

Case study: Rehabilitation of the District Heating System in Topoloveni town, Arges county, Romania

Chapter I Generalities

Necessity and opportunity of modernization. The present situation.

Fig. 1.1. presents the plan of the Topoloveni town including the location of the sources - district heating stations - running on liquid fuel and/or gases, of the district heating distribution networks, supplying the consumers connected to the system.

The system has four boiler houses designed to operate on solid fuel (pulverised coal). After their delivery, the boilers were modified to burn natural gas (BH1) or liquid fuel (BH1, BH2 and BH3).

The connection to BH4 was not performed, the latter remaining in conservation together with all its relating installations (electrical network, piping, heating pipe network in ducts that cannot be entirely inspected). The consumers to be connected to BH 4 were redistributed to BH1 and BH3.

In general, the district heating system of Topoloveni has the same deficiencies as the majority of similar systems in our country.

In particular, the main characteristic of the Topoloveni system, which is not so obsolete in fact but was developed by means of low technical characteristics equipment and materials and under poor quality conditions, is its unsatisfactory operation from the point of view of energy efficiency, considering the costs evolution and the amount of burnt fuels (gases and CLU3) and the general tendency to eliminate subsidies from the cost of the heat supplied to population.

The consumer heat transmission and distribution network is of the tree type, in underground concrete ducts, which can be only partially inspected.

The heat carrier transport is performed through 2 pipes for heating (supply and return) and 2 steel pipes for household hot water use.

The total length of the pipe ducts is of 3.8 km. The pipes laid down in ducts are insulated and protected by means of mineral wadding and rabbits plastering, protected by bitumen board, and is over 50 % destroyed.

The three BH supply heat for central heating and hot water for domestic use to 48 blocks of flats (11 entrances and 5 buildings of social utilization).

The supplied consumers live in residential blocks of flats of the Ground floor +2...4-floor type.

The resistance structure of the buildings is made up of great panels, panels with reinforced steel frames or frames and brick masonry.



The studies that have been carried out on the occasion of the district heating stations inspections, verifying the correspondence between the existing capacities and the requirements in the Decree-Law no. 56/1990 establishing the heat amount necessary for population and regulating the heating temperatures in the building to 20°C led to the following conclusions:

- The maximum necessary heating amount per hour at present for Topoloveni is of 15.6 Gcal/hour, out of which 12.6 Gcal/hour for heating and 3 Gcal/hour representing the average loading for the corresponding domestic water preparation.

- This necessary amount was established on the basis of the existing consumers, namely: 48 blocks of flats, representing the existing 1885 3-room actual flats (1453 3-room average conventional flats), 7 commercial spaces + 5 buildings with social destination (representing the equivalent of about 272 actual flats, or 210 average conventional flats),

The total number of conventional average apartments belonging to Topoloveni is of 1663 (including residential, commercial, social destination spaces).

We should underline that the above mentioned values were established in accordance with the calculated (designed) necessary heat amount, therefore after having taken into account the corresponding condition both of the interior installations and the supplied buildings envelope. In other words these are the necessary heat loads that should be covered even in case all the measures for the thermal rehabilitation of the buildings and their interior installations, as well as of the heat transmission and distribution installations are taken; they represent the season average heat load the system operates at most of the time.

The installed average radiating area is of 11.5 sqm/average conventional apartment and the resulting number of occupying persons is 3.1 persons/conventional average apartment.

As we have already mentioned the existing situation of the Topoloveni district heating stations and heat transmission and distribution networks cannot be maintained, as it endangers the operation of the entire system.

In order to improve the system efficiency, both from the technical and economic points of view, it is necessary to make changes in all its main sections.

The heat sources - the BH - represent the most important part where energy efficiency improvement can be performed.

The minuses in the existing situation are grouped as follows:

- Manufactured boilers, both obsolete and worn;
- Heating installations, obsolete and worn due to inefficient utilization, as well;
- Old heat exchangers of great dimensions whose thermodynamic performance was low even from their design stage, and which further diminished during their operation (due to deposit formation);
- Utilization of great amounts of untreated make-up water which led to efficiency diminishing and boiler destruction in the course of time;
- Almost entire lack of control and measurement instrumentation, both at the sources and the end user (buildings) levels.
- Lack of energy management/metering elements in the district heating stations and/or consumers.

The distribution and transmission networks represent other vulnerable and in poor condition sectors.

