

The improving of the heat networks operating process under the conditions of the energy efficiency providing

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Abstract. Among the priorities it is important to highlight the modernization and improvement of energy efficiency of housing and communal services, as well as the transition to the principle of using the most efficient technologies used in reproduction (construction, creation) of objects of municipal infrastructure and housing modernization. The main hypothesis of this study lies in the fact that in modern conditions the realization of the most important priorities of the state policy in the sphere of housing and communal services, is possible in the conditions of use of the most effective control technologies for the reproduction of thermal networks. It is possible to raise the level of information security Heat Distribution Company, and other market participants by improving business processes through the development of organizational and economic mechanism in the conditions of complex monitoring of heat network operation processes

1 Introduction

The relevance of this study is due to the major directions of the state policy in the sphere of housing and communal services. Housing and communal services is a basic sector of the Russian economy, providing vital public services, and the industry provides the necessary infrastructure. The turnover of housing and communal services is 4.1 trillion rubles, which corresponds to 5.7% of the gross domestic product of Russia.

The main priorities, objectives and tasks of the state policy in the sphere of housing and communal services are defined by the Strategy of development of housing and utilities sector up to 2020, approved by the Federal Government on January 26, 2016 № 80-p. This strategy has been developed in accordance with the Presidential Decree of May 7, 2012 № 600 "On measures to ensure the citizens of the Russian Federation, affordable and comfortable housing and improving the quality of housing and communal services" and the Federal Law of the Russian Federation № 261. (2009, November 23). «On energy saving and energy efficiency and on Amendments to Certain Legislative Acts of the Russian Federation». The goal of the state policy in the sphere of housing and communal services is

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to improve the quality of life by improving the quality and reliability of utility services, as well as making them accessible to the public. [1] [2]

Among the priorities it is important to highlight the modernization and improvement of energy efficiency of housing and communal services, as well as the transition to the principle of using the most efficient technologies used in reproduction (construction, creation) of objects of municipal infrastructure and housing modernization. [3]

Quality and reliability of utility services contain the smooth delivery of services heating, hot and cold water supply, sewerage, electricity and gas, and other mandatory requirements for housing, established by the current legislation. The heating system is one of the largest and most high-tech elements of housing and communal services, on which effectiveness rates of return and profitability throughout the housing sector depend. Thus the current state in the housing heating system is characterized, in general, by low efficiency of thermal energy used by the consumer, that is caused by significant heat losses in transport systems and heat consumption plants, unplanned modes of heat, insufficient use of energy-saving equipment, low degree of automation of accounting and control of thermal energy and other factors. Inefficient heating leads to huge cost overruns of energy, material and financial resources. [4]

In order to achieve the priorities it is required to improve the housing and utilities management system in the field of legal regulation, as well as in the field of information security and to enhance transparency of the organizations in the sphere of housing and communal services for consumers, investors, regulatory authorities, for providing of which the state information system of housing and communal services (HCS GIS) has been created. Furthermore in order to ensure balanced development and reproduction of utility infrastructure systems, taking into account future needs mechanisms for spatial and investment planning must be coordinated.

The main hypothesis of this study lies in the fact that in modern conditions the realization of the most important priorities of the state policy in the sphere of housing and communal services, is possible in the conditions of use of the most effective control technologies for the reproduction of thermal networks. It is possible to raise the level of information security Heat Distribution Company, and other market participants by improving business processes through the development of organizational and economic mechanism in the conditions of complex monitoring of heat network operation processes.

The purpose of the research is the development of an organizational-economic mechanism of increase of efficiency of operating processes of thermal networks of the municipality in a complex monitoring and recording of the necessary financial and material resources for their reproduction.

The object of the research is heating networks as objects of heat-supply of real estate complex in the housing and communal services of the municipality.

The subject of research is the system of organizational and economic relations, conditions of formation, functioning and development to improve the efficiency of operation of heat networks process mechanism.

