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USE OF GEOTHERMAL ENERGY AT KIFAR WELL, EGYPT IN WATER TRANSPORTATION

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ABSTRACT

Kifar-1 thermal well (57 °C) in the northwestern desert of Egypt considered as the most productive flowing water well in the region is proposed to be used as a source to supply Marsa Matruh resort area on the northwestern coast of the Mediterranean Sea with potable water through a pipeline. Because the well discharges a huge amount of pure and fresh water (TDS 464 ppm) under a high pressure of 5 kg/cm^2 from 1"diameter outlet from a rechargeable aquifer of the Nubian system of eastern Sahara, the hydrologic characteristics of the aquifer are in favor for transporting water from Kifar to Matruh. Pumping power will be obtained from electricity that could be provided from the heat of the discharged water using a binary cycle turbine . It is also planned to tap some water at selected places from pipeline between Kifar and Matruh to be used for irrigation purposes. The opinion of water transportation by geothermal energy will accordingly satisfy the need of Matruh for fresh water resulting in a tourism development in addition to agricultural development of the area between Kifar and Matruh.

INTRODUCTION

Matruh city situated on the Mediterranean coast (Fig. 1) is characterized by having one of the fascinating and attractive beaches for tourism in the world.It is considered as one of the beautiful resorts that attracts many torists and people from all Egypt during summer to enjoy fine weather and sea water. The city is lacking sufficient fresh water particularly during summer. The main domestic water supply is brackish provided from available shallow wells in the vicinity. A limited amount of drinking water supply is provided from Alexandria (Fig. 1)distant 220 km from Matruh. The present work deals with the opinion of transporting fresh water from Kifar thermal well (Fig. 1) making use of the geothermal energy to provide electricity to pump water along a 220 km pipeline to Matruh.

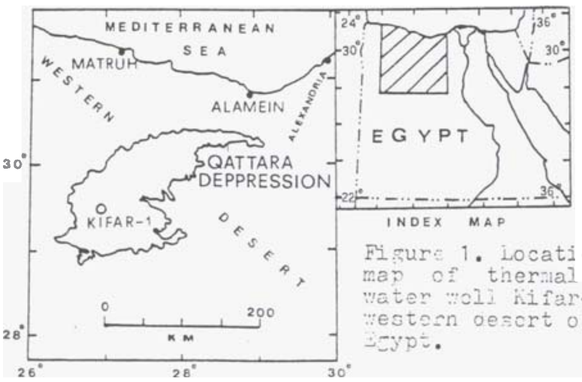

Figure 1. Location map of thermal water well Kifar-1, western desert of Egypt.

GEOLOGICAL AND HYDROGEOLOGICAL SETTING

Kifar is situated in Qattara Depression (Fig. 1) represented by Quaternary sabkha deposits of silt, clay and evaporites and at the rims of the depression by Tertiary Lower Miocene Moghra formation of shale and sandy carbonate (CONOCO/EGPC, 1986).The main area between Kifar and Matruh is represented by Middle Miocene Marmarica formation of limestone with marly intercalations followed to the north by a belt parallel to the sea of Pliocene limestone with interbedded marl reaching a width of ~18 km near Matruh followed by a Quaternary coastal deposits of sands and gravels of a width of ~10 km at Matruh.

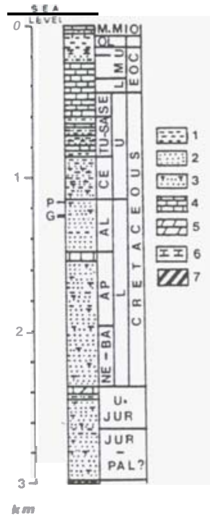

Figure 2. Geologic log of Kifar-1 (GPC,1972).
OL-Oligocene ,SE-Senonian,
SA-Santonian,TU-Turonian,
CE-Cenomanian,AL-Albian,
AP-Aptian,NE-Neocomian,
BA-Barramiyan ,
P-Producing horizon,
G-Plug level,
1-Shale,
2-Sand,
3-Sandstone,
4-Limestone,
5-Dolomite,
6-Calcareous,
7-Igneous.

The geologic section at Kifar well is shown in Fig. 2. The water-producing horizon is top Albian Lower Cretaceous sandstone fed from the Nubian aquifer system of eastern Sahara. The well discharges water from the interval 1166-1174 m from ground level at a rate of 406 m^3/hr from 1" diameter outlet at a pressure of 5 kg/cm^2 at 57 °C having TDS of 464 ppm as measured in March 198[illegible] (GPC, 198[illegible]). The measured water pressure when the well was closed amounts to 11.7 kg/cm^2 and was stable at that level for [illegible] hours and drops to 5 kg/cm^2 after 1[illegible] minutes from discharge till the end of the hours.

