities of planning it, showed both points to be insufficient.

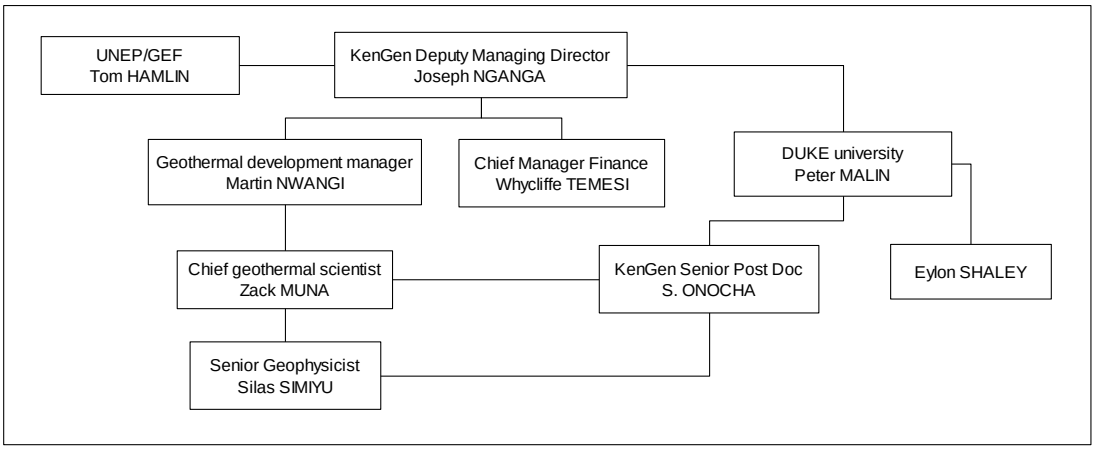
In a project, which almost by definition cannot be duplicated, the following points are traditionally studied and explained with graphics:

- The project breakdown structure (PBS) explains in detail the different material elements of which the Project consists, such factual elements also being its expected results.

- The work breakdown structure (WBS) explains in detail, for each material element of the PBS, the different tasks (workforce) and equipment necessary for achievement of the Project.
- The organisation breakdown structure (OBS) explains, for each task of the WBS, which person is in charge of it.
- An analysis of the project planning existed, but was too weak. It would have been necessary to accomplish a true graph of Gantt (GANTT) and a valuation of Program and a review of technology (PERT). Those techniques allow taking into account the availability of different means (workforce and equipment) and of the links between the various tasks. This allows calculating the initial duration of the Project and, at a later stage, to change it if some unforeseen events occur.

In fact, it is not clear that this kind of approach had been done for the JGI project by KenGen.

The only organisation chart and "work plan and timetable" at beginning of the project was the following one in the contract.



3.1 Workplan and Timetable

ACTIVITIES	PROJECT-MONTHS
Completion of project activities	0 6 12 18 24 30 36
1. Facilities	xxxxxxxxxxxxxx
2. Joint imaging development	xxxxxxxxxxxxxxxxxxxxxxxxx
3. Joint imaging field campaign	xxxxxxxxxxxxx
4. Joint imaging guided drilling	xxx - xxx
5. Technology transfer and training	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
6. Regional plan development	xxxxxxxxxxxx

From a management point of view, the following items were missing:

- An appointed project manager whose responsibility would have been both the coordination and management of the project, and the source of information for the project sponsors during periodical meetings of the Steering Committee;

- A Steering Committee gathering the sponsors of the project (KenGen, Duke University and UNEP/DGEF) with the capability to take all decisions about financing and planning necessary to the progress of the project;
- A specific person responsible for the development of software and its transfer to KenGen;
- A clearly defined procedure for choosing and purchasing the probes that takes into account the administrative procedures of KenGen.

The situation differed for the MT and MEQ probes. For the MT probes it was a question of buying more modern equipment than those already in KenGen's possession, but with the same functions.

In the case of the MEQ probes it was not a question of updating the equipment owned by KenGen, but to acquire equipment of a new type, especially conceived for the Project, with new functions. This means that the terms of reference for manufacturing, reception conditions, and field-use rules were fundamental elements.

Furthermore, the following points were not clear or were missing:

- Terms of reference for construction of the probes;
- Description of required probe performance and accuracy of the measurements;
- Written procedures for acceptance of the probes;
- Description of the final documentation of the probes;
- Specification of spare parts requirements;
- Training for local repair of the probes.

For the JGI software, the following points were not clear or were missing:

- Terms of reference of the software with, notably, the nature and format of data input and output, notably graphic, and the precision of the resulting calculations;
- Written description of the final product and its documentation;
- Mirror organisation (see below);
- Training of several persons, to avoid the risk of losing everything if one person has to back out for any reason.

A "mirror" organisation is an extremely classical organisation for the design and transfer of computer software. It consists in setting up an identical structure, as for the final product, between the supplier, here Duke University, which develops software, and the client, here KenGen, who will have to use it. Such a structure allows the client to have a progressive takeover of its new software. The supplier initially assures the training of the client in his new equipment, after which he carries out the transfer and checks on the software. Finally, he trains the Client's agents in the latter's environment, in the operation of the new software.

In JGI project, one decided to let the responsibility of all software transfer to a student doing a PhD thesis. In view of my own experience as PhD student, a researcher and

then a manager of geothermal research laboratory, I consider inadequate this decision, which concerned a key and very complex point of the project.

2.4 Results

In 2004, KenGen purchased the magneto-telluric probes from KEFTEK, a Canadian company, after selection with an open procedure.

The probes, which are used in Kenya and in other countries, work perfectly well and give good data for interpretation with KenGen's software.

The GEOSPACE seismic probes were purchased by KenGen after selection by Duke University. They have posed and still pose problems to KenGen.

KenGen was not involved in drawing up the terms of reference for the probes and now consider them as black boxes. The manufacture and procurement of these probes has been also a source of major delays, around 10 months.

Each probe is independent, with a GPS locator and a rechargeable battery that has one week of running time. The probe records the data on a detachable hard drive. This data has a special coding and KenGen's technicians cannot read them on their computers. They can only send them to Duke University for interpretation, or store them in the hope to have, some day, the computer code to exploit them. The KenGen's technicians cannot do any data output do not even know if the data were correctly recorded on the disks.

Duke University did not give any interpretation software to KenGen for the new seismic sensors. Apparently all the necessary knowledge was given by Duke to Dr ONOCHA, then employee of KenGen, who also participated in designing the software. The problem is that Dr ONOCHA resigned from KenGen in early 2008, before transferring his knowledge to his colleagues at KenGen. He is presently *"at the Institute of Earth Science and Engineering (IESE) at the University of Auckland in New Zealand working on research in geothermal exploration and development"*(sic). He is *"working on methods to improve targeting of geothermal wells and also understanding the deeper structure that can be targets for drilling."* (Sic)

Three KenGen technicians were trained in the use of the new probes, in the US, Iceland and in Kenya. They are very satisfied with their training.

JGI's approach was used for locating six wells on the Olkaria Dome, with positive results. The predicted production in June 2007 was an average of 5.6 MW per well, instead of 1.4 MW per well for Olkaria 1 and 2.8 for Olkaria 2.

The certification in Longonot field was abandoned because this location was based on specific financing by the German KfW (Kreditanstalt fuer Wiederaufbau), with a specific geothermal risk coverage (like GeoFund) that was not obtained from the World Bank.

It should also be noted that the work on JGI has led to interesting collaborative work between KenGen and the Icelandic national power company, the California Energy Commission, and PUNA (Hawaii).

Project's initial duration was 36 months, from December 2002 to December 2005. Due to unforeseen delays, the duration was lengthened 36 month, until June 30 2008.

Hereafter the summarised schedule of the project.

2002	December, signature of the contract. **Tom HAMLIN UNEP/DGEF Task manager.**
2003	**Training of two KenGen technicians** with magneto-telluric equipment from Phoenix Geophysics at the San Andreas Fault Observatory, before delivery of the REFTEK probes to KenGen. Supported by USGS and the US NSF (0.25 MUSD). Terms of reference of the GEOSPACE equipment. Call for tenders for the magneto-telluric equipment.
2004	**Anne-Marie VERBEKEN new UNEP/DGEF Task manager.** Manufacturing of the 20 seismic sensors by GEOSPACE. **Training of two KenGen technicians** at Casa Diablo geothermal field, near Mammoth Lake, USA. During the test and field-data acquisition of the magneto-telluric and seismic (20 GEOSPACE sensors) equipment, some software problems detected. The cost was shared between Ormat, Duke and the California Energy Commission. **Training of three KenGen technicians** at Krafla, Iceland, during tests and field-data acquisition. Funded by the US DOE, Duke and the Icelandic government. After comparison with REFTEK seismic equipment, the GEOSPACE probes were sent back to the manufacturer for improvement. REFTEK'S MT equipment delivered to KenGen; equipment then used in Kenya and Zambia. **At Longonot and Olkaria Dome** geothermal fields, data acquisition with GEOSPACE' seismic equipment and REFTEK'S MT equipment.
2005	**At Krafla in Iceland**, training of three KenGen technicians during tests and field-data acquisition, funded by the US DOE, Duke and the Icelandic government. Satisfactory data used for software development. **Geothermal resource council (GRC) meeting at Reno,** results published and presented.
2006	**Peerke DE BAKKER new UNEP/DGEF Task manager**. Mr ONACHA finished his thesis. **New Zealand annual workshop**, results published and presented.
2007	**Mr ONACHA earns his PhD**. Recommends the purchase of Mat lab Licences as a platform for the seismic software (total cost 6,000 US$). At KenGen, Mr NGANGA, Deputy Managing Director and Mr MWANGI, Geothermal development manager, retire.
2008	**Mr ONACHA resigns from KenGen**. KenGen starts the following actions: training on MT equipment in Canada and on seismic equipment in Houston; software training on seismic data interpretation in Germany or in the Philippines; purchase of software for interpretation of MT data and MEQ data; purchase of laptop computers for

	MT and MEQ data handling. Those actions that had to be completed before June 30 2008, were not at the time of the valuation.

3 SCOPE AND OBJECTIVE

The objective of this terminal evaluation was to examine the extent and magnitude of any project impacts to date and determine the likelihood of future impacts. The evaluation also assessed project performance and the implementation of planned project activities and planned outputs against actual results. The evaluation focused on the following main questions:

Has the project:

- Demonstrated that the East African Rift geothermal resources can be more accurately located and assessed with improved geophysical equipment, facilities and joint mapping and interpretation methods?
- Improved the existing in-country capacity for geothermal exploration, data collection, analysis, and interpretation methods?
- Demonstrated that the Joint Geophysical Imaging mapping method can reduce geothermal power cost, development time and investment risks significantly by locating high-production wells? Was a joint inversion model achieved?
- Contributed to CO_2 emission reductions by making geothermal power equally competitive with fossil-fuel alternatives?

The Terms of References (TOR) of this Terminal Evaluation consultancy are given in annex A.

4 METHODOLOGY AND LIMITATIONS

This terminal evaluation was conducted as an in-depth evaluation using a participatory approach whereby the UNEP/DGEF Task Manager was kept informed and regularly consulted throughout the evaluation.

The findings of the evaluation are based on the following:

A desk review of project documents including:

1) The project documents, outputs, monitoring reports such as progress and financial reports to UNEP and the UNEP/DGEF annual Project Implementation Review reports, and relevant correspondence.

2) Other project-related material produced by the project staff or partners.

3) Interviews with project management and staff based in the KenGen Geothermal project office in Naivasha.

Interviews with the UNEP/DGEF project task manager and Fund Management Officer, and other relevant staff in UNEP.

The tasks of the evaluator were spread over three phases summarised below:

Phase 1 - Preparation and Planning	4 days
Phase 2 - Field Mission	11 days
Phase 3 - Report Writing	11 days
TOTAL	26 days

The field mission took place from November 9 to November 19, 2008, according to the schedule presented Annex D.

It was said in the TOR that the findings of the evaluation will be based, notably, on interviews with project management and staff based in KenGen headquarters, Nairobi, as well as in the KenGen Geothermal Project office in Naivasha.

For the KenGen Geothermal Project office at Naivasha, the ongoing UN geothermal course at the same time meant that KenGen staff were not very available. As far as the KenGen Nairobi headquarters and the Ministry of Energy were concerned, Dr SIMIYU was unable to give me an organisation chart, or to organise a meeting for me in Nairobi.

For that reason, it was impossible for me to know whom to ask the following questions:

1) What is the geothermal development strategy in Kenya?
2) What is the projected budget for such a strategy?
3) How and on which criteria does one select the regions to be developed, i.e. the Dome of Olkaria and Longonot?
4) What is the level of financial independence of KenGen?
5) Was the JGI plan widely known? And was it actively supported?

