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GEOTHERMAL EXPLORATION AND DEVELOPMENT IN KENYA

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ABSTRACT

Electricity demand in Kenya has continued to grow steadily over the years. This has caused great pressure on the conventional forms of energy like hydropower, which is normally affected by weather changes. In order to provide reliable, sustainable, and environmentally friendly form of energy, the Ministry of Energy through the support of bilateral and multilateral donors has continued exploration of geothermal resources along the Kenya Rift Valley and several prospects have been identified for further work. In addition to the 57MW produced at Olkaria geothermal power stations, KenGen, a government company, together with Independent Power Producers (IPPs) are expected to produce a total of 128 MW of electricity from geothermal energy by the year 2003 and to increase the total output to 576 MW by the year 2015. In order for the envisaged program to succeed, the government will require to raise funds and also involve all other interested parties in both resource assessment stage and development of various proven sites.

1. INTRODUCTION

The Kenya Government has liberalized power generation to encourage private sector participation. The government established Electricity Regulatory Board as an autonomous body to regulate the power sector. Its functions, including tariff setting were until 1998 performed by the Minister in charge of energy. However, licenses for power generation and distribution are still granted by the Minister for Energy upon advice by the Board. Under Geothermal Resources Act of 1982, the Minister also grants licenses for geothermal resources devilment. Kenya Electricity Generating Company (KenGen) is a government company that conducts development of the geothermal resources after the exploration work has been conducted by the

Geoexploration Department in the Ministry of Energy. So far most of the prefeasibility studies have been conducted all along the Kenya Rift Valley see map Fig. 1, and several geothermal resources identified for further exploration. Once the resources have been proved, they are going to be developed by KenGen or IPPs in order to meet the electricity needs of the country.

2. LOCATION OF GEOTHERMAL RESOURCE IN KENYA

The eastern arm of the East African Rift transacts Kenya in a North-South direction. The area has a number of quaternary volcanoes on the floor of the Rift Valley where most of the East African lakes are found. Many of these lakes are salty but a few of them have fresh water, which also acts as recharge to geothermal systems. The major exemption is Lake Victoria that lies in the depression between eastern and Western Rift Valley.

The quaternary volcanism has led to geothermal manifestations such as fumaroles, steam jets, hot springs, geysers, hot mud pools and hydrothermal rock alterations in many parts of the Kenyan Rift Valley. There are however exceptions with a few geothermal resources occurring outside the Kenya Rift Valley. These off axis quaternary volcanoes such as Homabay, Jombo Hills, Chogoria and Maji moto all exhibit low enthalpy characteristics.

The geothermal resources fall into different categories of low, intermediate and high temperature systems, which can be harnessed for both direct

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utilization and electricity generation.

3. CURRENT POLICY ON GEOTHERMAL DEVELOPMENT

The Geothermal Energy is covered in the geothermal resources Act of 1982. Licenses for Geothermal Development are granted by the Minister of Energy. The government of the Republic of Kenya has liberalized power generation to encouraged private sector participation and established Electricity Regulatory Board (ERB) to regulate activities in the power sector.

4. VISION OF THE GEO-EXPLORATION DEPT., MINISTRY OF ENERGY

According to statistics of energy demand by the 2015 additional 500MW electrical Energy from Geothermal Resources should be on line. This means many more geothermal power stations should be operational by that date. There is need for urgent surface exploration activities for all the fields, in order to meet this target. Further exploration and development of geothermal sources for Electrical Energy will require support and funding. The involvement of bilateral, multinational and IPP developers in resource evaluation and development are encouraged.

