DEVELOPING CRITICAL HUMAN COMPETENCIES IN GEOTHERMAL ENERGY TECHNOLOGY

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ABSTRACT

Geothermal energy is anticipated to play an important role in meeting the global energy demand in the coming century. Geothermal in Africa is expected to compete with other renewable energy sources, in particular solar. However, the rate of geothermal development in Africa has been slow partly due to lack of trained human resources in geothermal technology and risk funds. This paper looks at the need to develop critical human competencies in Eastern Africa required for accelerated geothermal development in the region. Among the areas with inadequacies within the East African Rift Countries include geology, geochemistry, geophysics, reservoir engineering, drilling, steam-field engineering, power plant operation and maintenance and environmental management. The paper recommends that an aggressive training programme needs to be put in place to address the identified training needs. The recommended training should include overseas training for degree and diploma certificates; short courses of one to four months duration, and local and foreign internships The Geothermal Development Company and KenGen are proposed as local organizations that can support training via internships.

INTRODUCTION

Training in geothermal technology that started in 1970 at the International School at Pisa (Italy) and at Kyushu University (Japan) were non-degree overview type courses. These lasted between 9 and 2 months in Pisa and 4 months in Kyushu. This decade saw a rapid expansion of geothermal projects in developing countries sponsored by international and bilateral aid. Overview teaching, however, could not cope with demand for specialized and academic type training. At the request of the UN Development Programme (UNDP) and with the support of the NZ Ministry of Foreign Affairs (MFA), the Geothermal Institute (GI) was established in 1978 at the University of Auckland (UA). Its purpose was to offer a post-graduate, 10 months academic Diploma course for earth scientists and engineers (Hochstein, 2005). However, UA course was suspended between 2003 and 2006 but resumed in 2007 with post graduate certificate course in geothermal technology (Newson et al., 2010). The Pisa school has not held its annual course since 1993 due to drastic cuts in government financing, but has occasionally held short courses (1-3 weeks) in developing countries while the International Group Training Course at Kyushu University was closed in 2001.

After the University of Auckland training programme, a 6-months training course in geothermal technology was initiated at Reykjavik (Iceland) in 1979 as part of a United Nations University training programme (Friðleifsson, 2010). The United Nations University-Geothermal Training Program (UNU-GTP) currently trains masters and PhD students in collaboration with the University of Iceland. Despite the availability of these courses, trained manpower in Africa over the year's number only about 329 out of which some have retired while others work in foreign countries. This, therefore, calls for a new approach to fast track training of additional 460 technical staff to provide the needed human capital to drive the Eastern Africa's agenda of generating additional 4,000MW from geothermal sources by 2020.

WORLD GEOTHERMAL RESOURCE USE

On a global scale geothermal resources constitute a small, yet rapidly growing, energy resource. It is a very important renewable energy source for many countries. In the year 2010 geothermal energy constituted about 0.75% of the annual worldwide energy consumption (IEA, 2009). Geothermal resource has been identified in more than 80 countries and utilization of the resource had been recorded in 76 countries in the world. Geothermal energy, as natural steam and hot water, has been used for decades to generate electricity, in space heating and industrial processes. In 2010 a total of 25 countries were generating electric power from geothermal resources (Bertani, 2010) and 78 countries were using geothermal energy directly (Lund et al., 2010). The world installed electrical capacity from geothermal resources is 10,715 MWe (year 2010). Installed capacity of electricity from geothermal sources is expected to reach over 18,500 MWe by 2015 (Bertani, 2010). The global thermal capacity of non-electrical uses (greenhouses, aquaculture, and district heating and industrial processes) is 121,696GWh/yr (Lund et al., 2010).

GEOTHERMAL USE IN AFRICA

Among African countries only Kenya and Ethiopia have been generating electricity from geothermal sources. Kenya commissioned its first plant (45MW) between 1981 and 1985 while Ethiopia commissioned an 8.5MW plant in 1998. Kenya has since installed further 160MW at Olkaria giving her a total installed capacity of 205MW. Additional 4MW off grid plants have been installed to directly supply agricultural industry. Ethiopia commissioned its first 8.5 MWe geothermal plant in 1998 at Aluto in the Lakes District (Teklemariam et al., 2000). Exploration for geothermal resources has been conducted to varying extent in Cape Verde, Djibouti, Eritrea, Tanzania, Uganda, Zambia, Malawi, Rwanda, Egypt, Comoros, Tunisia, Algeria, DRC and Burundi.

