Prospects for the Introduction of an Automatic Control System of the Technological Process in the Substations of the Energy System of Uzbekistan

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Abstract: The article considers the expediency of the introduction of an automatic control system of the technological process in the existing substations in the energy system of Uzbekistan. The automatic control system of the technological process of the substation is a functionally software-technical Komplex, which is designed for the management and control of energy objects, convection, operational-distillation control and monitoring of the operating mode of the substations. In addition, in the system of automatic control of the technological process, an assessment of the quality of electricity, the state of telemechanics and computing systems, the presence of a recording function of the accident profiles, the main advantages and disadvantages of its application are identified, acquainted with its main functions. The impact of this system on the reliability of power supply and the role it plays in increasing the safety of operational work has been considered.

Keywords: ACS TP electric substation, remote operational control, electric substation, monitoring, RPA.

Introduction. Today, in the energy system of the Republic of Uzbekistan, the work on modernization and reconstruction of obsolete equipment in electrical networks in order to ensure the practical implementation of a number of decrees and decrees of the president of the Republic of Uzbekistan continues intensively. In particular, various projects are being implemented in the substations of the main electrical networks for the replacement of spiritually obsolete equipment and the introduction of new technologies. Given the fact that high-voltage power networks are of strategic importance for the development of the country's economy, the reliability and safety of these works remains an urgent problem that requires a solution. Further expansion of reforms and introduction of new technologies serve as the most urgent task to increase the efficiency of energy facilities and the entire energy system as a whole. In the existing substations in the energy system, a solution of many of the tasks set by the introduction of an automatic control system of the technological process is found. That is conducting preliminary modernization work in the existing substations, which are located mainly in the territory of the city.

The main part. Scientific and practical work is carried out in our country on increasing the efficiency of existing technological facilities and processes in the regions at an accelerated pace. The issues of step-by-step numbering of technological processes and profiles in the regions eliminate many problems that exist in the system. Increasing the efficiency of technological facilities and processes is ensured by solving the following problems [1-6]:

- control and accounting of technological process parameters;
- to ensure the reliability and safety of process control and, on this basis, to increase the reliability of power supply to consumers;

- process control optimization;
- storage and resource expansion of technological equipment;
- prevention of accidents and elimination of their consequences at low cost;
- save operational cost;
- reduce economic losses as a result of inadequate information and overall security.

The emergence of new international standards and the development of modern Information Technology open up opportunities for innovative approaches to solving tasks, which will allow the introduction of an automated control system into newly developed substations. To date, an automated system of process management is successfully implemented in some substations of the main electrical networks [7-10].

Automated control system in substations is the lowest level of energy management system in general, which is directly connected to technological equipment. In the structure of the automated system of process management, primary information is collected on all parameters of technological processes, Metrological support tasks are solved, direct regulation and remote control procedures of equipment are carried out, resource-saving work is carried out. It follows that the efficiency of technological processes is ensured mainly at the level of automated process management system [3, 8, 11-16].

In addition, this level is a source of information for high levels of management structure and largely determines the efficiency of managing the entire energy system. Therefore, the task of creating automated process management systems in substations is very relevant within the framework of the complex of work on improvement and modernization of the management system of the unified energy system of Uzbekistan.