In the current macroeconomic situation, you must make maximum use of internal resources for the development of housing and communal services by improving the efficiency of infrastructure management, promotion of energy conservation and the transition to the use of the most efficient technologies used in modernization (reproduction) of utility infrastructure [1-14].

2 Methods

2.1 The process of reproduction of heating networks

The thermal network as property, have their own life cycle, from the three main stages of the life cycle: construction - operation - recovery and exploitation stage heating system to a greater extent is associated with a reduction in the quality of operation of the system, due to the accumulation of wear and tear.

The process of reproduction of heat networks - is primarily a process of restoration of the technical characteristics of thermal energy transportation and distribution system. Partial reproduction allows you to restore or improve the condition of some (not all) elements and structures of heating networks, and full reproduction is almost a complete renewal of the distribution system. Accordingly, the simple reproduction makes it possible to eliminate the physical wear and tear, and expanded reproduction involves the removal of functional deterioration or increase in heat networks by renovation and new construction.

In accordance with this definition, when the thermal networks are executed there are works carried out related to the dismantling of dilapidated utility networks and the construction of new, reconstruction, major overhaul and modernization of thermal networks, content control and communication facilities in the given design conditions, carrying out repairs and maintenance of heat networks in accordance with the existing legislation.

Features of operational processes of heating networks consist in the fact that the impact on the network and the construction is going on at the most prolonged period of time and has a decisive influence on the quality characteristics, which are largely determined by the engineering, technical and design decisions taken at the stages of design and construction.

The duration of the maintenance period of heat networks depends on a variety of factors and conditions, which include structural and technical characteristics of the object itself; provision of material, labor, financial resources to maintain the facility during the operational phase; quality and timeliness of maintenance and current repair and object; timeliness and quality of the overhaul facilities.

Management, maintenance and reproduction of the whole heating system should not be based on intuitive management decisions, but on economic calculations with the use of the system of scientific-methodical substantiation of a choice of primary objects of investments and sources of financing. The basis for this must be a constant monitoring of production, organizational, economic and legal processes in the municipality, analysis, forecasting and optimization of management decisions with use of modern technologies and methods of decision making.

In the conventional context, monitoring means the process of observing the object, assess its condition, monitoring the nature of the events, a warning of undesirable trends. Monitoring has targeted and action-oriented, that is applied to specific objects and processes for solving tasks. It is also an ongoing process, organizing a sufficiently long period of time, allowing you to assess trends of processes and predict the development of these trends. Monitoring is a continuous process of collecting, processing, evaluation and preparation of decisions aimed at achieving the goals and objectives of the organization.

2.2 Reproduction problems

The existing today information and methodological base of management decision making in the municipal administration, including the sphere of management of heating system does not provide a solution of reproduction problems in order to improve energy efficiency and sustainable development of the economy of the municipality. Among the problems of information support of the municipality the following can be distinguished:

- Orientation of public information systems to the needs of the federal government, while the specifics of the municipal and industrial development need to improve monitoring systems at the local level.

- Lack of adequate information on the development of heat supply system in the form of the creation of a single integrated system (monitoring). The uniform system of indicators of heat supply system development has not yet been formed due to lack of proper relationships, continuity and completeness of the different reporting forms and how one-time surveys in scope of certain populations, and on the composition of indicators.

- Existing indicators are enlarged, many developing processes can not be installed by them that derives primarily from the methodical information-gathering problems. Having existing today and constantly evolving computer technologies for the collecting, processing and reporting of information the solution of the problem is the use and storage of the database of the primary indicators.

- The most important task is providing of transparent technology acquisition, transmission, processing, storage and presentation of information, as well as the formation of analytical information on the basis of the integrated guidelines when key indicators of heat supply system development should be collected in a complex according to methodical uniformity of requirements.

- There is no possibility of not only automatic formation of a consolidated energy balance of the municipality, but even by hand it causes difficulties due to the fact that the methodology of its formation is outdated and does not correspond to international practice, there is no sufficient data for its formation, there are no specialists who know calculation methodology.

The municipality as the main owner of heating networks is a key element in the control system, heat supply companies, solve problems in the operation and safety of the heating system.

