Paper to be presented at *Workshop for Decision Makers on Geothermal Projects and Management,* organized by UNU-GTP and KengGen in Naivasha, Kenya, 14-18 November, 2005

DEVELOPMENT OF A GEOTHERMAL TRAINING CENTRE IN KENYA

Silas M. Simiyu
Kenya Electricity Generating Company Ltd
Olkaria Geothermal Project
P.O Box 785, Naivasha-20177
KENYA
ssimiyu@kengen.co.ke

ABSTRACT

The East African countries are endowed with vast, non-polluting geothermal energy resource occurring along the East African Rift System, which is estimated at over 7,000 MWe. The development of this enormous resource has, however, been slow partly due to lack of expertise in the field of exploration and development. Taking into consideration the present and especially the forthcoming demand of developing this green indigenous source of energy in the East African countries, specialists in the fields of exploration, exploitation and utilization will be required. The United Nations University Geothermal Training Programme (UNU-GTP) in Iceland and the Kenya Electricity Generating Company (KenGen) are therefore considering the need for the establishment of a Geothermal Training Centre (GTC) to offer short courses in geothermal technology in Kenya in order to address this problem. The Centre is expected to offer up to 7 weeks training in various geothermal technology disciplines, in accordance with the potential requirements of the countries in the region. Instructors will be composed of scientists and engineers from the region who are highly specialized and experienced in geothermal technology, UNU-GTP lecturers, local university lecturers, and invited foreign specialists in the field of geothermal technology. The fellows of the GTC will utilize the existing scientific equipment, laboratories and geothermal libraries at KenGen and will carry out their practical field experiences in the geothermal fields at various stages of development in the region. The Centre will have a study board with representatives from UNU-GTP and collaborating member countries. The official inauguration may take place in 2006 or 2007. Financing of the Centre will be sought with KenGen, UNU-GTP, United Nations Environmental Programme (UNEP), Global Environmental Fund (GEF), African Development Bank (ADB), other multilateral donors, and bilateral agencies.

1. 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 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 128 MWe.

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.

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.

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.

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.

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 MWe in the East African Rift. Currently a total of about 137 MWe has been installed in the region and out of these, the only operational power plants are in Kenya representing 128 MWe (99.3%).

2. NEED FOR ESTABLISHMENT OF A GEOTHERMAL TRAINING CENTRE (GTC) IN THE EAST AFRICA REGION

The key issues for the exploration and development of this enormous green indigenous source of 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.

The creation of a GTC 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 a Centre and has offered its support (Malin, 2001).

3. MISSION AND OBJECTIVES

The mission of the Geothermal Training Center will 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 in the African region.

The main objective of the Geothermal Training Centre is capacity building in promoting geothermal energy resource development and utilization in the African 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

4. LOCATION OF THE CENTRE

The UNU-GTP has decided to expand its capacity building activities by introducing short courses in geothermal development in selected countries in Africa, and later in Asia and Central America. It has already secured funding and the announcement to start annual short courses was made at the Bonn 2004 conference for Renewable Energies (Fridleifsson, 2005). These courses may later develop into regional training centres. The first short course in Africa will be held in Kenya at Naivasha, which is close to Olkaria, the home of the first geothermal power station in Africa in November 2005 in collaboration with KenGen, African Rift Geothermal Facility (ARGeo) that is being established by UNEP, GEF, ADB, several African countries, and aid agencies from several countries.

It is proposed in the present paper that a Geothermal Training Centre be established in 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 availability of 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.

5. TRAINING AND CURRICULUM

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. Upon completion of the course, the graduates will be awarded with a certificate. It is envisaged that some trainees of the Centre will later be admitted to the UNU-GTP for advanced training. It is also expected that the Centre will with time extend the duration and the academic standard of the training.

The duration of the training will be 7 weeks. Table 1 in Appendix 1 shows the curriculum and the approximate time schedule of each of the courses that will be offered at the Centre.

6. GEOTHERMAL TRAINING CENTRE ADMINISTRATION SET UP

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 GTC:

- The GTC: The Centre 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 Centre. 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 Centre 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 Centre 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.

7. 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 GTC 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 and should preferably not exceed 20. 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.

8. FUNDING

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 KenGen, UNU-GTP, UNEP, GEF, other multilateral donors, and bilateral agencies.

9. CONCLUSION AND RECOMMENDATION

It is recommended that a Geothermal Training Centre, which will be responsible for promoting development of geothermal energy as an economically viable source of renewable energy in the African region, be established in Kenya.

ACKNOWLEDGEMENT

Many people contributed ideas that let to writing of this paper. These include Scientists and Engineers at Olkaria Geothermal project and I would like to thank them. I also wish to acknowledge Mr. John Lagat for editing this paper.

REFERENCES

Fridleifsson I. B., 2005: Capacity building in geothermal energy technology for professionals in ARGeo countries. *ARGeo SC meeting Addis 2005.*

Malin P. E., 2001: Establishment of a Geothermal Resources Center to accelerate development in the East African region. *GEF/UN Draft Proposal.*

Ng'ang'a J. N., 1998: Status of geothermal development in Kenya. *United Nations University 20th Anniversary Workshop 1998*. 29-38

Teklemariam, M., 2003: *Overview of Geothermal Utilization and Potential in East Africa, East African Rift System.*

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, Afforest-ation, 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				