DEVELOPMENT OF A REGIONAL GEOTHERMAL TRAINING INSTITUTE IN KENYA

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ABSTRACT

Kenya and the East African region countries are endowed with vast, non-polluting geothermal energy resource occurring along the East African Rift System. In Kenya, the potential is estimated at over 7,000-10,000MWe. The development of this enormous resource has, however, been slow mainly due to lack of expertise in geothermal resource development, lack of proper equipment and lack of adequate funding. Taking into consideration the present and especially the future demand of developing this green indigenous source of energy, specialists in the fields of exploration, exploitation and utilization of geothermal energy will be required. The Geothermal Development Company Ltd (GDC) has taken a bold step in establishing of a Geothermal Training Institute (GTI) to offer courses in geothermal technology in Kenya in order to address this problem. GDC has few well trained professionals in all fields that will be used as resource persons. In addition, GDC will have fields, laboratories, workshops and equipments including drilling rigs to handle the training effectively. GDC in collaboration with United Nations University-Geothermal Training Program (UNU/GTP) and Kenya Electricity Generating Company Limited (KenGen) have successfully held short courses on Geothermal exploration in Kenya before and therefore it has the necessary experience. The courses that will be offered at the Geothermal Training Institute will include, short courses of 2-3 months mainly for practicing professionals leading to certificates, medium term courses of 3-6 months for advanced training leading to awards of diploma certificates and long term courses of 6 months to 2 years specifically tailored for research students pursuing geothermal related disciplines in Sciences and Engineering. GDC is already developing the curriculum in collaboration with UNU/GTP.

INTRODUCTION

The East African countries of Burundi, Comoros, Djibouti, Ethiopia, Eritrea, Kenya, Malawi, Rwanda, Tanzania, Uganda and Zambia all lie in the highly volcanic East African Rift. The East African Rift is a zone where the earth's interior heat escapes to the surface as manifested by volcanic eruptions and geothermal manifestations (hot springs, fumaroles, geysers). This indicates the presence of a remarkable geothermal potential in the region and therefore presents an opportunity for major geothermal power developments in these countries. A brief update of geothermal development in the countries within the region is outlined below.

Kenya

Kenya was the first country in Africa to tap geothermal energy for electric power generation.

Exploration for geothermal energy started in the early fifties when two wells were drilled at Olkaria. In 1970, the UNDP and the Kenya Power and Lighting Company (KPLC) carried out an extensive exploration program in the Kenya Rift. This survey identified Olkaria as the best candidate for exploratory drilling. Kenya's first 15 MWe unit of the 45 MWe electric power generating plant was commissioned in 1981. It has been operating since then and has proven reliable and economic, running at 98% availability (Ng'ang'a, 1998). The total installed geothermal capacity in the country currently stands at 209 MWe. High potential fields run along the Kenyan rift from North–South with an estimated potential of 7,000-10,000 MWe. The potential fields are shown in figure 1. A brief update of geothermal development in Kenya is outlined below.

Of the 16 potential prospects, only Olkaria field has been partially developed currently generating about 209 MWe. The main reasons for this is mainly due to; lack of adequate and well trained personnel (expertise) to carry out geothermal resource exploration and development, lack of equipment required for carrying out the work and also inadequate financial resources to carry out the work.

