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REORGANIZATION OF THE INTEGRATED GEOTHERMAL PROJECT "BANSKO", MACEDONIA - TECHNICAL, LEGAL AND REGULATORY ASPECTS -

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ABSTRACT

Geothermal system "Bansko" is the system with the best annual heat loading factor in Macedonia. It is an excellent combination of heat consumers consisting greenhouse heating, space heating, sanitary warm water preparation, swimming pool heating and balneology of a spa and agricultural center. It is a good example how geothermal energy can be competitive to any other energy source when technically properly organized. However, unsolved legal aspects for the property of the energy source and for the rights of consumers for the way of use of the available thermal water flow resulted finally with a "total war" between them. System is destabilized and no one of the consumers is satisfied with the quality of covering its heat requirements.

Based on the experiences of the Kotchany geothermal integrated system in Macedonia and some other in Italy, France and U.S.A., a set of necessary technical, legal and regulatory measures to be taken by the state and local community is presented in the paper. That should resolve the present negative situation and improve possibilities for better technical efficiency and profitability of the system.

1. INTRODUCTION

Development of the integrated geothermal project "Bansko" began 25 years before, by the completion of the first geothermally heated glasshouse in the world (3,2 ha). Gradually, the project has been enlarged with the connection of a system of small soft plastics covered greenhouses, the hotel complex "Tsar Samuil" and, finally, the sanitary warm water preparation system of the hotel "Spiro Zakov" and two other rest houses. Ten years ago, it was a good example for a properly organized integrated geothermal project, using optimally the locally available alternative energy resource.

However, the process of proper exploitation and development has been disturbed with the political changes in the country. Previously state owned glasshouse and hotel complexes came into an undefined property position. Small farmers (owners of the complex of small soft plastics covered greenhouses) made a continual pressure to get their "rights" for the geothermal water exploitation. They began to use the water in an unproper way and previously accommodated water distribution has been destroyed. For already 6 years, the system doesn't work properly, as a consequence of their "war for water". Now, everybody is unsatisfied with the quantity and quality of energy, supplied to the users. Project doesn't work anymore as an organized system, with all the escorting negative aspects of it.

However, the process of stabilization of the new economy system in the country is going to the end now-a-days, and it is again becoming possible to organize the project in a correct, economically and technically feasible way. The results of a recently made study for reconstruction, recompletion and reorganization of the integrated project "Bansko" are presented in this paper.

2. GEOTHERMAL HEAT POTENTIAL OF THE RESOURCE

From the structural-tectonic aspect, the Strumica Valley and its borders belong to two tectonic units: Serbian/Macedonian Mass and Vardarian Zone. Its surface can be divided in four structural-geological units: Belasica horst, Ograzden batolit, Smrdea horst and Strumica graben. Base structures are also the deformations: Belasica, Bansko, Gabro, Ilovica, as are the hydrogeothermal changes in the Drvos-Çanakale zone, too.

The Strumica graben origins from the relative depression along the Belasica and Ograzden mountains during the time of Pliocene, The depth is still not precisely determined but according to the geophysical investigations, it can be supposed to be between 700 and 1,000 m.

Occurrence of thermal waters can be found in the village Bansko, where are a natural spring of 30-35 l/s and 72ºC and the borehole B1 with 55 l/s and 69.5ºC, plus several small flows of changeable capacities.

However, when estimation of the total heat potential of the hydrogeothermal flows is in question, it is necessary to underline the confirmed existing interactions between the borehole Bl, main natural thermal spring and the small springs. When the flow from B1 is over 40 l/s, the main one stops and the small springs disappear gradually. When B1 is closed, the main spring has rather continual flow (with small seasonal changes) and the changes of small springs are in known limits. According to the long years practice, the following design parameters can be taken as relevant:

- Natural "feeding of the reservoir 30 l/s
- Maximal continual flow of the

	main natural hot spring (if additional boreholes are closed)	35 l/s	72ºC
-	Maximally allowed flow from the borehole B1 (up to 12 h)	55 l/s	69.5ºC
-	Maximal allowed flow from the borehole B1	52 l/s	69.5ºC
-	Maximal allowed flow from the borehole B1 for continual exploitation	50 l/s	69.5ºC
-	Available flow from the small thermal springs	Chang.flows and temperat.	
-	Average recoverability of the field during the year	35 l/s	

Chemical structure of the water of the borehole B1 and the main natural spring is as follows: Na 210, K 8.5, Cl 20.5, B 0.37, F 5.9, Na/K 41.93, Na/Cl 15.8, Cl/B 16.89 and Cl/F 1.86. It is natrium-sulphate water, with a total mineralization of 1,157.2 mg/l. High concentration of B and F initiates that the water origin is from big depths.

If taking the temperature of effluent water of 25ºC as economically feasible for the existing composition of users, maximal geothermal heat power on disposal is 10,3 MW.

3. COMPOSITION OF THE INTEGRATED GEOTHERMAL PROJECT 'BANSKO'

Presently, the system is composed of the users, listed under points 1, 2 and 5 and of the Table 1. Composition of heat users for sanitary warm water preparation is in the item 3 (Table 1). The data about users under 5 are under question mark (changeable composition of small greenhouse units). Alltogather, that's about 7.5 MW design heat power of the heat consumers with different daily and annual characteristics. Main reason not to connect some other heat users has been the orientation to cover all the heat consumption over the year only with heat of geothermal origin (also the peak loadings).

According to the results of the feasibility studies made (Popovski et al, 1989), (Popovski, 1992) and (Popovski, Lund, 1999), it is technically possible and economically feasible to connect the heat users listed under 4, 6 and 7 by introducing a heat accummulator and activation of the already installed light oil boilers (in the hotel "Tsar Samuil") for covering the peak loadings during the cold winter mornings. In that way, the system shall be composed of heat users with a total design heat power of 7.8 MW. If market conditions for out-of-season vegetable improve, it shall be possible to reach even 9 MW (by connecting a larger number of small greenhouses, using the lower part of the temperature difference on disposal), which is very near to the maximal heat power on disposal.

As the existing one, new composition comprises geothermal heat use in cascades and, in that way, much better annual heat loading factor (Fig.3). If maximal allowed flow from the borehole B1 is 52 l/s, the diagram shows that with absolute accommodation to the changeable weather conditions and other requests of the heat users of the system "Bansko" and a 100% efficiency of the heating installations, it is possible to reach an annual heat loading factor of 0.37. However, due to the normal unprecise work of the automatics and the orientation towards maximization of the geothermal energy use, it is in reality 0.44. That is a very high value of the annual heat loading factor for applied types of the heat users and local climate conditions, enabling very competitive price of the supplied heat energy. Practically, at least in Macedonia, there is no other energy source or heating technics which can offer lower energy price.

4. TECHNICAL PROBLEMS FOR PROPER EXPLOITATION OF THE INTEGRATED SYSTEM

The problems of technical nature for proper exploitation of the presently completed integrated geothermal system "Bansko" can be summarized in two groups:

4.1. Regime of the Heat Supply

Quality of the regime of the heat supply depends on:

- Quality of the central heat distribution station completion;
- Quality of the design and completion of the pipe distribution system;
- Quality of the design, completion and exploitation of the automatic equipment for regulation of the heat supply to each one of the consumers; and
- Quality of the design and completion of the equipment for covering the peak heat requirements.

Presently, and as a consequence of the influencing factors during the initial development period, the system doesn't consist a technically proper completion of any one of the listed factors. Regulation of the water supply from the central pump station goes manually. That is not an one pipe distribution system but a complete of three separate main lines, dimensioned for the water flows under the design climate conditions. Except in the hotels (partially), there is no automatic systems for regulation of the heat supply to the consumers. Finally, even installed, the peak loading boilers in the hotels are not in use, and there is no equipment for covering the peak loadings of the other heat users.

As result of the above listed, a proper and stabile work of the distribution system has been possible before only by introduction of a strong exploitation discipline (which doesn't exist anymore). That is the reason why the introduction of the central distribution pumps with variable capacity is recommended, introduction of a water heat accumulator, activation of the installed peak loading boilers, and installation of the automatic regulation completes for heat supply for each one of the heat users.

4.2. Design and Completion of the Heating Systems of connected Users

Quality of a proper heat supply to the consumers depends also on the quality of the design, completion, maintenance and exploitation of the applied heating systems.

Presently, it is possible to say that only the systems in both hotels are technically properly designed and completed. The other ones are designed and completed by nonprofessionals and are full with mistakes and wrong technical solutions. Proper maintenance has been abandoned during the recent 6 years in all the projects.