According to experts, in order to properly assess the condition of heating and other objects of heat it is necessary to carry out an objective inventory of all objects, as well as to coordinate the scheme of urban heating, allowing to remove the technical limitations of existing heat network infrastructures. According to Federal Law № 190-FZ of 27.07.2010 "On Heat Supply", it is necessary for each municipality to approve the heating circuit for the next 10-15 years, but unfortunately today, in many municipalities, the reconciliation process is not completed. [5]

Driving settlements heating is a document that contains pre-materials for substantiation of effective and safe operation of heating systems and directions of development in the long term (at least 15 years).

According to the non-commercial partnership "Energy Efficient City", in 83 regions of Russia there are 517 urban districts and 20544 urban and rural settlements, in total - 21 061 municipality in which according to the law "On Heat Supply" district heating schemes must be developed and approved. Adoption of these schemes is the responsibility of the Ministry of Energy Russia - for cities with a population of 500 thousand people or more, and local governments - for settlements with a population of less than 500 thousand people. Today, district heating schemes approval process continues. All background information can be divided into several main blocks:

1) spatial planning documents (general plan of settlement, land use planning scheme municipal districts), topographic base areas, etc. ;

2) development plans and programs (the input of housing construction plans, investment programs of municipal utilities, software development systems for municipal infrastructure, energy efficiency program, and other plans and programs);

3) More information about the heat sources;

4) Details of heat networks. [6]

Often, 50% of the documents in the administration of municipalities do not have or are outdated and do not correspond to reality. Quality heating scheme will allow to make management decisions on the development of heat supply system of the municipality and to

save not only the budget but also the consumers' money. As noted earlier, the improvement of energy efficiency in order to reduce public spending on public services is one of the priorities of socio-economic development of the Russian Federation. Currently, the total payment for municipal services is more than 10% of all expenses. This indicator is one of the highest in the world. [7]

The proposed approach to the formation of organizational and economic mechanism, based on monitoring as a tool for monitoring the heat network economic development parameters can be represented as a conceptual model, which includes a collection of objects of observation, the list of problem-oriented areas (indicators) and software-tools aggregation and reporting, as well as optimization and ground of management decisions, ensuring the highest possible degree of detail of the information provided for each indicator.

As a problem-oriented areas of process monitoring operation of heat networks are available:

- manufacture, trade and consumption of electricity;
- the indicator of the investment potential of the electric power companies;
- financial state;
- cost-structure and pricing;
- the indicator of the formation of the energy balance of the region;
- factors of institutional change.

2.3 Monitoring

In order to improve process control efficiency of operation of heat networks it is necessary to have a information provision of the organizational and economic mechanism, which allows to determine the level of the existing control system, its strengths and weaknesses. The basis of the organizational-economic mechanism is formed by the monitoring system not only processes the technical operation of real estate, but also its legal and economic framework, through the system of factors affecting them. Factors influencing the activity of the enterprises and the quality of heat supply taking into account the integrated approach of the analysis can be grouped into four main groups: resource and technological, organizational and economic mechanisms; political and legal.

The purpose of process monitoring operation of heat networks is to obtain information about the status of the test process and on this basis, setting targets to improve the existing control system with a target-oriented improvement of qualitative characteristics of thermal networks, reducing heat loss, ensuring compliance with regulatory requirements for the maintenance of facilities utility infrastructure, increase in investment activity in the sphere of reproduction, and so on.

The thermal network in operation should be under the systematic supervision and control of those responsible for the engineering and technical personnel. To this end, the operating organization creates a system of monitoring of thermal networks. Monitoring of the technical condition of heat network is a system of monitoring the technical condition, under which the collection, classification and information on their technical condition of thermal network analysis are made.

The basic principles for monitoring of the technical condition of heating networks:

- Validity of obtaining of information about the technical condition of heat networks;
- Continuous monitoring of the technical condition of heat networks;
- Openness access to the monitoring results.