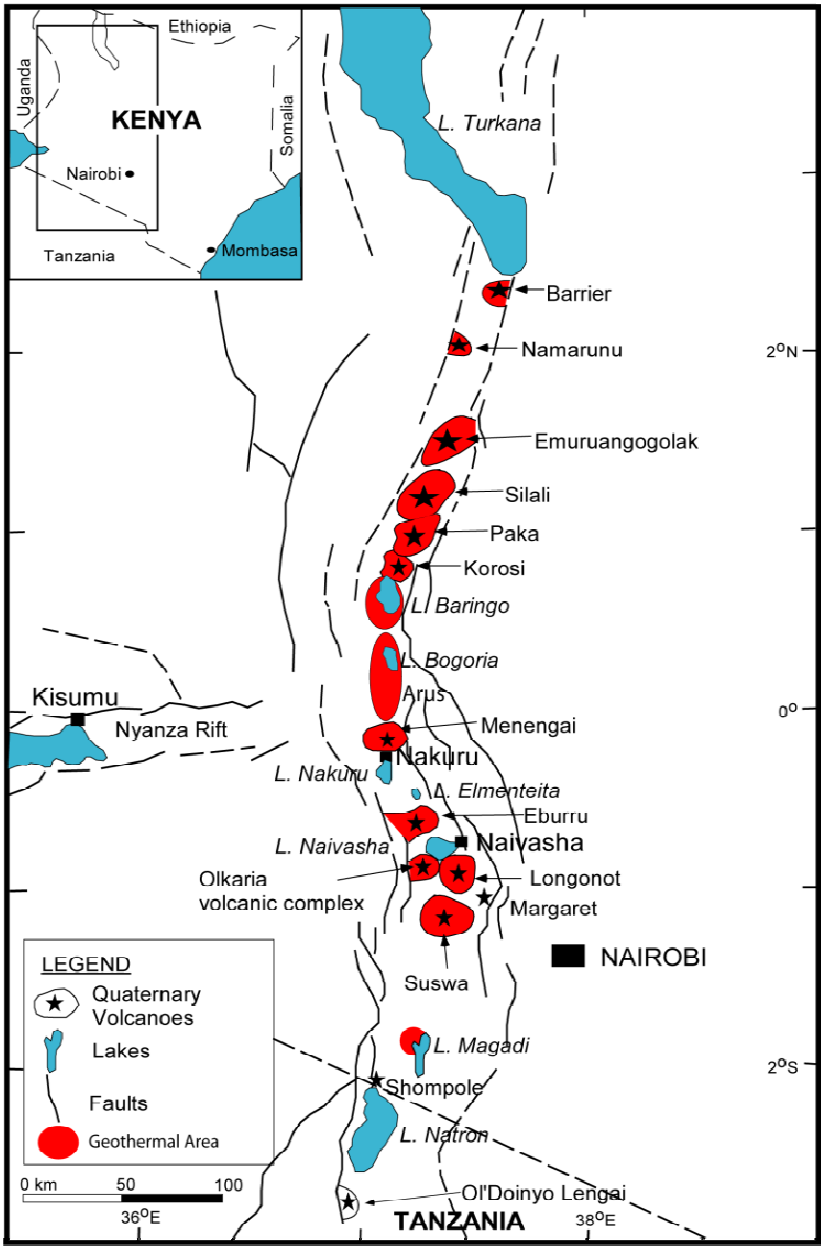

Figure 1: Geothermal prospects along the Kenyan rift**.**

Ethiopia

Ethiopia started a long-term geothermal exploration undertaking in 1969 and over the years a good inventory of the possible resource areas within the Ethiopian Rift has been built. Exploration work peaked during the early to mid-eighties when exploration drilling was carried out at Langano (Lakes District). A 7.2 MWe net capacity pilot plant was installed in the area in 1999 (Teklemariam, 2003). It operated for a short while before encountering operational difficulties that are essentially due to lack of appropriate field and plant management skills.

Zambia

In Zambia, reconnaissance survey has been carried out on geothermal areas since 1950's. A mini geothermal pilot power plant of 200 KW capacity was installed on the basis of limited exploration work. The plant, however, never became operational due to lack of trained manpower. Plans are in place to restore the plant and make it operational.

Djibouti

In Djibouti, much effort has been expended since the seventies, in view of developing the country's indigenous energy resource. About six exploratory wells have been drilled in the Assal geothermal field and intercepted a very high temperature system. However, due to the high salinity of the encountered fluids, the resource development has been delayed. The high salinity could be due to the close proximity of the Assal field to the Gulf of Aden.