In fact, although my mission was known to KenGen since November 4th, 2008, together with my request to encounter KenGen staff in Nairobi as well as the Ministry of Energy staff, nothing was organised. I renewed this request in Nairobi on November 10th to Dr Mariita in the presence of Mr. De Bakker, as well as in Naivasha to Dr SIMIYU on November 13th. To summarise, the scheduled time in Kenya was too short for lack of reactivity by KenGen to organise appointments in Nairobi with the staff of KenGen and the Ministry of Energy.

The written documents handed to me concerning the JGI project are, mostly, undated and not signed. They are often very repetitive on objectives. On the contrary, I did not find most key elements, such as mission reports, planning, and the results of simulation calculations.

Moreover no synthesis document was given to me on the situation of geothermal energy in Kenya. Even no "Country update", published every five years during the "World geothermal congress (WGC)" of the International Geothermal Association (IGA). More

precisely, no document about the location of Kenyan geothermal resources was given to me, whether an atlas or a map.

For an external expert, it is difficult to appreciate if these dysfunctions are structural, due to an absence of documentary logic and a lack of information management, or whether they are caused by a short-term increase in activity or by an ongoing reorganisation within KenGen and the Ministry of Energy.

5 PROJECT PERFORMANCE AND IMPACT

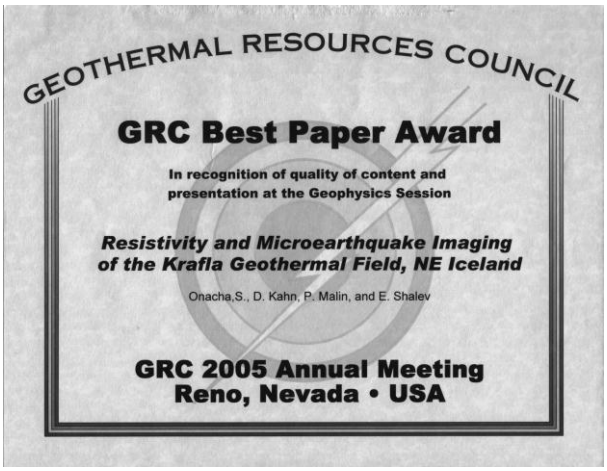
5.1 Attainment of objectives and planned results

5.1.1 Baseline data

At the beginning of the project, no baseline analysis was made. The question was not asked in what measure the project could speed up the tendency to improve exploration techniques.

At the time of the present evaluation, if the question was asked ***"what would have happened in any case?"***, one would be tempted to answer that the situation would have been the same as in the years 2003-2004. KenGen would not have made an R&D effort, and the international community would have no interest to give its results for free to KenGen.

In fact, the JGI research work was at the heart of the development of exploration techniques and has contributed to their acceleration. This is amply certified by the publications written and the recognition of their level of excellence by the GRC award got in Reno in 2005.



5.1.2 Effectiveness

The effectiveness assessment rate is "**moderately satisfactory"**.

From a formal point of view, despite important delays, the objectives of the project were attained. This is attested by the purchase of new geophysical equipment for KenGen, the PhD of Dr. ONOCHA, the training of three KenGen technicians, and the drilling of wells located by JGI methodology with good results.

As a result of the JGI project, KenGen was endowed with a new pool of seismic (MEQ) and magneto-telluric (MT) probes. These probes are even in the vanguard as far as the Geospace seismic sensors are concerned.

The seismic probes were successfully used in Kenya, and now are standard equipment of KenGen. As for the MT sensors, they were satisfactorily used in Kenya, and well as in other countries participating in the ARGEO project.

Concerning the transfer of the drilling target from Longonot to Olkaria Dome for funding reasons, one cannot say that this is significant for the evaluation of JGI technology, as the geological condition are probably quite similar.

However, the resignation of Dr ONOCHA has made the transfer of competence concerning software interpretation impossible, to the disadvantage of KenGen.

Concerning the new MEQ sensors, at the moment of the evaluation, they are still "black boxes" for the KenGen geophysicists. They can neither repair them in case of breakdown, nor read or interpret the data which they are being supposed to record. To remedy it, the corrective actions that KenGen had to terminate for June 30th were not still launched.

In retrospect, one can say that giving too much responsibilities to just Mr ONOCHA, was identical to putting all eggs in the same basket. However, in this respect one could also say that the responsibility is shared between KenGen and UNEP/DGEF: KenGen by excess of trust, and UNEP/DGEF as they did not see this weakness in defining the project.

5.1.3 Relevance

The relevance assessment rate is **"satisfactory"**.

In retrospect, the project's outcomes are consistent both with the operational program strategies, removing barriers and reducing implementation costs to adoption of renewable energy, and country priorities to develop geothermal energy.

In the field of geothermal energy development, the costs of wells are fixed charges. Therefore, it is fundamental to augment the productiveness of wells, by choosing their drilling locations in the most productive zones. All exploration methods, when properly implemented, concur in this objective: geology, thermal exploration, geochemistry and geophysics.

Geophysical methods allow an in-depth investigation of the sub-surface with relatively inexpensive means, which makes them particularly suitable. In addition, two technological advances make geophysics methods increasingly attractive.

First, the arrival on the market of removable hard disks of very large capacity and low cost, which allows acquisition autonomy over long periods. Second, the ongoing evolution of ever cheaper and more powerful computers, which has led to considerable improvements in the processing and interpretation of signals.

In fact, all countries with large geothermal resources develop these methods, such as the USA, Italy, Indonesia, the Philippines, New Zealand, Iceland, etc.

5.1.4 Efficiency

The efficiency assessment rate is **"satisfactory"**.

The cost-effectiveness ratio of the project is rather good. In the initial budget, the level of participation by KenGen was 45% with the realisation of one well evaluated at 1.2 M$, 2002value. The 2007 cost of a geothermal well, is 4.5 M$. If the budget had been updated, the KenGen participation would be 75 %.

Even more, delays in the project, some of them unforeseen, have caused an increase of the project costs. Faced with the refusal of UNEP/DGEF to take them even partly into account, KenGen and Duke University succeeded in obtaining funds from American and Icelandic organisations to compensate for these shortfalls and not penalise the project.

Finally, the JGI approach was used not only for one well sitting, but for that of six wells at the Olkaria Dome, with positive results. The predicted production rate is an average of 5.6 MW per well, instead of 1.4 MW per well for Olkaria 1 and 2.8 MW for Olkaria 2.

5.2 Sustainability of project outcomes

5.2.1 Financial resources

The financial resources assessment rate is **"likely"**.

Searches concerning methods to determine the best location for geothermal wells are conducted at an international level. It is a question of avoiding the drilling of unproductive or poorly productive wells.

The support of UNEP/DGEF has been of great benefit to KenGen by giving it an international legitimacy and by allowing it to make contacts with competitive teams in the USA and Iceland. Certain of its members are now consultants involved in the United Nations training course on geothermal energy.

Moreover, it is very unlikely that, without new financial support of UNEP/DGEF, the present approach will stop. On the contrary, it is likely that it will accelerate, not only because of increasing fossil fuels prices, but also because of the "mechanism of clean development", as part of the Kyoto Protocol.

In Kenya, the increase in the price of electricity generated by fossil fuels will render electricity generated by geothermal heat even more attractive.

In addition, the countries mentioned in Annex 1 may be interested in investing in the development of geothermal energy in Kenya, to obtain relatively cheap credits of greenhouse gas emissions.

5.2.2 Socio-political

The socio-political assessment rate is **"likely"**.

The JGI project participates in the improvement of geothermal exploration. At present, the development of geothermal energy is entrusted to KenGen, a national company whose resources come from the Kenyan State. Any promotion of the results of the JGI project therefore will be a partly political decision. In so far as the project confers an advantage to KenGen, it seems logical that KenGen has an interest in promoting its results at the level of the State. Recent statements by high-ranking politicians show that the development of geothermal energy is a national priority.

On a social level, the development of geothermal energy increases energy independence as well as national wealth. From this point of view, it is attractive because it reinforces the economic macro solidity of the State. Furthermore, it generates more jobs than fossil energies.

However, it is important to ensure that the local populations benefits from this development, through the creation of roads and other general infrastructure.

Up to now, the State has tried to involve the local population in the caretaking of drilling sites of a Chinese company, which ended in failure, principally for reasons of cultural contrast.

5.2.3 Institutional framework and governance

The assessment rate for institutional framework and governance is **"moderately likely"**.

As far as I know, KenGen and the Kenyan government are about to change the entire organisation of geothermal energy development in Kenya. This is to be on the basis of a key study called "G2G", for: "KenGen's good to great transformation".

The progress due to the JGI project has to be registered in this new context. The only negative outcome might be a loss of influence of the new techniques, if key actors such as Dr SIMIYU and Dr MARIITA are put in positions without reference to their technical competences.

5.2.4 Ecological

The ecological assessment rate is **"likely"**.

The benefits of geothermal energy development for the environment are undeniable.

The JGI project aims at reducing the number of unproductive or poorly productive geothermal wells, as well as decreasing the cost of geothermal electricity and increasing its efficiency. Both factors will contribute to reducing CO_2 emissions, by substituting clean geothermal electricity for polluting fossil-fuel energy: the equivalent CO_2 emissions from geothermal power plants are 2000 times lower than those from fossil fuel plants.

However, the development of geothermal power in Kenya will have to resolve two main problems: its incorporation (pipes for steam and water) in remarkable wildlife landscapes and the long-term impact of releasing non-condensable dangerous gases such as H_2S into the atmosphere. Specific studies are necessary to solve these two problems. For the rest, the systematic injection of geothermal water in its original aquifer restricts the environmental impact.

Two positive points must be mentioned: the limitation of the number of drilled wells and the agreement, signed in 1994, between KenGen and the Kenyan Wildlife Service (KWS). The JGI project, by limiting the number of drilled wells for the same electricity output, limits the impact on the environment during drilling as well as in the operational stage. During drilling, fewer access roads and drilling platforms are needed, and fewer pollutants are rejected, especially drilling mud. During operations, fewer access roads and connection pipes for steam and water are necessary.

Finally, the Memorandum of Understanding signed between KenGen and KWS shows that the former is conscious of the imperative to preserve the wildlife that is one of Kenya's trump cards. Examples of critical sites are Lake Naivasha, the Longonot parks, and the Oserian wildlife sanctuary.

5.3 Achievement of outputs and activities

The assessment rate for achievement of outputs and activities is **"moderately satisfactory"**.

In the contract the project outputs were the following:

1) *The construction of a dedicated, portable seismographic MEQ, electrical resistance MT/TEM, and self-potential SP instrument pool, support laboratory, transport, and field logistics capacity for expanded geothermal exploration and well-siting.*

2) *The completed development and adaptation to Kenya of a combined or "joint geophysical imaging" microearthquake, electrical, and self-potential data collection, analysis, and interpretation method.*

3) *The application of the JGI analysis and interpretation to the data collected with the new MEQ, MT/TEM, and SP instrumentation.*

4) *KenGen test drilling based on the results of the joint inversion map of subsurface conditions. Potential high permeability zones will be targeted.*

5) *Technology transfer from Duke University to KenGen at both scientist and technician levels.*

For the achievement of these objectives it is possible to draw the following conclusions:

- For points 1), 2) and 3) the targets were reached;
- For point 4), the target is reached but with a changed initial objective from Longonot to Olkaria Dome;

- For point 5), the transfer of technology from Duke University to KenGen was effective at the technician level, but not at the scientist level. The training, including the Ph.D. research-and-development work by S. ONOCHA, was done as combined field and office work involving data collection and development of a joint inversion analysis software for TEM, MT, SP, and MEQ data interpretation. However, the departure of Dr ONOCHA has weakened the transfer-of-competence aspect of the project, at least provisionally.

This problem, which can be relatively easily overcome, should not hide the other, very positive, consequences of the JGI project, such as the drilling of good geothermal wells in the Olkaria Dome. This became possible during the thesis work by S. ONOCHA, when MT and MEQ data acquisition allowed the successful sitting of new wells.

Since the beginning of the project in 2002, progress was made concerning the interpretation of data from seismic sensors. KenGen now has two possibilities, either to buy interpretation software and train its technicians in its use, or to sign an interpretation contract with Duke University for the acquired data. The second solution could be the first stage of the first solution. A problem is that KenGen did not purchase the Mat Lab software required to run interpretation software, as recommended in 2007.

5.4 Monitoring and Evaluation Systems

5.4.1 M&E design

The assessment rate for M&E design is **"unsatisfactory"**.

