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Salihli (Manisa) Integrated Geothermal System

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ABSTRACT

Thoughts about utilization of the geothermal resources in Salihli area began in 1992 with drilling of 2 geothermal production wells by MTA General Directorate in Kursunlu geothermal field.

Salihli Geothermal Integrated System includes geothermal district heating, geothermal air-conditioning, balneological utilization, greenhouse heating and raisin production which will be explained in further details in this paper. Now, only the geothermal district heating system and balneological utilization is operational.

The geothermal field is at 3-4 km distance from the Salihli city center with a higher altitude of 100 m. geothermal fluid is carried to the heating centre located very near to the city center and transported back again to the geothermal field for reinjection.

1. INTRODUCTION

42 MWt (August 2004) capacity heat exchanger and pump group has been installed in the heating center of the system which is suitable for modular extension. Each modul (unit) has a power of 14 MWt.

During 2003-2004 winter season 3000 residences equivalence geothermal district heating has been operational (TGA, 2004). According to the further plans the installations and connection of the residences is continuing for the extension of the system. 4000 – 5000 residences heating is targeted for 2004 –2005 winter season.

2. GEOTHERMAL FIELD

The potential geothermal production area has been estimated as 20 km^2 according to the geological, hydro-geological, geophysical and geochemical properties of the geothermal field. This area is composed of Caferbeyli geothermal field and Yılmazköy vicinity.

The reservoir rocks are metamorphic quartz-schist and marbles with widening to a large area with suitable tectonic and feeding conditions for a good geothermal potential.

The down hole temperature has been measured as 94-96 ^{o} C in the existing 7 geothermal production wells. The produced geothermal water from the 4 wells is used for geothermal district heating and the production of 1 well only for balneological purposes. In Figure 1, Salihli K-5 geothermal well is shown. There exists also one reinjection well in the field. Existing geothermal wells are shown in Table 1.

For the extension of the total capacity of the integrated geothermal system, total 15 production wells with a varying depth of 300 – 1100 m, and 5 reinjection wells with an average depth of 300 m are planned to be drilled in Kursunlu and Caferbeyli geothermal fields.

Studies in order to investigate second and third reservoir and deeper production wells at the Kurşunlu Geothermal Field, drilling of an exploration well, whose depth is 1500±250 meters will be started in 2005.

Table 1: Existing geothermal wells in Salihli Geothermal Field

Well No	Date of Drilling	Well Depth	Production Temp. (°C)	Production Flowrate (Lt/sec)	Explanation
K-1	1976	44	87	-	Reinjection
K-2	1992	70	94	25	With Pump
K-3	1992	114	96	30	With Pump
K-4	1996	262	57	40	With Pump
K-5	1997	115	95	30	With Pump
K-6	2003	178	70	2	-
K-7	2003	158	100	25	With Pump

Figure 1: Salihli K-5 Geothermal Well

3. SALIHLI INTEGRATED GEOTHERMAL SYSTEM

3.1 Geothermal District Heating and Air-Conditioning

Geothermal district heating system has an installed capacity of 24.000 residences equivalence. Now, 3000 residences equivalence are heated geothermally in Salihli City. The extension of the system is continuing by connecting residences to the system (ORME, 2000). The feasibility report of this investment has been prepared in October 2000 by ORME Jeotermal Inc.. This was followed by the

application project. The construction is undertaken by the Salihli Municipality. ORME Geothermal fulfilles the consultancy services of this investment.

Beside of heating, 2000 residences cooling (air-conditioning) and domestic hot water supply will be included in the Salihli Geothermal Integrated System Project. Moreover, studies for geothermal air-conditioning of a hospital with a capacity of 120 residences equivalence are continuing. This air-conditioning system has a capacity of 800 kW and will start-up in 2005.

3.2 Balneological Utilization

Balneological utilization in Salihli geothermal field refers to many decades. Previously it was in the form of primitive utilization, but now Apart houses with 270 bed capacity and two thermal pools. 300-400 people in average make use of this facility per day during the year.

Additional to the existing spa utilization in Kursunlu geothermal field, a big thermal facility complex (aqua parks, curing centers etc.) is planned to be build as an integration to the system.

3.3 Greenhouse Heating

Due to;

- the existence of suitable land area for greenhouse construction
- the convenient outside temperature and other meteorological conditions
- the progress obtained in agriculture in Salihli region, 240.000 m^2 greenhouse heating application will be integrated to the system.

3.4 Raisin Production

In Salihli and its vicinity, grape raising is very popular and developed. Raisins are produced and exported in this area which constitutes one of the main commercial occupations. Drying of the grapes are made under the sun naturally as the existing situation. Whereas great areas are required for this purpose and carries limited quality conditions. Also, raisin production is taken into account in Salihli Geothermal Integrated Project and 175,200 tons/year capacity (25000 kW heat power) geothermally dried raisin production will be integrated to the system.

The general technical data of the Salihli Geothermal Integrated Sytem is as follows:

- District Heating installed capacity : 139.400 kW
- Geothermal : 121.400 kW
- Cooling installed capacity : 16.800 kW
- completely with geothermal
- Grape Drying 25.000kW completely with geothermal
- Greenhouse Heating 37.584kW, 240.000 m^2 completely with geothermal
- Peak geothermal fluid demand : 600 kg/sec

In the feasibility study, a fuel-oil running peaking is included in the system. But, a peaking system is not operating now, it is planned that it will be operational after 10,000 residence equivalence capacity have been reached.

