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EFFECTIVE MONITORING AND FORECASTING METHODS OF GPU TECHNICAL CONDITION ACCORDING TO THE BASIC TECHNOLOGICAL PARAMETERS

The appointment of a gas transportation system (GTS) of Ukraine is to ensure reliable and uninterrupted transit of natural gas from suppliers to importers and to supply domestic consumers with gas. The principle elements of the GTS are the main gas pipelines, gas distribution, gas metering stations, underground storage facilities and compressor stations with a set of main and auxiliary equipment.

Now Ukraine has a large number of different GPA types. The most common are GPA with a gas turbine driven compressor unit with a free power turbine and a centrifugal supercharger. In the operation of the pipeline the pressure is changing significantly and the temperature at the inlet to the supercharger, gas flow, the number of parallel working GPA, causing corresponding changes of operational parameters at the outlet of the compressor station. The supercharger mode changes constantly in the mode of operation. This is due to the changes in gas flow, gas composition, ambient conditions and changing of GPA technical condition overall. The main parameters of GPA is the gas pressure at the inlet (PBX) and output ofsupercharger (Rvyh), the revolutions of its rotor, the gas temperature at the inlet and outlet of the blower, the temperature of combustion products before the turbine of high pressure (TBT).

The reliability of GPA affects the operation of the pipeline which causes the uninterrupted supply of gas to consumers, as well as transportation through the territory of Ukraine. Modern development of supply technology and processing of information brings new requirements to existing control and diagnosing systems: the implementation of modern diagnostic automated complex compressor plant (SAC) KC in the system of automatic control of compressor shop (ACR) KC with given functions of remote control parameters, the condition of the equipment, and the management of a basic technological equipment from the upper level - systems engineer's workstation (AWS), that affects significantly the reliability and dependability of Ukraine's GTS. The efficiency and reliability of equipment operation is largely determined by a perfect service system, which depends both on the system performing repairs and the skill level of maintenance personnel, and on the appropriate level of operating control system performance and maintainability of the equipment.

To ensure the proper level of operation it is necessary technical diagnostics, which aims at detecting failures and faults in the early stages of their development. Technical diagnostics is the science of recognizing the state of the technical system. The structure of technical diagnostics involves two interrelated areas: the recognition theory and the theory of control suitability. Control suitability is the product property, characterizing its adaptability to the given means of control [1, 2].

The theory of recognition is used to build models of diagnostic objects and for developing recognition algorithms and decision making rules. The theory of control suitability includes

the development of tools and methods for diagnostic information and to control the technical state of the object and troubleshooting. Control suitability must be ensured by the construction of products and the system of technical diagnostics.

The present level of gas transmission development and the development of diagnostic technologies lead to increasing the importance of knowledge about the technical condition of the equipment, which in its turn requires the expansion and deepening of the instrument and methodological base of diagnostic tests.

For quality study of technical state complex systems should be divided into subsystems and components. Inside the subsystems we can consider structurally and functionally completed system components which interaction achieves the goal with the scheduled task. As elements into consideration are included parts that are the result of a distribution system design without adherence of the principles of constructive and functional completeness of parts.

Each element of the system is associated with other elements in a certain way, and identical elements may have different properties in different systems. So, first of all, it is necessary to identify relations and conduct its structural analysis. Thus, obtained information may be provided in a variety of charts, drawings, technical descriptions, maps, logical transitions, etc. [3, 4, 5].

A compressor unit can be defined as a complex technical system, which can not distinguish between the effects of variables of different physical nature because they can not be reduced to the sum of the parts, and are some single entity that has qualities that are not typical for its parts [6,7].

All that which is not included in a technical system is considered to be an outer environment. The system can feel the influence of the environment and influences it io its own. The first can be defined as the input, the second – the output. The input can be divided into adjustable, dynamic random action and "noise" of the system. The set of output parameters can be described as the basis vector of a technical condition. In its turn the vector of technical condition is perceived by sensors of measuring complexes and is the subject to certain research analysis methods, creating a feedback system, the gradient changes which indicate a change of a technical condition.

Troubleshooting and searching defects that originate in the flow of a centrifugal compressor (axial compressor, turbine) can not be limited only vibration, which provides about 60% accurate information about the state of the gas path. Therefore, to obtain timely information on the state of the flow and nature of the gas flow it is necessary to assess the current parameters of the gas flow, the deviation of which from acceptable standards could result in failure of the compressor components and assemblies. The detection of dangerous regimes on time, if they occur, will prevent failures and avoid accidents.

The definition of the technical state of the gas path of a centrifugal supercharger compressor unit (as well as using axial compressor turbine drive) is the method of functional diagnostics [1, 8, 9, 10], based on analysis of results of measurement deviations of basic measured operating parameters – a direct analysis method. If some values of diagnostic parameters are not exposed to direct measurement their values are determined by mathematical calculation of others. Actual values may differ from the related to them physical and mathematical relations with taking into account possible errors and methods of measurement (an indirect analysis method). This method will allow to detect only those faults that cause the change of deviations of thermogasdynamic parameters (pressure, temperature, gas flow) from the avarege, specified by technical documentation values. The main difficulty of technical state of a centrifugal supercharger flow is the difficulty of mathematical modeling or quantitative assessment of the processes occurring in the supercharger, which leads to complex problems of performing a reliable diagnosis in a fixed period of time.

A large number of measured parameters of GPA are in physical dependence one from another. Using these dependences we calculate analytical values of some parameters via measured values of others. This allows to maintain the control and regulation of parameters under failures of individual measuring channels and to continue the GPU work on a given mode.[7].

There are also calculated (not measured) parameters of control (fuel gas, fuel pumps, limits on stock surge), which we calculate in a number of ways, that differ by arguments composition[6]. Such duplication of calclations allows to use alternative calculation in violation of measuring channels of separate arguments. Analytical block is used only for those security settings of GPA and regulation of its mode (critical parameters) for which unambiguous analytical dependence of other parameters are set.

The result of the analytical identification of measurement channel failure is a sign of uncertainty of a corresponding parameter that allows manual diagnostic of unreliability of any measured parameters and discrete detectors for maintenance of appropriate channels without stopping GPA. SAC operates continuously in all operating modes GPA. Functions of switching to analytical parameter value under conditions of the loss or unreliability of its measurement is activated per parameter.

As a mathematical apparatus for the usage in systems SAC KC may be recommended neural network technology that will allow to take advantage of useful features and significant benefits over previously used methods of calculations.

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