Uganda

A reconnaissance survey has been carried out on geothermal areas of Uganda, starting in 1935 when the first documentation of hot springs was made. Recent geoscientific studies have focused on three geothermal systems, Buranga, Katwe and Kibiro, all located in the active volcanic belt in the western rift. No drilling has been done in Uganda.

Eritrea

The Eastern lowlands of Eritrea are of potential geothermal interest, and first priority was given to the Alid Volcanic center for exploration as it has numerous manifestations in the form of hot springs and fumaroles. Detailed geoscientific investigations are underway in this prospect area indicating geothermometry reservoir temperature of about 250ºC.

The rest of the countries have not made much progress in the exploration and development of this enormous, untapped resource estimated at over 7,000-10,000 MWe in the East African Rift. Currently more than 220 MWe has been installed in the region and out of these, the only operational power plants are in Kenya representing about 209 MWe (99%).

NEED FOR ESTABLISHMENT OF A GEOTHERMAL TRAINING INSTITUTE (GTI) IN THE EAST AFRICA REGION

The key issues for the exploration and development of this enormous green energy in the East African countries are financing and technological transfer. There are opportunities for utilizing this largely untapped source of energy in East Africa and therefore specialists in the fields of exploration, exploitation, and utilization will be required.

Currently there are less opportunities for geothermal training than there were in the 1980's and 1990's. The UNU-GTP is at present the only international graduate school offering specialized training in all the main fields of geothermal science and engineering. Two international schools were established in 1970 in Italy and in Japan and in 1978, two more were established in Iceland and in New Zealand. Unfortunately the Pisa school in Italy has not held its course since 1993 due to drastic cuts in government funding however, it has occasionally held short courses (1-3 weeks) in developing countries. The International Group Training Course at Kyushu, Japan was discontinued in 2001 while the Diploma course at the University of Auckland in New Zealand was also discontinued in 2003 due to withdrawal of government financing. Current geothermal professionals in Kenya and the region have been trained in these graduate schools. Nevertheless, still there are few trained professionals in geothermal related areas because such kind of training is only available abroad. This is expensive for these countries and it is difficult to train many people, hence the need to have local training.

Geothermal Development Company Limited (GDC) of Kenya is mandated to carry out exploration and development of geothermal resources and also to built capacity for geothermal development in terms of human resources and equipment on behalf of the Government of Kenya. GDC intends to widen its scope and mandate to the larger East African Region and African Continent as a whole. This can only be achieved through training of regional personnel and by equipping and operating laboratories and engineering workshops. To achieve this, GDC intends to establish a Geothermal Training Institute (GTI)

The creation of a GTI in Kenya will therefore be an important contribution to address the technical capacity and confidence barriers through shared experience and technical assistance in geothermal exploration, exploitation and utilization in the region. The 12-week course will give valuable orientation and practical hands on training in field operations and how to carry out specific tasks in laboratories. The African Rift Geothermal Facility (ARGeo) under establishment by UNEP has strongly recommended the creation of such an institution and has offered its support (Malin, 2001).

MISSION AND OBJECTIVES

The Mission of the Geothermal Training Institute will therefore be to pursue the establishment of an organized skill training and skill-improvement system for the specialists in the field, within the context of the growth of use of geothermal energy development in the African Region.

The main objective of the Geothermal Training Institute is capacity building in promoting geothermal energy resource development and utilization in the region. The primary aim is to assist African countries with significant geothermal potential to build up groups of specialists that cover most aspects of geothermal exploration and development.