As a consequence of the above listed foundlings, the quality of

heating is of doubtful quality in all the projects during the recent years. That is the reason that reconstruction and recompletion of all the heating systems is proposed according to the results of all the studies made, in order to reach a stabile, high quality and economical heating of all the connected geothermal heat users.

5. PROBLEMS OF THE UNDEFINED LEGAL ASPECTS

Previously, all the heat users except the small farmers, have been "publicly owned" and it was possible to define the rights and responsibilities of the heat users. In that way, also governing and financing the work of the system could and have been organized and managed.

Presently, the geothermal heat source and the common elements of the integrated project (well, central station, distribution pipes, etc.) belongs to nobody, and nobody is responsible for its proper maintenance and exploitation. The well is over-pumped continually during the winter months because everybody has "undoubtfull" needs and has "older" rights than the others for the free of charge energy use. Practically, there is a kind of "war for water" in the system with all the escorting problems, i.e. stealing the water from each other (when other ones are not present at the site), continual arguing and fights between the users, a list of intepelations to the local court, etc., etc.

Even the new legal system of the country is still not properly completed, it is obvious that some legal aspects influence crucially the organization, exploitation and economy of the work of the integrated geothermal system "Bansko". The last study located the main problems in:

- Absolute need for definition of the ownership (or the right for exploitation) for the geothermal energy source;
- Location of the ownership, rights and obligations for the common parts of the integrated geothermal system;
- Introduction of the right of the owner (or the one who has right for exploitation) of the system for conditioning the minimal technical completion and quality of heating systems of the users, connected to the integrated system; and
- Introduction of the right to price the used energy. It is recommended to use a system of pricing which stimulates the use of lower part of the temperature difference on disposal in order to improve the total efficiency of the integrated geothermal system. However, the energy should not be free of charge in any case! It's another question that the possible profit can (and should) be limited and further development of the system stimulated.

Some of the above listed aspects are of legislative nature and should be resolved by the state (ownership, right to "sell" the energy, pricing the supplied energy, etc.), some are of organizational nature (definition of inter-relations between the heat supplier and users, responsibility for minimal technical completion of the users installations, division of responsibilities for maintenance the "common" and "user's" parts of the system, etc.), and finally, some of them are of a purely technical nature (definition of the design of connecting "stations" of the users, completion of the central regulation station with pumps equipped with variators for regulation of the water flow, recompletion of the distribution system and heating installations of the users, etc.).

According to the present activities of the government, the legal aspects are going to be resolved until the end of the year 2000. Several new laws shall enable proper solutions for of all the listed problems. However, without a final solution for the privatization of the geothermal system and projects of users, it is not possible to resolve the organizational problems, i.e. there is no possibility to define any effective organization of the exploitation, maintenance and development of the integrated project, composed of different heat users, with different daily and annual heat loading factors. Finally, without both, it is not possible to make any serious technical intervention in the system and, in that way, to put it again in a proper use. Therefore, according to the conclusions of the last study (Popovski, Lund 1999), it is necessary to prepare a feasible plan for recompletion and reorganization of the integrated geothermal project "Bansko", to locate the responsibilities for execution of the consisting activities and then to initialize the start of the process of the project revitalization.

6. REORGANIZATION OF THE INTEGRATED GEOTHERMAL PROJECT "BANSKO"

According to the combination of influencing factors, collected experience with the efficiency of the political and economic transition of the country during the recent 7 years and possibilities to organize the adequate financing of necessary investments for performing the recompletion and reorganization of the system, the 5 years plan in Table 2 is proposed. Planned results are as follows:

a) *Defined property of the system*: One firm shall get the right to exploit the geothermal water and to sell it to different users under known technical and financial conditions;

b) *Defined regulatory aspects*: Defined rights and obligations between the supplier and users, defined competition of the state, defined conditions for exploitation, maintenance and development of the geothermal source and integrated system of users, defined tariff system for pricing different categories of geothermal water users depending on the temperature and time of use;

c) *Organization of a proper technical team* for exploitation, maintenance and development of the integrated geothermal system "Bansko";

d) *Defined technical conditions*: Defined regime of the heat supply to each one of the heat users, defined minimal technical completion of the central distribution and connection stations of heat users, installed equipment for measuring the heat supply, defined maintenance obligations of the supplier and heat users;

