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PROMISING UNDISCOVERED THERMAL WATERS POTENTIAL OF UKRAINE PLANNED FOR COMMERCIAL UTILIZATION

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ABSTRACT

Results of estimation of promising thermal waters potential for a number of regions of Ukraine suitable for future cogeneration plants exploitation is presented. The potential has been estimated using generalized method of boreholes for the condition of formational pressure maintained by reinjection. Heat capacity of the cogeneration plants was calculated. The estimated commercially viable geothermal resources of Ukraine are about 20-30 million cu.m/day of geothermal waters having temperature higher than 60°C. This makes it possible to build geothermal power installations with total capacity of more than 50 thous. MW.

1. The most urgent problem facing the fuel and energy complex of Ukraine is to boost the recovery of its own stored energy for the generation of heat and electricity. One way of doing this is the development of nontraditional energy sources among which a geothermalsystems are first in the line. The prospects for use of geothermal energy are not far conditioned by needs for heat and electricity in any region of this country in the first place but depend on the availability of thermal water reserves already prepared for commercial recovery. Unfortunately, at present the reserves of geothermal heat carriers on the territory of Ukraine have not yet been adequately studied, which makes the evaluation of evaluate the real exploitation potential impossible. So far the most prepared for commercial utilization in Ukraine are geothermal fields with the water temperature of up to 100°C. The operational reserves to a depth of 3500 m have been explored and evaluated by the Committee for Geology and Use of Mineral Resources of Ukraine as being able to supply thermal water at a rate of 27303 thous. m^3/day with makes realistic the devepment of geothermal heat supply systems with total capacity of 50 thous. MW. The mentioned reserves were estimated on the basis of exploration drilling on tae territory of Prichernomorsky (Odesky and Khersonsky regions, Autonomous Republic of Crimea) and Zakarpatsky (Zakarpatsky region) artesian basins for a spouting, pumping and circulation exploitation modes.

Among other promising regions of Ukraine sutable for commercial use of thermal waters as heat supply source special attention deserves Dneper-Donets depression (Czernigivsky, Poltavsky, Kharkivsky and Donetsky regions). Here in the process of drilling oil and gas exploration wells with depth of 5000 metres the pressure thermal aquifers having water temperature of 80°-100°C and even higher have been discovered as a welcome byproduct. The commercial exploitation of these aquifers in spouting, pumping and circuchtion modes seems to be highly possible.
The potential of high-themperature thermal heat carriers for generation of electricity in Ukraine has not yet been estimated. At the same time according to the results of testing several single wells the construction of geothermal power plants is may be possible in Zakarpatsky region (Zaluzh area: depth 4200 m, registered temperature 210°C), Kharkivsky region (Izjum, Spivakovsky areas: depth 3900 m, registered temperatures correspondingly 198°C and 174°C) and Autonomous Republic of Crimea (Tarkhancutsky and Kerchensky areas: depth 4000 m registered temperature is in excess of 200°C). Prediction estimates bring out the possibility of building geothermal power plants with a total capacity of 1000 MW in the above-listed areas.

It has been suggested to construct geothermal systems for heating residential, industrial and agricultural buildings and structures in these regions of Ukraine for the tapping and commercial use of already explored reserves of geothermal heat carriers with the temperatures of up to 100°C. An analysis of the potential consumers of thermal heat showed that these consumers are situated for the most part in the small settlements with heat demand of 0.5 MW -6.0 MW. For the rating of the economically attractive construction concepts of geothermal heating systems of the mentioned capacity the feasibility studies have been made assuming the following parameters: 1. Geothermal heating systems are constructed at the thermal water deposits under operating conditions with forced recovery of geothermal heat carrier. 2. The capacity of heat supply system being 1.5 MW; 3.6 MW; 6.0 MW. These capacity are achieved by a peak source (gas-fired boiler house) and a geothermal source. In this case 20% of the specified capacity is generated for hot water supply and 80% for heating. 3. A temperature interval of circulation water in the heat supply system is taken to be from 95°C to 70°C. 4. The temperature of geothermal heat-carrier at the mouth of producing wells is: 60°C, 70°C, 80°C, 90°C. 5. The mean distance from the producing well to the boiler-house and geothermal heat exchangers is 400 m. 6. The static level of the thermal waters in the producing wells is located at 10 m below the earth surface. 7. The standard heat exchanging and pumping equipment made in Ukraine is used in the construction of geothermal heating systems. 8. The flow dattern of the heat supply systems considered here is as follows: geothermal heat-carrier upflows via the production wells to the geothermal heat-exchangers, transfers its heat to the circulation water in the heaters and returns to the underground reservoir via the injection wells.

For the parameters and the circut specified above the following values are calculated: 1. The amount of annual heat consumption for a heat supply systems under variety of heat loads. 2. Electric power consumption for the production,

pumping and disposal of geothermal heat-carrier. 3. Number of producing and injection wells. 4. Heat exchange area of geothermal heat-exchangers.

A total of 12 versions of the geothermal projects that differ in the heat capacity of heat-supply system and in the temperature of thermal waters have been analyzed. As a result the basic equipment and materials necessary for the realization of considered projects of geothermal heating systems have been selected.

On the basis of the selected equipment and materials the capital investments and operating costs for the construction and exploitation of geothermal heat supply systems have been evaluated.

Using the calculated data of the capital investments and operating costs the money flow and economic indices of the construction concepts of geothermal heating systems were determined. The calculations of current costs and economic indices were performed under the following assumptions: 1. The duration of geothermal heating system construction is one year. Within the limits of this period the invested costs do not depreciate. 2. The selling price of 1 MWh of heat is equal to current tariff in Ukraine and comprises 18.62 USD. 3. Profits tax is 30%. 4. Inflation of USD comprises 0.5% a year. 5. The projects are financed as investment ones. 6. Discount rate is 10%.

From the analysis of money flow and economic indices calculations for considered construction projects it follows that:

1. Specific investments required for the construction of geothermal heating systems nith the capacities of 1.2 MW - 6.0 MW vary from 270 USD to 700 USD for 1 kW of installed power, including the expenditures on the construction of wells, surface facilities and peak-load boiler houses. The amount of specific investments decreases as the capacity of heat supply system and the temperature of thermal waters increase. In this case, when the capacity increases five-fold the specific investments drop 3 times, but if the thermal waters temperature increases from 60°C to 90°C only a 5% reduction in specific investments is achieved.

2. The production cost of heat generated by a geothermal heating systems with the capacities ranging from 1.2 MW to 6.0 MW varies from 16.0 USD to 26.0 USD per 1 MWh, including the expenditures for maintenance of peak-load boiler houses and geothermal complex, expenditures for electric power, fuel for peak-load boiler houses, wages, depreciation. As the capacity of geothermal heating systems is under 3,6 MW the production cost of generated heat is above the tariff set up in Ukraine. Rise of in temperature of thermal waters from 60°C to 90°C brings down the output cost price by 20%.

3. Under the current heat tariffs in Ukraine the investing of building and operation projects of geothermal heating systems is economically attractive and profitable for the capacities higher than 6.0 MW and the thermal water temperatures exeeding 80°C. The net current cost for these projects comprises 11 thous. USD and more, internal rate of return is 10,24% and above, profitability index is 1,0147 and more, payback period does not exeed 8 year.

4. The discovered thermal waters reserves in Ukraine may be considered as its own energy source and their commercial use will make it possible not only to cut the import of expensive fossil fuel but to set up the production of cheap heat energy as well.