SCOPE AND MANDATE OF THE TRAINING INSTITUTE

The scope and mandate for the proposed Geothermal Training Institute will be;

- To train all cadres of staff in all disciplines related to geothermal exploration, development and utilisation (Capacity building)
- To offer relevant courses (for staff involved in geothermal development)
- The Institute will be affiliated to the United Nations university
- The Institute will Initiate institutional collaborations with other re-known geothermal schools for exchange of programs and students.
- To establish and Manage a geothermal information system.
- To establish and manage a technical advisory Assistance program

LOCATION OF THE INSTITUTE

It is proposed that the Geothermal Training Centre be established in Nakuru, Rift Valley Province, Kenya because of the following factors:

- Close to known and well-studied geothermal systems, which will provide hands on training in all phases of geothermal development from geothermal exploration to operation of power plants.
- Easy availability of trained staff in most aspects of geothermal exploration and development to offer practical examples.
- Easy travel access by road and air for staff from all areas of the region both as trainees and trainers and for conferences
- Existence of infrastructure e.g. laboratories and equipment and experienced operators. This will assist the proposed center to take-off faster
- Due to the central locality in the Kenyan Rift Zone, easy accessibility to new geothermal prospects and to the already developed geothermal fields at Olkaria, opportunities are available for geothermal professionals in the region to work with experienced consultants on attachments. Consultancy work in areas of reservoir management, optimization studies and drilling operations will greatly assist in technology transfer

ADMNISTRATIVE SETUP OF THE TRAINING INSTITUTE

The administration set-up can be in a combination framework similar to the UNU-GTP in Iceland and the former Geothermal Training Institute in New Zealand, but adapted to local conditions. The following management structure is recommended for the GTI:

- The GTI: The Institute should be autonomous in its operations. However, it should work in close collaboration with organizations in the host country that are involved with geothermal development and the UNU-GTP.
- The Director: The director will be in charge of the day-to-day operations of the facility. It is recommended that the director (who will work with a designate director) be seconded from the UNU-GTP to set up the operations of the Institute. He/She is expected to hand over to the designate director with time.
- The Study Board: The director will be answerable to a study board that shall include representatives from stakeholders and member countries. The board will decide the timetable of operations for the Institute and program development to suit their individual country needs. On the board there will also be representatives from UNU-GTP and other universities at advisory level.
- Resource Personnel: These should not be permanent employees of the Institute and when required should be hired from member countries depending on their expertise and other geothermal experts from around the world.
- Maintenance and Operation personnel: A small maintenance and operation personnel should be hired by the board or seconded by stakeholders to the center.

The training complex will have the following facilities:

- Administrative block which will host GDC offices.
- A demonstration centre where uses of geothermal energy will be demonstrated with an aim of sensitizing people (potential users) on the benefits of using geothermal energy.
- Scientific Laboratories and engineering workshops where all the fabrications and analysis of samples will be done. The laboratories will be well equipped to cater for the needs and requirements for geothermal users. When fully operational the laboratories will be a part of income generating unit for GDC by serving customers from other institutions.
- Lecture rooms for training students and staff.
- Accommodation hostels for hosting students and staff during training.
- GDC staff canteen.

TRAINING AND CURRICULUM TO BE OFFERED

It is proposed that the Centre be set up to offer training in all basic aspects of most geothermal technology disciplines. The Centre will provide the required training needs for each member country and will have limited introductory theory and practical classes to those who do not have previous training in geothermal technology. This can be undertaken to certificate or diploma levels with time and in such a case, the Centre would need to be affiliated to a recognized educational institution of higher learning. Practical hands on training on various aspects of geothermal technology will be provided for staff already involved in geothermal work in their home countries but lacking equipment.

Course at the Geothermal Training Institute will be offered as follows;

- Short courses (2 weeks – 3 months)- mainly for practicing professionals leading to certificates
- Medium term (3-6 months) – advanced training leading to awards of diploma certificates
- Long term (6 months – 2 years) – tailored for research students and strictly on geothermal science and engineering
- Sponsorships – from development partners (AFD, JICA, USTDA, BGR, UNU/GTP etc)

SELECTION OF CANDIDATES

A consultancy firm will be engaged to assess the requirements of each ARGeo member country. In consultation with the ARGeo team members, the firm will make use of the results of the sub-regional assessments, available Country Strategy Papers (CSP's) of the countries in the region to identify training and capacity building needs.

