Plan
scientific research work
Departments of "Energy Systems"
for 2023-202–2024 academic year

1) on the initiative topic "CAD in the electric power industry"

n /	a Job title Completion	dates	Expected results
1	Development of cargo airlift power supply systems	September	Comp. model of cargo airlift power supply system
2	Development of cargo airlift alarm systems	October	Comp. model of cargo airlift alarm system
3	Development of Cargo airlift control systems	December	Comp. model of cargo airlift control system

2) on the initiative topic "Analytical research and development of a package of computer programs for predicting the properties of electrical materials for the electric power industry, insulation equipment and high voltage equipment"

n /	a Title of work	Deadlines	Expected results
1	Analysis of physical and chemical properties and crystal structure features of layered materials (crystal hydrates, layered silicates, ceramics, etc.) used in modern industry.	01.05.2023-01.06.2024	1.1 A description of the crystallographic (geometric) and physico-chemical features of the crystal structure and an analysis of the properties of hydrogen-bonded crystals (HBS) detailed on a wide range of changes in field and temperature parametersств кр. Classification of KVS by structural features and electrophysical properties. 1.2. Electrophysical, magnetic and optical properties of KVS. Determination and investigation of the polarization and conduction processes in KVS, from the point of view of the theory of proton semiconductors and dielectrics (PPD). Formulation of the main provisions of the universal physical and mathematical model of proton-relaxation polarization and conductivity in the PPD.
2	Development of experimental schemes for studying the electrophysical properties of KVS. Determining the conditions for performing experiments.	01.06.2024-01.07.2024	2.1. Development and approbation of the methodology for experimental studies of the properties and parameters of the CFS structure by dielectric spectroscopy. 2.2. Description of the methodology for the preparation of samples of CVS (mica, talc, water compounds of inorganic salts) of micrometer dimension (1-10 microns). Schemes of various options for connecting an experimental sample to a measuring cell, based on an electrical circuit consisting of nonlinear elements with a given type of electrical

			conductivity (capacitive, active, mixed elements) connected to a source of constant and variable EMF. Formulation of boundary conditions for the processes of space-charge polarization in a dielectric.
3	Experimental studies of thermally stimulated polarization and depolarization currents in KVS.	01.09.2023-01.	10.2023 Development and implementation of a scheme for precision measurements of temperature spectra of thermally stimulated polarization currents (TSTP) and depolarization currents (TSTD) in KVS. The Bucci and Fieschi method.
4	Theoretical studies of the physical mechanisms of thermally stimulated polarization and depolarization currents in KVS.		Calculation of theoretical spectra of thermally stimulated currents using the phenomenological and Reeve models. Numerical calculation of the characteristic parameters (activation energy and equilibrium concentration) of structural defects by thermostimulated depolarization. Comparative analysis of the results of numerical calculations of the parameters of relaxers using various mathematical models of thermostimulated depolarization in KVS. Identification of parametric limits of applicability of the Bucci-Riva formula. Conditions for restrictions on the frequency of natural vibrations and on the activation energy of relaxers (Bjerrum defects and water molecules).
5	Experimental studies of the dielectric loss spectra in KVS.	01.10.2023-01.	11.2023 Development and implementation of precision measurement schemes for frequency-temperature tangent spectra of the dielectric loss angle in ionic dielectrics. Resonant method for measuring dielectric losses based on an equivalent circuit consisting of parallel-connected oscillatory circuits (main and additional circuits) connected to a variable EMF source. Development of schemes for measuring the electrical capacitance and conductivity of experimental samples using a Q-meter and a low-frequency alternator. Determination of the resonant frequency for the processes of space-charge polarization in ionic dielectrics with a complex crystal lattice structure (CVS; ceramics; perovskites, etc.).
6	Theoretical studies of dielectric loss spectra in CVS.	01.11.2023-01.	12.2023 Development of a methodology for theoretical studies of the frequency-temperature behavior of complex permittivity (CDP) spectra in ionic dielectrics. Output of variance relations for KDP components. Construction and research of Cole-Cole diagrams. Output of the calculation formula for the tangent of the dielectric loss angle.

7	Methodology of numerical calculation of parameters of relaxers.	01.12.2023 - 01.01.2024	Numerical calculation of the characteristic parameters (activation energy and equilibrium concentration) of structural defects in dielectrics by the resonance method. Activation energies calculated from experimental and theoretical graphs of the tangent of the dielectric loss angle. Optimization of numerical values of the characteristic parameters of relaxers by minimizing the comparison function (MFS - method) of theory and experiment, by computer-automated enumeration of the values of the desired parameters (microscopic and macroscopic) on a set of points of the continuum measure in the vicinity of the experimental maximum of the measured value (current density, polarization, CDP).