DOI https://doi.org/10.36059/978-966-397-303-6-54

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SYSTEM APPROACH PRINCIPLES FOR THE DEVELOPMENT OF COMPUTERIZED CONTROL SYSTEMS

Computerized control systems for autonomous, including ship electric power systems, are among the most complex modern artificial systems. The general principle of the system approach as applied to solving automation problems is to consider parts of a complex automation system for autonomous electric power systems (AEPS), taking into account their interaction [1, p. 24].

The solution of many tasks of ensuring the quality of electricity of AEPS and improving electromagnetic compatibility conditions has always been achieved to a certain extent through individual technical solutions [2, p. 18; 3, p. 252]. However, a system approach to the development of computerized control systems for the processes of generating and converting electricity will allow solving the tasks at a higher level.

The AEPS automation system is a hardware and software complex [4, p. 53]. The modular-hierarchical approach in designing the hardware and the object-oriented approach in designing the software part of the automation system, which are a concretization of the system approach and which express a number of important structural principles, use the ideas of decomposition of complex systems into hierarchical levels and aspects.

The end aim principle – the purpose of building an automation system for AEPS is to create hardware and software tools that provide control and monitoring of the electric power plant parameters, as well as the creation of a human-machine interface, taking into account all the requirements for such systems.

The principle of hierarchy – AEPS automation tools are most often used as part of command and information networks. An automated workstation of an operator with specialized software performs the functions of a task creator and data receiver, performs secondary processing, systematization, storage and visualization of data. Conventionally, the AEPS automation system can be divided into three hierarchical levels. The first (upper) level is the level of receiving, processing and displaying data. The middle level is the level of network organization. The third level is the level of organization of stations, which are used as specialized automation tools.

The principle of modular construction – the design of all automation hardware in the form of functionally complete modules that have the same structural and electrical interface with the main bus. With regard to software, the use of this principle introduces greater structural certainty into the program model by distributing data and functions between classes of objects.

The principle of functionality – joint consideration of structure and functions with priority of functions over structure.

Development principle – with regard to the hardware-software control and monitoring of AEPS parameters, this principle is implemented through the possibility of connecting additional modules and automation tools with new capabilities to the microprocessor control network, changing software algorithms, optimizing the structure of the control system based on information obtained during the operation of the AEPS.

Connectivity principle – any part of the system is considered together with its connections with subsystems and modules. For the AEPS automation system being developed, this principle manifests itself in providing the operator with information about the possible consequences of connecting the load, the state of the generator synchronization process, and the ability to control diesel units and the load.

The principle of unity – with regard to automation tools, this principle means that they must be interchangeable and each must have the properties of the entire system.

The principle of uncertainty – the design, modeling and optimization of the system must be done taking into account the statistical nature of the system. When designing a computerized system for AEPS, there is a lack of reliable initial data, the uncertainty of decision-making conditions (for example, the composition of a library of graphic components and their visual display). When modeling the operation of the system, the process of switching loads, the load on the information network, the occurrence of emergency situations are random in nature, and taking into account the statistical nature of the data is largely based on the method of statistical tests, and decision making is based on the use of fuzzy sets, expert systems.

Feedback principle – the functioning of a complex system is constantly accompanied by the control of initial and intermediate characteristics. To do this, the automation hardware of the AEPS must have inputs for receiving analog and discrete information from many sensors and outputs for controlling executive modules (actuators). Feedback makes the system more robust and resistant to random changes in parameters.

Software tools can display both a general picture of the system state, and the state of individual subsystems and devices. Therefore, by its structure, the AEPS control and monitoring software tools are multi-dialog, in which the possibility of quick access to auxiliary information is performed by calling additional dialog windows on the screen. Mimic diagrams are widely used on dispatcher control panels, which are implemented in modern systems on a computer and are a source of information for the operator about the current state of the AEPS elements. The construction of mnemonic diagrams is based on several principles that should be taken into account when developing software: the principle of conciseness (the mnemonic diagram should be simple and not contain unnecessary elements, information should be displayed clearly and in a convenient form), the principle of generalization (the most significant features of managed objects are highlighted), the principle of emphasis (control elements are distinguished by color, size, shape), the principle of spatial correlation of control and measurement elements and indicator devices, the principle of using familiar associations.

When analyzing AEPS and its computerized control systems, one cannot neglect any of the possibilities for eliminating existing problems. It is necessary to introduce new equipment, new directions in science, and search for opportunities to apply new discoveries in technology. The requirements for the system architecture obtained as a result of applying the system approach are further used to perform a structural synthesis of control object models and automation tools without taking into account their internal structure, which makes it possible to determine the composition and interaction of elements in the designed computerized control system of AEPS.

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DOI https://doi.org/10.36059/978-966-397-303-6-55

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IMPROVEMENT OF FAULT-RESISTANT CHARACTERISTICS OF SPECIALIZED PROCESSORS BASED ON THE SYSTEM OF RESIDUAL CLASSES

At this time, there is an unresolved problem in modern computers, which consists in correcting error in the process of performing arithmetic operations. In an arithmetic device based on a binary position number system (PNS), errors once arise, propagate uncontrollably. As a result, in the computers of all time and peoples working in traditional (binary) PNS, control and correction of errors (control of even, excess coding, majority, etc.) are provided only in storage and transmission systems, and the arithmetic-logical devices of the processor of even modern computers are one of the main sources of failures and errors [1, p. 10].

Therefore, today there are active searches for ways to improve the reliable characteristics of specialized computers through the use of position-residual representation of operands. Let operand A in positional representation: