ANALYSIS OF DISTRIBUTED TECHNOLOGICAL COMPLEXES AS OBJECTS OF CONTROL AND MONITORING

АНАЛИЗ РАСПРЕДЕЛЕННЫХ ТЕХНОЛОГИЧЕСКИХ КОМПЛЕКСОВ КАК ОБЪЕКТОВ КОНТРОЛЯ И МОНИТОРИНГА

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Abstract: *The article analyzes the distributed technological complexes of the Republic of Kazakhstan as objects of control and monitoring. Examples of distributed technological complexes are the oil transportation system, the mega-cities heat supply system, high-voltage power transmission system. Two distributed technological complexes were analyzed. The aim of creation and application of control and monitoring system for each complex is substantiated. A structure has been developed for constructing a control and monitoring system for the heat supply system for megacities and a high-voltage power transmission system. The generalized functional diagram of the upper level of the monitoring and monitoring system was developed.*
***KEYWORDS**: CONTROL, MONITORING, DISTRIBUTED TECHNOLOGICAL COMPLEXES.*

1. Introduction

Modern technological complexes perform the task of spreading the flows of technological resources (for example, oil, gas, electricity, heat energy, etc.). Examples of distributed technological complexes can be:

1 Oil transportation system.
2 Gas transportation system.
3 The system of heat supply of megacities.
4 High-voltage power transmission system.

We will analyse the system of heat supply of megacities and high-voltage power transmission system as objects of control and monitoring.

2. Problem discussion

Complex monitoring of the state of the equipment of distributed technological complexes is based on a system of software and hardware that provides continuous obtaining in real time information about the technical condition of the equipment and the adoption on the basis of this information of decisions on the necessary corrective organizational and technical measures.

The application of a system for control and monitoring technical condition is due to equipment with the following features:

- its destruction can lead to an incident, an accident and human casualties, significant material and environmental losses;
- access for the implementation of its periodic inspection and control by instrumental methods is absent or difficult;
- stopping it for another full-scale survey may result in a reduction in the life of the equipment itself and in violation of the operating mode of the technological complex as a whole;
- a significant amount of preparatory work and monitoring of equipment requires its partial or complete stop, the manufacture of special equipment for monitoring, leads to significant costs and reduces the efficiency of operation;
- its inclusion in the list of equipment to be monitored will allow to increase the time between routine stops for technical inspection and in the future to move to operation according to the technical state.

3. Analysis of systems as objects of control and monitoring

3.1 The system of heat supply of megacities.

Heat supply systems largely determine the viability of megacities in countries with a sharply continental climate such as in Kazakhstan. The structural complexity of heat-supplying complexes of megacities (H-SCM) in the first approximation is directly proportional to the number of population. Obviously, such complexes belong to the class of large distributed systems.

The main goal of H-SCM is the delivery and distribution of the coolant with the specified parameters (pressure and temperature) to the consumers, which are the municipal, industrial, administrative buildings and facilities of the metropolis [1].

The main elements of the H-SCM are: heat supply sources (HSS), main heat networks (MHN), pumping stations (PS), individual and central heating points (IandCHP).

Delivery of the coolant is carried out by pump units (PU). The amount of PU is determined by the size of the H-SCM, topographical and climatic characteristics of the H-SCM areas formalized in the geographic information system (GIS) database. Modern concepts of H-SCM are based on the use of frequency-controlled asynchronous electric drives of pump units at pumping stations in the forward and reverse lines of H-SCM. Existing (and gradually installed) adjustable valves in the nodes of the main heat network must have a two-position, and better regulated within the limits of the consumption characteristics of regulating bodies (RB), one and multi-turn actuators (O-MA) with electric drives. Modern O-MAs for the thermal power systems have a full set of monitoring facilities for their condition, local control from industrial logic controllers (PLCs), remote control of H-SCM adjusters in the locations of O-MA installation and automated control of dispatchers of the H-SCM system by means of SCADA systems [2].

The management of pump aggregates and monitoring of parameters on the PU, HSS, IandCHP, MHN nodes are possible with products with unified electrical signals equipped with means of interaction with local and global information networks.

It is doubtful that the automobile and engine manufacture could find the economic (and other) incentive necessary to develop alternatively fuelled products strictly on their own volition.

It is obvious that H-SCM is efficient, although many of them are ineffective and have large energy losses in virtually all technological parts. The main reason for such facts lies in the difficulty of managing the gigantic in their dimension of heat supply systems for megacities by traditional means, which were emphasized by the founders of the theory of heat supply for megacities.

Therefore, one of the main directions that allow to find solutions to the problem of ensuring quality heat supply is the creation of a monitoring and monitoring system for BM parameters. The aim of the system is to increase the level of H-SCM in formativeness.

The system for monitoring and monitoring parameters consists of 3 levels [3].

The lower level consists of a network of primary sensors that transmit data on the functioning of heat networks (temperature at control points, pressure, water flow, pump parameters) to the dispatching server, which is the upper level, which are analysed by the computer program complex.