e) *Recompleted installations of the heat supplier*: Installation of a water accumulator of 1,000 cub.m. for covering the short lasting peak loadings and protection of the overloading of the system, installation of pumps with variators, installation of a pressure control system;

f) *Reconstructed and recompleted pipe distribution system*: Taking into account that the complex is located in a spa center, it is necessary to reconstruct the distribution lines in a way that

they are not disturbing the esthetics of the environment;

g) *Recompleted installations of the heat users*: Beside the regular maintenance, i.e. change of old parts and equipment, all the connection stations shall be recompleted or newly installed (small greenhouse producers), existing oil boilers shall be put in exploitation for covering the peak heat demands of concrete users, and technically proper heating installations shall be installed in the projects of small users (until now, they use very primitive ones);

h) *Full reconstruction of the big greenhouse project*, consisting new set of heating installations with different regime of heat use;

i) *Connection of new heat users*: Reorganization of the integrated geothermal system "Bansko" shall enable connection of new heat users (heating, preparation of sanitary warm water for other hotels and swimming pools) with a maximal heat power of about 1.2 MW. That shall improve total economy of the system exploitation.

The main uncertainty of the plan is the question of building of a new big greenhouse instead of the existing one, which is not in a proper working condition. It is an expensive investment, economically feasible but uncertain because conditioning fresh capital concentration which presently doesn't exist in the country. Other investments are quite small and they are not problematical because the users already know the advantages of geothermal energy application and are ready to invest for a guaranteed continual and high quality heat supply over the year.

7. CONCLUSION

Destiny and the present state-of-the-art of the integrated geothermal project "Bansko" is a good illustration for the problems of maintenance of the existing geothermal projects and their revitalization and development in the so-called "countries in transition" in the Central/East European region. Not the technical/techno-logical problems but the change of legislative, regulatory and economy aspects put them in a very bed economy situation and most of them have been abandoned, temporarily or for ever.

It is necessary to underline that some of the problems are simply "ununderstandable" for the possible investors from EC and other developed countries, which is slowering their incorporation in the process of this energy sector revitalization.

The aim of the paper is to summarize all the measures and activities which are necessary to be performed in order to open normal conditions for the existing geothermal projects revitalization and further development. Introduction of new developed technologies and experience is also given in order to illustrate the possibilities for improvement of the heat supply and economy of the projects.

Opening of a wider process of the geothermal energy projects revitalization and development of new ones shall prevent the lost of collected specific "know-how" in the Central/East European countries and shall bring back the already proven benefits of the indigenous end environmentally friendly energy resource.

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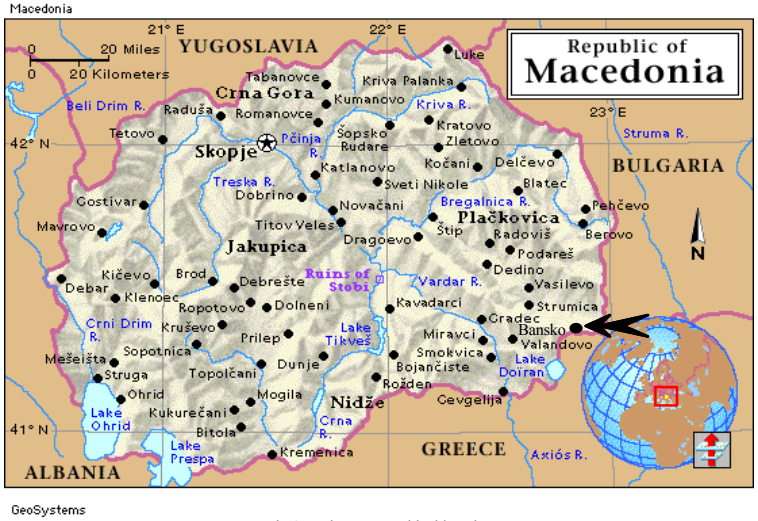

Fig.1. Project geographical location

Year	Activity	Responsible
1999/2000	Finalization of the procedure for new legislation Initialization of the process establishment and organization of financing development of geothermal projects	Ministry of Economy Ministry of Economy Ministry of Finance Banks
2000	Finalization of the procedure for giving concession for the use of geothermal water Signing the contract between the supplier and heat users Preparation of technical documentation for the project reconstruction	Comm. of Strumica & Ministry of Economy Heat supplier Heat supplier
2000-2001	Organization of financing the project reorganization	Haet supplier and heat users
2001	Recompletion of the central distribution station and connection stations of users	Heat supplier and heat users
2002-2003	Recompletion of the existing heating installations in hotels and small greenhouses	Heat users
2003-2004	Building a new glasshouse and its completion with heating installations (in phases)	Heat user
2004-2005	Finalization of the reconstruction and reorganization process	Heat supplier and heat users