5. ROLE OF GEOTHERMAL DIVISION, GEO-EXPLORATION DEPT, MINISTRY OF ENERGY

1. Survey of all geothermal areas presumed to contain the resource in the country.
2. To undertake drilling test in order to promote development in the untapped areas before tendering them to developers.
3. Field survey to test the geothermal resource exploration techniques i.e. the suitable exploration methods for various fields and equipment.
4. Research and development of geothermal resources that are not related to geothermal power generation but rather those that are broad based e.g. medicinal, agriculture, industry and any other direct uses of geothermal energy.
5. Formulation of acts, rules governing the geothermal exploration, utilization and safety standards.
6. Monitoring of operations of Independent Power Producers (IPPs).
7. Licensing of exploration and development of geothermal resources.

6. HISTORY OF GEOTHERMAL EXPLORATION IN KENYA

The history of geothermal exploration in Kenya dates back more than 30 years ago. It was recognized that the central Rift Valley, in particular Olkaria area could contain a geothermal energy resource. In 1956 two wells were drilled with the second one X2, approximately 3 km to the North-West of the present geothermal power production area reaching a depth of 1035 meters was found to have a temperature of up to 235 °C. It was not until 1970 when detailed exploration, with government of Kenya and UNDP funding, commenced investigation in Olkaria, Eburru, and Bogoria. Olkaria was subsequently given top priority after detailed review in 1972.

Subsequently exploratory drilling was undertaken in the Olkaria area in 1973, which led to the first geothermal power plant of 15MW being commissioned in 1981. Another two, each of 15MW followed this plant. These three power units are supplied with steam from an area of 1.5 square Kilometers.

Table. 1 attached is summary of further exploration that has been conducted to date. This chart shows the institutions that have been involved and the results. The comments in the chart also indicate what is anticipated of each area in future. These exploration activities have identified a number of geothermal prospects along the entire parts of the Rift Valley. These prospects are shown in the accompanying map of the geothermal fields of the Kenya Rift Valley (Fig. 1).

7. ROLE OF KENGEN/ IPPs

Kenya Electricity Generating Company (KenGen) is a Government Company licensed in early 1982 to generate electricity from Geothermal Energy amongst other sources in Olkaria Geothermal Field on behalf of the Government.

Further exploration was carried out in Olkaria to determine the boundaries of various fields. There is a continuous monitoring of the behavior of the reservoir during production. In addition there is drilling of make up wells to maintain constant

production and field maintenance. The Independent Power Producers (IPPs) are licensed to produce electricity from their own geothermal power plant and sell it to Kenya Power and Lightning Co.Ltd. (KPLC). The company that transmits and distributes electrical power in Kenya.

8. CURRENT PRODUCTION AND POTENTIALTY

Geothermal power production is in Olkaria. From Olkaria 1 field first 15 MW generator plant, began operations in July 1981 and the next two 15 MW in 1982 and in 1985 respectively. The Geothermal power plant is owned by Kenya Electricity Generating Company (KenGen). In 2000 an IPP Installed a geothermal power plant in Olkaria 111 field producing 12 MW of electrical power. Two other geothermal power stations, each of 64 MW are planned for commissioning in Olkaria 11 and 111 fields respectively by the year 2003. One of the two geothermal fields will be developed by KenGen and the other by Independent Power Producer (IPP).

The following is a summary of the status of the various geothermal fields in Kenya as of 2000:-

1. Olkaria 1 - 45 MW of electric power being produced by KenGen.
2. Olkaria 11 - Under construction to produce 64 MW being developed by KenGen to be commissioned by 2003.Total power proven so far is 80 MW.
3. Olkaria 111 - Planned 64MW for development by IPP by 2003, at present only 12 MW is being produced.
4. Olkaria 1V - Open and under assessment by the Government.
5. Domes area (Olkaria) - Under exploratory drilling and so far three wells have been completed and are undergoing discharge tests.
6. Longonot area - Planned exploratory drilling and machinery are being moved to the site for the first well to be drilled.
7. Eburru - Drilled and some 10 MW of geothermal power planned.
8. Menengai - Under review, to be compared with Suswa for exploratory drilling.

Table. 2 shows the status of the various geothermal fields in Kenya as of year 2001.