The project does not have a sound M&E plan to monitor results and track progress towards achieving project objectives. This for two reasons, on one hand the absence of a precise enough definition of tasks (technical, administrative and financial) to accomplish the project and, on the other hand, absence of installation of a true structure of management for the project. All elements extremely classical.

In a complex project such as JGI, the following points are traditionally studied and explained with graphics:

- The project breakdown structure (PBS), which explains in detail the different material elements of the Project that are its expected results.
- The work breakdown structure (WBS), which explains in detail for each material element of the PBS, all the different tasks (workforce) and equipment necessary for its achievement.
- The organisation breakdown structure (OBS), which explains, for each task of the WBS, who is in charge of it.

A planning analysis of the project existed, but was too weak. It would have been necessary to accomplish a true GANTT graph and a valuation of Program and a technology of review (PERT). Both techniques allow taking into account the availability of different means (workforce and equipment) and of the links between the various tasks. This allows calculating the initial duration of the Project and, at a later stage, to change it if some unforeseen event occurs.

The construction of a detailed technical flowchart of the project allows evaluating all the resources (manpower, material, financial, legal, etc.) necessary for implementation of the project. It also allows assessing the volume of the monitoring tasks and finding the critical aspects of its implementation. In the absence of this type of precise background, predictions on length and final cost of the project were extremely uncertain.

5.4.2 M&E plan implementation

The assessment rate for M&E plan implementation is **"unsatisfactory".**

The project has no visible M&E system in place. Initial weaknesses in the organisation and planning of the project did not allow its efficient piloting, which probably caused some of its delays.

Moreover, the absence of periodical meetings between the different actors (Ministry of energy, KenGen, Duke University and UNEP/DGEF), did not allow for the necessary cooperation to rectify the situation.

During the project, KenGen exercised no piloting over the activities of Duke University and often only acted as a mail box for transmitting the progress reports and budgetary situation to the UNEP/DGEF.

5.4.3 Budgeting and Funding for M&E activities

The assessment rate for budgeting and funding for M&E activities is **"unsatisfactory".**

Despite the importance of the M&E activities for such an international R&D project , no budget was identified for it. Corresponding activities were accomplished by KenGen and Duke University on other budgets, so it is impossible to evaluate them.

5.5 Catalytic role

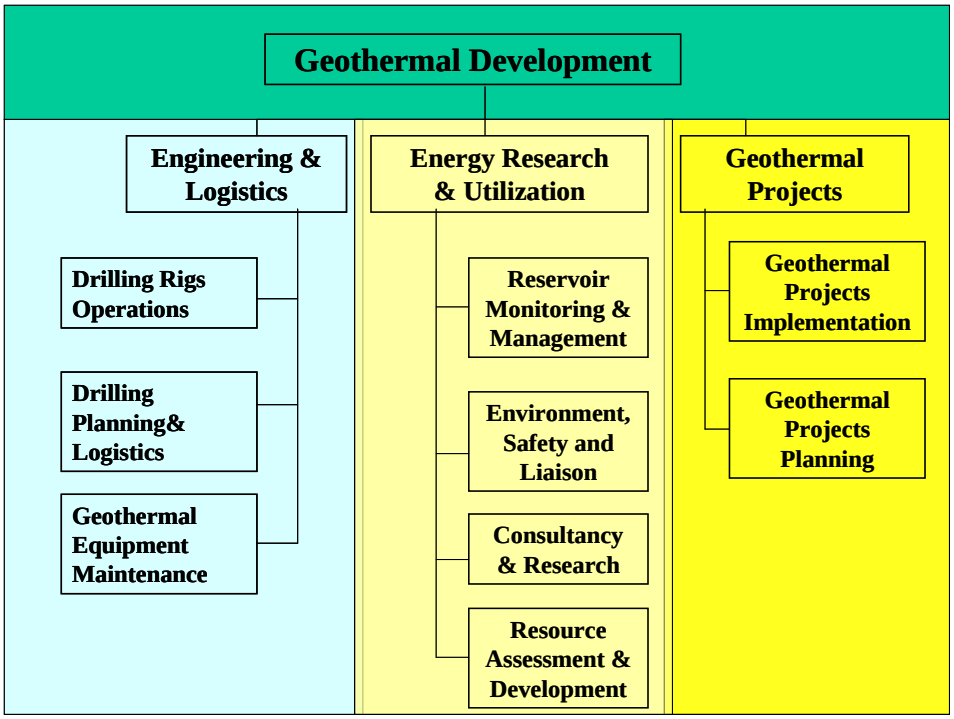
The catalytic role assessment rate is **"satisfactory".**

It can be said that the JGI project gave an international visibility to KenGen. Since last year, the KenGen scientists and technicians are among teachers of the United Nations Geothermal Training Course. This programme, created in 1975, is under the responsibility of Orkustofnun, the National Energy Authority of Iceland. Moreover, equipment bought for the project is also used for exploration in the countries of the ARGEO Project, thus giving a leader's position to KenGen.

On the local plane, the situation is difficult to assess because of the retirement from KenGen of the historical actors in the project, Mr. Joseph Nganga, Deputy managing Director, and Mr. Martin Mwangi, Geothermal development manager. For that reason, it was impossible to question them about the project. Another reason that does not facilitate a proper assessment is the reorganisation of geothermal energy as well as its development programme. Pursuant to the Good to Great (G2G) transformation

programme, the a new organizational structure had been settled at the end of year 2007 to support this strategy.

However, the fact that the government has assigned major importance to geothermal-energy development, is very likely due to the promising aspects of the project.



5.6 Preparation and readiness

The assessment rate for preparation and readiness is **"unsatisfactory".**

Though the project's objectives were well identified, the means to reach them were evidently not sufficiently analysed and evaluated. These initial gaps in the evaluation of the means of implementation, as well as the absence of organisation and proper management of the project, were a fundamental weakness of the project.

If the partnership with Duke University was properly identified, the responsibilities and roles were not sufficiently described, for example in a "Memorandum of Understanding" (MOU), before the beginning of the project. This is probably the main reason for the delay of the JGI project.

Negotiation of a MOU between KenGen, UNEP/DGEF and Duke University, would probably have identified the problems and difficulties of project implementation and, then, set up suitable solutions.

5.7 Country ownership/Drivenness

The assessment rate for Country ownership/Drivenness is **"satisfactory".**

The project is consistent with the objectives of energy development in Kenya. It will also have a positive impact on an international level, with the cooperation of KenGen in the ARGEO Project.

The objectives of the government of Kenya are to increase the production of electricity of geothermal origin to 1000 -1200 MW (equal to the entire national electricity generation of Kenya in 2008) before 2015. However, it is not possible to evaluate the impact of the project on governmental decisions.

What is certain, however, it is that by reducing the number of little or not productive wells, the project will contribute to better effectiveness of national and international financing, and so make geothermal energy more attractive in a general sense.

5.8 Stakeholder involvement

The assessment rate for stakeholder involvement is **"satisfactory".**

The State KenGen company is the main electricity producer of Kenya, supplying about 80% of the electricity consumed in the country. To produce the electricity, the company employs various sources of energy, including hydraulic, geothermal, thermal and wind energy. The main source is hydraulic, with an installed capacity of 677.3 MW, or 72.3% of the installed capacity of the company.

Concerning the project, the level of KenGen involvement, only stakeholder, is satisfactory, there being no alternative.

5.9 Financial planning

The assessment rate for financial planning is **"moderately satisfactory".**

Despite delays in financial statements transfer, the project has the appropriate financial controls, both in KenGen and in UNEP/DGEF. To compare the statement of expenses given by UNEP/DGEF with the initial budget, it has been necessary to refer to two distinct contracts.

The first document is entitled "United Nations Environment Programs Total Facility Sub-Project Document Section 1 – Project "Joint Geophysical Imaging (JGI) Methodology for Geothermal Reservoir Assessment – Kenya ". This document was signed on 12/11/2002 for UNEP by Mr. Ortega, and for KenGen by Mr. Bondet. This document includes in Annex 6 the budget managed by KenGen for a sum of 779,059 $.

The second document is entitled: United Nations Environment Programs Total Facility Document Section 1 - Project "Joint Geophysical Imaging (JGI) Methodology for Geothermal Reservoir Assessment". This document was signed on 12/11/2002 for UNEP by Mr. Ortega and includes in Annex A the budget called "UNEP Budget for portion executed by UNEP / DTIE" for a sum of 200,000 $.

At the time of the evaluation, the JGI project presented a positive balance of 99,766 $, see the table hereafter.

Expenditures and Disbursement Details_As at 10th Nov 2008

		2002	2003	2004	2005	2006	2007	2008	Total
Umbrella Budget_executed by UNEP									
1200	Consultants (Description of activity/service) w/m								
1201	Resource Management Consultant		-	-	-				-
1202	Regional Experience and Baselines		59 464	(214)	-				59 251
1203	Regional Perspectives*		6 000	-	-				6 000
1204	GRC Business Plan*		-	-	-				-
1600	Travel on official business								
1601	Staff travle (excluding M&E)	-	13 879	10 644	-	(1 805)			22 718
2300	Sub-contracts with commercial organisations								
2301	Resource Management Expert	-	33 335	(33 335)	21 432	(21 432)			-
3300	Meetings Conferences								
3301	Workshop and Meetings	2 797	48 429	18 987	-	(22 791)			47 421
5200	Reporting Cost								
5201	Printing and Distribution		-	-	-				-
5300	Sundry								
5301	Contingency							-	-
5500	Evalutaion Cost								
5501	Terminal Evaluation							20 562	20 562
	SUB-TOTAL	**2 797**	**161 107**	**(3 918)**	**21 432**	**(46 028)**	**-**	**20 562**	**155 952**
Sub-project Budget_ executed by KENGEN									
		2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**Total**
1300	Administrative support Title Grade w/m								
1321	Temporary Assistance Casual labour	-	-	-	-				-
1600	Travel on official business								
1601	Staff Travel	-	4 000	-	1 793	2 506			8 299
2100	Sub-contracts (MOUs/LAs for cooperating agencies)								
2101	Duke University	-	51 397	31 112	25 915				108 424
3100	Fellowships								
3101	Total stipend/fees/family support	-	53 297	28 800	28 800	3 200			114 097
3200	Group training (Title)								
3201	Group training (study tours, field tripsworkshops, seminars)	-	7 397	7 700	11 140				26 237
3202	Training of EA staff on use of equipmnt						-	19 739	19 739
3300	Meetings/conferences (Title)								
3301	Meetings/conferences, etc.	-	7 075	8 128	8 723	5 438			29 364
4100	Expendable equipment (items under $1,500 each)								
4101	Office supplies	-	2 548	1 325	968				4 841
4102	Library acquisitions			263	377		-		640
4120	Unspecified	-	280	1 319	66	446			2 111
4200	Non-expendable equipment (see items listed on budget worksheet)								
4201	Design and testing equipment Peter Malin	-	8 980	-	2 571	2 571		7 595	21 717
4202	Purchase and testing equipment	-	370 585	-	-				370 585
4203	S/W MEQ, extra license, Laptops						-		-
4300	Premises (rent)								
4301	Maintenance of premises	-	-	-	11 000				11 000
5100	Operation and maintenance of equipment								
5101	Repair and maintenance of vehicles and insurance	-	-	-	-				-
5300	Sundry								
5301	Communications (telex, telephone, fax)	-	1 003	1 102	3 734	448			6 287
	SUB-TOTAL	**-**	**506 562**	**79 749**	**95 087**	**14 609**	**-**	**27 334**	**723 341**
Grand Total		**2 797**	**667 669**	**75 831**	**116 519**	**(31 419)**	**-**	**47 896**	**879 293**
Total GEF grant									**979 059**
Unspent funds as at 10th Nov 2008 (Note 1)									**(99 766)**

Note 1: Final financial statement from KENGEN awaited.

This balance of 99,766 $ is split between 44,048 $ for the umbrella budget and 55,718 $ for the part of the JGI project managed by KenGen. This sharing out is presented in the next two tables.

Concerning the "Umbrella budget", it is possible to suggest that a positive balance will be used, first and foremost, for the examination of the construction and programming of the ARGEO Project by an external consultant.

Concerning the JGI budget managed by KenGen, it is possible to suggest that the positive balance will be used, in priority, for solving the problem of the seismic data interpretation, by mean of the purchase of suitable software.