Many African countries have made some direct uses of their geothermal resources. These countries are Algeria, Egypt, Ethiopia, Kenya, Tunisia, and Zambia. Tunisia, which is one of the world leaders in the use of geothermal energy for greenhouse heating and irrigation, is currently leading in Africa with about 110 hectares of greenhouses (Mohamed, 2003). In Kenya, Oserian Development Company, a flower-growing firm utilizes geothermal energy to heat 50 hectares of greenhouses. Other African countries are keen to exploring their geothermal resources both for direct applications and electricity generation. Kenya plans to add 3,000 MW of geothermal power by 2020 while the other eastern African countries plan to install 1,000 MW.

GEOTHERMAL TRAINING IN AFRICA

The UNU-GTP is at present the only international graduate school offering specialized training to diploma and degree levels in all the main fields of geothermal science and engineering (Friðleifsson, 2010). University of Auckland offers post graduate certificates and also intends to offer degrees in geothermal technology in the near future (Newson et al., 2010). From the geothermal development plans of eastern African countries, more than 460 personnel need to be trained in all aspects of geothermal development including exploration, drilling, reservoir management, environmental management and power plant operations and maintenance. To this end, UNU-GTP commenced post graduate certificate short course in Kenya on geothermal exploration.

The first course was held in Kenya in 2005 in collaboration with Kenya Electricity Generating Company (KenGen) and the UNEP/GEF African Rift Geothermal project (ARGEO) with participants from Kenya and neighbouring countries with geothermal resources. The teaching was a blend of Icelandic experts and former UNU Fellows in eastern Africa. The current version of the course lasts three weeks and is co-sponsored by the Government of Iceland, KenGen and Geothermal Development Company Limited (GDC).

As part of its aggressive plan to develop steam equivalent to 5,000 MWe by year 2030, GDC plans to set up a training facility for its staff. The training facility will handle short courses that include exploration techniques (geology, geochemistry, and geophysics), drilling technology, reservoir studies, environmental management and safety, utilization and power plant operation and management. These courses will typically last three weeks to three months. Detailed plan about the centre is covered in another manuscript in this conference's proceedings.

TRAINING PROGRAMS FOR THE FUTURE

To meet the required trained human capacity to develop geothermal resources in eastern Africa, both traditional training programs and other capacity building programs need to be utilized at the same time. It is hoped that UNU-GTP program and the scholarship thereof will continue to be offered to deserving African countries. Recent survey by Teklemariam (2010) indicated that the region would need four hundred and sixty (460) trained experts to post graduate diploma and another fifty (50) to M.Sc. and PhD degrees by year 2013. The UNU-GTP and higher degree graduates would form the core of trained experts in various countries and who can be relied upon to further train other graduates in their countries (Friðleifsson, 2010). African trained personnel have successfully been used for the short courses held in Kenya since 2005. They Africans comprise the bulk of the trainers.

To further fast track capacity building, GDC recently hired consultants from UNU-GTP to undertake local training of their graduates and technicians on exploration methods. The courses covered include geology, geophysics, and geochemistry. Theory and practical aspects were covered over a period of 30 days and included actual field work. Forty graduates and technicians underwent through the course. The course had a great impact on the trainees as they are now able to deploy field equipment and undertake basic interpretations. Additionally, it was cost effective to bring in three consultants than take fort trainees to Iceland for similar training. GDC plans to continue with that approach to develop critical mass of trained personnel in exploration, drilling, reservoir and modeling.

GDC is also working on plans to train some staff through local or foreign internship with renowned laboratories and/or projects. It is anticipated that the attachment to the experts would provide international exposure and work ethics required for rapid geothermal development. GDC is seeking internships in Iceland, New Zealand and USA for its staff. Conversely, GDC and KenGen having well developed capacity in exploration, drilling and geothermal power plant operation and maintenance should offer internship to graduates and technicians from eastern African countries to learn from their experiences.

ArGeo stakeholders meeting held in Nairobi in March 2010 resolved that the African rift countries should strive to incorporate teaching of geothermal technology in the local universities (Teklemariam, 2010). The syllabus would follow similar curriculum for MSc degree in geothermal technology programs to those of the Institut Teknologi Bandung, Indonesia (Saptadji, 2010). The curriculum would include courses in exploration (geology, geochemistry, geophysics), drilling technology, management and economics of geothermal, geothermal energy utilization, geothermal production engineering, geothermal reservoir studies (modeling and simulation), environmental management, direct utilization and power plant operation and management.

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