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METHODOLOGY FOR THE OPTIMAL DEVELOPMENT OF DISTRICT HEATING SYSTEMS: THEORETICAL AND PRACTICAL RESEARCH

The paper presents a synthesis of research results on the development of scientific and methodological support for the comprehensive solution of the main technical, economic and organizational problems of designing, functioning and development of modern district heating systems (DHS). These studies were conducted at the Melentiev Energy Systems Institute of SB RAS during 2017–2019 under the support of the Russian Science Foundation (Grant No. 17-19-01209). The most significant results of these studies are presented in [1–5].
Within the framework of the developed scientific and methodological support, the following basic problems were solved: optimization of levels of district heating in DHS with feasibility study for connecting new consumers, selection of optimal forms and models of heating market for DHS, comprehensive analysis and ensuring (optimization) reliability of DHS taking into account the fuel supply of heating sources (HS), and other additional problems. Studies were carried out also on some aspects of the implementation of prosumer in DHS, mainly in terms of the optimal distribution of loads between district HS and prosumer's HS operating in DHS, as well as to ensure the reliability of DHS functioning taking into account redundancy of the prosumer.
Solving the statement problems posed in the framework of the work based on various methods, models and approaches: general systems analysis approaches, methodological principles of system research in the energy [6], optimization models based on linear and nonlinear programming methods, mathematical models of the general reliability theory and its application in technical systems, probability theory and random processes (in particular, Markov random processes), methods of the theory of hydraulic circuits (THC) [7], the method of statistical tests (Monte Carlo method), simulation modeling, methodical approach of the nodal assessment of heat supply reliability [8], iterative algorithms based on the coordinate-wise relaxation method, bi-level programming methods, fundamental laws of heat supply and heat transfer processes, game theory methods, methods of statistical analysis and approximation of actual data to obtain analytical characteristics of the studied objects for their mathematical modeling, technical and economic analysis of energy projects, and other methods.
The developed scientific and methodological platform makes it possible to solve different problems for the innovative transformation of DHS (designing, management, reliability and others) in a joint complex, taking into account their logical relationship and methodological compatibility, which ultimately provides support for decisions to achieve the maximum efficiency, economy and reliability of heat supply to consumers.
Based on the developed scientific and methodological ensuring following practical researches were carried out on existing DHS schemes of cities of the Irkutsk region:
1) optimal management of DHS in Angarsk, Irkutsk region, taking into account the diverging interests of heating market participants;
2) determination of the optimal scale of development of the existing DHS in Irkutsk based on the optimization of the effective heat supply radius taking into account the reliability of heating to consumers;
3) comprehensive reliability analysis of DHS in Shelekhov, Irkutsk region, taking into account the fuel supply to HS.
Provided practical studies have confirmed the applicability and efficiency of the methods and models developed in the project, not only for test calculation schemes but also for existing DHS of cities. Based on the results of practical calculations, new indices and characteristics for studied systems were obtained, directions for their effective functioning and development were formulated with the joint solution of the complex of the most key and relevant technical and economic problems for the heat supply industry.

References

1. Postnikov I., Stennikov V., Mednikova E., Penkovskii A. Methodology for optimization of component

reliability of heat supply systems. Applied Energy 2018, vol. 227, pp. 365–374.

2. Penkovskii A., Stennikov V., Mednikova E., Postnikov I. Search for a market equilibrium of Cournot-Nash in the competitive heat market. Energy 2018, vol. 161, pp. 193–201.
3. Postnikov I., Stennikov V. Modifications of probabilistic models of states evolution for reliability analysis of district heating systems. Energy Reports 2020, vol. 6, pp. 293–298.
4. Stennikov V., Penkovskii A. The pricing methods on the monopoly district heating market. Energy Reports 2020, vol. 6, pp. 187–193.
5. Stennikov V., Mednikova E., Postnikov I., Penkovskii A. Optimization of the effective heat supply radius for the district heating systems. Environmental and Climate Technologies 2019, vol. 23(2), pp. 207–221.
6. Melentiev L. System research in the energy. Elements of the theory. Directions of development. Moscow: Nauka, 1983.
7. Merenkov A.P., Khasilev V.Ya. Theory of hydraulic circuits. Moscow: Nauka, 1985.
8. Sennova E.V., Smirnov A.V., Ionin A.A. et al. Reliability of heat supply systems. Novosibirsk: Nauka, 2000.

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