	Umbrella Budget_executed by UNEP	Budget	Expenses	Balance
1200	Consultants (Description of activity/service) w/m			
1201	Resource Management Consultant	33 000	-	33 000
1202	Regional Experience and Baselines	29 000	59 251	-30 251
1203	Regional Perspectives*	13 000	6 000	7 000
1204	GRC Business Plan*	9 000	-	9 000
1600	Travel on official business			
1601	Staff travle (excluding M&E)	17 000	22 718	-5 718
2300	Sub-contracts with commercial organisations			
2301	Resource Management Expert		-	
3300	Meetings Conferences			
3301	Workshop and Meetings	98 000	47 421	50 579
5200	Reporting Cost			
5201	Printing and Distribution	1 000	-	1 000
5300	Sundry			
5301	Contingency		-	
5500	Evalutaion Cost			
5501	Terminal Evaluation		20 562	-20 562
	TOTAL	**200 000**	**155 952**	**44 048**

	Sub-project Budget_ executed by KENGEN	Budget	Expenses	Balance
1300	Administrative support Title Grade w/m			
1321	Temporary Assistance Casual labour	6 000	-	6 000
1600	Travel on official business			
1601	Staff Travel	14 000	8 299	5 701
2100	Sub-contracts (MOUs/LAs for cooperating agencies)			
2101	Duke University	108 739	108 424	315
3100	Fellowships			
3101	Total stipend/fees/family support	108 600	114 097	-5 497
3200	Group training (Title)			
3201	Group training (study tours, field tripsworksho	73 100	26 237	46 863
3202	Training of EA staff on use of equipmnt		19 739	-19 739
3300	Meetings/conferences (Title)			
3301	Meetings/conferences, etc.	15 420	29 364	-13 944
4100	Expendable equipment (items under $1,500 each)			
4101	Office supplies	3 800	4 841	-1 041
4102	Library acquisitions	1 000	640	360
4120	Unspecified	1 600	2 111	-511
4200	Non-expendable equipment (see items listed on budget worksheet)			
4201	Design and testing equipment Peter Malin	43 607	21 717	21 890
4202	Purchase and testing equipment	364 193	370 585	-6 392
4203	S/W MEQ, extra license, Laptops		-	
4300	Premises (rent)			
4301	Maintenance of premises	21 000	11 000	10 000
5100	Operation and maintenance of equipment			
5101	Repair and maintenance of vehicles and insurance	13 000	-	13 000
5300	Sundry			
5301	Communications (telex, telephone, fax)	5 000	6 287	-1 287
	TOTAL	**779 059**	**723 341**	**55 718**

Considering the costs of the wells drilled in Olkaria Dome, it can be concluded that KenGen contributed the envisaged co-financing to the project.

However, if one takes into account the drift of prices, the turnout rate of KenGen would not be 45%, but 75%. Indeed, in the initial budget, the price of a well is still 1.2 M$, 2002 value, while the real value is now about 4.5 M$.

Activity	GEF	In kind 2002	In kind 2008	Total 2002	Total 2008	2002	2008
KenGen: 1.Test facility setup	487 400	223 156	223 156	710 556	710 556	26%	12%
2.Methodology development	108 739	124 117	124 117	232 856	232 856	9%	4%
3.Field Application	88 520	23 015	23 015	111 535	111 535	4%	2%
4.Well drilling	0	1 220 000	4 500 000	1 220 000	4 500 000	45%	75%
5.Technology transfer	94 400	113 976	113 976	208 376	208 376	8%	3%
UNEP: 6. Regional Plan Development	200 000	50 000	50 000	250 000	250 000	9%	4%
Project Total (Project Costs):	**979 059**	**1 754 264**	**5 034 264**	**2 733 323**	**6 013 323**		

5.10 Implementing approach

The assessment rate for the implementing approach is **"unsatisfactory".**

Concerning the progress reports, they were mostly written by University, KenGen was only a pillar box. In fact, the main part of the project was directly done by DUKE University (computer code) or under its responsibility (design, purchase and reception of the sensors). It is more than probable that KenGen has considered itself more as a beneficiary than as an implementing agency, and has considered UN as a black box.

Here lies the weakness of the project, probably the reason of its delays and of the present unsatisfactory feeling both in KenGen and in UNEP/DGEF.

5.11 UNEP Supervision and backstopping

The assessment rate for UNEP Supervision and backstopping is **"moderately unsatisfactory".**

On the UNEP/DGEF side, supervision of the project was certainly affected by Task manager changes. Since the start of the project in 2002 until the period of the present evaluation, there have been three different Task managers. This was a handicap because of the scientific complexity of the project and its organisational weakness.

It is highly probable that such staff changes complicated supervision and were a source of tensions. It is also quite likely that at the start of the project, UNEP/DGEF staff did not fully realise the complexity of this R&D project and had no precise idea of the necessary means for reaching the objectives, nor how this kind of project was to be designed and organised. Subsequently, UNEP/DGEF have not understood that its role, for this kind of project, had to be more a partner than a controller.

We have to note that the positive implication of the last Task manager has led the project to the most satisfactory end.

In conclusion, at the beginning of the project, UNEP/DGEF does not seem to have verified that KenGen had the adequate level of competence to assure the project management, as implementing agency.

6 CONCLUSIONS AND RATING

Criterion	Evaluator's Summary Comments	Rating
A. Attainment of project objectives and results (overall rating)		MS
A. 1. Effectiveness	Despite important delays, all goals are formally attained	MS
A. 2. Relevance	Project outcomes consistent with UNEP/DGEF objectives and country priorities to develop geothermal energy	S
A. 3. Efficiency	The final rate of KenGen participation is 75%. The JGI approach was used not only for one but for the siting of six wells at Olkaria Dome, with positive results	S
B. Sustainability of Project outcomes (overall rating)		L
B. 1. Financial	The energy crisis and the Kyoto protocol will boost geothermal development in Kenya	L
B. 2. Socio Political	Development of geothermal energy allows increasing energy independence as well as national wealth. Furthermore, it generates more jobs than fossil energies	L
B. 3. Institutional framework and governance	Kenyan government is about to change the organisation of geothermal energy in Kenya	ML
B. 4. Ecological	The project will contribute to reducing CO_2 emissions. However, the development of geothermal power in Kenya will have to resolve two main problems: its incorporation in a remarkable wildlife setting and the long-term impact of releasing non condensable dangerous gases such as H_2S in the atmosphere	ML
C. Achievement of outputs and activities	The resignation of Dr Onocha has weakened the transfer of competence, but this problem, besides solvable, should not hide the very positive results of the JGI project	MS
D. Monitoring and Evaluation (overall rating)		**U**
D. 1. M&E Design	No visible M&E plan	U
D. 2. M&E Plan Implementation (use for adaptive management)	No visible M&E system in place	U
D. 3. Budgeting and Funding for M&E activities	No budget for M&E	U
E. Catalytic Role	The project has both a catalytic and a replication effect	S
F. Preparation and readiness	The lack of formal project management was a structural weakness of the project	U
G. Country ownership / drivenness	The project is on line with the Kenyan programme of geothermal energy development and the general international imperatives of struggle against greenhouse gas emissions	S
H. Stakeholders involvement	Kenya's government plan to massively	S

Criterion	Evaluator's Summary Comments	Rating
	develop geothermal energy in Kenya and KenGen, national company will have a leading role	
I. Financial planning	Despite delays in document transfer, the project has the appropriate financial controls, both in KenGen and in UNEP/DGEF	MS
J. Implementation approach	Here lies the main weakness of the project	U
K. UNEP Supervision and backstopping	At the beginning of the project, UNEP/DGEF, have not provided the adequate competency level in project management (eventually by appointing an external expert) to evaluate the complexity of the project and the weakness of its organisation by KenGen. If UNEP/GEF had been able to identify the problem, KENGEN would have been asked to change the organisation and financing of the project and in so doing put it on better rails. experts)	MU
Overall rating		MS

7 LESSONS LEARNED

The project planning has to take into account administrative procedures and corresponding durations (calls for tenders, terms of payment, etc.).

Before the beginning of a project, it is very important to verify (possibly by an independent expert) the project's organisation and dedicated means.

During the project, impose periodical meetings of the Steering Committee.

It is necessary to have specific management rules for R&D projects, especially the possibility to add additional funding. Because this kind of project has to attain uncertain results with limited resources. In some cases, it is necessary to stop the project or to increase its duration or its means.

The contract documents must present the concrete tasks to be accomplished to reach the objectives and the corresponding resources. A precise definition of the means lead automatically to a good definition of the planning and of the budget.

8 RECOMMENDATIONS

Considering the objectives of the JGI project, UNEP should post pone the completion of the project to allow KenGen to utilise the remaining budget for training the technicians and to purchase an interpretation software.

Ken Gen should dedicate a specific budget to undertake a comprehensive organisation assessment with a view of making Ken Gen more effective in managing the Geothermal project. The assessment should cover various levels including the: organizational, technical, legal, financial aspects and general planning of the project.

Annex A

TERMS OF REFERENCE (final)

1. PROJECT BACKGROUND AND OVERVIEW

The aim of this project was locating and reducing the cost of renewable, nearly CO_2-free[1] geothermal power in Kenya and East Africa through the transfer of an improved geophysical data interpretation methodology. By finding new high-production wells, the cost of geothermal power would be reduced further so that the cheapest source of electricity is available to Kenyans. Geothermal emissions are less than 1/2000 of those of fossil fuel. The project sought to reduce the total of wells drilled for a 64 MWe power from 33 to about 15. This was to result in substantial savings for the proposed development of 512 MWe from geothermal resources. The project also sought to provide a sustainable capacity in these advanced techniques at KenGen's Olkaria facility. It also included an assessment of new resource target areas.

The project was done in cooperation with KenGen geothermal experts. The rationale for the research-and-development approach of the project was based on past Action plans and Programs completed by KenGen and Duke University. From the results of these Plans and Programs, it was apparent that the project could significantly reduce the number of wells drilled and reduce risks in geothermal exploration through a combined, or "joint", geophysical mapping approach based on seismic, electrical, and self-potential measurements and analysis, which would also include structural geology information. The project objectives were thus threefold:

- Improve the existing capacity for making such measurements;
- Improve their joint data collection, analysis, and interpretation methods;
- Improve on reservoir assessment, monitoring and management.

The specific methods to be combined were micro earthquake (MEQ) monitoring, Magneto Telluric profiling (MT), Transient Electromagnetic profiling (TEM), and self-potential profiling (SP). An improved, in-country capacity including instruments, instrumentation vehicle, and field logistics for these methods was to be established. This included the capacity of multiple shallow-bore-hole or outcrop-coupled seismograph installations and multiple (MT/TEM and SP stations. These facilities were to be used in a joint data collection campaign. The resulting data would be jointly analysed and interpreted for maps of a subsurface geothermal conditions. Taken individually, the micro earthquake data locate zones of permeability, the electrical data locate fluid rich zones and the heat sources, and the self-potential gives an indication of active hydrothermal fluid movement. Taken jointly, the methods locate zones of high porosity and permeability with potentially mobile hot fluids, which will be targeted for drilling.

[1] Less than 30 Kg/Mw

KenGen and Duke studied the use of these three geophysical exploration methods in the geological, natural, and cultural environments of the Kenyan rift valley. Similar conditions extend to the north and south of Kenya, so the project work had international implications beyond sustainable, environmentally cleaner, energy development in Kenya alone. In the year 2000, under U.S. Department of Energy support, a temporary 60-station network of modern seismographs on loan from the U.S. was tested in the areas of Mt. Longonot and Suswa. By combining the seismic and MT/TEM measurements with data from older equipment, KenGen was able to delineate the filed sizes within the Greater Olkaria Geothermal Area or "GOGA" and Mt. Longonot areas. The JGI project sought to improve on this by identifying high permeability zones within newly targeted field areas.

The general conclusion of these studies was that, to confidently locate high production wells within the known geothermal resources, multiple seismic, electrical, and self-potential measurements needed to be jointly and broadly collected over drilling target areas. This collection effort needed to take into account the thick volcanic geology of the Rift by deploying instruments with special coupling techniques and station geometries. The specific conclusions was that a facility of dedicated, multiple, simplified, robust, in-country MEQ borehole or outcrop seismograph, modern MT/TEM, and modern SP facilities needed to be built. A joint inversion program that takes into account the unique geological setting needed to be developed to improve the understanding of the reservoir characteristics. Available commercial field collection and software analysis programs are not adequate, for example, in defining potential fluid rich layers when MT/TEM measurements are combined. The rationales for building and using such joint seismic electrical and self-potential instrument facilities are:

- The known local resources generate relatively numerous micro earthquakes;
- These resources are associated with significant, deep resistance and, potentially, SP anomalies;
- The three measurements give joint and separate information on the subsurface;
- Facilities from elsewhere are not appropriate or available for dedicated use;
- It is necessary to develop in-country skills in computer programming and suitable, locally adapted analysis codes. Experience has shown that importing skilled computer experts and data analysis codes from elsewhere will lead to facilities and methods that are not adequately familiar with or adapted to the local geology.