- At a visual inspection, the pipes display (show) a high level of inner and outer corrosion causing frequent pipe breaking and significant heat and heat carrier losses;

The network routes are inadequately chosen and do not enable operations and interventions.

Taking into consideration the above-mentioned facts various solution variants have resulted that should substantially increase energy efficiency by components and at the level of the entire system.

The project proposes a radical solution consisting in abandoning and taking out of operation the entire equipment and installations of the existing 4 district heating stations, as well as their

related exterior networks and developing a unique district heating station utilizing only its envelope with some structure and finishing modifications that are required.

The installed power of the district heating station is of about 18.6 MW covering the heat demand of the town relating to heating and hot water preparation for domestic use. The supplied heat carrier is water at 90/70⁰ C. The station also supplies hot water for domestic use at 60⁰C. The station burns both natural gas- in the basic mode - and CLU3 in the peak mode.

For the district heating networks were analysed the four or two line pipe systems. The pipes will consist of preinsulated pipes, with very low insulation thermal conductivity (0.027 W/mK), that leads to heat losses that are very low, too.

Equipment and materials

Boilers

To prepare the heat carrier hot water steel boilers have been chosen, with pressurised burning, of 4 Gcal/h, p=5 bar, equipped with GI M1ST 510 DSPNM type mixed burners (natural gas – CLU) which are fully automated and whose operation can be controlled.

Pumps

The boiler injection pumps, make-up and recirculating pumps are of the WILO type, whose reliability is very high.

Pressure equalizing cylinders

The scheme including a pressure equalizing cylinder enables the harmonisation of the boiler working conditions with the consumers', the cascade operation of the boilers with the automatic hydraulic separation of the boilers taken out of operation without requiring operations of the stoppers.

Plate heat exchangers

At present, the district heating stations in the Topoloveni town are equipped with tubular heat exchangers with ICMA type brass tubes for the preparation of domestic hot water. Their heat transfer coefficients are of 600-800 W/m³K, which may diminish up to 250-300 W/m³K.

The operation and maintenance of the heat exchangers require great annual costs due to the frequent tube breaking or their cleaning to remove the deposits.

The plate heat exchangers consist of frame and pressure plate applied on each side of the plate package. The plates are provided with special distribution patterns that will guarantee a proper distribution of the flow. This pattern also creates high turbulence and heat transfer coefficient. The plate heat exchanger is easy to install due to low weight and compactness. If needed, the plate heat exchanger can easily be opened and cleaned simply by removing the tightening bolts.

Automatic protection installations preventing accidental overpressures

The expansion modules automatically ensure the taking over of the water in excess resulting from the dilatation of the heating circuit, and, under automatic control, the maintenance of the minimum pressure in the heating circuit and the gradual filling up with treated water of this circuit. Expansion vessels covered by V=5mc membranes have been chosen.

Filling and compensation water treatment stations

The treatment stations that have been chosen are fully automated, have auto regeneration and a diminished salt consumption and cationic mass and increased softening level.

House water supply plants

The house water supply plants are packed, fully automated, utilised in the drinking water supply networks for increasing pressure. Among their advantages we should mention: easy installation (fully assembled module, that can be immediately installed through its direct connection to the water and electricity supply network) and minimum consumption.

Expansion/make up module

The module automatically ensures the taking over of the excess water resulting from dilatation (expansion) in the heating circuit, protection of the heating circuit against overpressure, recovery of the treated water discharged from the heating circuit during expansion, maintenance of minimum pressure in the heating circuit and make up/filling up with treated water of this circuit, as well as pressure measurement in all circuits.

Preinsulated pipes and pipe elements

The new technological solution proposed for the rehabilitation of the distribution district heating networks supplying the consumers consists of preinsulated steel pipes for heating and galvanised pipes for the domestic hot and recirculating circuits.

Pipe preinsulation is performed in the factory by means of rigid polyurethane foam through two solutions' injection and a high hardness polyethylene pipe for the external protection.

Automation equipment

The equipment provided for automation (regulators, three way valves, thermostats) ensures the sequential start /stop of the boilers, heat carrier temperature regulation in agreement with the exterior temperature, preparation of domestic hot water, maintenance of a pre-established pressure in the heating installation.

Metering systems

The heat meters provide information relating to the heat amounts necessary for heating and domestic hot water preparation supplied by the district heating station to consumers. They are highly sensitive and reliable.

