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**“STAFF TRAINING IN SOLAR ENERGY: TECHNOLOGIES,  
METHODS AND INSTRUMENTS”**

**PROGRAM**



**Development of the targeted Educational program for Bachelors in  
Solar Energy in Uzbekistan**

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# DEVELOPMENT OF MONITORING METHODS OF OUTPUT QUANTITIES AND PARAMETERS OF SOLAR, WIND ENERGY SOURCES, ACCUMULATOR BATTERIES AND CENTRALIZED POWER SOURCE

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**Abstract.** In the article given the methods of developing of monitoring and researching of the output quantities and parameters of solar, wind energy sources, accumulator batteries and centralized power systems, constructing of models for research of their output electrical quantities and parameters, methods of analyzing of researched results. In the article are modeled on the basis of computer solar, wind power sources, accumulator batteries and centralized power source s, theoretically and experimentally researched the dates of stationary and mobile power sources, devices of remote monitoring of single and three-phase currents and voltages of the electrical power, determined indicators of isolated power sources, developed monitoring methods of output quantities and parameters of power source.

**Key words.** Solar energy, wind energy, energy converters, battery, energy source, energy system, current, voltage, graph, quantities, parameters, model.

**Introduction.** The scientific research carried out to improve of the methods of research of solar, wind energy sources, accumulator batteries and centralized power source of hybrid power system and methods of control and monitoring of their output parameters. In particular, expanding the capabilities of the electric current and voltage control system in production and utility devices and equipment, which are among the most responsible consumers in the provision of electricity, is one of the urgent issues, in which the main output parameters of the

hybrid power system and current and voltage conversion devices and equipment by indicators such as high accuracy, speed, reliability, sensitivity, as well as the quality and continuity.

Attention is being paid to updating the types of electrical current and load, control and monitoring information-measuring instruments and equipment of solar, wind energy sources, accumulators' batteries and centralized power source and output electrical quantities and parameters. Control and monitoring of current and damage of electric energy in the conditions of this state is considered to be one of the important roles of improved types and practice of stationary and mobile power sources, devices and equipment [1-3].

In the preparation of the article, great importance was attached to the data of theoretical research and practical tests of researching output values and parameters of solar, wind energy sources, accumulator batteries and centralized power source of energy system.

**The main tasks of the research:**

- development of analytical and simulation models for theoretical and practical monitoring of output values and parameters of solar, wind energy sources, accumulator batteries and centralized power source of power system systems;

- development of criteria of rationalization of the output quantities and parameters of solar, wind power sources, accumulator batteries and energy system systems;

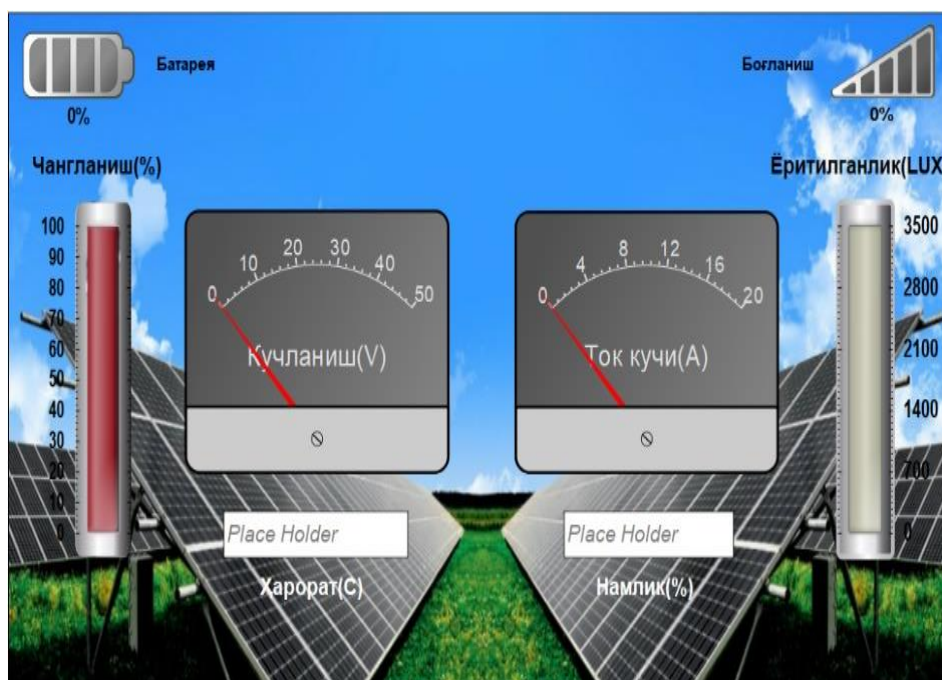
- development of practical guidelines and conclusions on use of solar, wind energy sources, accumulator batteries and centralized power source and the method of their formation on the bases on international standards;

- on the basis of DEBSEUz project of the European Union "Erasmus+" project, the implementation of test-experimental activity and scientific research works in cooperation with well-known scientists of partner universities of European universities on solar, wind energy sources, accumulator batteries and centralized power system.