The goal of a sustainable technical capacity was to be accomplished through the establishment of a modern pool of instruments at the Olkaria Geothermal Group of KenGen. It was intended that a consulting capacity (including some test equipment) and results produced by the geophysical mapping project would reside in the KenGen laboratory and be used for further work. .

Relevance to GEF Programmes

The project falls under GEF Operational Program 6: Removing barriers and Reducing Implementation Costs to adoption of Renewable Energy. The project was to share successful experiences with neighboring countries in the African Rift Valley.

Executing Arrangements

The Duke Joint Geophysical Imaging (JGI) Team and KenGen carried the primary responsibility for implementation of the project.

Project Activities

The project duration was initially set to start December 2002 and end December 2005. In order to achieve actual project results (i.e. results of well drillings) the completion date was later revised and extended to June 2008, bringing total project duration from an initial 37 months to 67 months.

1. Facilities Setup**:** The construction of a dedicated, portable borehole-and/or-outcrop seismographic MEQ, electrical resistance MT/TEM, and self-potential SP instrument pool, support laboratory, and transport and field logistics capacity for expanded geothermal exploration and well-sitting in Kenya. The application of the data collection and interpretation methods in the geothermal prospects in the Rift Valley.
2. The refinement of combined or joint micro earthquake, electrical, and self-potential data collection, analysis, and interpretation methods. This activity was aimed at joint "inversion" of the three data types for improved knowledge of subsurface geothermal conditions.
3. The application of the joint inversion analysis and interpretation to the data collected with the new seismographic, electrical, and self-potential instrumentation facility. The joint inversion is aimed at producing a map of high permeability zones that can be targets for drilling.
4. Drilling of appraisal and production wells by KenGen.
5. Improve of the reservoir monitoring and management by providing information on re-injection.
6. Technology transfer and publications.

JGI Project Budget

Cost to the GEF Trust Fund was set at USD 979,059. Co-Financing was assumed before project start to amount to USD 1,754,262. Total cost: USD 2,733,323. The amount of USD 200,000 of total cost to GEF Fund was reserved for the "umbrella project" facilitating regional activities and the preparation of the regional ARGEO (African Rift Geothermal) project.

TERMS OF REFERENCE FOR THE EVALUATION

1. Objective and Scope of the Evaluation

The objective of this terminal evaluation is to examine the extent and magnitude of any project impacts to date and determine the likelihood of future impacts. The evaluation will also assess project performance and the implementation of planned project activities and planned outputs against actual results. The evaluation will focus on the following main questions:

Has the project :

- Demonstrated that the East African Rift geothermal resources can be more accurately located and assessed with improved geophysical equipment, facilities and joint mapping and interpretation methods?
- Improved the existing in-country capacity for geothermal exploration, data collection, analysis, and interpretation methods?
- Identifies new resource target areas?
- Demonstrated that the Joint Geophysical Imaging mapping method can reduce geothermal power cost, development time and investment risks significantly by locating high production wells? Was a joint inversion model achieved?
- Contributed to CO2 emission reductions by making geothermal equally competitive with fossil fuel alternatives? Results of well tests of sites identified by joint inversion of MEQ, MT and SP? Resulting geothermal kWh cost price projections?

2. Methods

This terminal evaluation will be conducted as an in-depth evaluation using a participatory approach whereby the UNEP/DGEF Task Manager, key representatives of the executing agencies and other relevant staff are kept informed and regularly consulted throughout the evaluation. The consultant will liaise with the UNEP/EOU and the UNEP/DGEF Task Manager on any logistic and/or methodological issues to properly conduct the review in as independent a way as possible, given the circumstances and resources offered. The draft report will be circulated to UNEP/DGEF Task Manager, key representatives of the executing agencies and the UNEP/EOU. Any comments or responses to the draft report will be sent to UNEP / EOU for collation and the consultant will be advised of any necessary revisions.

The findings of the evaluation will be based on the following:

1. A desk review of project documents including, but not limited to:
   (a) The project documents, outputs, monitoring reports (such as progress and financial reports to UNEP and GEF annual Project Implementation Review reports) and relevant correspondence.

   (b) Other project-related material produced by the project staff or partners.

2. Interviews with project management and staff based in KenGen headquarters Nairobi as well as KenGen Geothermal project office in Naivasha, 100 kms West of Nairobi will be undertaken.

3. The Consultant shall seek additional information and opinions from representatives of the Kenyan Ministry of Energy and the Energy Regulatory Commission by e-mail, through telephone communication, or by actual meetings.

4. Interviews with the UNEP/DGEF project task manager and Fund Management Officer, and other relevant staff in UNEP. If necessary, the Consultant shall also gain broader perspectives from discussions with relevant GEF Secretariat staff.

Key Evaluation Principles.
In attempting to evaluate any outcomes and impacts that the project may have achieved, evaluators should remember that the project's performance should be assessed by considering the difference between the answers to two simple questions ***"what happened?***" and ***"what would have happened anyway?"***. These questions imply that there should be consideration of the baseline conditions and trends in relation to the intended project outcomes and impacts. In addition it implies that there should be plausible evidence to attribute such outcomes and impacts to the actions of the project.

Sometimes, adequate information on baseline conditions and trends is lacking. In such cases this should be clearly highlighted by the evaluator, along with any simplifying assumptions that were taken to enable the evaluator to make informed judgements about project performance.

3. Project Evaluation Parameters

1. Attainment of objectives and planned results:

The assessment of project results seeks to determine the extent to which the project objectives were achieved, or are expected to be achieved, and assess if the project has led to any other positive or negative consequences. While assessing a project's outcomes the evaluation will seek to determine the extent of achievement and shortcomings in reaching the project's objectives as stated in the project document and also indicate if there were any changes and whether those changes were approved. As the project did at that time not establish an elaborate baseline (initial conditions), the evaluator should seek to estimate the baseline condition so that achievements and results can be properly established (or simplifying assumptions used). Since most GEF projects can be expected to achieve the anticipated outcomes by project closing, assessment of project outcomes should be a priority. Outcomes are the likely or achieved short-term and medium-term effects of an intervention's outputs. Examples of outcomes could include but are not restricted to stronger institutional capacities, higher public awareness (when leading to changes of behaviour), and transformed policy frameworks or markets. The evaluation should assess the extent to which the project's major relevant objectives were effectively and efficiently achieved or are expected to be achieved and their relevance.

- *Effectiveness:* Evaluate how, and to what extent, the stated project objectives have been met, taking into account the "achievement indicators" specified in the project document and logical

framework[2]. In particular, the analysis of outcomes achieved should include, *inter alia*, an assessment of whether and to what extent the results of this project have informed national, regional or international processes such as greenhouse gas inventories, the IPCC or others.

- *Relevance:* In retrospect, were the project's outcomes consistent with the focal areas/operational program strategies and country priorities? The evaluation should also assess the whether outcomes specified in the project document and or logical framework are actually outcomes and not outputs or inputs.
- *Efficiency:* Cost-effectiveness assesses the achievement of the environmental and developmental objectives as well as the project's outputs in relation to the inputs, costs, and implementing time. Include an assessment of outcomes in relation to inputs, costs, and implementation times based on the following questions: Was the project cost-effective? Was the project the least cost option? Was the project implementation delayed and if it was then did that affect cost-effectiveness? The evaluation should assess the contribution of cash and in-kind co-financing to project implementation and to what extent the project leveraged additional resources. Comparisons of the cost-time vs. outcomes relationship of the project with that of other similar projects should be made if feasible.

2. Assessment of Sustainability of project outcomes:

Sustainability is understood as the probability of continued long-term project-derived outcomes and impacts after the GEF project funding ends. The evaluation will identify and assess the key conditions or factors that are likely to contribute or undermine the persistence of benefits after the project ends. Some of these factors might be outcomes of the project, e.g. stronger institutional capacities or better informed decision-making. Other factors will include contextual circumstances or developments that are not outcomes of the project but that are relevant to the sustainability of outcomes. The evaluation should ascertain to what extent follow-up work has been initiated and how project outcomes will be sustained and enhanced over time. In this case, sustainability will be linked to the continued use and influence of scientific models and scientific findings, produced by the project.

Four aspects of sustainability should be addressed: financial, socio-political, institutional frameworks and governance, and ecological. The following questions provide guidance on the assessment of these aspects:

- *Financial resources.* To what extent are the outcomes of the project dependent on continued financial support? What is the likelihood that any required financial resources will be available to sustain the project outcomes/benefits once the GEF assistance ends (resources can be from multiple sources, such as the public and private sectors, income generating

[2] In case in the original or modified expected outcomes are merely outputs/inputs then the evaluators should assess if there were any real outcomes of the project and if yes then whether these are commensurate with the realistic expectations from such projects.

activities, and market trends that support the project's objectives)? Was the project successful in identifying and leveraging co-financing?

- *Socio-political:* To what extent are the outcomes of the project dependent on socio-political factors? What is the likelihood that the level of stakeholder ownership will allow for the project outcomes/benefits to be sustained? Is there sufficient public / stakeholder awareness in support of the long term objectives of the project?
- *Institutional framework and governance.* To what extent are the outcomes of the project dependent on issues relating to institutional frameworks and governance? What is the likelihood that institutional and technical achievements, legal frameworks, policies and governance structures and processes will allow for, the project outcomes/benefits to be sustained? While responding to these questions consider if the required systems for accountability and transparency and the required technical know-how are in place.
- *Ecological.* Are there any environmental risks that can undermine the future flow of project environmental benefits? The TE should assess whether certain activities in the project area will pose a threat to the sustainability of the project outcomes.[3]

As far as possible, also assess the potential longer-term impacts considering that the evaluation is taking place upon completion of the project and that longer term impact is expected to be seen in a few years time. Frame any recommendations to enhance future project impact in this context. Which will be the major 'channels' for longer term impact from the project at the national and international scales? The evaluation should formulate recommendations that outline possible approaches and necessary actions to facilitate an impact assessment study in a few years time.

3. Catalytic role

The terminal evaluation will also describe any catalytic or replication effect of the project. What examples are there of replication and catalytic outcomes that suggest increased likelihood of sustainability? Replication approach, in the context of GEF projects, is defined as lessons and experiences coming out of the project that are replicated or scaled up in the design and implementation of other projects. Replication can have two aspects, replication proper (lessons and experiences are replicated in different geographic area) or scaling up (lessons and experiences are replicated within the same geographic area but funded by other sources). If no effects are identified, the evaluation will describe the catalytic or replication actions that the project carried out. No ratings are requested for the catalytic role.

4. Achievement of outputs and activities:

- Delivered outputs: Assessment of the project's success in producing each of the programmed outputs, both in quantity and quality as well as usefulness and timeliness.

[3] For example, construction of dam in a protected area could inundate a sizable area and thereby neutralizing the biodiversity related gains made by the project or, a newly established pulp mill might jeopardise the viability of nearby protected forest areas by increasing logging pressures.

- Assess the soundness and effectiveness of the methods and approached used by the project.

5. **Assessment of Monitoring and Evaluation Systems:**
   - **M&E design.** Did the project have a sound M&E plan to monitor results and track progress towards achieving project objectives? The Terminal Evaluation will assess whether the project met the minimum requirements for project design of M&E and the application of the Project M&E plan (Minimum requirements are specified in Annex 4). The evaluation shall include an assessment of the quality, application and effectiveness of project monitoring and evaluation plans and tools, including an assessment of risk management based on the assumptions and risks identified in the project document. The M&E plan should include a baseline (including data, methodology, etc.), SMART (see Annex 4) indicators and data analysis systems, and evaluation studies at specific times to assess results. The time frame for various M&E activities and standards for outputs should have been specified.
   - **M&E plan implementation.** Was an M&E system in place and did it facilitate tracking of results and progress towards projects objectives throughout the project implementation period. Were Annual project reports complete, accurate and with well justified ratings? Was the information provided by the M&E system used during the project to improve project performance and to adapt to changing needs? Did the Projects have an M&E system in place with proper training for parties responsible for M&E activities to ensure data will continue to be collected and used after project closure?
   - **Budgeting and Funding for M&E activities.** Were adequate budget provisions made for M&E made and were such resources made available in a timely fashion during implementation?
   - **Long-term Monitoring.** Is long-term monitoring envisaged as an outcome of the project? If so, comment specifically on the relevance of such monitoring systems to sustaining project outcomes and how the monitoring effort will be sustained.