The cogeneration module

This module is a complex equipment, made up of a piston engine, electric synchronous generator, economiser, module automatic full protection, control and operation regulation system.

The operation principle is to simultaneously generate electricity and heat by means of the same amount of fuel. This equipment has been selected for the hot water preparation within the district heating system (through heat recovery from the lubricating oil, engine cooling water and discharge gases). The engine is connected in parallel to the National Power System (the normal operation mode). The connection in the Transformer station is performed immediately after the electricity-metering device acquired from CONEL.

The thermal connection is in parallel with the existing district heating station, the boiler ensuring the heat difference or the back-up solution in case the engine stops functioning.

The overall efficiency of energy utilisation is of min. 85%, and the polluting emissions are extremely low.

Chapter 2 Description of the proposed modernisation works

The proposed variants will be analysed from the economic point of view. The consumers' heat demand will be entirely (fully) covered in all instances.

The reference variant (0) – minimum from the point of view of the investment effort to be made. It proposes minimum repair works, necessary for maintaining the system in operation, by means of the existing equipment, and eventually putting back into operation the boilers that were taken out of operation or are under conservation, if this is considered feasible from the technical point of view. New boilers could also be added to cover the heat and hot water demand of the consumers connected to the system in normal conditions. The main characteristic of this technical variant is preservation (as much as possible) of the existing type of equipment and location of the

capacities for the heat carrier preparation, necessary for heating and hot water (without structural modifications of the system) preparation. Nevertheless, this variant which is considered for comparison entails low investment costs, but high operation costs.

Variant 1 will include, in fact, three subvariants, which will be distinctly analysed. The location of these three subvariants is the same, namely the district heating station no. 1 (BH1).

Subvariant 1.1. – Envisages BH1 (representing the only source of the entire system) equipped with heat sources whose capacities are dimensioned so that to cover the entire demand of the town – modern mixed gas/liquid fuel boilers, for the centralised preparation of the heat carrier for heating.

The hot water will continue to be prepared within the district heating system, centralised at the source level, as follows:

- central heating modules, equipped with internal combustion engines working in a cogeneration mode-for domestic hot water preparation in a base load regime;
- high performance boilers - for the preparation of domestic hot water and heat carrier for heating in peak load regime.

The consumption hot water recirculating pipe was given up, the calculations and practical determinations showing that, for a 7 hours interruption in the hot water supply, the latter's temperature decreases only by 5⁰C, from 55⁰-60⁰C to 55⁰-50⁰C, temperature still requiring its mixing with cold water.

From the point of view of the working conditions correlated with the evolution of heat consumption in the form of domestic hot water at the site and the performances of the selected engine, we consider that two district heating modules are necessary. The district heating modules will function daily (the first for 21 hours/day, in the interval between 3 and 24, and the second for 20 hours, in the interval between 4-24), supplying:

- heat in the form of domestic hot water – based on the load curve – which will be supplied through the distribution network of the domestic consumers;
- low voltage electricity – to be partially utilised for technological and own consumption, the rest following to be supplied through the distribution networks to the domestic consumers.

Subvariant 1.2. Envisages BH1 integral equipped (as the unique source of the entire system) with heat sources whose capacities should be dimensioned so that to cover the entire demand of the town – modern boilers burning both gases and liquid fuel, for the centralised preparation of the heat carrier for heating and installation of capacities for the domestic hot water preparation at the local level. The main difference as compared to subvariant 1.1. is that in subvariant 1.2. the distribution network is transformed into a two pipe type solution. Thus, the complexity of the source equipped solution is diminished by eliminating the specific equipment from BH1 (hot water pumps and recirculating pumps, heat exchangers, measurement, regulation and control instrumentation). At the same time the domestic hot water supply and recirculating pipes, including their related metering devices, are eliminated. Last but not least the town water consumption will be transferred from the source level directly to the level of the supplied buildings.

Subvariant 1.3. – considers the BH1 equipped (as the unique source of the entire town) with heat sources whose capacities will be dimensioned so that to cover the entire demand of the town – modern boilers burning both gases and liquid fuel, for the centralised preparation of the heat carrier necessary for heating and capacities installation for the centralised domestic hot water preparation.