The upper level includes a software package that automatically generates and solves large-scale systems of non-linear equations of operational and emergency thermal-hydraulic regimes of a variable technological structure. The tools of the software package make it possible to create an animation model of the complex, on which each element (pump, pipeline, gate valve, diaphragm, etc.) is reflected, its characteristics (pipe diameter, meter reading) and position at the moment (on or off, at the moment), which allows the dispatcher to visually see the work of the entire network and its components and control the mode directly from the monitor screen, adjust the results both by elements and globally across the entire model. In addition, the software complex, depending on the formulated task, can automatically maintain the present mode, reflecting its actions to control the operator, who is offered the optimal variant of achieving the result for the completion of the evaluation and decision making.

The middle level provides management of all process units: water treatment plants of CHP, district boiler houses, network pumping stations, control and distribution and central heat points, individual heat points of heat consumers and is represented by control stations and controllers connected by an industrial network with objects of upper and lower levels [3].

3.2 High-voltage power transmission system

The electrical network is a set of electrical installations for power transmission and distribution. It consists of a substation, switchgear, conductors, overhead and cable transmission lines, distributed over large areas, and refers to the distribution of technological complexes. Accidents on the high-voltage lines may be associated with insulation breakdown, breakage of current-carrying wires, supports of high-voltage power lines fall. They can lead to a lack of power supply of entire regions of the country. The present level of development of software and hardware automation makes it possible to create a system of control and monitoring elements of high-voltage power lines, with the transfer of information in the control room for the prevention and elimination of emergency situations. Developments in the field of distributed systems of information transfer along high-voltage lines are not available. Therefore, the creation of such a system is an urgent task that will ensure reduction of accidents and increase the reliability of power transmission on strategic high-voltage power lines [4].

Reliability of operation and the value of active power losses of transmission lines depends on the state of suspension insulators. Condition monitoring is carried out by suspension insulators periodic testing high voltage, resistance measurement, control voltage distribution on insulator structure, their visual inspection. The ineffectiveness of these methods is the complexity, high-risk and the need to disconnect the equipment from the power source. Such methods is not possible to detect the deterioration of the insulation or the insulators at an early stage of their operation. The main parameter characterizing the condition of the insulation are leakage currents. In the development of the automatic control system of the state of suspension insulators should be performed by measurements of leakage currents. Information about the state of insulators of high-voltage transmission line supports must be periodically transmitted to the control station [5].

Icing accident at the high-voltage lines are one of the most difficult and hard disposable due to off-road winter, frozen ground, and at the same time a large number of affected areas. Due to the icing deposits on the wire and ground wire appears broken wires, insulators mechanical destruction and deterioration of their properties. Timely removal of ice on the wires is an important task of power supply organizations [6].

Control and monitoring system consists of 4 levels.

The zero level of the complex allows using the control indicator sensors to monitor parameters: leakage currents of insulators, icing current wires, the positioning of the support of high-voltage power lines, the amplitude of the vibration supports.

The first level in each support of high-voltage power lines are transmitted telemetry data from the sensors to a local subsystem of collection and primary processing and preparation of the information collected for subsequent transfer it to the control station.

The second level of the system is realized the following tasks:

– the transfer of information from the supports (from the local collection and primary processing sub-systems) to the control station;

– systematic diagnosis telemetry communication channel.

The third level of the system is realized the following tasks:

– analysis of information on the reliability;
– restoration of lost or inaccurate information;
– construction of approximating functions of emergencies;
– construction of predictive models;
– diagnosis and localization of accidents occurring;
– notification of the dispatcher on the ensuing emergency;
– the formation of the current accounting log information;
– visualization of the received information;
– archiving and storage of incoming information;
– the formation of algorithms and mathematical models of information management with the support of the diagnosed portion of power lines [6].

4. Conclusion

Two distributed technological complexes were analyzed.

The aim of creation and application of control and monitoring system for each complex is substantiated.

A structure has been developed for constructing a control and monitoring system for the heat supply system for megacities and a high-voltage power transmission system.

The generalized functional diagram of the upper level of the monitoring and monitoring system was developed (Fig.1).

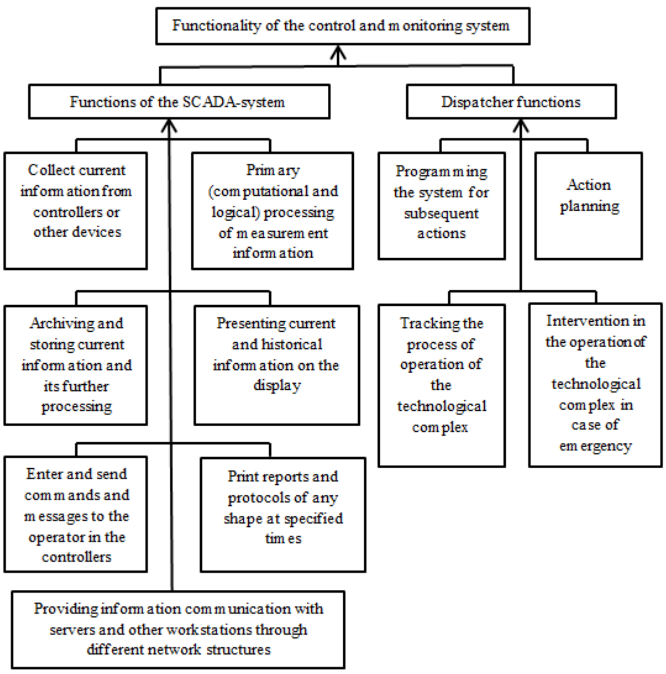

Figure 1: Functional diagram

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