CONCEPT, PURPOSE, AND OBJECTIVES OF BUILDING AN AUTOMATED POWER MANAGEMENT SYSTEM OF AN INDUSTRIAL ENTERPRISE

CONCEITO, OBJETIVO E OBJETIVOS DA CONSTRUÇÃO DE UM SISTEMA AUTOMATIZADO DE GESTÃO DE ENERGIA DE UMA EMPRESA INDUSTRIAL

CONCEPTO, PROPÓSITO Y OBJETIVOS DE LA CONSTRUCCIÓN DE UN SISTEMA AUTOMATIZADO DE GESTIÓN DE ENERGÍA DE UNA EMPRESA INDUSTRIAL

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ABSTRACT
In recent years, there has been an increased interest in the issues of effective management of production processes in the industry. This circumstance is due to several important factors, such as significant losses during the downtime of technological installations, the rapid development of computer technology, algorithmic and software for many scientific tasks, and intensive implementation of computers into the practice of industrial enterprises. The operation of the energy service can be considered as a set of various organizational and technical measures, united by the solution of a single task – maintaining the uninterrupted operation of electrical equipment while ensuring the rational use of energy resources and reducing electricity losses in the course of converting it into other types of energy. Any control system solves three main tasks: collecting and transmitting information about the controlled object, processing information, and, finally, issuing control actions on the control object. This is confirmed by the energy service operation. Data on the electrical equipment condition serve the initial information.

Key words: Automated control system, effective management, production processes in the industry

RESUMO
Nos últimos anos, tem aumentado o interesse pelas questões de gestão eficaz dos processos produtivos na indústria. Essa circunstância se deve a vários fatores importantes, como perdas significativas durante o tempo de inatividade das instalações tecnológicas, o rápido desenvolvimento da tecnologia de computadores, algorítmicos e softwares para muitas tarefas científicas e a implementação intensiva de computadores na prática das empresas industriais. A operação do serviço de energia pode ser considerada como um conjunto de várias medidas organizacionais e técnicas, unidas pela solução de uma única tarefa – manter o funcionamento ininterrupto dos equipamentos elétricos, garantindo o uso racional dos recursos energéticos e reduzindo as perdas de eletricidade no curso. convertê-la em outros tipos de energia. Qualquer sistema de controle resolve três tarefas principais: coletar e transmitir informações sobre o objeto controlado, processar informações e, finalmente, emitir ações de controle sobre o objeto de controle. Isso é confirmado pela operação do serviço de energia. Os dados sobre a condição do equipamento elétrico servem como informação inicial.

Palavras-chave: Sistema de controle automatizado, gestão eficaz, processos de produção na indústria

RESUMEN
En los últimos años, se ha incrementado el interés por los temas de la gestión eficaz de los procesos productivos en la industria. Esta circunstancia se debe a varios factores importantes, como pérdidas significativas durante el tiempo de inactividad de las instalaciones tecnológicas, el rápido desarrollo de la tecnología informática, algorítmica y de software para muchas tareas científicas, y la implementación intensiva de las computadoras en la práctica de las empresas industriales. La operación del servicio de energía puede

considerarse como un conjunto de varias medidas organizativas y técnicas, unidas por la solución de una sola tarea: mantener el funcionamiento ininterrumpido de los equipos eléctricos al tiempo que garantiza el uso racional de los recursos energéticos y reduce las pérdidas de electricidad en el curso. de convertirla en otros tipos de energía. Cualquier sistema de control resuelve tres tareas principales: recopilar y transmitir información sobre el objeto controlado, procesar información y, finalmente, emitir acciones de control sobre el objeto de control. Así lo confirma la operación del servicio de energía. Los datos sobre el estado del equipo eléctrico sirven como información inicial.

Palabras clave: Sistema de control automatizado, gestión eficaz, procesos productivos en la industria.

1. INTRODUCTION

An automated control system (ACS) is a human-machine system that provides automated collection and processing of information, necessary to optimize management in various spheres of human activity. The optimization process involves the choice of such a control option, in which the maximum or minimum value of some criterion, characterizing the quality of management is achieved. ACS may differ in the type of control objects, the nature and scope of the tasks being solved, and several other features.

Unlike automatic systems, where a human is completely excluded from the control loop, the ACS assumes his active participation in control, thereby achieving the flexibility and adaptability of the system. The essential features of the ACS are the presence of large information flows, a complex information structure, and rather complex information processing algorithms.

Russia has accumulated considerable experience in building various ACS in metallurgy and chemical industry, oil production and refining, electric power industry, and other branches of economic mechanism (Abramenko, Kuznetsov, 2008; Baronov et al., 2009; Plyaskin, 2005; Samsonov, 1990; Sekushin, 2013). At the same time, due to the specifics and complexity of the process, creating the ACS in many respects has not yet been formalized, and often there are different standpoints on the same issues in the literature. The same tasks implemented on a computer at different enterprises have essentially different algorithms and use different mathematical apparatus. In the electric power industry, the main attention was focused on developing ACS of electric grid enterprises and their structural

divisions. The issue of creating ACS of energy services of industrial enterprises is considered in some works (Khorolsky, Taranov, 2013; Chichev, Kalinin, Glinkin, 2009).