Variant 2 – proposes BH4 as the (unique) centralised source location for the entire system, equipped with heat sources whose capacities should be dimensioned so that to cover the entire demand of the town-modern boilers burning both gases and liquid fuel, for the domestic hot water preparation at local level.

All the variants are based on the same hypothesis, namely to cover the same maximum hourly heat demand (at its peak in wintertime). All variants consider a unique district heating station for the whole town as an energy management node, operated by a reduced number of personnel.

The unique heat source will run on gases and liquid fuel, which requires the necessity to ensure a corresponding capacity of the CLU storage enabling the modernised system rhythmic operation without undesired breakdowns.

At the same time a supplementary connection to the cold water network was provided.

Chapter 3 Evaluation of the modernisation works effects

To establish which of the technical variants has the most advantageous economic effects the investment costs and the heat generation costs, respectively, both in the reference variant and the four modernisation variants analysed were calculated. The investment costs have been determined on the basis of the offers received from some firms that are present on the Romanian market and sell the equipment and materials envisaged required by the proposed installations.

The investment costs – the main component elements of the investment costs as well as their values are given in *Table 3.1*.

Table 3.1. **Million ROL**

<i>Computation elements</i>	<i>Reference variants</i>	<i>Variant V11</i>	<i>Variant V12</i>	<i>Variant 13</i>	<i>Variant 2</i>
Heat networks	3063.717	9789.05	8192.76	11823.11	11823.11
District heating station equipment	2804.283	24425.848	10264.198	12596.737	11264.198
Supplementary meters	0	670	100	670	100
Compact heat substations	0	0	11232.11	0	11232.11
TOTAL	5868.0	34885	29789	23056	34419

Production costs – the calculations were based on the following hypotheses:

- The five solution variants aim at improving the existing situation, implicitly rendering favourable or not so favourable economic effects;
- From the economic point of view the five variants have effects only on some of the actual production costs structure namely:
 - Make-up water consumption (material and heat);
 - Electricity consumption;
 - Maintenance and repair works amount;
 - Salaries;
 - Fuel consumption.
- The other elements of the production costs structure are considered identical in all variants for the values obtained up to the present moment;
- The share of the production cost elements values against the actual values are given in *Table 3.2*.

Table 3.2. **Values %**

Calculation elements	Actual situation	Reference variant	Variant V11	Variant V12	Variant V13	Variant 2
Make-up water consumption	100	90	15	10	15	15
Electricity consumption	100	100	30	32	30	50
Maintenance and repair works	100	85	50	50	50	50

amount						
Salaries	100	100	50	50	50	50
Fuel consumption	100	95	90	71	71	74

The values of the production costs in the present situation for the five variants analysed calculated on the basis of the hypotheses previously presented are those given in Table 3.3.

Table 3.3 **Million ROL**

Calculation element	Actual situation	Reference variant	Variant V11	Variant V12	Variant V13	Variant 2
Fuel costs	3352	15371	10855	11488	11488	11973
Make-up water costs	81	354	59	39	59	59
Electricity costs	195	939	282	300	282	470
Maintenance and repair costs	153	628	370	370	370	370
Salaries	488	488	244	244	244	244
Other costs	625	4881	4881	4881	4881	4881
Total	4894	22661	16691	17322	17324	17997

Chapter 4 Economic analysis of Topoloveni heat supply system modernisation

The economic analysis was performed on the basis of the following hypotheses:

– Investments will be carried out step by step, in equal tranches over a three years period of time;

– The average electricity and heat tariffs are:

- Heat supplied to consumers 492606 ROL/Gcal

- Electricity bought 998 ROL/kWh

- The decision indicator for the economic analysis is the Net Present Value calculated over a 20 years periods of study, a 15% discount rate and an installation development time corresponding to a year investment tranche.

For each variant the Net Present Value, the Internal Rate of Return and the Simple Payback Period of investments from the value of the operation costs savings were calculated. The results of these calculations are presented in **Table 4.1**.

Table 4.1.

Calculation item	Reference Variant	Variant V11	Variant V12	Variant 13	Variant 2
Investment Costs (mil ROL)	5868	34885	29789	23056	34419

Production costs (mil ROL)	22661	16691	17322	17324	17997
Income out of which:	23618	27847	23618	23618	23618
-electricity (mil ROL)	0	4229	0	0	0
Simple Payback Period (years)	957	11156	6296	6294	5621
Net Present Value (mil. ROL)	6,1	3,1	4,7	3,7	6,1
Internal Rate of Return (%)	0	29336	7715	13597	40

Variant 11 (centralised heating and centralised preparation of the domestic hot water by means of cogeneration) is the most advantageous for the Topoloveni district heating system.

