Development of the theory of complexly closed city electrical networks

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Abstract. The article discusses the issues of optimization and selection of the most rational scheme of a complex electrical network for the power supply of a microdistrict. And this requires the development of a more accurate definition of the calculated electrical loads of consumers, as well as the total loads of TP, RP, GRP, standard daily schedules, specific standards for calculating electrical loads, new building codes and regulations to replace the old KMK 2.04.17-98, determination of the most advantageous power and number of transformer substations, calculation of systems of complex power supply circuits using various methods, new technologies and digital automatic relay protection of urban power supply systems, use of reverse power automatic machines, contactless elements in power supply systems.

1 Introduction

Currently, due to the widespread use of electronic technology, the consumer of electricity in cities, when drawing up a contract, requires an uninterrupted and high-quality electricity supply from the energy supply organization.

Based on the Decrees of the President of the Republic of Uzbekistan on the comprehensive construction of massifs, neighborhoods, microdistricts under one cadastre, where there will be no more new construction of facilities, these requirements of electricity consumers can be met on the basis of complex urban electrical networks.

The relevance is confirmed by the need to reconstruct and modernize existing and planned new urban electrical networks that meet the requirements of new times; this poses the task of developing new approaches, methods and formulas for determining maximum (calculated) electrical loads, calculating optimal power consumption modes, rational use of electricity, reliable and high-quality power supply receivers and consumers of electricity in cities. Analysis of the structure and scale of electricity consumption in cities, accurate and reliable determination of maximum (calculated) electrical loads, optimization of modes and calculation of electricity losses, energy saving, energy efficiency and energy saving, as well as reliability, rational construction of power supply schemes and quality of electricity at this stage are very relevant and vital. The solution to these problems is of great economic and scientific importance.

2 Experimental research

In this regard, the task is to achieve high energy efficiency in urban power supply systems; for this it is necessary to solve the following problems [15-26]:

1. Development of reliable design of urban power supply based on a more accurate determination of the calculated electrical loads of consumers, as well as the total loads of transformer substations, distribution centers, and gas distribution centers using new patented methods for calculating electrical loads, probabilistic statistical approaches to solving the problem.

2. Development of new specific standards for calculating electrical loads of all similar consumers in the residential zone of cities.

3. Development of standard daily schedules of electrical loads for each type of electricity consumer in cities. (based on summer and winter daily maximum load patterns.)


5. Development and determination of the most advantageous capacity and number of transformer substations, the array, block, microdistrict under construction.

6. Optimization and selection of the most rational scheme of a complex electrical network for power...
supply of an area, block, microdistrict. Choosing the most reliable and economical power supply scheme.

7. Calculation of systems of complex power supply circuits using various methods. Choosing the most economical option.

(Loop current method, equalizing power method, superposition method, nodal voltage method, transformation method, transformation method, moment method, circuit splitting method, etc. Calculation of lines with two-way power supply.)

8. Development of new technologies and digital automation for relay protection of urban power supply systems. The use of digital automation in power supply systems, reverse power circuit breakers, new relay protection technologies, the use of contactless elements in urban power supply systems.


The number of measurements and justification of the results of the energy audit of each individual type of electrical consumer with an interval of 5 minutes is required $n = 10760$, during summer and winter maximum loads.

3 Research results

Issues of reliability and quality of electricity, regardless of the category of consumer reliability, poses the task of uninterrupted and high-quality power supply. In this regard, on the basis of the Decrees of the President of the Republic of Uzbekistan “On the integrated construction of arrays (under one cadastre)” in Tashkent “New Sergeli”, “New Tashkent City”, “New Olympic Town”, New areas in Namangan, Andijan, Khorezm, Karakalpakstan, etc. Under one general plan, under one cadastre, where there will be no new construction. As a result, it is possible to use complex electrical networks using digital automation when designing power supply in cities [27-35].

The consumer receives electricity from 2-3 sides. The reliability of power supply is increasing dramatically. Next, the optimal power supply scheme, which is the most economical, is developed and selected. On the one hand, with three times the reliability of power supply, and on the other hand, it allows you to get the same voltage at all network nodes, and this means high-quality electricity.

The use of digital automation and computer software products makes it possible to fully automate the entire process of design and operation of complex urban electrical networks.

The weakest and most unreliable link in the energy system of the Republic of Uzbekistan is the electrical networks of 0.4 – 6 – 10 kV, which have a length of more than 80% and large losses of electricity. These electrical networks require modernization and reconstruction, since they were built 50 years ago.

4 Conclusion

1. Thus, for the first time in the Republic of Uzbekistan, the complex and very urgent problem of rational construction of urban power supply systems, reliability, quality of electricity, optimal choice of transformer power, energy saving in cities and energy efficiency of new technologies for metering and control of electricity consumption are being considered.

2. Based on a systematic approach, information and analytical models of power consumption, solving the complex problem of optimizing electrical modes and energy saving of all structural elements of urban power supply systems, it is possible to ensure a significant national economic effect, expressed in reducing electricity losses, saving non-ferrous metals, increasing the reliability and quality of electricity, energy saving in urban networks.

3. Solving the problems of power supply to cities is unthinkable without an accurate and justified determination of the calculated electrical loads, since electrical loads form the basis of all calculations of power supply and the rational construction of urban electrical networks. Their magnitude largely determines the network configuration and the choice of its parameters. In recent years, there has been a tendency towards a sharp increase in the share of electricity consumption of the municipal and public sector in the total electricity consumption of cities. An important component of the utility load is the load of public buildings and a sharp increase in the amount of electricity and power consumption by small and medium-sized businesses.

4. The electrical load of urban networks plays a large role in the formation of daily and annual schedules of energy systems and is the source material for the design of new and reconstruction of existing urban electrical networks. As a result, the study of actual loads, their correct determination and forecasting, allows, on the one hand, to ensure high-quality power supply to consumers, and on the other hand, makes it possible to avoid unnecessary expenditure of money, transformer power and cable products in urban networks, and obtain high energy efficiency and energy saving.

5. The use of new energy metering and control technologies has been so important in recent years that, on the basis of this, the government of Uzbekistan has
published a number of Resolutions and regulatory documents, as a result of which the imbalance of electricity on a general scale has sharply decreased [36-43].

References

9. A. G. Saidkhodjaev and Kh.R. Nuriddinova Reforming of energy sector of Uzbekistan: Transition to market and increasing generation Cite as: AIP Conference Proceedings 2552, 050037 (2022); https://doi.org/10.1063/5.0112388 Published Online: 05 January 2023