Table 3. Five years plan for the reorganization of the integrated project "Bansko"

Nº	USER	MAXIMAL HEAT POWER		MAXIMAL HEAT POWER OF GEOTH. ORIGIN		NECESSARY GEOTHERM. WATER FLOW
		kW	ºC	kW	ºC	l/s
01 -	ZIK "Strumica" Greenhouse complex of 3.0 ha	3.984	70/40	3.984	70/40	31,72
02 - - -	Hotel "Car Samuil" Heating rooms Sanitary warm water Swimming pool Medical balneology	1.563 500 150	80/40 50/38 40/25 38	800 500 150	70/40 70/25 40/25	6,37 2,65 2,39
03. - -	Hotel "Spiro Zakov" Heating rooms Sanitary warm water	380 220	80/40 50/40	200 220	70/40 70/25	1,59 1,17
04. - -	Hotel ZIK "Strumica" Heating rooms Sanitary warm water	200 120	80/40 50/40	120 120	70/40 70/25	0,96 0,64
05. -	Private farmers Complex of small soft-plastic covered greenhouses	1.000	40/25	1.000	40/25	15,93
06. - -	Open air swimming pool Sanitary warm water Swimming pool	60 150	40/25 40/25	60 150	40/25 40/25	0,96 2,39
07. - -	Resthouses for children and retired people Heating rooms Sanitary warm water	450 250	80/40 50/40	250 250	70/40 70/25	1,99 1,33
	TOTAL	8.927		7.804		70,09