9. DEMAND FOR ELECTRIC POWER AND SOURCES IN KENYA

The Electric power production in Kenya has an installed capacity of 1013.4 MW broken down by source as follows:

674.0MW	Hydro
281.5MW	Thermal
57.0 MW	Geothermal
0.4 MW	Wind

10. CONCLUSIONS

For the Geothermal Projects, only the 128MW plants at Olkaria have been identified and are under construction. The exploration and development of the remaining 348MW will require support and funding. The involvement of bilateral, multinational and IPP developers in resource evaluation and development are encouraged.

Seven isolated diesel stations with an installed capacity of 9.2MW.

The projected demand for electric power between 2000 and 2015 is as follows:

YEAR	PEAKLOAD
2001	1013.4MW
2005	1136.0MW
2010	1543.0MW
2015	2086.0MW

To meet this projected demand, it is envisaged that the following projects will need to be put in place between now and 2015.

Hydro (Under construction)	140MW
Hydro	180MW
Thermal	680MW
Geothermal	512MW

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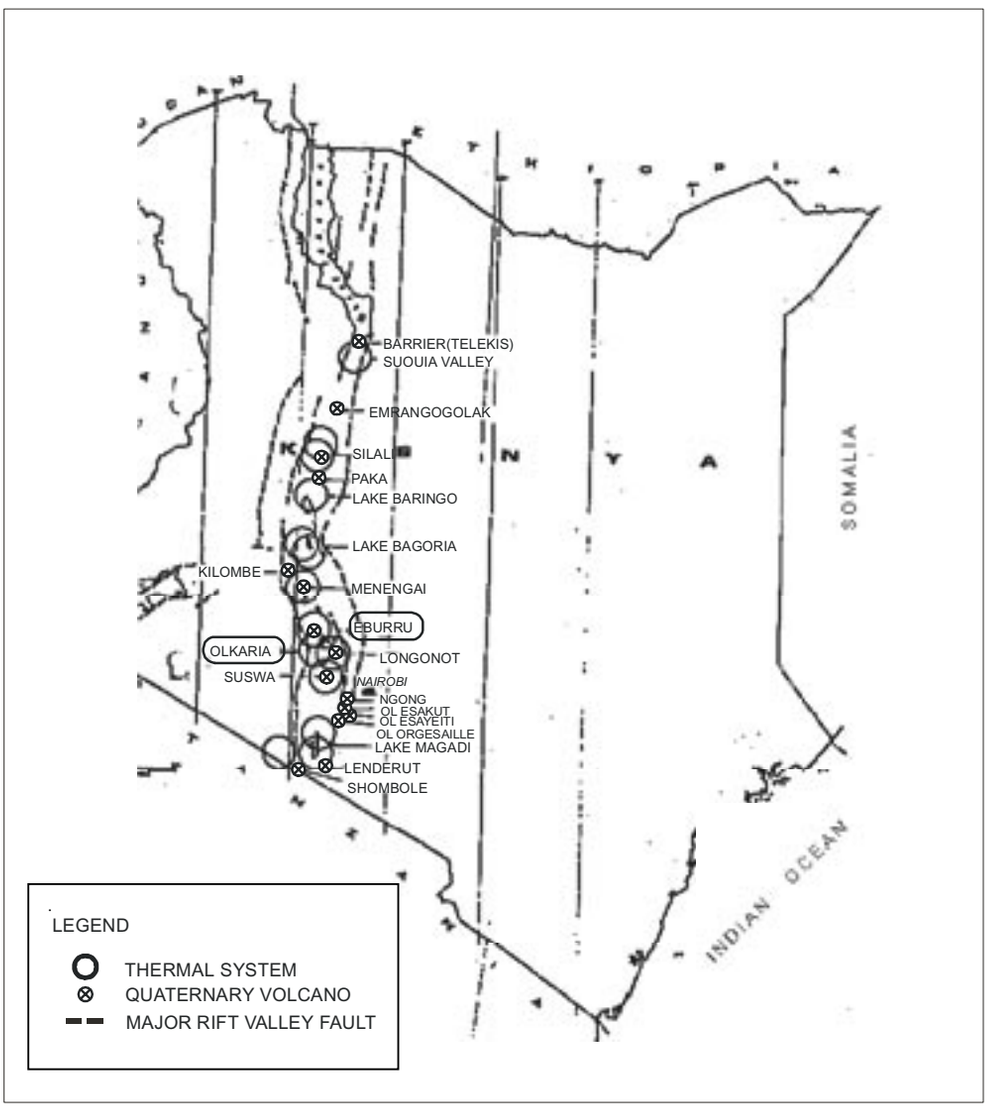

