ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
Vol. 10, Issue 9, September 2023

Concept for the development of an automated dispatch control system in the power system

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ABSTRACT: The article discusses the development of an automated dispatch control system in the energy systems of Uzbekistan. The Electrical Management System (EMS) and Distribution Management System (DMS) are described in detail, along with a description of the Common Access Interface (GID). The structure of the SCADA network and dispatch centers is considered and the tasks of SCADA systems are defined. A software and hardware complex for the operational information complex Automated Dispatch Control System (ADCS) is presented. The requirements for the construction of the operational information complex ADCS of the Uzbek energy system are laid down. All this will contribute to more efficient and sustainable functioning of the electricity system as a whole.

KEY WORDS: Automated dispatch system (ADCS), electrical management system (EMS), distribution management system (DMS), access interface (GID), SCADA network.

I.INTRODUCTION

Currently, in all developed countries of the world, great attention is paid to electric power systems that use the most modern equipment and technologies, measurement and control tools, which make it possible to ensure the reliability and cost-effectiveness of the functioning of electric power systems at a higher level.

The electric power industry is developing rapidly, and without automated systems we can no longer ensure either quality or reliability. The creation of modern automated dispatch control and management systems in the energy sector requires solving such important problems as modernizing telemechanics systems, revising the communication component of the control system, and remote monitoring of the system condition.

The latest technologies used in networks, based on adaptation of equipment characteristics depending on the operating situation, active interaction with generation and consumers make it possible to create an efficiently functioning system into which modern information diagnostic systems, automation systems for controlling all elements included in the production and transmission processes are built , distribution and consumption of electricity.

A modern automated dispatch control system (ADCS) in a power system is a hierarchically constructed human-machine system that provides the entire territory covered by electrical networks with the collection, transformation, transmission, processing and display of information about the state and mode of the power system, the formation based on the collected information, transmission and implementation of control commands in order for the system (at the expense of available funds) to perform the functions of reliable and economical supply of electrical energy of the required quality to all its consumers.

In accordance with Presidential Decree No. PP-4699 “On measures for the widespread implementation of the digital economy and e-government” dated April 28, 2020, a project is envisaged for the implementation of supervisory control and data acquisition (SCADA) and energy management systems (EMS) [1].

The project will introduce modern digital and telecommunication technologies and solutions to improve the process of monitoring, managing and operating the electricity transmission system. They include the creation of a new software and hardware complex for dispatch control and data acquisition (SCADA), as well as an energy management system (EMS) for the central and regional dispatch centers of National Electric Grids of Uzbekistan JSC. Project activities will make it possible to replace outdated systems that have been in operation since Soviet times. This task is, of course, relevant for the energy system of Uzbekistan [2].

This article discusses the development of an automated dispatch control system for the power system, the implementation of a common information model and the provision of access to it in accordance with the CIM (Common Information Model) group of standards.

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II. RESEARCH METHODS

The concept for the development of an automated dispatch control system for the power system is based on the need to implement a common information model and provide access to it in accordance with the CIM (Common Information Model) group of standards [3,4,5].:

IEC61970-301 (Rev. 14) – Electricity generation and transmission systems (EMS);

IEC61968 (version 10) – power distribution systems (DMS);

IEC 61970-403 – Generic Interface Description (GID).

In addition, it is necessary to provide a unified structure for the dispatch control system of the power system (the structure of the SCADA network and dispatch centers).

An Electric Management System (EMS) is a highly specialized, computerized, real-time management system designed to assist electric power system operators in monitoring, managing and optimizing the distribution network and/or improving reliability and efficiency.

The Distribution Management System (DMS) is designed for smart grids. It is based on real-time applications focused on distribution network operation and management, focusing on distribution network business process, data collection integration, real-time monitoring, fault processing, application analysis and production management, as well as full automation monitoring and distribution network planning, production, operation and maintenance.

An Electric Management System (EMS) and Distribution Management System (DMS) monitors, manages and optimizes the generation, transmission, distribution and consumption of electricity to provide customers with maximum efficiency and lower costs. The system monitors the entire energy network and develops a precise control strategy to optimize power supply.

While CIM serves as a common language for systems to communicate, the GID standard defines interfaces that can connect applications to each other, to data stores, and to an integration platform. A GID defines a common technical mechanism that allows applications to communicate and provide their data. Additionally, unlike most interfaces previously used for integration, GID interfaces provide information about the data stored in the application.

GID describes four software interfaces (Table 1), based on industrial standards of the Object Management Group and OPC Foundation and supplemented with tools for solving specific problems in the electric power industry [6,7,8,9,10].

Table 1.

