THE PRESENT STATUS OF GEOTHERMAL ENERGY UTILIZATION IN GEORGIA

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Key Words: Geothermal Circulating Systen, Projects, Economics, Georgia

ABSTRACT

Due to economic crisis nowadays all geothermal activity has come to a standstill. Many promising projacts have been developed. They can be accomplished in several years provided financing is sufficient.

INTRODUCTION

In the territory of Georgia the explored reserves of thermal waters as by 1990 reached 100 thousand cu m per day. Their temperature ranges between 35 and 108°C and the heat energy exceeds 8 thousand G cal/day, accounting for 0.5 million tons of conventional fuel (TCF) a year (Buachidze, 1995). Further investigations involving increases of production, especially through the creation of geothermal circulating systems (GCS), will provide for the release of about 2 milion TCF out of this thermal-energetical complex (Buachidze et a., 1980).

By their use for technological Purposes (papermaking, wool manufacture, tea and canning factories) in West Georgia, thermal waters perform a significant role both for communal service (heating and hot-water supply) and farm development (soil protection, poultry plants and farms, citric plantations). Current problems include scaling and the presence of hydrogen sulphide within the thermal waters. These have been, however, successfully solved by our specialists with their proposed method tested on a production scale. Almost all of these thermal systems are located in West Georgia; nowadays they are not functional and badly need restoration.

WEST GEORGIA

In situ studies have included: injection in changeable regimes, influence of pumping on the field, alteration of physical-chemical conditions of thermal water, water-rock interaction.

Best Results:

Bield Kindghi -
- Transmissivity - 40 m^2/day
- Permeability - 250-925 mDarcy
- Injection rate - 1000-2500 cu m/day with draw-down 1.3-10.6 kg/sq cm and 50 m interval gives coefficient of injectivity P=20-50 cu m/day.m

Bield Zugdidi-Tsaishi -
- Transmissivity - 400-500 m^2/day with draw-down less than 1 kg/sq cm P=200-300 cu m/day.m (Injection at zero well pressure or gravitational injection)

Field Tbilisi -
- Transmissivity - 100-150 m^2/day
- Permeability - 200-300 mDarcy
- Injection rate - 2000 cu m/day P=40-50 cu m/day.m.

And it is quite natural, because the most significant fields - Kindghi-Okhurei and Zugdidi-Tsaishi - are located in West Georgia. As an example we present the scheme of Kindghi field exploitation with application of a geothermal circulating system (GCS) (Fig. 1).

EAST GEORGIA. TBILISI-LISSI GCS

This GCS is sutuated in the west surburb of Tbiisi being confined to Paleogene (and Cretaceous) deposits of the ddjara-Trialety folded zone (Fig. 2). Intensely circulating underground waters are tapped by the wells at the depth of 1.8-2.8 km and flow amounts to 2-4 thousand cu m/day, and as hot as 62-70°C (Buachidze, 1993).

The available wells have proved to interfere with each other, thus providing for the possibility of creating a GCS at this site for increasing the Earth heat utilization rate (Buachidze et al., 1994).

Submersible pumps should be installed in the production wells. Since the existing wells allow use of pumps with diameters below 200 mm and productivity below 3.600 cu m/day, we can appoint three wells (Nos 5, 7, 8) with a total yield of 10.800 cu m/day.

Wells No 1 and No 9 located 1.5 km from the production wells are intended for use as injectiun wells. It should be noted that of all the wells only No 9 needs some restoration work.

Thus, a GCS conventionally called 'Contour. One' is to be created within the Middle Eocene deposits. Its productivity is 10.800 cu m/day or 450 cu m/hr, with water temperatures of 62°C accounting for the local heat reserve of 27.9 G cal/hr.

To assure efficient use of these reserves it is proposed to set up a geothermai heat plant (GHP-I) at the site adjoining well No 5 (Fig. 3).