**Methodical bases.** In the process of scientific-methodical research of receiving, changing and processing energy used methodic of signal processing, monitoring, data forming graphs, error theory, descriptions of sensors and transducers of signals, values of active and reactive power, current and voltage of electric energy measurement and research algorithms, control and monitoring of the database.

**Modeling.** Processes of signals transforming, forming output voltage in the activity of measure and monitoring of output quantities and parameters of solar, wind energy sources, accumulator batteries and centralized power source, extracting important information from them and parameters based on integrated data nets importance during development of automatic recognition methods. Actually, the main reason for this is that the complexity of the control and management devices surrounding humanity has led to the difficulty of the principles of interaction with them. This situation has not bypassed the digitization of energy supply processes today. In systems and equipment's of remote monitoring of energy supply sources, much attention is paid to the identification of the type of source, which using in information systems, design and implementation of mechanisms of control of power sources, according of the level of energy production in the interfaces of many software applications.

Web interface for researching of power sources was developed in order to performed tasks set in stage of modeling the remote monitoring system of solar, wind energy sources, accumulator batteries and centralized power source of energy system, on the basis of output quantities and parameters (Fig. 1).

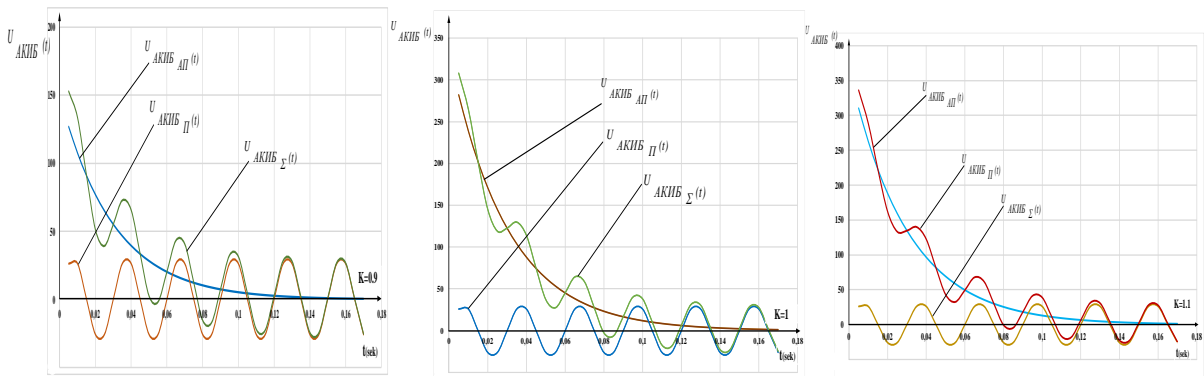


**Fig. 1.** Web interface of modeling the remote monitoring of solar, wind energy sources, accumulator batteries and centralized power source, on the basis of output electrical quantities and parameters

The process of converting the dates of primary electric currents and voltages to output signals, as a secondary voltage in signal conversion, monitoring and control of solar, wind energy sources, accumulator batteries and centralized power source energy supply monitoring, requires modeling of the signal conversion devices involved in the process and the physical and technical effects that occur in them.

### **Results:**

The results of the dynamic descriptions of the output quantities in the monitoring of solar, wind energy sources, accumulator batteries and centralized energy source of power supply are presented in the following sequence (Fig. 2).



1)  $K=0.9, T=0.03$

2)  $K=1, T=0.03$

3)  $K=1.1, T=0.03$

**Fig.2.** The dynamic characteristics of the output values as voltage, researched during remote monitoring of solar, wind energy sources, accumulator batteries and centralized power source of energy system

The results of researches showed, that simulation model signal processes of the monitoring of solar, wind energy sources, accumulator batteries and centralized power source of energy supply system is highly level formed, along with the exact physics of energy change and include technical effects and provide high accuracy of researched dates.

### Conclusion:

1. Taking into account the load, the temperature of the power supply system, and the dustiness of the surfaces of the solar energy converting panels, determined possible improved their service life and technical condition by 4-5% by on time monitoring of sources of solar energy.

2. The geometric dimensions of measuring and control devices corresponding to the requirements of remote monitoring and control of power system output sizes and parameters with stationary and mobile energy supply sources were researched, and technical maintenance of energy supply sources in objects was carried out based on their practical application and submit possible to reduce rendering time about 8-11%.

3. As a result of the research, the technical parameters of the energy efficiency measurement and control device, include primary voltage 0~260 V, nominal current 100 A and power – 25000 W, frequency – 45/65 Hz and the measurement accuracy of the device is within 0.5 class ensured.

4. Created measurement and control was confirmed on the basis of research, that the amount of output voltage changes linearly up to 7.1634 V, when primary currents up to 100 A, through the conductors of monitoring devices, on this basis of linearity of the measured value, when the criterion is met, the output voltage of the device is within the norm.

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## **RESEARCH ON THE WORKING EFFICIENCY OF BETA-TYPE STIRLING ENGINES WORKING AT LOW TEMPERATURE DIFFERENCES**

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**Abstract.** Stirling engines are distinguished from other types of engines by their quiet operation and the ability to operate using any heat source. The fact that



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