INNOVATIVE TECHNOLOGIES OF POWER TRANSMISSION LINES USED IN AGRICULTURE IN ARMENIA

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Key words: electricity, power transmission line, innovation, technological progress, electricity, technology

Introduction. The power transmission line (here in after referred to as the transmission line) is one of the main components of the electrical network. These objects are a system of power equipment, the purpose of which is to transfer electrical energy using electric current. As part of this system, there is an electric line that goes beyond the conversion of a power plant or substation. Cable and overhead power lines differ. It is also worth noting that gas-insulated lines (GIL) are becoming increasingly popular today.

In addition to electricity, information is also transmitted through power transmission lines (via high-frequency signals). This option is used for dispatching control, the transmission of telemetry data, as well relay protection signals, and maintenance of emergency automation. Separately, it is worth noting overhead power lines (overhead lines). This device is used for transmission and distribution of electricity through wires located outdoors and attached using traverses, insulators, and fittings to supports and other structures [Myasoedov, Korzhova, 2019, 24-34].

Methodology. We use theoretical and empirical research methods. As a result of the work, we made references to scientific materials of such authors as Myasoedov Yu.V., Korzhova O.N., Gavryushina N.T., Gavryushin S.S., Arbuzov E.V., Burnysheva T.V., Kozhevnikov A.N., and others. Each of these papers examines in more detail one of the issues related to the topic of this study. Thus, in the literature used, such issues were disclosed as melting ice on power lines: methods, innovations, operation; power supply of an alarm system from a high-voltage power line; a capacitive power source for devices measuring parameters of an overhead power line and others.

Literature review. One of the priority directions of socio-economic development in rural areas of Mordovia is the development of energy infrastructure. The level of development of the energy economy, and the provision of rural settlements with electricity is a kind of indicator of the quality of life in rural areas. Electrification of agricultural consumers is of great importance because it contributes to the development of agri-

culture on an industrial basis and is the solution to many social issues of rural residents. The provision of rural settlements with electricity is a kind of indicator of the quality of life in rural areas. Electrification of agricultural consumers is of great importance because it contributes to the development of agriculture on an industrial basis and is the solution to many social issues of rural residents [Gavryushina, et al., 2018, 110-121].

In agriculture, aluminum, steel aluminum (that is, aluminum with a steel conductor bearing the main mechanical load), and steel both multi-wire and single-wire are used. For the designation of wires, letters are used denoting the material from which the wire is made, and numbers indicating what is the cross-sectional area of the wire. For example, PSO-5 means a steel wire, single-wire, with a diameter of 5 mm; A-16 – aluminum, multi-wire, having a cross-sectional area of 16 mm2; AC - 16 - the same, but steel-aluminum, etc. For rural overhead lines, wooden, wooden with reinforced concrete prefixes, and reinforced concrete supports are used. According to the value of the support, it is divided into intermediate, anchor, corner, end, branch, and cross. By design, the supports are single-line, with struts, braces, and U-shaped.

Analysis. When creating a new generation of power lines, an important role is assigned to wires, the nomenclature of which has already reached several dozen names and will only expand in the future. Different cross-sections of both traditional (steel-aluminum) and innovative conductors determine the carrying capacity of the wire, its weight per unit length, structural strength, metal consumption, the amount of capital investment, and subsequent costs.

The technical and economic feasibility of using modern wires has been repeatedly proven, which can significantly increase the capacity of lines, reduce power losses, and have improved physical and technical characteristics, which as a result will affect the efficiency of the functioning of energy and capacity markets and the quality of regime management. The use of new generation wires makes it possible to solve the main tasks of the power grid complex related to increasing reliability, uninterrupted power supply, reducing losses, and increasing throughput. The use of new generation wires can reduce the losses of power transmission lines by up to 30% and increase their throughput from 1.5 to 2 times. Replacing existing wires with new generation wires allows you to achieve savings by reducing losses to 98 thousand rubles per 1 km of line per year and at the expense of an additional transmitted capacity of 150 - 250 million rubles. per line per year [Korzhova, 2021, 43-56]. One example of a new generation of wires is high-performance wires with a composite core ACCC (Aluminum Composite Core Conductor - aluminum wire with a composite core) are a novelty for the Russian electric power market. This technology of the American company STS uses in its development of composite materials made of carbon fiber – carbon filaments, which are significantly light and durable relative to steel. It should be noted that the implementation of full-scale

innovative projects, for example, Smart Grid, is impossible without the introduction of a new generation of wires, which are an innovative solution based on new technologies and materials, high-quality raw materials.

Due to the obvious increase in the cost of energy resources, losses that were previously almost ignored have now become too expensive. The high level of losses in Russian power grids (about 5% for FGC and 8-11% for IDGC) is determined not only by the high level of deterioration of power grid equipment and the difficult conditions of the Russian climate. During the implementation of pilot projects with new generation wires, it turned out that despite all the obvious advantages and economic effects, there are administrative barriers to the introduction of innovative wires.