Operation of the GBP involves the following principle: the thermal water yielded by the three production wells is supplied by the

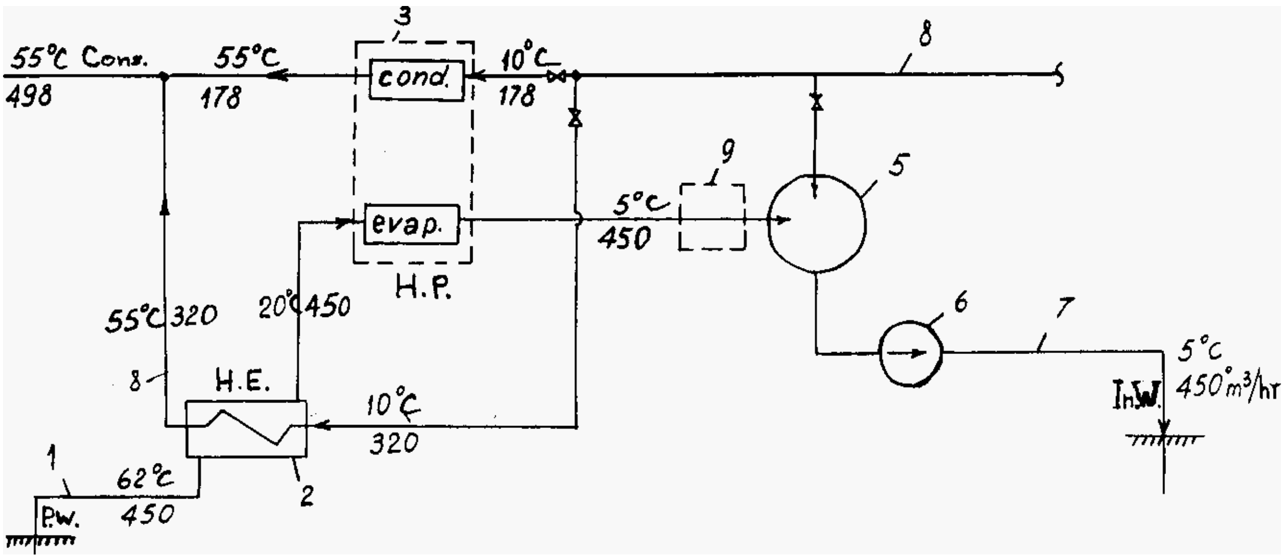

Figure 3. Scheme or Geothermal Heat Plant (GHP)

Table 1. Total Data on Technical and Economical Substantiation for Efficient Utilization of Tbilisi Thermal Waters

Indices	Unit of measurement	Total for the field	including				
			Lissi		Saburtalo District Heating Station (DHS) W No 4-T	Vedzissi District Heating Station (DHS) W No 1-C	Vashlidjvari District Heating Station (DE) W No 6-T
			GCS, Contour I	GCS, Contour II			
Circulating water yield (temperature)	cu m/hr (°C)	900	450 (62	450 (110)	-	-	-
Expected discharge of wells	cu m/hr	-	-	-	100	90	30
Annual output of heat	thousand G cal	567	188.0	245	54	50	30
Amount of the released fuel	thousand TCF/year	113.4	37.6	49.0	10.7	10	6
Granted capital outlays	million $	8.12	1.70	5.50	0.31	0.32	0.30
Heat prime cost	$/G cal	a/v) 2.34	2.28	2.50	1.87	2.0	4.24
Self-repayment term	year	2.26	0.93	2.26	0.57	0.6	1.93