Fig. 1 Location map of geothermal fields in Kenya

Table. 1 1HISTORY OF GEOTHERMAL DEVELOPMENT IN KENYA

GEOTHERMAL PROJECT	YEAR	OPERATOR	OBJECTIVE	COST	RESULTS	COMMENTS
OLKARIA	1956	COL.GOV. BELFOUR/BETTY	WAR MATERIALS	?	WELLS X1, X2	WAR ENDED BEFORE RESULTS
UNDP PHASE I BOGORIA, EBURRU,OLKARIA	1970-1976 1978-1984	GOK , UNDP	LOCATE/ VIABLE FIELD	60 MILLION US $	REPORTS 45 MW PLANT	
EBURRU	1979-1983 1986-1989	GOK/JICA WORLD BANK KPLC	LOCATE/DRILL WELLS EXPL.DRILLING	? 13,5 MILLION US $	REPORTS DRILL SITES REPORTS WELL DATA	AWAITING APPRAISAL
UNDP PHASE II	1986-1992	GOK/UNDP ODA	LOCATION OF PROSPECTS,TRAIN ING CAPACITY TO PROGRESS	4 MILLION US $	REPORTS PROSPECTS DATA	EXPLO DRILLING AWAITED
GEOTHERMAL MAPPING IN RIFT VALLEY	1985-1992	GOK/ODA	REGIONAL GEOLOGY, HYDROLOGY/ GEOCHEMISTRY	1,860,000 UK #	REPORTS DATA	GEOPHYSICAL EXPLORATION AWAITED
OLKARIA I,II, OLKARIA III DEVELOPMENTS	1982-2004	WORLD BANK GOK/KENGEN	DEV. OF POWER STATIONS	>130 K# MILLION	POWER STATION REPORTS DATA	
GEOTHERMAL RESOURCE ASSESSMENT		GOK KENGEN	TEST RESERVOURS LONGONOT SUSWA/ MENENGAI	17.4 MILLION US $	NEW FIELDS	ON GOING

Table. 2 STATUS OF GEOTHRMAL FIELDS IN KENYA

FIELD	SIZE Ha	No OF WELLS DILLED	POWER POTENTIAL	STATUS
OLKARIA 1	750	30+	45 MW	PRODUCING
OLKARIA 11	1600	20+	64 MW	UNDER CONSTRUCTION
OLKARIA 111	1150	10+	64-100 MW	UNDER CONSTRUCTION
OLKARIA 111			12 MW	PRODUCING
OLKARIA 1V	1200	4+	>50 MW	INVESTIGATION
OLKARIA NW	1560	4	?	INVESTIGATION
OLKARIA SW	1470	2+	?	INVESTIGATION
EBURRU	6000	6	>20 MW	INVESTIGATION
SUSWA	14300		?	INVESTIGATION
LONGONOT	21600		?	EXPOLRATION
MENENGAI	80500		?	EXPOLRATION
ARUS				
PAKA				
SILALI				
KOROSI				
BARRIER				

NOTE:

1. Olkaria 1V, Olkaria NW and Eburru are open area for bids in future.
2. Suswa, longot, and Menengai are at exploration drilling stage
3. Arus, Paka, Silali, Korosi and Barrier areas are awaiting geochemistry and geophysical exploration.