Table 1: Composition of heat users of the Bansko integrated geothermal project

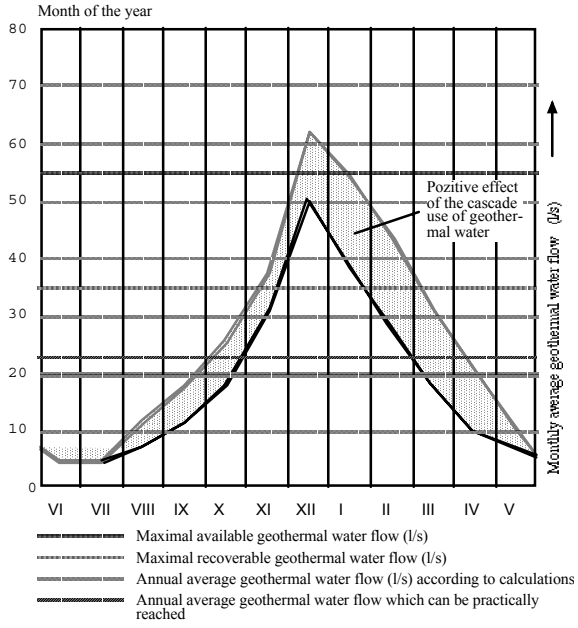

Fig. 3. Annual changes of the thermal water flow of the integrated system "Bans

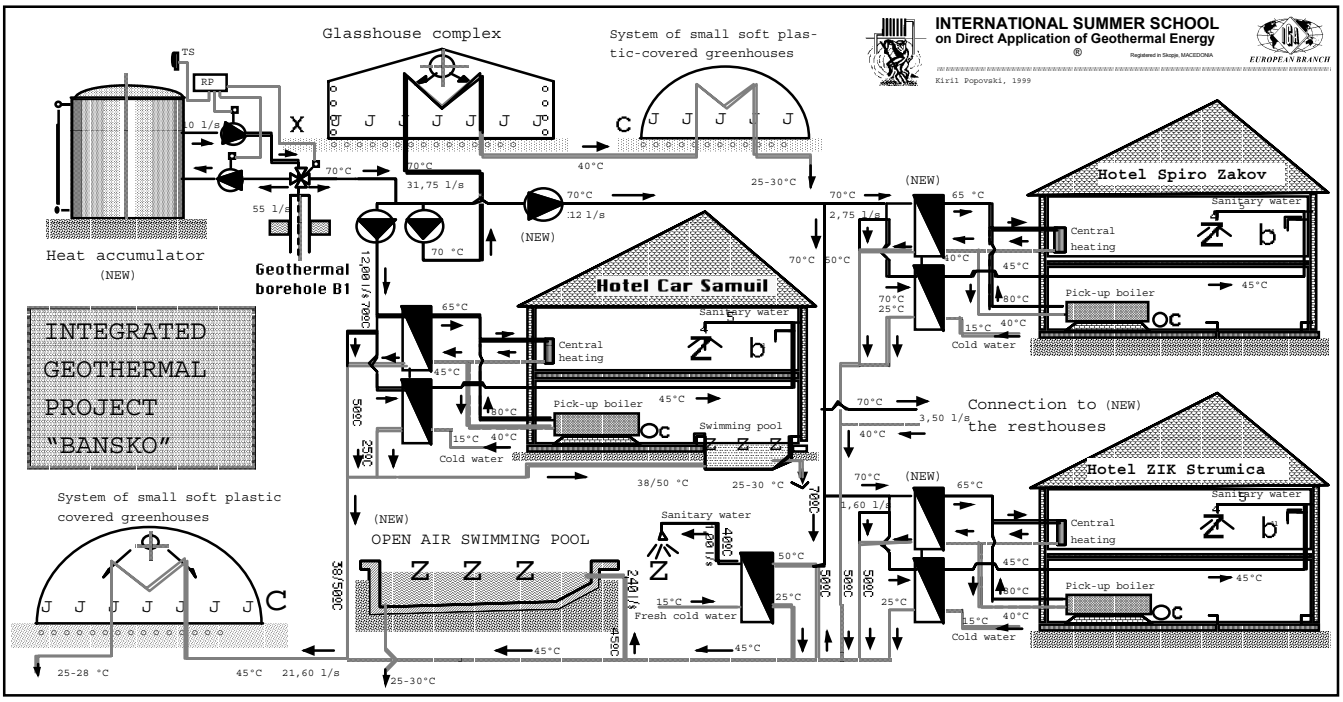

Fig.2. Composition of the integrated geothermal project ²Bansko²

Month of the year / USER	July	Augu	Sept	Octo	Nove	Dece	Janu	Febr	Marc	Apri	May	June	
	Average geothermal water flow (l/s)												
ZIK Strumica - Greenhouses	0	0	1.40	2,80	6,30	10,50	33,60	28,00	22,40	16,10	7,00	2,10	
Hotel "Car Samuil" - Central heating - Sanitary water - Swimming pool	0 0,78 1,20	0 0,78 1,20	0 0,78 1,20	1,25 0,39 1,20	3,75 0,39 1,20	5,63 0,52 1,20	6,25 0,65 1,20	5,00 0,78 1,20	2,50 0,65 0	0,63 0,52 0	0 0,39 0	0 0,39 1,20	
Hotel "Spiro Zakov" - Central heating - Sanitary water	0 0,36	0 0,36	0 0,36	0,30 0,18	0,90 0,18	1,35 0,24	1,50 0,30	1,20 0,36	0,60 0,30	0,20 0,24	0 0,24	0 0,24	
Hotel "Strumica" - Central heating - Sanitary water	0 0,20	0 0,20	0 0,20	0,20 0,10	0,50 0,10	0,72 0,15	0,80 0,17	0,64 0,20	0,32 0,17	0,10 0,15	0 0,10	0 0,10	
Private farmers - Plastic houses	0	0	4,00	8,00	12,00	15,00	15,00	15,00	15,00	12,00	10	4,00	
Open air swimming - Sanitary water - Swimming pool	0,50 1,20	0,50 1,20	0,40 2,00	0,20 2,00	0 0	0 0	0 0	0 0	0 0	0 0	0,20 2,00	0,40 1,60	
Resthouses - Heating rooms - Sanitary water	0 0,39	0 0,39	0 0,39	0,36 0,20	1,08 0,20	1,62 0,26	1,80 0,32	1,44 0,39	0,72 0,36	0,18 0,26	0 0,20	0 0,20	
TOTAL	4,63	4,63	10,73	17,18	26,60	37,19	61,59	54,21	43.02	30,28	20,13	10,23	

Table 2. Annual arrangement of the average thermal water flows of the heat users connected to the integrated geothermal projec "Bansko"