However, the GTI students shall mainly come from African countries that have developed projects for the utilization of geothermal resources but are facing a shortage of trained manpower. The number of students who will register for the program will depend on the number of places designated by the Study Board. Candidates must have at least a diploma or its equivalent in science or engineering, one-year geothermal experience, working knowledge in English, and be permanently employed by a specific institution. The candidates will be interviewed with a view of selecting students with interest, knowledge, and development potential in the field.

Admission of students will come from the region with a larger proportion from Kenya. Students from outside the region may be considered on merit and the Category of students to be divided into two:

- ✓ Graduate professionals (with degree certificates)
- ✓ Technician professionals (with diploma certificates)

Both fresh and experienced graduates and students attached from local universities will be also admitted.

FUNDING

The initial estimated cost of financing of the Training Institute is U$ 5,000,000 and this will be raised from:

Fund raising from stake holders:

- ✓ GoK (providing/buying land)
- ✓ GDC funds (internally generated when fully operational)
- ✓ Donors (Development partners: AFD, JICA, UNU/GTP, BGR),
- ✓ Collaboration with other international geothermal organizations:
- ✓ International Geothermal Association (IGA)
- ✓ GDC is already the patron of the Geothermal Association, Kenya and can easily request assistance from IGA
- ✓ From UNU-GTP (mainly to run the programs)

Taking into consideration the economic resources of the countries in the region, the candidates who qualify to secure a place for admission will receive a fellowship. The fellowship will cover the tuition, living and travel expenses in Kenya and a return ticket to their respective countries. This will be co-financed by GDC, UNU-GTP, AFD, BGR, JICA and other multilateral donors, and bilateral agencies.

PLANS FOR ESTABLISHING THE TRAINING COMPLEX

GDC is in the process of securing land and other infrastructural facilities to put up the institute and once this is done, the procurement of required equipment will follow shortly.

The Curriculum for the institute is being developed by the United Nations University in collaboration with GDC and financial pledges have been given by development partners (AFD, JICA, USTDA, UNU) totaling to U$ 9,500,000

TIMELINES FOR PLANNED ACTIVITES

Activity	Start date	End date	Remarks
Procure land	May 2010	June 2010	On-going
Proposal	June 2010	June 2010	Presented
Procure Design Consultants	July 2010	Sept. 2010	Open tendering
Design (Architectural) and approval	October 2010	Dec. 2010	Open tendering
Construction including tendering	January 2011	June 2011	Open tendering
Equipping	June 2010	May 2011	Sourcing of equipment on-going
Commissioning	August 2011	August 2011	-

The proposed development will take place in phases.

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APPENDIX

TABLE 1: Curriculum and approximate time schedule of courses to be offered at the Geothermal Training Centre

Week No.	Geological Exploration and Borehole Geology	Geophysical Exploration	Borehole Geophysics and Reservoir Engineering	Environmental studies and Chemistry of Thermal fluids
1	Introductory lectures on all main aspects of geothermal energy exploration, exploitation and utilization including practicals and short field excursions			
2	Introduction to geological field mapping methods and borehole geology. Alteration mineralogy, XRD and Fluid Inclusions	Introduction to geophysical methods (Gravity, Resistivity, Magnetics and Seismics)	Introduction to Logging and Well Testing Practices. Reservoir Physics, Simulation Studies, Tracer Tests and Computer Programs	Introduction to EIA, Monitoring, Afforestation, Brine Disposal Geochemical Sampling & Analytical Methods, Geothermometers
3				
4				
5	Excursion to major geothermal fields in Kenya. Visits to direct (greenhouses, spas and plant drying facilities) and electric generation plants			
6	Data processing and project report writing.			
7				