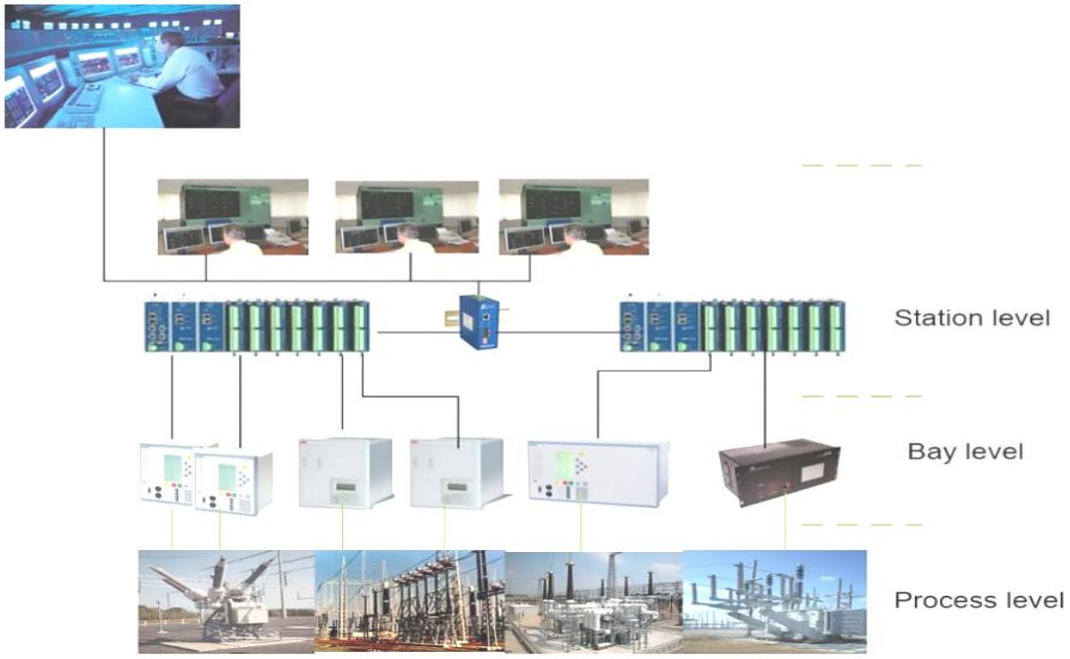

Fig.1. Automation steps of existing substations in the system.

The automated process control system of the substation includes monitoring of energy facilities, electricity taqsimlash processes, operational dispatch control and operation mode of the substation and its equipment, emergency recording, electricity accounting and quality control, telemechanics.

A set of technical tools of automated process control systems of substations has a three-level structure, which usually includes the lower (field), middle and upper levels:

- the lower (field) level includes devices that are directly connected to the control object. With their help, information is collected and control commands are issued, which are necessary for the operation of the system;
- devices that perform the tasks of collecting, processing and aggregating information for the transmission of medium to high-level and remote control centers. At this level, the integration of the army substation systems is carried out;
- a high level includes data storage, presentation and transmission servers, automated staff work desks, and local area network facilities.

The creation of automated control systems at substations has the following objectives [8, 15, 16]:

- ✓ Improving the efficiency of operation and management of substations and the entire technological complex in normal and abnormal (including emergency) modes;
- ✓ Ensuring the required quality indicators of electricity and the level of service when solving problems of transmission, conversion and distribution of electricity;
- ✓ Reduction of the accident rate, reduction of damage from accidents and reduction of the time for the elimination of accidents;
- ✓ Improving the reliability and safety of operation, improving the maintenance of the main and auxiliary technological equipment, as well as reducing the cost of repair work;
- ✓ Creation of an information basis for the construction of an integrated multilevel hierarchical system of technological control of the automated process control system of a substation.
- ✓ Provision of system and integrated integration of:
- means of REA and emergency automation with automated control systems;
- means of collecting and transmitting tele-information, monitoring and diagnostics of the state of the main equipment of the power facility and registration and retrospective analysis of emergency processes;
- autonomous means and control and management systems with SSPI subsystems, as well as with subsystems for collecting, processing and presenting information about emergency processes;
- information support and interaction with ASKUE and other external subsystems.
- ✓ Reduction of substation operating costs;
- ✓ Increasing the level of information and general security of the substation's technological complex.