Another direction of innovative development of power transmission lines is digitalization and intellectualization of objects. It is through information technologies that high efficiency and rationality of the use of enterprise resources are achieved and ensured today, as well as innovative solutions, are being developed in the professional sphere of human activity. One of the most relevant and innovative areas in the field of information technology development is the Internet of Things (IoT). The concept of the Internet of Things is based on a data transmission network, through which people get the opportunity to communicate with technical devices, and technical devices with people [Zaidullina, Potapchuk, 2018, 97-106].

IoT technology allows you to organize two-way communication through power lines. In other words, data exchange becomes possible even where there is no cellular network coverage, and satellite and terrestrial wired communications are unavailable. The development is based on the technology of broadband data transmission through power lines (BPL, Broadband over Power Lines). For the organization of communication, special SSL modems connected to electrical lines are used. The equipment operates on a power line with a voltage from 0.4 to 35 kV. It is important to note that the system is suitable for exchanging various traffic. This can be telemetry data, voice information, video signal, and so on. With the help of the Internet of Things, devices are combined into a single computer network, through which it is possible to collect, analyze, process, and transfer data between objects through specialized software or another technical device. Smart devices function autonomously, while a person can configure them and provide access to data. Internet of Things technologies work in real-time, and they often include networks of smart devices and a cloud platform to which they are connected via Bluetooth, WiFi, or other types of communication. Internet of Things technologies can significantly rationalize and improve the efficiency of modern electric power systems [Uzbekov, Nematzhonov, 2019, 11-18].

Fluctuations in power flow and an exponential increase in network complexity require more flexible assets with broader capabilities that go far beyond existing

monitoring, control, and automation systems. For a digital and decentralized network, high-voltage transmission devices at substations, such as transformers, switchgear, and circuit breakers, must be connected by default. The operational data of intellectual assets can be analyzed in real-time, and recommendations for improving performance can be implemented. This type of integration and operation creates the Internet of Energy (IoE) for the networks of the future (Fig. 1). IoE is a new generation of digital products, systems, and solutions for modern power lines. It can be independent or integrated either into a corporate network or interact with the cloud.

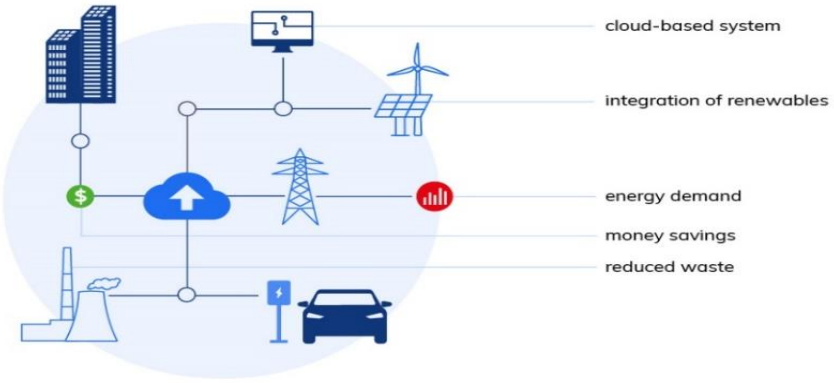

Figure 1. The architecture of the Internet of Energy

It is also necessary to note the innovative technologies in power lines associated with the ability to self-rebuild. DLR is a technology of intelligent power transmission lines that allows you to determine the "rating" of a power line conductor based on its temperature in real-time. Currently, conductors are usually assigned a conservative static rating based on almost the worst weather conditions [Tuichiev, Ismoilov, Tursunov, Baynazarov, 2019, 67-78], [Bagautdinov, Kuvshinov, 2016, 4-11].

Conclusion. These products combine the strengths of local and high-performance data processing directly on the local system with the advantages offered by the cloud: application-based data analysis, data processing, and storage concepts, application up-dating and versioning, as well as appropriate device management. The data does not leave your local substation network, which gives additional flexibility in making in-formed and timely decisions.

Thus, the main purpose of this article was modern technologies and innovations in power lines. As a result of the work, the main trends and innovations in the aspect of the development of modern power transmission lines were studied. In conclusion, it should be noted that the technical modernization of modern power lines is a rather complex and multifaceted process, which is based on the coordination and integrated use of innovative technologies with traditional solutions. It is this approach, taking into account

the current state of the operating conditions of electric power complexes, that can achieve significant technical and economic results [Burnysheva, Kozhevnikov, 2021, 113-121].

As a result of the work, we obtained unique conclusions representing scientific novelty in the field of rural power lines. The scientific significance of the work lies in the possibility of using the presented materials in further research on this topic and the development of promising solutions that require the study of the subject area.

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We make a unique study of the use of modern power lines and the identification of the main disadvantages. In addition, we also suggest possible solutions. As a result of the work, the technical and economic feasibility of using modern wires has been proven, which can significantly increase the capacity of lines, as well as reduce electricity losses, and have improved physical and technical characteristics, which as a result will affect the efficiency of the functioning of energy and power markets and the quality of regime management. Also, for the first time, we comprehensively analyzed the issue of intellectualization of rural power lines and applied the definition of the Internet of Energy in this direction.

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