1	Generic Data Access (GDA)	Interface for working with CIM model data and metadata. You can both receive and modify data, and the user does not necessarily have to have information about the CIM model. GDA allows you to navigate through the CIM model without knowledge of this model (for example, get all the properties of a class or all objects associated with a given object). The interface is based on the OMG Data Access Facility (DAF) standard.
2	Generic Eventing and Subscription (GES)	An interface that allows messages to be published and those messages to be received by specific subscribers. GES is a vendor-independent interface for working with integration products (for example, with the IBM MQ Series guaranteed message delivery system, with the InterSystems Ensemble integration platform, etc.). The interface is based on the OMG Data Acquisition from Industrial Systems (DAIS) and OPC Foundation Simple Eventing standards.
3	High Speed Data Access (HSDA)	Interface for transferring large amounts of data from SCADA systems. It allows you to query information about the schema(s) and instances of those classes that contain real-time data. Using HSDA, you can request data from SCADA systems, organize their publication and subscription to changes. The interface is based on the OMG DAIS standard and the OPC Foundation Data Access specification.
4	Time Series Data Access (TSDA)	An interface that allows you to efficiently transfer time series (archival data). It allows you to query information about the schema(s) and instances of those classes that contain time series. With TSDA you can receive information, organize publication and subscription to changes. The interface is designed for historical/archival data retrieval and is based on the OMG Historical Data Access From Industrial Systems (HDAIS) standard.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
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Now let's look at the structure of the SCADA network and control centers. SCADA (Supervisory Control And Data Acquisition) is a software package designed to develop or ensure real-time operation of systems for collecting, processing, displaying and archiving information about a monitoring or control object.
All modern SCADA systems include three main structural components: a remote terminal (RTU - Remote Terminal Unit), a control center (MTU - Master Terminal Unit) and a communication system (CS - Communication System). In Fig.2. the structure of the SCADA system is presented.

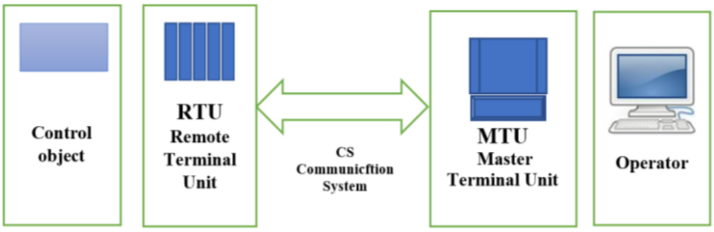

Fig.1. SCADA system structure.

1.Remote Terminal Unit (RTU) - a remote terminal that processes information in real time.
2.Master Terminal Unit (MTU) - control center (main terminal); carries out high-level data processing and control, usually in soft (quasi-) real time; one of its main functions is to provide an interface between the human operator and the system (HMI, MMI). Depending on the specific system, MTU can be implemented in a wide variety of forms, from a single computer with additional devices connecting to communication channels to large computing systems (mainframes) and (or) workstations and servers integrated into a local network.
3.Communication System (CS) - a communication system is necessary for transmitting data from remote points (objects, terminals) to the central operator-dispatcher interface and transmitting control signals to the RTU (or remote object, depending on the specific design).

III. RESEARCH RESULTS

The following data transmission channels can be used as a communication system: leased lines, radio networks, analog telephone lines, ISDN networks, GSM (GPRS) cellular networks. Devices are often connected to multiple networks to ensure reliable data transfer.
In fact, the operational information complex ADCS (SCADA) unites 5 regional dispatch centers for parts of the power system: Central, Eastern, Northwestern, Southwestern, Southern.
SCADA systems solve a number of problems:

- Data exchange with the data center (communication device with the object, that is, with industrial controllers and input/output boards) in real time through drivers.
- Processing information in real time.
- Displaying information on the monitor screen in a form that is convenient and understandable for humans.
- Maintaining a real-time database of technological information.
- Alarm signaling and alarm management.
- Preparing and generating process progress reports.
- Implementation of network interaction between SCADA PCs.

Providing communication with external applications (DBMS - database management system), spreadsheets, word processors, etc.). In an enterprise management system, such applications are most often applications classified at the MES level.
A characteristic feature of the technological process of operation of the power system is the close relationship between the operating modes of all its elements, which is ensured by the use of modern information technologies and software.
The operated automated dispatch control system (ADCS) is the basis for dispatch control of the modes of the Uzbek energy system and provides operational information services to all the main control links of the energy system. ADCS allows dispatch personnel of the power system to control the continuous technological process of production, distribution, transmission and consumption of electrical energy.
All energy system enterprises involved in this technological chain are connected to the operational information complex ADCS of the energy system of Uzbekistan and transmit telemetric information about the operating mode of power facilities in real time around the clock, according to the functional diagram, to the operational information complex ADCS.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
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The operational and information complex ADCS is a software and hardware complex, which includes:
- measuring current and voltage transformers, indicating devices, sensors (converters) of information;
- dispatch and technological control means (telemechanics devices, communication means and channels, dispatch panels and consoles);
- means of processing and displaying information (PC computers of operational information and computing complexes, LAN);
- information, standard and applied mathematical support.

As a result of the analysis of domestic and foreign experience, the following requirements form the basis for the construction of the operational information complex of the automated control system of the Uzbek energy system:

- Functional distribution. The functions of receiving, transmitting, additional calculation, scaling, monitoring received information for reliability (authentication), storing, displaying, documenting information are implemented as separate functionally complete tasks and are performed either on one PC in multitasking mode or on a LAN on different PCs.