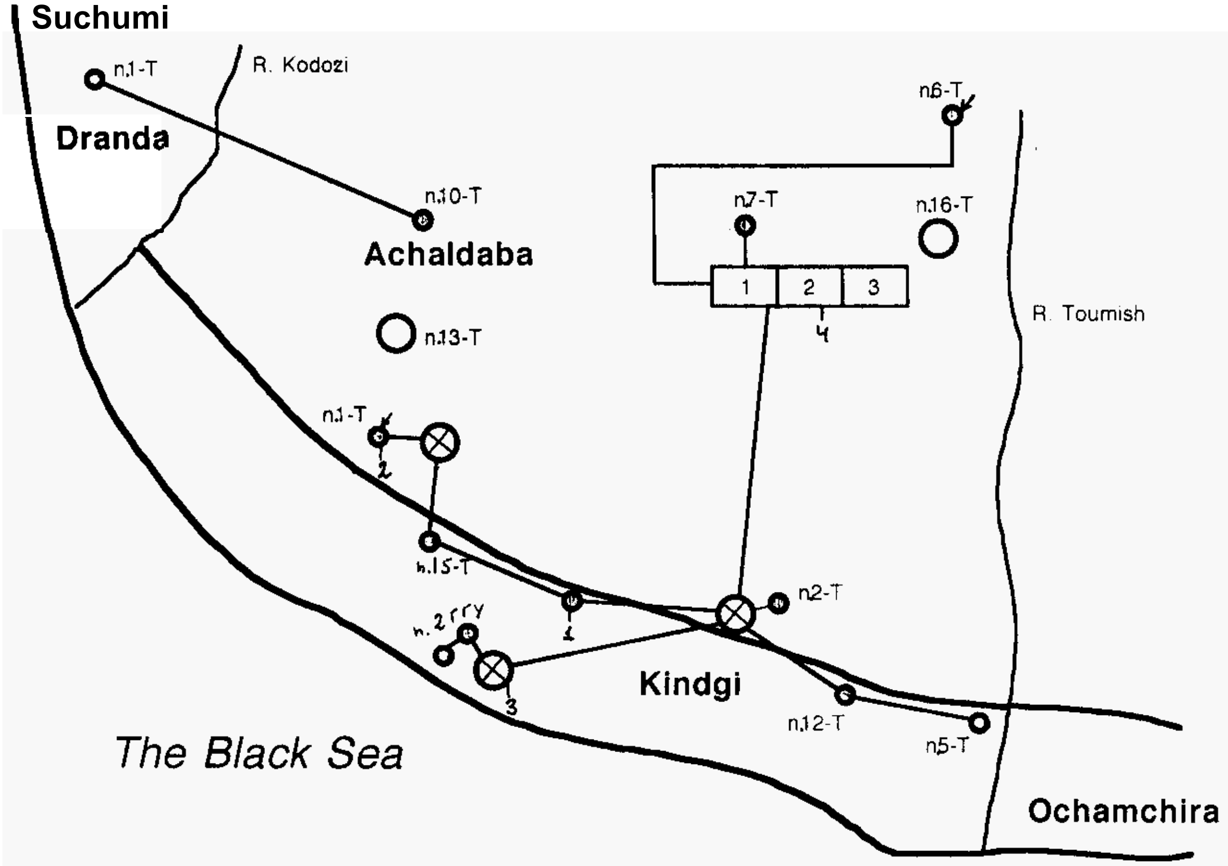

Figure 1. Scheme of Kindgi Field.
1 - production wells, 2 - injection wells,
3 - Geothermal heat station, 4 - consumer.

