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GEOTHERMAL RESOURCES AND DEVELOPMENT IN IRAN

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ABSTRACT

Geothermal energy development program in Iran commenced in 1975 indicating substantial geothermal energy potential in the northern part of the country. The regions of Sabalan, Damavand, Maku-Khoy and Sahand were considered as the most promising prospects for power generation purposes. The program was temporarily terminated in 1983 and resumed with definition of more extensive and comprehensive exploration studies in 1995 focusing precisely in the most promising region in NW Iran, Sabalan region, with the objective of development of the first geothermal power station. At the same time new attempt was taken for geothermal resource mapping in other part of the country. Currently, in addition to development program of 55 MWe geothermal power project in the Sabalan region, a number of other programs are being considered for developing direct use application of the nationwide geothermal resources such as development of 105 MWt direct use of geothermal energy in the form of several tourist attraction resorts and also geothermal heat pumps application.

INTRODUCTION

Geothermal energy interest in Iran was originated based on a visit to Iran made by an UN expert in 1974. This was followed by a contract agreement in 1975 between Iranian MOE (as client) and joint consortium of Iranian Tehran-Berkeley and Italian ENEL (as consultant) for further investigation. Preliminary surface investigation and studies had been carried out in northern part of the country covering an area of 260,000 km2. As a result, four quaternary volcanic centers were selected for further detailed exploration studies. Geo-scientific studies of regional scale were conducted in the selected regions with total area of 30,000 km2. Final reports of the regional investigations were delivered to MOE during 1980-1983 based on which priorities were given to the areas of Sabalan, Damavand, Khoy-Maku and Sahand respectively (Figure 1). The Iranian MOE intends to develop its first geothermal power project in the Sabalan area and therefore, has put particular interest in fulfillment of the exploration activities in this region. Comprehensive detailed surface and deep drilling exploration program have been implemented in Sabalan area during 1998-2004 and presence of substantial geothermal energy potential has been approved according to the compiled geo-scientific data and resource assessment study. Several other attempts have been carried out by MOE for developing direct use of geothermal energy with particular emphasis on tourist attraction resorts, geothermal heat pump and greenhouse heating. The government is carrying out resource study and some pilot project with the aim of clearing the ground for private sector to come forward and invest effectively with more confident.

Figure 1. Geothermal Resource Areas (North of Iran), mapped in 1980

GOTHERMAL PROJECTS

1- Resource mapping and data gathering

In addition to previously recognized four geothermal resources in the northern part of the country in the nineteen eighties, a new attempt was taken for discovering more geothermal resources in other parts of the country at reconnaissance stage in 1997/1998. As a result, ten new promising areas had been indicated with resource temperature ranging from 120 to 250 degree C based on application of different geo-thermometers on existing surface thermal springs (Figure 2).

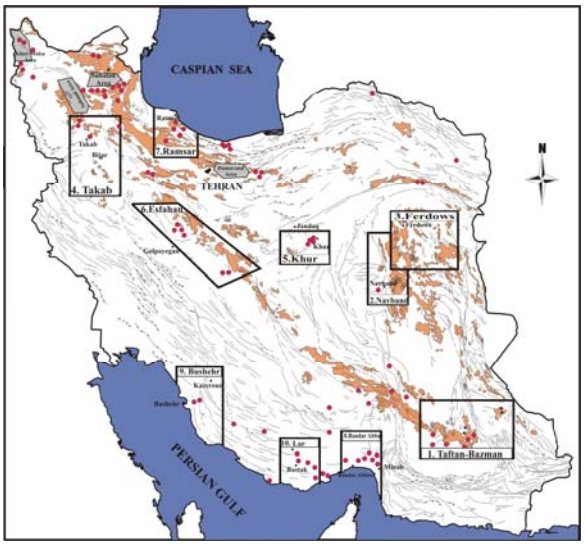

Figure 2. Geothermal Resource Areas, mapped in 1998

Different application of the new recognized areas are to be decided after conducting a series of more detailed geo-scientific works.

2- Power Generation

2-1 Sabalan Project

After some initial interest in the nineteen seventies in the development potential of geothermal resources in north of Iran, a series of progressively more detailed investigations have been undertaken into the geothermal potential of the Sabalan area in NW Iran. The work was undertaken in two separate stages since 1998. Stage 1 includes a review of previously collected field data, re-sampling and analysis of surface thermal features, a detailed MT geophysics survey, detailed geological mapping and integrating all geo-scientific data to produce a pre-drilling exploration model. Stage 2 includes a three deep well exploration drilling and testing program in harsh weather condition (Figure 3).