TOPOGRAPHY

The topsgraphic profile of the proposed track of pipeline from Kifar to Matruh (Fig. 3) represented in Fig. 4 shows the presence of a plateau in between.

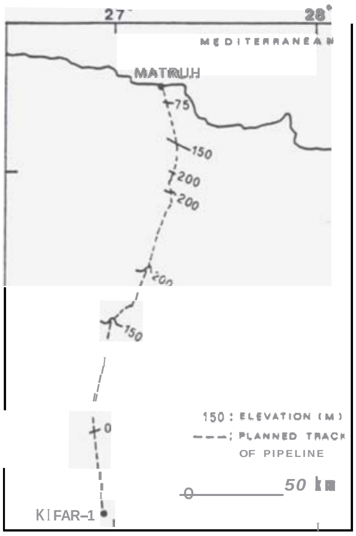

Figure 3. Proposed track of pipeline from Kifar to Matruh.

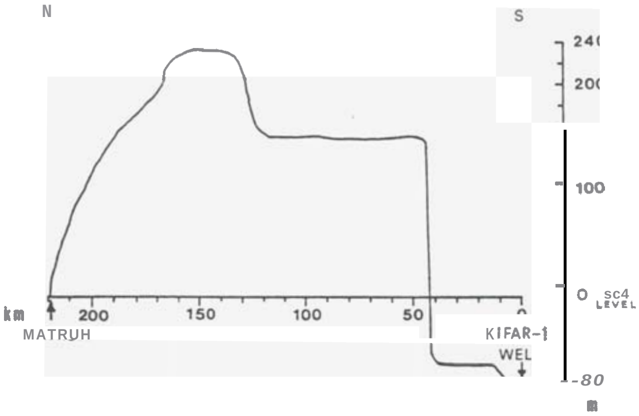

figure 4. Topographic profile passing by Kifar well and Matruh through the proposed track of pipeline (Fig. 3).

The difference between the ground level of Kifar well (-77 m) and the highest peak of the plateau is ~310 m. This difference requires at least 4 pumps to elevate water to that height. It is planned to lie tne pumps at Kifar site and at 40, 50, and 120 m from Kifar. When vater reaches the highest peak, it will later flow by gravity.

GEOTHERMAL ENERGY/ELECTRICITY CONVERSION

Electricity required to drive pumps in this remote area is proposed to be supplied from geothermal power plant to be established at Kifar well using a binary cycle turbine. The proposed pilot plant with a single stage binary process is schematically shown in Fig. 5. Efficiency can be increased if more than a single stage is applied. Ammonia is proposed to be used as an operating medium because of its superior thermodynamic properties, its thermal conductivity and very low boiling point (-33.5 °C).

Condensation of ammonia depends on the prevailing air temperature at the site. Based on the air temperature of the surrounding regions, because of the absence of meteorological station at Kifar, tne air in average a maximum of 35 °C by day time and a minimum of 20 °C by night during summer and a maximum of 17 °C by day time and a minimum of 10 °C and lower by night during winter. Maximum efficiency of electrical generation could be therefore obtained by night particularly during winter. The difference in temperature of the discharged water from Kifar and air temperature by night reaches 47 °C in winter and 37 °C in summer. It is therefore preferable to operate the geothermal power plant by night. During the first year of operation, it is advisable to keep the turbine working only for few hours by night to give a chance for the aquifer water temperature to be in equilibrium with the formation temperature at depth and ensure almost no drop of thermal water temperature. Continuous water flow for 8 years (1975-1982, 1987-1988) when the well head was damaged (GPC, 1982, 198.) causes a temperature drop of 8 °C (65-57 °C), i.e. a drop of 1 °C/year. Test for a continuous flow for few hours can be made during the first month of operation in order to determine the optimum time for a continuous flow without any noticeable temperature drop.

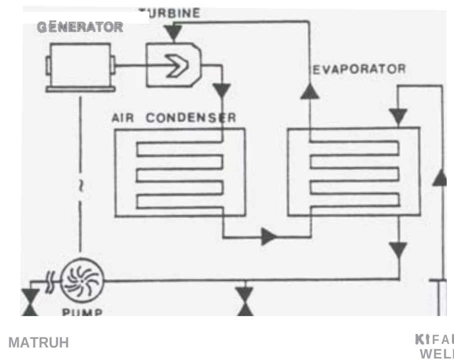

Figure 5. Schematic diagram of proposed geothermal power plant at Kifar well.

Water tanks filled fron pipeline whether at Matruh or at other places between Kifar and Matruh are supposed to be filled by night. If the water consumption exceeds the amount of stored water, operation of the geothermal plant can be further extended for some fen hours in the morning, depending on the amount needed.

The electrical power expected to be generated may exceed 100 kW in summer and 130 kW in winter. About 100 kW will be needed for pumping up water to the top of the plateau.

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