Therefore, information security is a priority area, like the economy or the social sphere. Success in the field of information security can only be achieved through a comprehensive approach that combines proper management (administrative level), the company's efforts to convince employees of the need to improve information security (procedural level), the creation of legislation and state control over the level of information security (legislative level), use of domestic software and information technologies (software and technical level).

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ACTUAL PROBLEMS OF DESIGNING AUXILIARY DIRECT CURRENT POWER SUPPLY SYSTEMS FOR ENERGY FACILITIES IN UKRAINE

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Auxiliary direct current power supply system (ADCPSS) is an important subsystem of any energy facility - power plants and high-voltage distribution substations. ADCPSS is designed for uninterrupted and high-quality power supply of such critical systems as a relay protection system, a process automation system, emergency technological equipment and emergency lighting, which are essential for the overall operation of the energy facility.

Therefore, standardized, enhanced requirements should be applied to the design of the DC EPS to ensure the following parameters:

– high reliability and durability of the system;
– required quality of electrical power in the DC power supply network;
– quick fault localization in individual sections of the system (sensitivity and selectivity of short-circuit protection);

– optimal configuration of the system, which ensures the required reliability and degree of power supply redundancy for critical systems, ease of operation (providing battery maintenance operations, performing rapid switching, monitoring the state of the system, maintenance of repair and replacement of other system elements), and safety.

ADCPSS includes the following main elements: batteries, rectifier chargers, DC switchboards, protection, monitoring and insulation control systems.

Currently, the following regulatory documents are in force in Ukraine, which establish requirements for the design of ADCPSS:

– Regulations for the installation of electrical equipment approved by the order of the Ministry of Energy and Coal Industry of Ukraine dated July 21, 2017, No. 476;

– Enterprise Standard. Technical policy of NEC "Ukrenergo" in the field of development and operation of transmission and interstate power grids" (SOU NEC 20.261:2021);

– Technological design standards for high-voltage AC substations from 6-750 kV (GKD 341.004.001-94);

– Technological design standards for power systems of electric networks of 35 kV and above (SOU-NEE 40.1-00100227-101:2014);

– Standards of individual enterprises and organizations of the energy industry.

However, these regulatory documents contain only general requirements that do not allow standardization of solutions for ADCPSS designing. Additionally, these regulatory documents include outdated requirements, contradictions, and ambiguous requirements, which significantly complicates decision-making during the design process. As a result, the technical solutions adopted in the design of ADCPSS for each construction, reconstruction, or technical re-equipment project in Ukraine vary significantly, often containing flaws and errors.

Thus, the development of guidelines for ADCPSS designing is essential. These guidelines should contain standardized technical requirements and typical solutions. This would allow standardization of ADCPSS technical solutions used in Ukraine, and ensure compliance with modern requirements for reliability, functionality, and safety.

Taking into account the transition of Ukraine to European standards it is necessary to solve the following tasks to develop guidelines for the ADCPSS designing:

– harmonize the requirements of existing European IEC standards and existing Ukrainian norms regarding ADCPSS;

– review, systematize and detail requirements for ADCPSS regarding reliability, safety, functions, and individual elements such as batteries, rectifiers, switchgears, and monitoring systems;

– develop standardized structural diagrams of ADCPSS for different types of energy facilities;

– create a modern methodology for battery capacity sizing and rectifier parameters determination;

– develop a modern method based on the DSTU EN 61660-1:2022 standard for short-circuit currents calculating and selecting protective devices for the direct current network, taking into account selectivity and sensitivity;

– determine the required number of protection levels and types of protective devices in the direct current network;

– define requirements for information volume transmitted from the ADCPSS monitoring system to the process automation system, as well as for transmission data protocols based on the IEC 61850 family standards;

– establish requirements for functions and parameters of the ADCPSS insulation monitoring system, such as working range of network capacitance, insulation resistance range for damage localizing, internal resistance of the system, maximum injected current or applied voltage, and others.

The relevance of developing standardizing documents for the ADCPSS system confirms the fact that currently, the International Electrotechnical Commission (IEC) is working on the development of the IEC TS 63346 family of standards for low-voltage auxiliary power systems. The goal of this family of standards is standardization in the field of low-voltage auxiliary power systems for electrical power stations and substations, including :

– system design;
– installation and acceptance;
– commissioning;
– operation and maintenance;
– safety and reliability.

This family of standards will include the IEC standard TS 63346-2-2 ED 1 «Low - voltage auxiliary power systems - Part 2-2: Design criteria - Low - voltage d . c . auxiliary power systems for substations», which will specify the requirements for the NSSTP. Developed guidelines for the design of ADCPSS will also need to be harmonized with this standard after its official publication.

Therefore, the development and implementation of guidelines for the design of ADCPSS is a relevant task. Its solution would, firstly, enable the improvement of the technical level of implemented SSNPT and bring them in line with European standards. Secondly, it would simplify and speed up the design process of these systems. Thirdly, it would increase the reliability of energy facilities, and ultimately, the level of energy security of the country.

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HYDRAULIC REGIME CHARACTERISTICS OF BRANCHED DISTRICT HEATING NETWORKS

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The desire to reduce heat losses in centralized heating systems has led to the emergence and development of the idea of replacing traditional four-pipe district heating networks with two-pipe ones. When conducting preliminary assessments of the thermal state of heating networks, it is convenient to use simplified methods developed under a set of assumptions and simplifications, given the limited input data. In real networks, the change in heat carrier flow rate along the length of the network has a stepwise nature with constant values on certain sections.

The development of simplified methods[1] for calculating thermal and hydraulic indicators of heating networks involves replacing the actual stepwise law of variation of heat carrier flow rates with a monotonic one and using the average diameter of the heat pipes. The study uses a stepwise distribution law of heat carrier flow rates along the length of the pipeline:

$$\bar{G}(\bar{x}) = 1 - \bar{G}_{\text{branch}}\,\bar{x}^{n}$$

where $\bar{G} = G / G_{max}$ is local relative flow rates of the heat carrier in the branch; G_{max} is the flow rate of the heat carrier at the branch inlet; $\bar{G}_{branch} = G_{branch} / G_{max}$ are relative flow rates of the heat carrier through all branches in the branch; $\bar{x} = x / L$ is relative coordinate; L is the branch length.

For n > 1, there is a sharp decrease in the flow rate of the heat carrier on the sections close to the entrance to the branch of the heating network, with a gradual decrease in flow rates to a minimum value of G_{min} on the branch. The value of n = 1 determines the linear nature of the flow rate change. For n < 1, there is a slight decrease in flow rates at the input sections and a sharp decrease in flow rates at the output sections.