6. **Assessment of processes that affected attainment of project results.**
   The evaluation will consider, but need not be limited to, consideration of the following issues that may have affected project implementation and attainment of project results:

   i. **Preparation and readiness.** Were the project's objectives and components clear, practicable and feasible within its timeframe? Were capacities of the executing institutions and counterparts properly considered when the project was designed? Were lessons from other relevant projects properly incorporated in design? Were the partnership arrangements properly identified and the roles and responsibilities negotiated prior to implementation? Was availability of counterpart resources (funding, staff, and facilities), passage of enabling legislation, and adequate project management arrangements in place at project entry?
      - Ascertain to what extent the project implementation mechanisms outlined in the project document have been closely followed. In particular, assess the role of the various committees established

and whether the project document was clear and realistic to enable effective and efficient implementation, whether the project was executed according to the plan and how well the management was able to adapt to changes during the life of the project to enable the implementation of the project.

- Evaluate the effectiveness and efficiency and adaptability of project management and the supervision of project activities / project execution arrangements at all levels (1) policy decisions: Steering Group; (2) day to day project management: (3) GEF guidance: UNEP DGEF.

ii. **Country ownership/Drivenness.** This is the relevance of the project to national development and environmental agendas, recipient country commitment, and regional and international agreements. Examples of possible evaluative questions include: Was the project design in-line with the national sectoral and development priorities and plans? Are project outcomes contributing to national development priorities and plans? Were the relevant country representatives, from government and civil society, involved in the project? Did the recipient government maintain its financial commitment to the project? Have the government approved policies or regulatory frameworks been in-line with the project's objectives? Specifically the evaluation will:

- Assess the level of country ownership, and whether the project was effective in providing and communicating information and tools that assisted governments in promoting the project objective.

iii. **Stakeholder involvement.** Did the project involve the relevant stakeholders through information sharing, consultation and by seeking their participation in project's design, implementation, and monitoring and evaluation? For example, did the project implement appropriate outreach and public awareness campaigns? Did the project consult and make use of the skills, experience and knowledge of the appropriate government entities, NGOs, community groups, private sector, local governments and academic institutions in the design, implementation and evaluation of project activities? Were perspectives of those that would be affected by decisions, those that could affect the outcomes and those that could contribute information or other resources to the process taken into account while taking decisions? Were the relevant vulnerable groups and the powerful, the supporters and the opponents, of the processes properly involved? Specifically the evaluation will:

- Assess the mechanisms put in place by the project for identification and engagement of stakeholders in each participating country and establish, in consultation with the stakeholders, whether this mechanism was successful, and identify its strengths and weaknesses.
- Assess the degree and effectiveness of collaboration/interactions between the various project partners and institutions during the course of implementation of the project.

- Assess the degree and effectiveness of any various public awareness activities that were undertaken during the course of implementation of the project.

iv. **Financial planning.** Did the project have the appropriate financial controls, including reporting and planning, that allowed management to make informed decisions regarding the budget and allowed for timely flow of funds. Specifically, the evaluation should:

- Assess the strength and utility of financial controls, including reporting, and planning to allow the project management to make informed decisions regarding the budget and allow for a proper and timely flow of funds for the payment of satisfactory project deliverables throughout the project's lifetime.
- Present the major findings from the financial audit if one has been conducted.
- Did promised co-financing materialize? Identify and verify the sources of co- financing as well as leveraged and associated financing (in co-operation with the IA and EA).
- Assess whether the project has applied appropriate standards of due diligence in the management of funds and financial audits.
- The evaluation should also include a breakdown of final actual project costs by activities compared to budget (variances), financial management (including disbursement issues), and co-financing. This information will be prepared by the relevant DGEF Fund Management Officer of the project for scrutiny by the evaluator (table attached in Annex 1 Co-financing and leveraged resources).

v. **UNEP Supervision and backstopping.** Did UNEP Agency staff identify problems in a timely fashion and accurately estimate its seriousness? Did UNEP staff provide quality support and advice to the project, approved modifications in time and restructure the project when needed? Did UNEP and Executing Agencies provide the right staffing levels, continuity, skill mix, frequency of field visits?

vi. **Co-financing and Project Outcomes & Sustainability.** If there was a difference in the level of expected co-financing and actual co-financing, then what were the reasons for this? Did the extent of materialization of co-financing affect the project's outcomes and/or sustainability, and if it did affect outcomes and sustainability then in what ways and through what causal linkages?

vii. **Delays and Project Outcomes & Sustainability.** If there were delays in project implementation and completion, the evaluation will summarise the reasons for them. Did delays affect the project's outcomes and/or sustainability, and if so in what ways and through what causal linkages?

The ***ratings will be presented in the form of a table*** with each of the categories rated separately and with **brief justifications for the rating** based on the findings of the main analysis. An overall rating for the project should also be given. The rating system to be applied is specified in Annex 1:

4. Evaluation report format and review procedures

The report should be brief, to the point and easy to understand. It must explain; the purpose of the evaluation, exactly what was evaluated and the methods used. The report must highlight any methodological limitations, identify key concerns and present evidence-based findings, consequent conclusions, recommendations and lessons. The report should provide information on when the evaluation took place, the places visited, who was involved and be presented in a way that makes the information accessible and comprehensible. The report should include an executive summary that encapsulates the essence of the information contained in the report to facilitate dissemination and distillation of lessons.

Evidence, findings, conclusions and recommendations should be presented in a complete and balanced manner. The evaluation report shall be written in English, be of no more than 50 pages (excluding annexes), use numbered paragraphs and include:

i) An **executive summary** (no more than 3 pages) providing a brief overview of the main conclusions and recommendations of the evaluation;
ii) **Introduction and background** giving a brief overview of the evaluated project, for example, the objective and status of activities;
iii) **Scope, objective and methods** presenting the evaluation's purpose, the evaluation criteria used and questions to be addressed;
iv) **Project Performance and Impact** providing factual evidence relevant to the questions asked by the evaluator and interpretations of such evidence. This is the main substantive section of the report and should provide a commentary on all evaluation aspects (A − F above).
v) **Conclusions and rating** of project implementation success giving the evaluator's concluding assessments and ratings of the project against given evaluation criteria and standards of performance. The conclusions should provide answers to questions about whether the project is considered good or bad, and whether the results are considered positive or negative;
vi) **Lessons learned** presenting general conclusions, based on established good practices that have the potential for wider application and use. Lessons may also be derived from problems and mistakes. The context in which lessons may be applied should be clearly specified, and lessons should always state or imply some prescriptive action. A lesson should be written such that experiences derived from the project could be applied in other projects or at portfolio level;
vii) **Recommendations** suggesting *actionable* proposals for stakeholders to rectify poor existing situations as well as recommendations concerning projects of similar nature.. In general, Terminal Evaluations are likely to have very few (only two or three) actionable recommendations;
viii) **Annexes** include Terms of Reference, list of interviewees, documents reviewed, brief summary of the expertise of the evaluator / evaluation team, a summary of co-finance information etc. Dissident views or management responses to the evaluation findings may later be appended in an annex.

Examples of UNEP GEF Terminal Evaluation Reports are available at www.unep.org/eou

Review of the Draft Evaluation Report
Draft reports submitted to UNEP EOU are shared with the corresponding Task Manager and his or her supervisor for initial review and consultation. The DGEF staff and senior Executing Agency staff are allowed to comment on the draft evaluation report. They may provide feedback on any errors of fact and may highlight the significance of such errors in any conclusions. The consultation also seeks agreement on the findings and recommendations. UNEP EOU collates the review comments and provides them to the evaluators for their consideration in preparing the final version of the report.

All UNEP GEF Evaluation Reports are subject to quality assessments by UNEP EOU. These incorporate GEF Office of Evaluation quality assessment criteria and are used as a tool for providing structured feedback to the evaluator (see Annex 3).

5. Submission of Final Terminal Evaluation Reports.
The final report shall be submitted in electronic form in MS Word format and should be sent to the following persons:

Segbedzi Norgbey, Chief,
UNEP Evaluation and Oversight Unit
P.O. Box 30552-00100
Nairobi, Kenya
Tel.: (254-20) 7623387
Fax: (254-20) 7623158
Email: segbedzi.norgbey@unep.org

With a copy to:

Maryam Niamir-Fuller, Director
UNEP/Division of GEF Coordination
P.O. Box 30552-00100
Nairobi, Kenya
Tel: +254 20 7624166
Email: maryam.niamir-fuller@unep.org

Carmen Tavera
Portfolio Manager
United Nations Environment Programme (UNEP)
Division of GEF Coordination (DGEF)
PO Box 30552
Nairobi, Kenya
Tel: 254 20 762415
Email: Carmen.Tavera@unep.org

Peerke de Bakker
Task Manager, Climate Change
United Nations Environment Programme (UNEP)

Division of GEF Coordination (DGEF)
PO Box 30552-00100
Nairobi, Kenya
Tel: +254 20 7623967
Fax: +254 20 7624041/2
Email: peerke.bakker@unep.org

Bernard Jamet
UNEP/GEF actg SPO Climate Change
United Nations Environment Programme (UNEP)
Division of GEF Coordination (DGEF)
PO Box 30552-00100
Nairobi, Kenya
Tel: +33 1 44 371858
Email: bernard.jamet@unep.org

The final evaluation report will be printed in hard copy and published on the Evaluation and Oversight Unit's web-site www.unep.org/eou. Subsequently, the report will be sent to the GEF Office of Evaluation for their review, appraisal and inclusion on the GEF website.

6. Resources and schedule of the evaluation

This final evaluation will be undertaken by an international evaluator contracted by the Evaluation and Oversight Unit, UNEP. The contract for the evaluator will begin on 20th October 2008 and end on 11th January 2009 (and cover 1 month and 2 weeks spread over 12 weeks (10 days including travel of mission to Kenya, Nairobi and a 4 day-mission to project site in Naivasha – and including 1 day briefing and 1 day debriefing at UNEP, and the rest of the time of desk study). The evaluator will submit a draft report on or before 12th December 2008 to UNEP/EOU, the UNEP/DGEF Task Manager, and key representatives of the executing agencies. Any comments or responses to the draft report will be sent to UNEP / EOU for collation and the consultant will be advised of any necessary revisions. Comments to the final draft report will be sent to the consultant by 26th December 2008 after which, the consultant will submit the final report no later than 11th January 2009.

The evaluator will after an initial telephone briefing with EOU and UNEP/GEF travel to Nairobi, Kenya and meet with UNEP DGEF Task Manager and project staff of the Executing Agency at the beginning of the evaluation.

In accordance with UNEP/GEF policy, all GEF projects are evaluated by independent evaluators contracted as consultants by the EOU. The evaluators should have the following qualifications:

The evaluator should not have been associated with the design and implementation of the project. The evaluator will work under the overall supervision of the Chief, Evaluation and Oversight Unit, UNEP. The evaluator should be an international expert with extensive experience in power generation projects in general including economics, geothermal power projects in particular and preferably have general knowledge on geothermal surveying techniques and analysis. Knowledge of UNEP programmes and GEF activities is desirable. Fluency in oral and written English is a must.

7. Schedule Of Payment

The consultant shall select one of the following two contract options:

Lump-Sum Option

The evaluator will receive an initial payment of 30% of the total amount due upon signature of the contract. A further 30% will be paid upon submission of the draft report. A final payment of 40% will be made upon satisfactory completion of work. The fee is payable under the individual Special Service Agreement (SSA) of the evaluator and IS **inclusive** of all expenses such as travel, accommodation and incidental expenses.

In case, the evaluator cannot provide the products in accordance with the TORs, the timeframe agreed, or his products are substandard, the payment to the evaluator could be withheld, until such a time the products are modified to meet UNEP's standard. In case the evaluator fails to submit a satisfactory final product to UNEP, the product prepared by the evaluator may not constitute the evaluation report.

When submitting the Travel Claim upon completion of travel, kindly note some of the following points: that UNON's primary operating currency is the US Dollar and reimbursements are made at the USD equivalent at the ruling UN exchange rate and not necessarily the currency of expenditure. If the consultant wishes to be paid in any other currency other than USD the consultant should indicate on the Travel Claim and special arrangements can be made with UNON's bank. The UN has standard rules for reimbursement of travel expenses and UNON enforces compliance on behalf of UNEP. Taxis to and from Hotel to Airport/Train/Bus station are covered by terminal allowances and the maximum reimbursable is USD 38.00. Taxis from Hotel to meeting venues as well as local telephone calls are covered by the Daily Subsistence Allowance (DSA).