- Full reservation. The functioning of the operational information complex of the ASDU is not interrupted as a result of the failure of any PC processing teleinformation. Teleinformation processing is carried out on two independent (including power supply) sets of technical equipment - the main and backup.

- Automatic switching. In the event of a failure of the PC processing teleinformation, the PC displaying information about the operation of the Uzbek energy system automatically switches to a backup set of equipment.

- Graphical interface. The information display system is built on the basis of interactive graphics.

These requirements are met by the existing operational information complex ADCS, and those proposed for implementation must also be met.

The operational and information complex ADCS is designed to automate the reception and transmission of measured values, calculate the necessary non-measured values necessary for monitoring the performance of the power system and carrying out analytical work, scaling, monitoring received information for reliability, storing, displaying, documenting information about the modes of the Uzbek power system.

IV. DISCUSSION

The use of modern information technologies makes it possible to implement, at each level of control of automatic and automated process control systems, the joint use of operational and retrospective information accumulated and used in each of the systems. This makes it possible to take into account limitations, more adequately predict the state of the control object, and, accordingly, improve the quality of control. At the same time, there are general limitations on the reliability of power supply to consumers and its components.

The basis for managing the regime of any Unified Energy System (UES), including the UES of Uzbekistan, in general is operational dispatch control performed by personnel, and operational and technological control performed by personnel of the relevant structural divisions.

V. CONCLUSION

The development of an automated dispatch control system in the electric power system will bring many benefits:

1. Improving the efficiency and reliability of the electrical power system: Automation will allow for more precise control and management of energy processes, minimizing the likelihood of errors and increasing the speed of response to inconsistencies or accidents.
2. Optimization of energy distribution: The automated system will be able to automatically balance the load in the power system, redistribute resources and optimize the operation of generators and consumers, reducing unnecessary load and preventing overloads.
3. Improving the speed and quality of response to situations: The automated system will continuously monitor the state of the power grid and instantly respond to possible threats or emergency situations. This will help reduce decision-making time and allow you to quickly restore system functionality.
4. Reducing costs and increasing economic efficiency: Automation will optimize the use of energy resources, reducing energy losses, reducing maintenance and repair costs, as well as improving work planning and using resources more efficiently.
5. Increased operational safety: The automated system will provide continuous monitoring and control of the state of the electrical power system, detecting and warning about dangerous situations such as overloads, short circuits, accidents, which helps reduce risks for personnel and society.

All this will contribute to more efficient and sustainable functioning of the electricity system as a whole.

ISSN: 2350-0328
International Journal of AdvancedResearch in Science, Engineering and Technology
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REFERENCES

[1]. Presidential Decree No. PP-4699 “On measures for the widespread introduction of the digital economy and e-government” dated April 28, 2020.
[2]. Website Ministry of Energy of the Republic of Uzbekistan https://minenergy.uz/ru
[3]. Odamov U.O., Makhammadiev F.M. Modern directions of development of the electric power industry based on the smart grid concept // Sciences of Europe # 119, (2023). vv.42-46.
[4]. Odamov U.O., Mukhammadiev F.M., Omanov O.A. Prospects of a development the intellectual power industry in Uzbekistan. International Journal of Advanced Research in Science, Engineering and Technology.Vol. 10, Issue 6, Jun 2023.
[5]. Shavazov A.A., Maxammadiev F. M., Seyfullaeva L.I., Dauletbaev A.B., Tuxtaev B.B. Role of Informational Technologies in the analysis of the effects of geomagnetic storms energy systems. International Journal of Advanced Research in Science, Engineering and Technology.Vol. 10, Issue 3, March 2023.pp.20454-20456.
https://ijarset.com/upload/2023/march/10-boburjon-16.pdf
[6]. Shavazov A.A.,Seyfullaeva L.I.,Maxammadiev F. M., Tuxtayev B.B. Intellectual approach to the effects of geomagnetic waves generated in solar flares on pumping stations high voltage transmission lines. International Journal of Advanced Research in Science, Engineering and Technology. Vol. 10, Issue 1, January 2023. pp.20329-20331. https://ijarset.com/upload/2023/january/10-boburjon-11.pdf
[7]. IEC 61970 Energy Management System Application Program Interface (EMS-API) - Part 301: Common Infor-mation Model (CIM) Base, cd2.0, April 2009.
[8]. Communication networks and systems in substations. Part 7-1,2,3,4. Basic Communication Structure for SubStation and Feeder Equipment. International Standard IEC 61850, IEC 2003.
[9]. The Benefits of Integrating Information Systems Across the Energy Enterprise. The Power of the Control Center Application Program Interface (CCAPI) and Common Information Model (CIM), EPRI ,2001
[10]. Energy management system applicatiom programm interface(EMS API).Part 301. Common Information model(CIM) base.International Standard IEC 61970. IEC 2003.