However, in this area, the research aimed at just defining the issue, focusing on the development of individual particular issues. In general, the problem of creating an ACS of the energy service has been studied and developed insufficiently.

Production management can be divided into two areas: organizational management and process management. These areas differ in the nature of the management objects: while in the first area, the object of management are collectives of people, engaged in the field of material production, in the second area the problem concerns machines, devices, and tools, which are controlled by the transmission of mechanical, electrical, and optical signals. Accordingly, two main types of ACS are distinguished: automated systems of organizational, economic, or administrative management, or management information and control system (MICS) and computerized process control system (CPCS). The areas of computer application in these systems differ significantly. This is due to the difference in the class of tasks to be solved and the difference in dynamic characteristics in each of the areas.

As a rule, the management process in the MICS is very inert. The issuance of control actions is preceded by the processing of information in the control device. The delay of the control action, given the speed of modern computers, has little effect on the effectiveness of the measures taken. The inertia of the MICS allows using input information in a documentary form as well as its discrete input into the computer. The results of information processing are also presented in a documentary form, which is then distributed to the relevant departments of the enterprise. The documentary discrete nature of the information at the input assumes the operating mode of the computer in the case of employing MICS corresponding to the operating mode of universal computers.

The CPCS includes such systems that are characterized by controlling objects that are rapidly changing their state. To obtain the necessary dynamic characteristics, discrete documentary input and output of information in the CPCS are not acceptable in most cases. To carry out dynamic communication with an object in such systems, special hardware is included in addition to computers that ensure the receipt, transformation, and transmission of information from the object to the machine and back.

Until recently, the practice of automated control at enterprises followed the path of the separate creation of ACS for technological processes and automated management systems of an organizational and economic nature. The main negative consequences of creating ACS based on such a concept are related to inconsistency of criteria, determined at different levels of tasks, non-compliance with the unity of control goals, as well as duplication of information due to the presence of autonomous systems for collecting and processing information for each of these types of ACS. Moreover, this is even more aggravated by the lack of information linking between the MICS and CPCS tasks and the possibility of integrated computer use.

All of the above consequences of the separate development of MICS and CPCS ultimately lead to a decrease in economic efficiency from the implementation of this class of systems. Therefore, it is not accidental that in recent years, integrated ACS have begun to appear, combining both directions.

There are also automated and automatic control systems. Automated systems include human as an organic component of the system. Automatic systems, after installation and commissioning, can operate without human intervention. As for the energy service, the management of such subdivisions is not conceivable without human participation. In this case, the role of a human is reduced to adjusting the goals and control criteria, introducing a creative element in the search for the best ways to achieve the set goals, making a final decision and giving it legal force, and finally, providing the system with primary information, whose collection is impossible and impractical to fully automate.

Currently, in Russia and abroad, the concept of decentralized information processing, creating local databases, focused primarily on solving particular planning and management tasks, has become widespread.

2. METHODS

The concept of decentralized information processing has been reflected in the massive creation of an automated workplace for specialists and administrative and managerial personnel.

With this in mind, the main task of building the ACS of the energy service is providing the decentralized automated processing of information at the workplace of the energy service head, creating personal databases, and, if necessary, local and global networks of ACS-based on personal computers.

Practice shows that at the first stages of the ACS implementation, the paper technology of interaction with departments not involved in the automation system is preserved. Therefore, ACS must have printing devices to generate a minimum of output documents, external memory to keep the normative reference information and working data sets active, as well as a minimum backup set of computer peripherals.

With this implementation option of ACS, an administrative access center is organized at the facility, where the user can call by phone or formulate a request to the operator.

The development of the ACS is based on the following basic principles: the personification of computing and self-learning of a non-programming specialist; auto-formalization of professional knowledge; automation of new functions; implementation of paperless technology; providing the rational combination of distributed, decentralized, and centralized information processing; as well as modularity, consistency, and ergonomics of the ACS.

The division of labor, characteristic of industrial production within each enterprise leads to technologically subject-based specialization of the enterprise's sections. This approach is typical for both territorial and functional energy services. In such conditions, effective service operation becomes possible only with careful coordination of the activities of all production areas.

3. RESULTS

Considering the energy serves as an object with a discrete or continuously-discrete production process, in which the process of servicing electrical equipment is carried out by separate teams, the coordination of the activities of individual units should ensure an unbroken and rhythmic technological process. For such service units, this coordination is achieved by drawing up a schedule of technical services and repairs, monitoring the progress

of its implementation, timely correction of the schedule in continuously changing production conditions.