Annex 1. OVERALL RATINGS TABLE

Criterion	Evaluator's Summary Comments	Evaluator's Rating
A. Attainment of project objectives and results (overall rating) **Sub criteria (below)**		
A. 1. Effectiveness		
A. 2. Relevance		
A. 3. Efficiency		
B. Sustainability of Project outcomes **(overall rating)** **Sub criteria (below)**		
B. 1. Financial		
B. 2. Socio Political		
B. 3. Institutional framework and governance		
B. 4. Ecological		
C. Achievement of outputs and activities		
D. Monitoring and Evaluation (overall rating) **Sub criteria (below)**		
D. 1. M&E Design		
D. 2. M&E Plan Implementation (use for adaptive management)		
D. 3. Budgeting and Funding for M&E activities		
E. Catalytic Role		
F. Preparation and readiness		
G. Country ownership / drivenness		
H. Stakeholders involvement		
I. Financial planning		
J. Implementation approach		
K. UNEP Supervision and backstopping		

RATING OF PROJECT OBJECTIVES AND RESULTS

Highly Satisfactory (HS): The project had no shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Satisfactory (S): The project had minor shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Moderately Satisfactory (MS): The project had moderate shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Moderately Unsatisfactory (MU): The project had significant shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Unsatisfactory (U) The project had major shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Highly Unsatisfactory (HU): The project had severe shortcomings in the achievement of its objectives, in terms of relevance, effectiveness or efficiency.

Please note: Relevance and effectiveness will be considered as critical criteria. The overall rating of the project for achievement of objectives and results **may not be higher** than the lowest rating on either of these two criteria. Thus, to have an overall satisfactory rating for outcomes a project must have at least satisfactory ratings on both relevance and effectiveness.

RATINGS ON SUSTAINABILITY

A. Sustainability will be understood as the probability of continued long-term outcomes and impacts after the GEF project funding ends. The Terminal evaluation will identify and assess the key conditions or factors that are likely to contribute or undermine the persistence of benefits after the project ends. Some of these factors might be outcomes of the project, i.e. stronger institutional capacities, legal frameworks, socio-economic incentives /or public awareness. Other factors will include contextual circumstances or developments that are not outcomes of the project but that are relevant to the sustainability of outcomes..

Rating system for sustainability sub-criteria

On each of the dimensions of sustainability of the project outcomes will be rated as follows.

Likely (L): There are no risks affecting this dimension of sustainability.

Moderately Likely (ML). There are moderate risks that affect this dimension of sustainability.

Moderately Unlikely (MU): There are significant risks that affect this dimension of sustainability

Unlikely (U): There are severe risks that affect this dimension of sustainability.

According to the EOU, all the risk dimensions of sustainability are deemed critical. Therefore, overall rating for sustainability will not be higher than the rating of the dimension with lowest ratings. For example, if a project has an Unlikely rating in any of the dimensions then its overall rating cannot be higher than Unlikely, regardless of whether higher ratings in other dimensions of sustainability produce a higher average.

RATINGS OF PROJECT M&E

Monitoring is a continuing function that uses systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing project with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds. Evaluation is the systematic and objective assessment of an on-going or completed project, its design, implementation and results. Project evaluation

may involve the definition of appropriate standards, the examination of performance against those standards, and an assessment of actual and expected results.

The Project monitoring and evaluation system will be rated on 'M&E Design', 'M&E Plan Implementation' and 'Budgeting and Funding for M&E activities' as follows:

- Highly Satisfactory (HS): There were no shortcomings in the project M&E system.
- Satisfactory(S): There were minor shortcomings in the project M&E system.
- Moderately Satisfactory (MS): There were moderate shortcomings in the project M&E system. Moderately Unsatisfactory (MU): There were significant shortcomings in the project M&E system. Unsatisfactory (U): There were major shortcomings in the project M&E system.
- Highly Unsatisfactory (HU): The Project had no M&E system.

"M&E plan implementation" will be considered a critical parameter for the overall assessment of the M&E system. The overall rating for the M&E systems will not be higher than the rating on "M&E plan implementation."

All other ratings will be on the six point scale.

Performance Description	Alternative description on the same scale
HS = Highly Satisfactory	Excellent
S = Satisfactory	Well above average
MS = Moderately Satisfactory	Average
MU = Moderately Unsatisfactory	Below Average
U = Unsatisfactory	Poor
HU = Highly Unsatisfactory	Very poor (Appalling)

Annex 2: Review of the Draft Report

Draft reports submitted to UNEP EOU are shared with the corresponding Programme or Project Officer and his or her supervisor for initial review and discussion. The UNEP Division staff and senior Executing Agency staff provide comments on the draft evaluation report. They may provide feedback on any errors of fact and may highlight the significance of such errors in any conclusions. The review also seeks agreement on the findings and recommendations. UNEP EOU collates the review comments and provides them to the evaluators for their consideration in preparing the final version of the report. General comments on the draft report with respect to compliance with these TOR are shared with the reviewer.

Quality Assessment of the Evaluation Report
All UNEP Terminal Evaluation Reports are subject to quality assessments by UNEP EOU. The quality assessment is used as a tool for providing structured feedback to the evaluator.

The quality of the draft evaluation report is assessed and rated against the following criteria:

Report Quality Criteria	**UNEP EOU Assessment notes**	**Rating**
A. Did the report present an assessment of relevant outcomes and achievement of project objectives in the context of the focal area program indicators if applicable?		
B. Was the report consistent and the evidence complete and convincing and were the ratings substantiated when used?		
C. Did the report present a sound assessment of sustainability of outcomes?		
D. Were the lessons and recommendations supported by the evidence presented?		
E. Did the report include the actual project costs (total and per activity) and actual co-financing used?		
F. Did the report include an assessment of the quality of the project M&E system and its use for project management?		
UNEP EOU additional Report Quality Criteria	**UNEP EOU Assessment**	**Rating**
G. Quality of the lessons: Were lessons readily applicable in other contexts? Did they suggest prescriptive action?		
H. Quality of the recommendations: Did recommendations specify the actions necessary to correct existing conditions or improve operations (‘who?’ ‘what?’ ‘where?’ ‘when?)’. Can they be implemented?		
I. Was the report well written?		

(clear English language and grammar)		
J. Did the report structure follow EOU guidelines, were all requested Annexes included?		
K. Were all evaluation aspects specified in the TORs adequately addressed?		
L. Was the report delivered in a timely manner		

Rating system for quality of terminal evaluation reports

A number rating 1-6 is used for each criterion: Highly Satisfactory = 6, Satisfactory = 5, Moderately Satisfactory = 4, Moderately Unsatisfactory = 3, Unsatisfactory = 2, Highly Unsatisfactory = 1, and unable to assess = 0.

Quality of the MTE report = 0.3*(A + B) + 0.1*(C+D+E+F)
EOU assessment of MTE report = 0.3*(G + H) + 0.1*(I+J+K+L)
Combined quality Rating = (2* 'MTE report' rating + EOU rating)/3
The Totals are rounded and converted to the scale of HS to HU

8.1 Annex 3: Minimum requirements for M&E

8.2 Minimum Requirement 1: Project Design of M&E[4]

All projects must include a concrete and fully budgeted monitoring and evaluation plan by the time of Work Program entry (full-sized projects) or CEO approval (medium-sized projects). This plan must contain at a minimum:

- SMART (see below) indicators for project implementation, or, if no indicators are identified, an alternative plan for monitoring that will deliver reliable and valid information to management
- SMART indicators for results (outcomes and, if applicable, impacts), and, where appropriate, corporate-level indicators
- A project baseline, with:
  - a description of the problem to address
  - indicator data
  - or, if major baseline indicators are not identified, an alternative plan for addressing this within one year of implementation
- An M&E Plan with identification of reviews and evaluations which will be undertaken, such as mid-term reviews or evaluations of activities
- An organizational setup and budgets for monitoring and evaluation.

4 http://gefweb.org/MonitoringandEvaluation/MEPoliciesProcedures/MEPTools/meptstandards.html

Minimum Requirement 2: Application of Project M&E

- Project monitoring and supervision will include implementation of the M&E plan, comprising:
- Use of SMART indicators for implementation (or provision of a reasonable explanation if not used)
- Use of SMART indicators for results (or provision of a reasonable explanation if not used)
- Fully established baseline for the project and data compiled to review progress
- Evaluations are undertaken as planned
- Operational organizational setup for M&E and budgets spent as planned.

SMART INDICATORS UNEP projects and programs should monitor using relevant performance indicators. The monitoring system should be "SMART":

1. **Specific**: The system captures the essence of the desired result by clearly and directly relating to achieving an objective, and only that objective.
2. **Measurable:** The monitoring system and its indicators are unambiguously specified so that all parties agree on what the system covers and there are practical ways to measure the indicators and results.
3. **Achievable and Attributable:** The system identifies what changes are anticipated as a result of the intervention and whether the result(s) are realistic. Attribution requires that changes in the targeted developmental issue can be linked to the intervention.
4. **Relevant and Realistic:** The system establishes levels of performance that are likely to be achieved in a practical manner, and that reflect the expectations of stakeholders.
5. **Time-bound, Timely, Trackable, and Targeted:** The system allows progress to be tracked in a cost-effective manner at desired frequency for a set period, with clear identification of the particular stakeholder group to be impacted by the project or program.

8.3 Annex 5 List of intended additional recipients for the Terminal Evaluation (to be completed by the IA Task Manager)

Name	Affiliation	Email
Aaron Zazuetta	GEF Evaluation Office	azazueta@thegef.org
Government Officials		
GEF Focal Point(s)		
Executing Agency		
Implementing Agency		
Carmen Tavera	UNEP DGEF Portfolio Manager	

Annex B

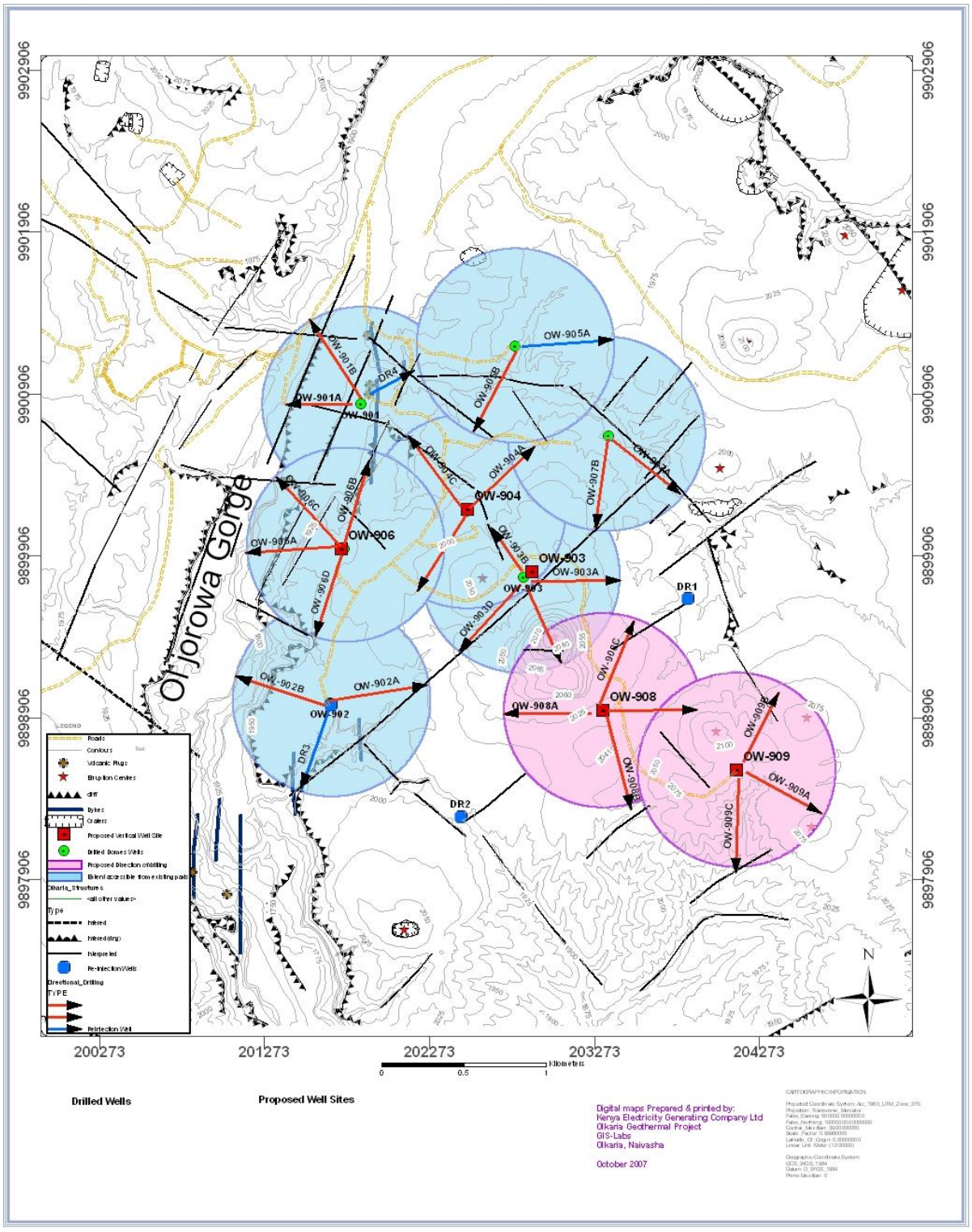
RECOMMENDED SITES FOR PRODUCTION DRILLING IN DOMES

Compiled by Dr Stephen A. Onacha
Geothermal Resource Assessment and Development Officer

This summary presents the recommended sites, drilling directions, order of drilling and the number of wells at each site in the Eastern part of Olkaria (Domes). The depth of drilling will be presented separately for each well. The prognosis will take into account that some areas will be good targets for deep drilling while other sites will be good targets for shallow drilling. The drilling directions and targets have taken into consideration the existing and interpreted structures so that drilling costs per MWe are minimised. The recommended sites take into account the need to prove adequate steam for construction of a power plant. This summary also recommends some areas in Domes for drilling re-injection wells that can be used as disposal sites during testing of the wells. However, the recommended re-injection sites can also be used as production wells. Additional re-injection wells are proposed at sites OW-901 (DR-4) and OW-902 (DR-3). The existing wells OW-902 and OW-905A are also recommended to be used as re-injection wells. This approach is aimed at providing adequate steam for construction of a new power plant at Olkaria. Based on the recommended sites for drilling 26 additional wells, we anticipate over 100 MWe of steam.