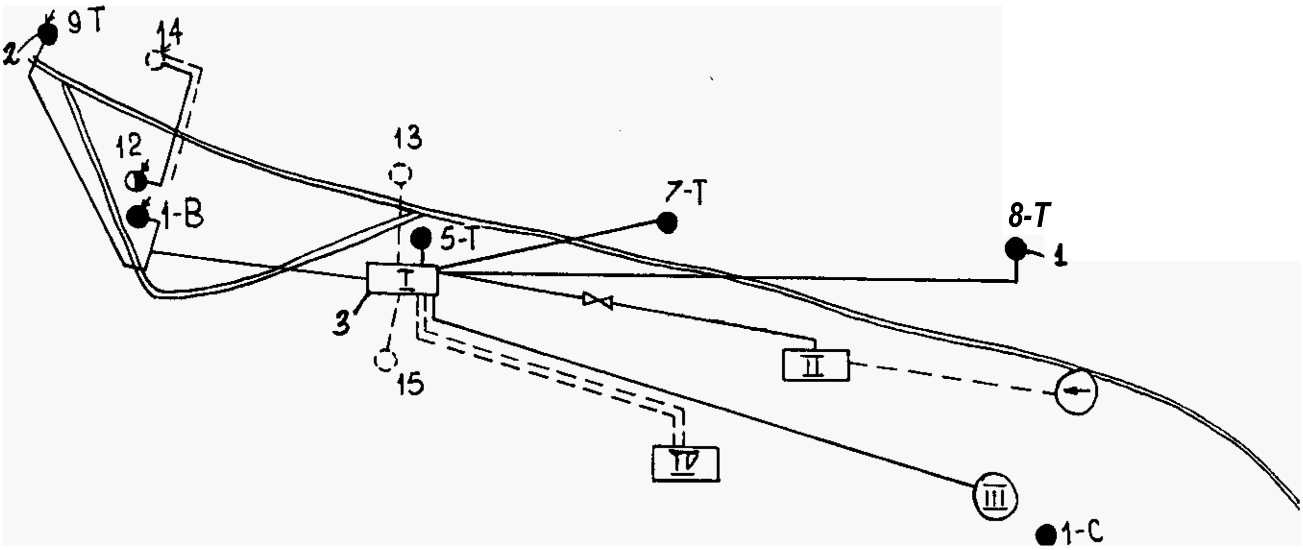

Figure 2. Scheme of Lissi Field.
1 - production wells, 2-injection wells,
3 - Geothermal heat station, 4 - consumer

pipeline (1) to the intermediate heat-exchanger (2), wherein it transfers the major part of the heat energy to the secondary contour tap-water (8), heating 320 cu m/hr of it up to 55°C while getting itself as cool as 20°C. Then it is pumped to the heat transformer (heat pump) (3), wherein it cools even more - down to 5°C. The produced heat is quite sufficient for warming additional quantity (178 cu m/hr) of the tap-water up to 55°C. The total amount (320 + 178 = 498 cu m/hr) of the secondary contour water is pumped by tile available pipeline (4) into the hot-water supply system to consumers of the city. The cooled (to 5°C) water having passed the heat transformer is then collected within a pool (5) to be afterward:, delivered by centrifugal pumps (6) and through the pipeline (7) to be reinjected into wells No 1 and No 9.

If admitting 100 l/day of hot water to be a standard consumption rate, then 140 thousand people, or about 36 thousand €amilies will be provided with sufficient amount of hot water.

Actual heat utilization rate for the Contour One will account for 22.5 G cal/hr, this increasing tile coefficient of geothermal heat usilization up to 80%(rather a high index).

It should be mentioned that the cooled water stored in the pool (5) might be used for air conditioning in summer time. For this purpose it should pass the 'water-air' exchanger (9) and then ventilate the buildings. Slightly warmed water will be pumped into the wells.

At present at Lisai field well No 12 is being drilled aiming at tapping the waters of the Upper Cretaceous anuifer. The design depth reaches 4.5 km while the predicted temperature exceeds 100°C. If these works are accomplished successfully it will be necessary to drill three more analogous wells - Nos 13, 14 and 15 (see the scheme) which will provide 'Contour Two' through two pairs of wells: No 13 and No 15 (producing ones), No 12 and No 14 (reinjection ones). The capacity of the system is conventionally 10 thousand cu m/day. The initial high temperature of the thermal water with its heat output of about 25 G cal/hr will allow us to heat a construction as large as 1 million cu m, or 50-60 multistory dwelling buildings.

In Tbilisi the cold season lasts €or 152 days. During this period the water with a temperature of 50-60°C from the heat supply system will feed the hot-water system. During the other 7 months the reserves will be completely used for hot-water supply adequate to the requirement of more than 140 thousand people. Thus, the heat yielded by this water (14 thousand cu m/day, t=55°C) will account for 32 G cal/hr.

Construction of Contour One will cost 91.7 million, maintenance expences amounting to $4.28 million a year, yearly income - $2.58 million, i.e. self-repayment is to come in 0.93 year (Table 1). Development of the second contour within the Upper Cretaceous rock will be much more expensive - $5.5 million and self-repayment comes in 2.26 years. In ecology aspect this will effect a saving of 293 thousand dollars a year for the first contour and 330 thousand dollars for the second one.

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