4. TECHNICAL PROPERTIES

4.1 Heating Centers (20.000/24.000 R.E)

Geothermal part of heating center is designed for 0^oC outside temperature. The installed capacity of geothermal part of the heating center will be 121.150 kW.

District Heating Center consists of;

- Pumps for geothermal water
- Circulation pumps
- Frequency converters
- Heat Exchangers
- Boilers
- Hydraulic Balance tanks and Pressure control systems
- Water treatment systems
- Water storage tanks
- Transformer
- Electrical installations
- Automatic control systems and equipments

4.2 City Distribution Network (20.000/24.000 R.E)

Heated hot clean water by geothermal water in the District Heating Center is supplied to the residences by means of pre-insulated pipes. After utilized in the residences as heating and sanitary hot water, the clean water will return to the District Heating Center.

City distribution network will be closed cycle and the flow rate in the network will be variable according to the heat demand of the consumers (Figure 2).

Figure 2 : Salihli City Distribution Network

4.3 Adaptations and Installations in the Buildings

For the connection of a building to the district heating system, the building should have a radiator system. In order to get sanitary hot water from the district heating system there should be a hot water preparation system consisting of water tanks, heat exchangers and related equipments and

these are added to the total cost of the Geothermal District Heating investment. Central heating installation of buildings, radiators, heating system from floor and hot water pipes cost is not added to the geothermal district heating system investment amount.

The installations in the buildings directly affect the operating conditions of the district heating system and designer firm should control system during construction. The firms that will make the installations should be educated and controlled by other related sides.

5. ECONOMY

The total investment amount of Salihli Integrated Geothermal System is 35 Million US$. Pay-back period of this investment is 7,4 years.

The heating and hot tap water supply fee paid by the residences (based on 100 m^2 area) to the Salihli Municipality is 17 US$ (1US$ = 1,500,000.-TL, August 2004) per month for 2003-2004 winter season.

6. CONCLUSION

Salihli geothermal field is very suitable for the development and extension of the Salihli Geothermal Integrated System.

By drilling new geothermal production and reinjection wells with suitable depths, the system can be enhanced easily.

Thanks to deep drilling and deep reservoir investigation, the implementation of geothermal district heating project of Salihli would be accelerated considerably. Additionally, by heating 20000 residences geothermally, 46,066 tons fuel oil would be saved and annually 142,539 tons of CO_2 emission would be decreased as well.

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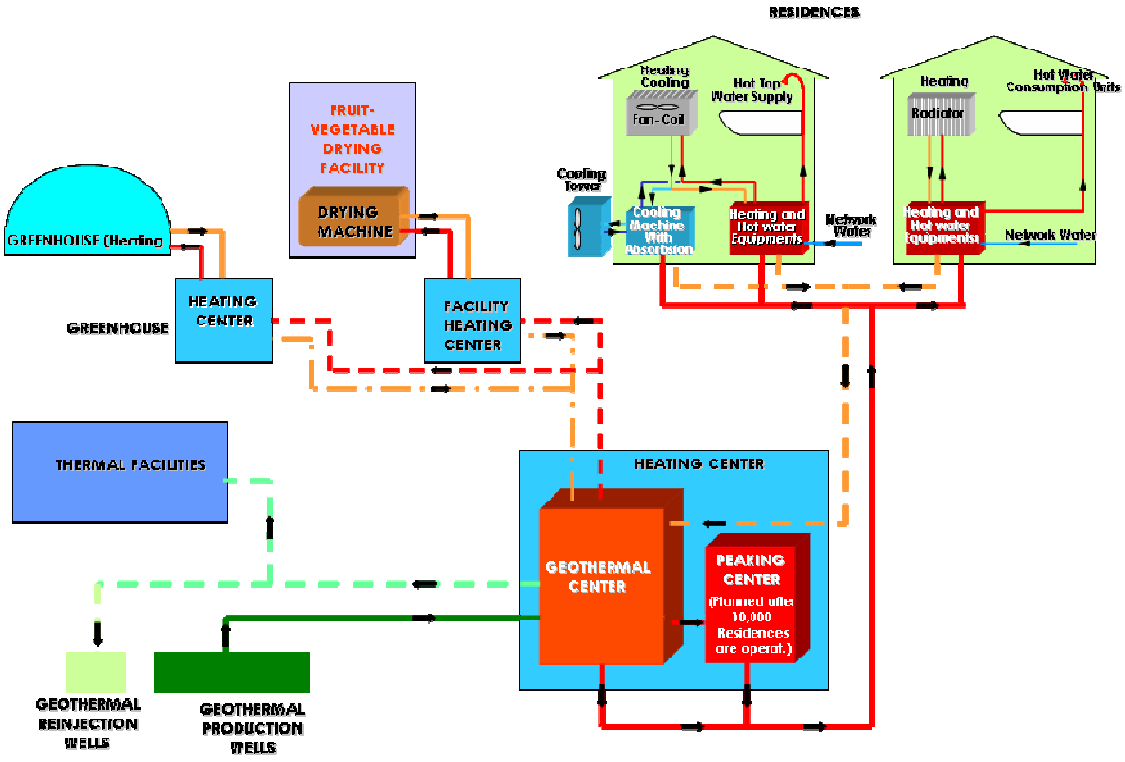

Figure 3: Flowchart of Salihli Geothermal Integrated System