The recommended sites and directions are shown in the map below. The sites for immediate drilling of deep vertical wells include OW-908, OW-903, OW-904, OW-906 and OW-909. Directional wells will also be drilled from the same well pads to minimize environmental effects, reduce site construction and pipeline costs.

OLKARIA-DOMES WELL-SITES MAP (update 25.04.08)



The order of recommended wells at each site is shown in the table below.

NAME	Order of Drill	Remarks
OW-908	1	
OW-903	2	Re-injection site DR-1 drilled before the 903 group of wells
OW-903B	3	
OW-903C	4	Fault intersections expected at horizontal displacement of 477 meters
OW-903D	5	
OW-904	6	
OW-904B	7	
OW-904C	8	
OW-906	9	Fault intersections expected at horizontal displacement of 356 meters
OW-906B	10	Fault intersections expected at horizontal displacement of 355 meters
OW-905B	11	Fault intersections expected at horizontal displacement of 572 meters
OW-906C	11	Fault intersections expected at horizontal displacement of 567 meters
OW-905C	12	Fault intersections expected at horizontal displacement of 599 meters
OW-906D	12	
OW-901A	13	Fault intersections expected at horizontal displacement of 418 meters
OW-901B	14	Fault intersections expected at horizontal displacement of 488 meters
OW-908A	15	Re-injection Site DR-2 drilled before 908 group of wells
OW-908B	16	
OW-908C	17	Fault intersections expected at horizontal displacement of 445 meters
OW-908D	18	
OW-909	19	
OW-909A	20	
OW-909B	21	
OW-909C	22	
OW-902A	23	Fault intersections expected at horizontal displacement of 610 meters
OW-902B	24	Fault intersections expected at horizontal displacement of 370 meters
OW-907B	25	Fault intersections expected at horizontal displacement of 579 meters
OW-905B	26	

This order assumes the use of one rig. However, two rigs can be used simultaneously to drill the wells while at the same time N370 can be used to drill some of the vertical wells upto a depth of 2200m. Sites OW-903, OW-904 and OW-906 and OW-909 are priority sites for both drilling vertical deep wells and directional wells. These sites should be prepared with adequate space for drilling at least 5 wells from the same pad. The re-injection DR-1 should be drilled before drilling the group of wells at 903. Re-injection site DR-2 should be drilled before drilling the directional wells at OW-908.
Sites DR-1, OW-908, OW-909, OW-904 and OW-906 should be prepared for drilling. The order of drilling in Domes will also depend on whether two rigs will be used.

Annex C

Some consulted documents & Request of opinion of Pr MALIN and Dr ONOCHA

9 SOME OF THE DOCUMENTS THAT HAS BEEN CONSULTED THERE THE OCCASION OF THE WRITING OF THE REPORT OF VALUATION

- Expenditures and Disbursement Details_As at 10th Nov 2008
- JGI_internalised subprodoc final
- JGI_internalised umbrella final
- GEF Equipment 2007 update
- JGIKenGen020407
- Onacha_dissertation_11_31_06
- PIRJGI07
- PIRjgi17-10-06
- Progress Report for 2006-11 140607
- Summary for DGEF Mngt June 2007
- Use of JGI Equipment in ARGeo 140607
- QUARTERLY OPERATIONAL REPORT (various)
- General correspondence by e-mail between GEF, KenGEN and DUKE
- The Joint Geophysical Imaging Project and Its Possible Replication Through the ARGeo Program
- Country Update Report for Kenya 2000-2005, Martin Mwangi Kenya Electricity Generating Company Ltd, P.O. Box 785, Naivasha, Kenya in: Proceedings World Geothermal Congress 2005, Antalya, Turkey, 24-29 April 2005
- Country Update Report for Kenya 1995-1999, Martin Mwangi Kenya Electricity Generating Company Ltd, P.O. Box 785, Naivasha, Kenya in: Proceedings World Geothermal Congress 2000, Kyushu - Tohoku, Japan, May 28 - June 10, 2000

10 REQUEST OF OPINION TRANSMITTED TO THE PR MALIN AND TO THE DR ONOCHA AND DR ONOCHA ANSWER

From: boisdet [mailto:boisdet@cabenr.com]
Sent: Monday, 17 November 2008 8:04 p.m.
To: Peter Malin; Stephen Onacha
Cc: peerke.bakker@unep.org
Subject: JGI project in KENYA

Dear Pr MALIN and Dr ONOCHA

Appointed by UNEP, I am in charge of the final evaluation of the GJI/GEF contract.
It not a scientific evaluation of the methodology of the JGI concept, but an analysis of the achievement of the contract, through a comparison of the present final state of the project and the objectives initially written, in the contract between GEF and KenGen.

I have already some point of view from KenGen and GEF, I really appreciate to have yours. So, could so kind to answer (even very briefly) the following questions.

Do you think the project was a success?
Do you think the management of the project was appropriate?
At the beginning of the project, do you think that the means to achieve the objectives of the project was sufficiently analysed, evaluated and described in printable documents?

Is there any fundamental reason why Duke don't transfer to KenGen the software to utilise the GEOSPACE sensors data?
Do you thing the software is transferable to KenGen?
Do you think it possible to have an interpretation contract through which the data from KenGen could be interpreted by DUKE or an other entity?

Pr MALIN, are you still member of DUKE university?
If not, what person to contact for further negotiation concerning the interpretation software?

For you, in retrospect, what were the most positives, respectively negatives aspect of this project?

Best regards

Alain BOISDET

De : Stephen Onacha [mailto:s.onacha@auckland.ac.nz]
Envoyé : lundi 8 décembre 2008 23:39
À : boisdet
Cc : peerke.bakker@unep.org
Objet : RE: JGI project in KENYA

This is a draft. The training for MEQ can be completed as originally planned

Do you think the project was a success?

In respect to the initial goals, the project was a success. The summary of the project activities, results and outcomes in the attached report submitted to GEF highlight the achievements of the project despite the delays and problems caused by style of management of the project. Duke University tried its best to obtain funding to continue research on the JGI problem. Many of the ideas generated from the JGI project, will continue as a research focus to improve on methods of geothermal reservoir assessment and monitoring. KenGen has built its capacity to acquire high quality data for geothermal exploration and offer consultancies services within the East African region. The JGI equipment has been used extensively for exploration work in the Kenya (7 fields), USA (Mammoth Lakes), Iceland, Zambia, Comoros and Rwanda.

Initial results have been validated by the results of drilling productive wells in the Olkaria-Domes area where JGI was used. These JGI data was recently used to change the direction of drilling of the proposed well sites both in Olkaria-Domes and Olkaria East fields. One of the wells drilled, is a higher producer compared to the wells previously drilled. The production from this one well is more than enough to cover the costs of the JGI project which went mainly to equipment. New methods of field deployment have been established for effective data acquisition. Use of both MT and MEQ now accepted as a vital tool in exploration and locating high potential geothermal wells.

Do you think the management of the project was appropriate?

The management style was not very appropriate for the project. The communication between Duke University and KenGen was not very good especially in the disbursement and utilization of funds. Duke University did not take part in some of the major activities in data acquisition, training and model validation as originally planned. At the end of the project, there were surplus

funds in the budget that could have been utilized to support the staff required for a project of this magnitude. Duke University had to source for funds to continue research work on JGI which is still ongoing to improve on the data interpretation.

At the beginning of the project, do you think that the means to achieve the objectives of the project was sufficiently analysed, evaluated and described in printable documents?

At the beginning, the means to achieve the project was adequately analysed but in the implementation, the budgets were reduced and the management structures changed. The delays in purchasing equipment meant that the staff originally hired could not be maintained to successful completion of the project.

Is there any fundamental reason why Duke don't transfer to KenGen the software to utilise the GEOSPACE sensors data?

The software has never been an issue because Stephen Onacha had always been a member of KenGen. The problem is that KenGen did not purchase the Matlab software required to run interpretation software as recommended in 2007 (see attached MEQ requirements made both to KenGen and UNEP in 2007). The training phase was never completed as originally planned. We are willing and ready to complete the training on the data interpretation and use of the software.

Do you thing the software is transferable to KenGen?

Yes it transferable together with originally planned training which was not completed.

Do you think it possible to have an interpretation contract through which the data from KenGen could be interpreted by DUKE or any other entity?

YES- We are willing and ready to continue to work with KenGen and UNEP on the data interpretation. We are continuing to improve on the JGI concept and we are happy to share this with KenGen and other countries in the geothermal exploration and optimization. We have in collaboration with Reftek continued to improve on the data acquisition equipment and we have designed a new data logger that acquires both MEQ and EM to improve on the data required for JGI.

Pr MALIN, are you still member of DUKE University?

Prof. Peter Malin is not a member of Duke University. He is now the Director of the Institute of Earth Science and Engineering (IESE) at the University of Auckland which is actively involved in geothermal exploration, development of new instruments and exploring deep geothermal resources. The institute also undertakes training in geothermal exploration and development.

If not, what person to contact for further negotiation concerning the interpretation software?

IESE

For you, in retrospect, what were the most positives, respectively negatives aspect of this project?

Positives	Negatives	Remarks
Purchase and Use of MT equipment	Management style and slow process of disbursement of project funds	It is the wish of the former Duke University group that the positive sides of the

		project are emphasized. It is important that positive collaboration is continued
Purchase and design of new MEQ equipment suitable for data acquisition in ragged environments		
Training of KenGen technicians in the USA and Iceland		
Extensive exploration of the geothermal projects in Kenya using JGI equipment		
Capacity building to provide consulting services		
Improvement on well targeting and productivity		Reduce risks in exploration and accelerate geothermal development
JGI studies have contributed to increasing the available size for development for the Olkaria-East field		This is important for geothermal resource optimization

Annex D

Schedule of mission

9	Travel	Paris-Nairobi
10	Nairobi	UNEP/DGEF briefing Mr Peerke de BAKKER, communication of documents. Meeting with Mr de BAKKER and Dr MARIITA from KenGen. UNEP briefing Mr Segbedzi NORGBEY, Mrs Jessica Kitakule-Mukungu, Mr Michael SPILSBURY
11	Nairobi	Mrs Sandeep BHAMBRA, Mr de BAKKER, meeting and desk review of project documents
12	Naivasha	Travel from Nairobi to Naivasha. Visit of the drilling site of Olkaria Dome. Visit of the geothermal site
13	Naivasha	Meeting with Dr SIMIYU (scientific manager) and Dr MARIITA (chief geophysicist), both PhD of the Texas university of El Paso.
14	Naivasha	Meeting with Mr Charles MUTURIA and Mr Peter WAMEYO who had participate to the training in USA (Mammoth Lake, San Andrea Fault) and in Iceland (KRAFLA).
15	Naivasha (morning)	Visit of the geophysics laboratory on Olkaria site and presentation of the new JGI probes
16	Travel	Naivasha to Nairobi
17	Nairobi	KenGen head quarter GEF desk review of project documents
18	Nairobi	Debriefing with Mr De BAKKER UNEP/DGEF. UNEP debriefing with Mr Segbedzi NORGBEY,Mrs Jessica Kitakule-Mukungu, Mr Michael SPILSBURY
19	Travel	Nairobi to Paris