Monitoring objectives:

- The prevention of emergency situations in the heat sector;

- Analysis of compliance activities for maintenance, repair and preparation of thermal networks for seasonal operation;
- Ensuring the efficiency of use of budgetary funds allocated for the maintenance, servicing and repair of heat networks;
- Determination of the service life of heating networks, as objects of monitoring and deadlines for carrying out major repairs of heating networks.
- Consideration of the effect on the service life of heating networks, as the quality of the monitoring facilities of work performed during the warranty period after the completion of construction, renovation and major repairs;
- Analysis of the course of the monitoring information; evaluation of the effectiveness and completeness of the implementation of laws and other normative legal acts in the field of maintenance and repair of heat networks;
- The integration of information flows generated by the different bodies involved in the monitoring. In addition to these tasks by inspection of buildings, the purpose of the technical inspection is to develop proposals to improve the technical operation of thermal networks, as well as the quality of all types of repairs.

Calendar terms of the general inspection of heating networks are established by the respective head of the unit for maintenance or the head of the operating organization. Calendar terms of the general inspection of heating networks are installed, depending on the climatic conditions. Monitoring ensures the completeness, comparability, timeliness and accuracy of information about the technical condition of thermal networks. And it is also aimed at realizing the following functions:

- analytic function, which assumes on the basis of continuous monitoring surveillance of operation of heat networks of the process, to analyze the state of the heating system, which includes the measurement and comparison of actual results with the parameters specified circuits of heating systems;
- diagnostic feature that allows you to get complete information on the status of heating networks in operation;
- predictive function, which consists in reasonable assumptions about possible changes in the state of thermal networks in operation;
- organizational and management function, which assumes control over the condition of heating networks and the preparation of recommendations for correction and proactive solutions.

The following can be taken as the main stages of the integrated monitoring of heat network operation processes:

- substantiation of methodical approaches to the organization and the monitoring of the processes of operation of heat networks, including the definition of principles, objectives and tasks of monitoring, a description of the object of monitoring;
- definition of key performance indicators (indicators);
- definition of the methods and frequency (frequency) data collection at different levels of the process control system operation of heat networks with reproduction, description of methods of analysis;
- Data collection, analysis, synthesis and interpretation of the description of the forecast of possible changes in the state of monitoring the facility;
- presentation of the monitoring results, including the conclusions and recommendations for correction and proactive management decisions.

In addition, comprehensive monitoring of operating processes of heating networks is a tool to make effective management decisions. Basing on the PDCA cycle (Plan -Do-Control-Activity), we can conclude that the monitoring operation of the processes of heat networks is the most popular in the implementation of management functions such as planning processes of reproduction and control over the implementation of these plans,

because one of these two functions ends management cycle (control) and the other (planning), using monitoring results, starts the cycle again.

2.4 Indicators

Monitoring is supposed to be carried out using a system of indicators, which must comply with such requirements as

- Focus - indicators should be focused on the adoption of appropriate operational decisions,
- The timeliness and frequency - the frequency of incoming information to make timely decisions required to minimize the damage from adverse changes and maximizing the effect of the use of emerging opportunities,
- The dynamism, and the prospect of comparability,
- The accuracy, completeness or adequacy of indicators, taking into account the specifics of each monitored Enterprise,
- Efficiency - the effect of the use of identified opportunities in a timely manner should be greater than on monitoring costs.

A system to monitor the structure of indicators covering the main aspects of activity of the enterprises of housing and communal services is presented.

Monitoring indicators consist of five groups: 1) The operating activities of the company; 2) The costs of operating budget; 3) Applicability prices for contractors; 4) Applicability prices for businesses and organizations; 5) Analysis of financial condition (only for municipal enterprises).

3 Results

Among the most important results that make up the importance and novelty of the research, are the following:

proposed structural-logical model of monitoring management software energy efficiency operation of heat networks;

developed method of determining the parameters of complex monitoring system hierarchy process control entities operating heating networks;

proved management decisions in a system of hierarchy based on the information the subjects of management of complex processes for monitoring operation of heat networks;

proved practical use of information for monitoring operation of heat networks in the development of strategic and investment programs of heat network companies and other participants in the heat and power market.