Figure 3. Exploration Deep Drilling (well NWS-1)

The wells drilled during 2003/2004 and vary in depth from 2265m to 3197m. Two of the wells were successfully discharged hot fluid with enthalpies in the range of 950 to 1000 kJ/kg (Figure 4). A preliminary resource assessment confirms the presence of a geothermal resource with temperatures within the drilled area up to 250^{o}C and with at least 5km^2 of proven commercially exploitable resource and possible expansion over a likely resource area of 19km^2. A first stage geothermal power development of 55MWe has been committed for commissioning by the end of 2010 according to an engineering feasibility study conducted for assessing possible development options for the field. This will be the first geothermal power development in both Iran and the Middle East. The plan includes drilling more 20 wells (delineation, production, and re-injection) as well as plant construction with allocated total fund of approximately 100 million EURO.

Figure 4. Discharge test (well NWS-4)

2-2 Damavand Project:

This project is considered as the second development plan for electricity generation of about 50MWe. Damavand geothermal area is located 100km to the northeast of capital (Tehran) and considered to be viable for power generation. The project has been completed at initial assessment stage and will be advanced with next stages of comprehensive exploration studies in the form of designated framework of the fifth five years development program of the country which requires 20 million EURO of fund.

3- Direct Use

3-1 Geothermal Heat Pump (GHP):

Temperature and humidity are high in southern part of the country during hot season from May to the end of October. Air to air conventional heat pumps are widely used for cooling purposes in the regions that consume considerable amount of electricity. This imposes heavy and full time load over the operating

power stations causing more consumption of fossil fuel and therefore more emission to environment. For controlling the issues, utilization of geothermal heat pumps is an important option for replacing conventional methods of cooling systems. Five geothermal heat pump units with total capacity of 26kW have been installed in five locations with different climatic condition (Figure 5). The result shows that application of geothermal heat pumps (cooling mode) can reduce 60% of the power consumption in comparison to the conventional cooling systems. Annually 200,000 conventional heat pumps are installed throughout the country. The average power consumption of each unit is 2500 watt. Replacement of 100,000 conventional units with the geothermal heat pumps equals to generated electricity from a 130MWe power station. Development of 1000 geothermal heat pump units, equal to 5MW in total, were targeted for the next five years which will also clear the ground for localizing the technology and encourage the private sector for investment. Capital investment of 35 million EURO has been estimated for implementing this project.

Figure 5. GHP with slink loop installed in 2007 (Bandar-Abbas)

3-2 Balneology/Swimming:

Currently, nationwide scattered surface thermal springs with temperature ranging from 30 to 85^{o}C are traditionally used for balneology/swimming purposes in the form of several tourist attraction resorts with annual energy usage of 800TJ through nearly 35MWt total installed facilities. Furthermore, a master plan is being prepared for further development of 100MWt various direct use facilities using separated geothermal brine from the previously mentioned power project in Sabalan area. Beside, a new research project is currently conducted for providing required heat for a greenhouse complex in Mahallat area, central Iran by using local thermal springs. Total investment of 50 million EURO is estimated to be required for further development of 100MWt direct use applications of geothermal energy with the objective of focusing on greenhouse heating and tourist resorts.

CONCLUSION

Based on existing geo-scientific data and evidences, Iran has substantial geothermal energy resources in 14 grater regions distributed throughout the country. The government of the Islamic Republic of Iran firmly intends to play an important role in developing nationwide renewable energy sources and more specifically geothermal energy where it is applicable. This will ensure the significant role which renewable energy and more importantly geothermal resources may perform in sustainable development of the country and offer a remarkable contribution to the local economy in near future. A number of national geothermal projects are currently being rendered by the government for power generation and direct utilization of geothermal energy purposes.

At the same time, the government of Iran, by investing nearly 200 million EURO and running pilot projects and feasibility studies, intends to prepare ground for private sector to invest confidently in the field of geothermal energy which is a key factor in making geothermal energy competitive in the local energy market as well as bring about innovation, creativity and dynamism to the local industries.

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