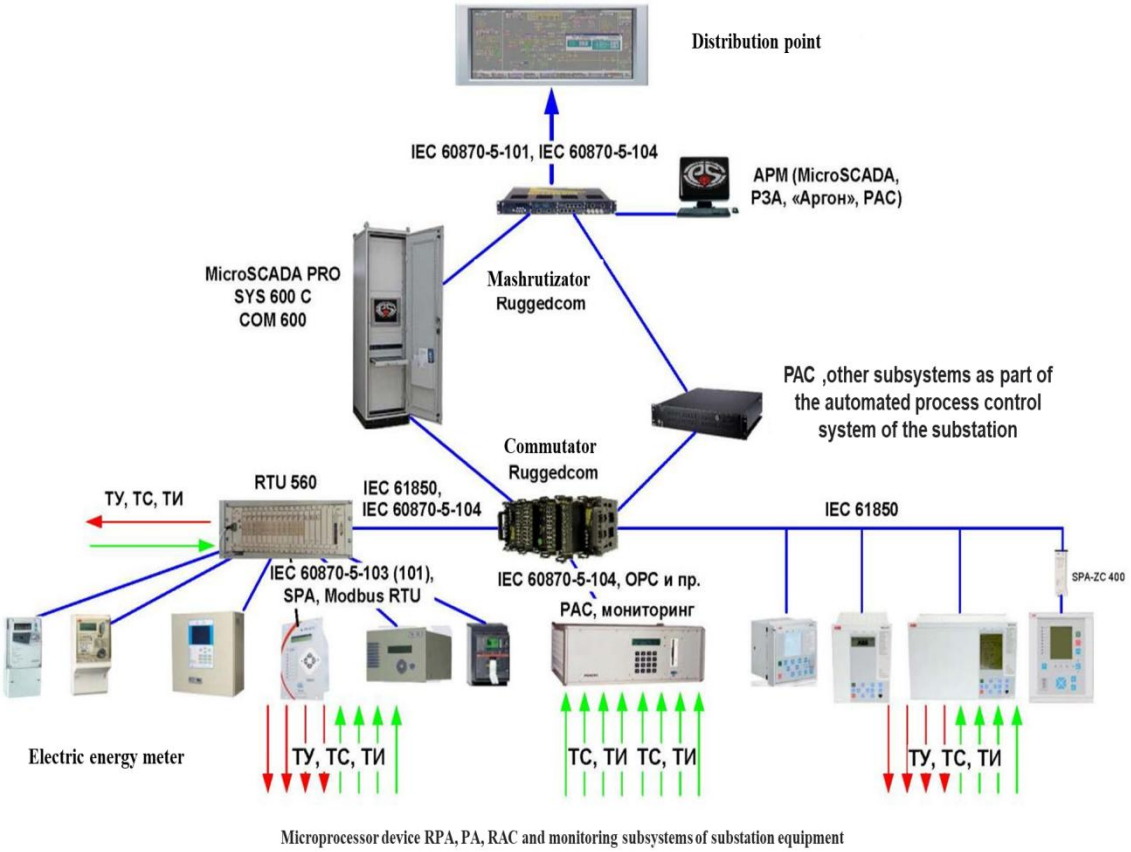

Fig.2. Structure scheme of ACS TP.

Due to the implementation of the software and hardware complex of the automated control system, solutions to the following tasks should be provided:

- ✓ Automatic and operational remote control of the main technological equipment;
- ✓ Monitoring and control of technological processes, the condition of the main equipment and the quality of electricity, including:
  - ➢ presentation to the operator (higher dispatcher) of electrical circuits of substations in the dynamics of their changes;
  - ➢ representation of digital values of technological parameters essential for conducting modes;
  - ➢ registration and alarm when the parameters of technological processes exceed the permissible limits;
  - ➢ display and signaling of changes in electrical circuits occurring in the process of maintaining the technological regime.
- ✓ Registration of parameters necessary for the analysis and evaluation of the operation of technological equipment, automation tools and personnel actions, including:
  - ➢ registration of technological events of normal mode;
  - ➢ registration of emergency situations and recording of emergency processes.
- ✓ System integration with systems and means of automatic control and management (*RPA, PA, ASKUE*).