Organizational-economic mechanism of energy efficiency in the operation of thermal networks based on the development (reproduction) of the property complex, through the use of integrated monitoring provides a synergistic effect in reducing the amount of energy losses and expenses for the development of heat distribution facilities;

4 Discussions

The management of the process of reproduction of heating networks involves many departments of the municipality administration (committees: housing and communal services; construction; maintenance of housing stock, the City Property Management, Labour and Social Protection, Energy and Engineering, Finance, Economy and Industry, and others.) . In this regard, in the management of the reproduction of thermal networks, there are certain difficulties of departmental nature that are aggravated by plenty of

mutually independent participants in this process: banks, insurance companies, construction companies, asset management companies, real estate owners, etc. It is therefore necessary to take into account the optimal combination of volumes of expanded and simple reproduction of the housing fund, ensuring their compliance with economic opportunities and the needs of society.

In the set of measures that form a system of economic stabilization of heat supply system of the municipality, the crucial importance should belong to the pre-empt emerging problems. The emergence of these threats creates various investment component of the territory, its attractiveness for inward investment from a variety of sources, including but not limited public investment, funds of enterprises, credit institutions, private individuals and others.

In the practice of process control operation of heat networks there are various risks associated with inadequate resourcing of the main directions of its development. The ways to limit these risks are:

- Continuous monitoring of the implementation of program activities, taking into account the factors of the current state of heat networks;
- Determination of status indicators and evaluation indicators of heat networks;
- Allocation of financial resources in view of the possible risks and depending on the pace of achieving the objectives of the implementation of the process approach in the distribution of functions, powers and responsibilities of all participants in the heat supply market.

In addition, when the reproduction of heating networks generated socio-economic effect must be taken into account in its implementation. Thus, the successful development of the reproduction of thermal networks is provided by the development of tools for the identification, assessment and risk management, taking into account the factors that ensure the fuel and energy balance, improve of the quality of investment planning, ensuring effective interaction between all participants in the process of reproduction and is aimed at increasing of the competitive advantages of the territory as a whole.

Accordingly, the main objectives of ensuring of the development of heating network management reproduction and the whole housing sector, should be:

- Rational and efficient use of existing engineering infrastructure, including heating networks;
- Reduction of heat loss during transport;
- Economical consumption of material, labor resources in the reproduction of thermal networks;
- Improving the information management system; [8]

Analysis of the current state of the conceptual bases for the operation of real estate, as well as trends in the construction industry as a whole, proves the necessity and inevitability of the transformation of criteria and indicators of the effectiveness of the decisions. It is possible to optimize decisions on the preservation and reproduction of real estate based on energy-saving measures setting multi-task dependencies. Organizational and technological support for the implementation of the tasks of effective operation should be based on the improvement of planning methodologies and repair work, which will increase the energy efficiency of the heating system operation.

5 Conclusion

Comprehensive monitoring of the condition of heating networks in operation, as part of improving the management system forms the surveillance and control systems carried out regularly on a specific program for a comprehensive assessment of the status of objects heat network management, as well as to analyze the changes occurring in them and the timely

identification of trends of these changes. Objective data obtained as a result of comprehensive monitoring and measurement, and based on them improvements are used in organization to continually improve the effectiveness of implemented thermal grid strategy.

A key landmark in the implementation of a strategy in the current conditions is to ensure the growth of the cost of the Heat Distribution Company. This issue is beyond the scope of this study and is a promising direction.

Since in the process of implementing of a specific strategy it is necessary to identify the most significant cost factors and include them as the comprehensive monitoring indicators to track the dynamics of promotion of Heat Distribution Company in the specified direction. The cost growth factors are always possible to determine its source. Correct definition of cost factors in the framework of a typical preferred strategy allows: in the planning - to establish their priority to ensure appropriate resources activities, and at the stage of execution – for managers and staff of the thermal grid companies to understand at what expense cost is maximized. Here introduce the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 10 pt. Here follows further instructions for authors.

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