On the other hand, considering the investment to be made, variant V13 (centralised heating and domestic hot water preparation in BH1 by means of high performance equipment) whose economic indicators are also high, is recommended to be implemented in Topoloveni, following to evaluate all the other effects (sensitivity, risk, environmental impact) it may have.

The main characteristic elements of variant V13 are the following:

- Investment costs 23056 mil.ROL
- Production costs 17324 mil.ROL
- Income 23618 mil.ROL
- Net income 6294 mil.ROL
- Simple Payback Period 3,7 ani
- Net Present Value 13597 mil.ROL
- Internal rate of return 26,93%

Chapter 5. Sensitivity analysis

Sensitivity analysis has been carried out on Variant 13 that has come out as the most advantageous from the investment and the closest economic indicators points of view as compared to Variant 11.

By means of this analysis it is possible to perform the evaluation of the financial components influence on the sensitivity indicators (**Net Present Value - NPV, Internal Rate of Return - IRR, and the Simple Payback Period – SPP**). The variables considered were the following:

- the investment costs;
- the fuel cost;
- the sold heat price;
- the electricity price

The variation domain ranged between 0.8 and 1.3 of the base values utilised for establishing the optimum variant.

The variation of the investment costs by the analysed range does not influence the NPV value, which is maintained at positive values, the variation ranging between +30% and –55 %. The other two indicators are more or less influenced, the SPP varying directly proportional (is modified by almost the same percentage) with the evolution of the variable, respectively, and IRR doubles for the analysed range.

The fuel price parameter greatly influences NPV, nevertheless without registering negative values, except for 30% price increases . The same variation is registered by IRR, while SPP is kept under 10 years.

Similarly, but more influenced by NPV and IRR, is the sold heat parameter for which NPV becomes negative when the price is diminished by 20% (very little, we presume), but NPV triples in the case of a 20% increase.

The electricity price parameter does not influence the economic indicators in the analysed range. The heat price has a major influence upon all the economic parameters, to be followed by the fuel price.

Chapter 6 The risk analysis

The main risk factors of the project are:

- **The market fluctuations** –which can diminish the revenues and endanger the investment recovery. In the case of our project their value is negligible though, because the diminishing in the heat demand necessary for the building heating supplied by Heating Company, it could be only due to some major modifications, which are not likely to occur. Diminishing in the heat demand necessary for building heating under the value considered is not likely to occur as the requirements of the strictest thermal insulation standards have been taken into consideration when establishing it in agreement with the Law no. 10/1995 relating to quality in constructions.

At the same time we cannot overlook any diminishing in the heat demand caused by the significant depopulation of the town over a medium term.

- **The variation of the economic hypotheses** – which can have a negative influence, especially concerning the requirements relating to environmental or social protection and can act only in favour of the project, which has a positive impact both on environmental protection and social field by increasing the level of comfort.

- **The technical risks** – represent in fact the possibility of a large scale failure occurring, entailing supplementary operating costs, correspondingly. This type of risk can have a slight influence, too, considering that the chosen solution is practically at the highest technical level in the developed countries where the experience with this kind of installations has been accumulated over a long period of time.

- **Risk elimination** – As long as we cannot practically eliminate any risk completely it is desirable that the project implementation should consider a series of measures to limit risks, dividing them among more partners by means of an association based on a long term contract. This kind of contracts should be concluded with the owners' associations as the beneficiaries of the centralised heating system as well as, with the fuel suppliers.

Chapter 7 Evaluation of other effects of the project

Although for the selection of the variant proposed to be implemented neither the environmental, nor the social effects have been quantified yet, their effect will be noticed in the increase of the Topoloveni community comfort.

The environmental impact – is important due to the fact that the heat supply source (the district heating station) runs on CLU3 with natural gases as backup.

By implementing the technical solution for improving the system proposed in Variant 13 the heat and primary energy consumption implicitly, will be diminished.