The activity of the energy service is multifunctional. When solving the issue of implementing ACS, the tasks to be automated must be defined and formulated. However, one should not think that creating the ACS of the energy service will result in the appearance of a robot that will eliminate malfunctions, or an automatic troubleshooting system will be developed. The use of ACS should free the energy service personnel from performing routine calculations.

The ACS can be developed both for the entire service and for solving individual most important tasks of the energy service, such as, for example, work planning, operational dispatch management, etc. The general control system covers the main production activities of the energy service, logistics, financial and other aspects of the service's activities. The interconnection of various aspects of the service's activities, the significant commonality of the source and processed information in various management tasks causes a desire to carry out complex automation, which makes it possible to achieve a more complete effect from using mathematical methods and computer technology.

However, creating the ACS of the energy service is associated with several difficulties of a scientific and technical nature, requiring money and time for its implementation. While recognizing the integrated approach as correct in principle, it is also necessary to recognize the practical expediency of prioritizing the use of those individual subsystems of the general management system that can be implemented with the greatest economic effect. From this standpoint, in relation to the ACS of the energy service, the management system of operational measures to increase the operational reliability and efficiency of electrical equipment looks particularly advantageous.

The ACS of the energy service is characterized by the interrelated solution of the following tasks:

1. Creating information support for the ACS, i.e. its database on machine media. One of the necessary directions in the development of information support is using a computer to create a system for automated collection and processing of information about the reliability and other indicators of electrical installations;

2. Conducting automated preparation of a schedule of preventive measures for the maintenance of electrical equipment. This kind of task consists in the temporary and quantitative coordination of the flow of material and labor resources at individual sites of the enterprise and is reduced to the implementation of algorithms that determine such a sequence of operational measures that ensure the fulfillment of certain criteria, for example, reducing the percentage of electrical equipment failure as well as lowering operating costs;

3. Optimizing the schedule according to the number of performers and the route of the operational units, labor intensity, and the priority of work performance;

4. Justifying the reserve fund of electrical equipment of the enterprise and the necessary material and technical support for operational activities;

5. Calculating the number of electrical personnel of the service;

6. Obtaining operational information on various indicators of the energy service;

7. Accounting for the availability and movement of materials, spare parts, and components;

8. Issuing operational machine tasks, i.e. work orders, and processing of information about the activities carried out;

9. Calculating cost estimates for energy services;

10. Conducting a statistical assessment of operational reliability of electrical equipment;

11. Accounting the certification status of the energy service personnel on labor protection issues, etc.

Some of the problems under consideration do not present serious difficulties from a mathematical perspective. This concerns calculation of the number of personnel, obtaining operational information, cost estimates, and personnel certification. It is much more difficult to solve the tasks, associated with creating information support, drawing a schedule of planned works, conducting optimization calculations, and processing statistical data on the reliability of electrical equipment.

Solving the issues raised requires the development of economic and mathematical models, which are a set of mathematical and logical formulas expressing the main characteristics of the production and economic activities of the energy service, as well as the

information processing rules (algorithms). At the same time, the computer is the main tool of the studied economic and mathematical models, being a technical means of simulation.

Besides the tasks of the information nature, the ACS allows solving several operational issues, such as issuing machine tasks for performing work when electrical installations are disconnected, processing the results of repair and restoration activities, preparing tasks according to the existing schedule of planned works.

The operation algorithm of the ACS's subsystem of the operational type is as follows. When a malfunction occurs in the electrical installation, a message is sent to the dispatcher, who contacts the repair department and simultaneously transmits the information to the operator, who enters the necessary data into the computer and prints out the work order. After carrying out repair work, the foreman informs the dispatcher about their completion, fills in the reverse side of the outfit with data on the time of repair, its complexity, materials used, and hands it over to the ACS operator, who enters the necessary information into the computer memory. As a result, an archive of completed works is constantly being generated on the computer. According to the schedule of planned works, orders for the implementation of preventive measures are also being prepared.

4. CONCLUSION

The presence of automated methods for solving problems of an informational operational nature gives a powerful apparatus to the chief power engineer of the enterprise.

Using a computer as an information processing organ significantly expands the boundaries of the control system by analyzing alternative options for building an electrical equipment maintenance system and choosing a preferred solution, as well as controlling the operation process based not only on directly changeable parameters, but also indirect parameters obtained by certain algorithms and programs.

At the that, technological process forecasting of electrical equipment operation can be performed based on mathematical models and selection of optimal control solutions, statistical modeling of possible situations, and random outcomes in case of violation of technological processes due to failures of electrical equipment, as well as memorization of

conducted operational measures and the creation of self-adjusting control systems in the future.

In general, the ACS of energy service should be attributed to the category of complex systems. This is confirmed by the following features: the presence of a large number of interrelated elements; the versatility of the system and its constituting elements; the presence of several interaction channels of the elements (exchange of information, energy, materials, etc.); the presence of a common goal for the entire system; the stochastic nature of the system's interaction with the external environment; the widespread use of computer technology to control the system; and the hierarchical nature of control in the system.

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