Automatic and operational remote control of the main technological equipment makes it possible to remotely and quickly operate switching equipment and respond to any changes in network parameters on the PS. Since three-level equipment management has been implemented in the automated process control system, the equipment can be controlled both from the workplace of the operational personnel of the substation, and from the dispatching center of the power node and the National Dispatching Center. Also, all information about the current state and the actual scheme of substation equipment is displayed in the control centers' automated control systems. This, in turn, creates additional convenience for personnel performing operational dispatch control of the operating mode of this substation and adjacent power facilities. The power quality control function allows you to respond in a timely manner to changes in network parameters and, in automatic control and regulation mode, take measures to normalize the parameters, without the direct participation of operational personnel [17, 18].

The function of monitoring the condition of the main and auxiliary electrical equipment will help to bring the control process to a new level. In real time, you can monitor the actual condition of the equipment, quickly determine physical wear and damage, as well as make a forecast schedule for the withdrawal of equipment for current and major repairs. With the introduction of round-the-clock monitoring into operation, it will be possible to increase the operational life of the equipment and revise the timing of commissioning. For example, the system can provide a monitoring function for the condition of the power transformer as a whole and its individual parts. For example, the insulation parameters of the power inputs, the state of the RPN drive, the pressure and temperature of the oil and winding. The monitoring unit can also display information on the status of relay protection and automation devices, SDTU, emergency and fire alarm systems, operational current systems, and the status of substation batteries in the automated control system. Due to this, it will be possible to achieve an economic effect [19, 20].

An important factor is the issues related to the safety of the work carried out. With the introduction of the automated process control system and remote control of substation equipment, the level of labor safety of operational and repair personnel of these facilities will also be brought to a new level. So, when performing operational switching, it is possible to reduce the percentage of erroneous actions of personnel, and increase the level of reliability of power supply and safety in general. For example, the automated process control system provides for operational blocking from erroneous voltage supply to a grounded section of the network or operating with high-voltage disconnectors that are under load. According to the statistics, more than 50% of erroneous actions of personnel are related to the supply of voltage to the grounded area.

As can be seen from the above, the introduction of the substation's automated process control system opens up new opportunities in increasing the quality of the work performed and the electric energy supplied. At the same time, the system itself is very difficult to operate, and requires the training of qualified personnel. Another new feature of the system implementation is the high cost of equipment and components, work on linking the system to existing equipment, the high cost of installation and commissioning. To date, the world leaders in the production of electrical equipment for automated process control systems today are Alstom, ABB, Siemens, General Electric, etc. The automated control system equipment operates on a single standard information exchange protocol IEC 61850.

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In the end, it can be concluded that, firstly, due to the introduction of this system at substations of main electric networks, it is possible to increase the reliability of electrical equipment, due to a decrease in the human factor during operational work. At the same time, the increase in reliability will also affect the safety of the work carried out. Since emergency modes or shutdowns associated with erroneous actions of personnel at the substation of the main electrical networks can lead to system-wide accidents and fan outages of consumers.

The automated control system will help to raise the process of monitoring and monitoring the condition of high-voltage substation equipment to a new level. The system itself can be used as a recorder of emergency modes of RAS, a determinant of the location of the WMD overhead line. The system will register not only emergency modes, but all operational actions of personnel.

It will also create the possibility of remote operational control (DOW) of substation equipment, remote monitoring of the condition, the introduction of direct three-level operational management - local, regional, centralized.

The automated process control system of the substation will be the first step in the implementation of the SCADA system and in the design and construction of a digital substation. In the future, the substation's automated process control system will be a key component of the digitalization of the electric power industry of the electric power industry of the Republic of Uzbekistan as a whole.

Conclusion. The use of new technologies also poses another task, the current rules and regulations have to be revised. Since the existing norms and rules are not relevant for new equipment, technologies with the use of automated process control systems, DOW PS. For example, in the PTB for a new type of substation with the use of CRUE and automated control systems, paragraph 3 was removed in the chapter "Technical measures to ensure the safety of work", "Checking the absence of voltage". Since there is no need to check the absence of voltage. If we start to introduce new types of equipment, then the current rules and regulations will also change. And this will prompt new studies of international standards and revision of the current rules. At the same time, the implementation of the automated process control system will require large capital investments.

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