By implementing Variant 13 the noxious substances presented in the following table are diminished, as follows:

Calculation element	MU	Value
CO ₂ emission reduction	TCO ₂ /year	6055
SO ₂ emission reduction	T SO ₂ /year	66
NO _x emission reduction	T NO _x /year	16

Social effects – They are also important as their influence is felt in multiple directions:

- Ensuring the buildings thermal comfort (uninterrupted and safe supply of heat and domestic hot water, at the quantitative parameters required, entirely covering the demand;
- Giving up the utilisation of complementary heating sources (peak load) during the periods of time when the distribution network cannot cover the demand. As a general rule, these supplementary sources would resort to electricity which, in case it is not consumed, has a local effect on the family budgets of the people living in the respective buildings, but also

entails a corresponding reduction of the noxious substances and resorts less to primary resources, at the regional level, respectively

- increase in the professionalism of the personnel and services supplied by Heating Company with favourable effects on the company's income and the employees' salaries.
- Increase in the awareness of the operating personnel and the domestic consumers' especially relating to energy efficiency and energy management.

Chapter 8 Conclusions

The paper aims at establishing and analysing the possibilities of modernising the district heating system of the Topoloveni town from the technical and economic points of view in order to increase economic efficiency and the safety level of the consumers' heat supply by retrofitting the sources and eliminating the unjustified losses of heat and heat carrier.

To achieve this a reference variant was proposed (from the simple rehabilitation, maintaining the present location of the heat sources) and four more modernisation solution variants (which differ from one another relating to locations and equipping possibilities of BH).

The economic analysis has pointed out that Variant 11 (centralised heating and domestic hot water preparation by cogeneration) is a promising solution to the heating supply system modernisation of the Topoloveni town, but Variant 13 (centralised heating and domestic hot water preparation by means of high performance equipment in BH1) has the advantage of lower investment costs.

During the meeting at the Topoloveni City Council in which participated members of the Local Council, the decision-makers of Heating Company, representatives of the companies offering equipment, as well as the developers of this study analysed the variants presented.

As a result of the discussions held, taking into account the necessary investment costs and the fact that from the technical point of view the other variants present certain particularities relating to execution and operation, Variant 13 was chosen to be implemented for the modernisation of the district heating supply system of Topoloveni. In the case of this variant all the other effects were estimated (sensitivity, risk, environmental impact).

The necessary equipment for the district heating station 1 (BH1) in variant 13 are:

- 4Gcal/h, p=5 bar boilers, equipped with automatic burners burning both gases and CLU – 4 pieces;
- 250 cm/h, p=4 m CA injection boiler pumps –4 pieces;
- 3 cm/h. H=50 m make-up water pumps CA – 2 pieces;
- 4x160 cubic m/h, H=5 m CA heating primary circuit ;
- 4x160 cubic m/h, H=5 m CA heating secondary circuit;
- Pressure balancing cylinders;
- Heat exchanger for heating, 4x3.15 Gcal/h;
- Module for domestic hot water preparation 2x2.25 Gcal/h;
- Automatic water softening station, 3cm/h;
- Closed expansion vessel, V= 5cm, -2 pieces;
- Heat meter for heating, Dn 400;
- Heating meter for domestic hot water preparation, Dn 125;
- Expansion and make-up water module;
- Fully equipped pumping unit, of the house water supply type, Q=89.6cm, H= 14.9 mCA;
- Automatization equipment (regulators, three line valves, thermostats, pressure gauges) for the sequential starting/stopping of the boilers, heat carrier temperature regulation with the exterior temperature, domestic hot water preparation, maintenance of a pre-established pressure in the heating installation;
- Stack –2 pieces

- Replacement of the old heat pipes for heating by new pre-insulated pipes, on new routes, by stages.

The economic indicators in this variant are the following:

- Investment costs	23056 mil.ROL
- Production costs	17324 mil.ROL
- Income	23618 mil.ROL
- Net income	6294 mil.ROL
- Simple Payback Period	3,7 ani
- Net Present Value	13597 mil.ROL
- Internal rate of return	26,93%

Other technical specifications:

- The routes of the new heating networks do not affect great agricultural pieces of land as they are developed within the building perimeter in the interior of the Topoloveni town.
- Modernisation of the centralised heating system will be performed within the existing construction;
- The equipment and installations supply with electricity does not require more power as they are mounted in the existing building equipped with the necessary electricity connections corresponding to the designed solutions;
- As regards drinking water supply, due to passing the entire water consumption to CT1 requires a water connection Dn 100, L=100 m, which was taken into consideration when the investment was evaluated.