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IMPROVING RELIABILITY OF ENERGY EQUIPMENT UNDER OPERATIONAL CONDITIONS

Reliability is a complex property, which, depending on the purpose of the object and the conditions of its operation, consists of reliability, durability, maintainability, and maintainability [1–3].

If the aim is to assess the reliability of the object, in particular energy equipment, during a certain time (season), then it is advisable to choose the probability of trouble-free operation as the main indicator. For energy equipment, the failure of which has a consequence - large technological losses even in case of a short-term disruption of their efficiency, the intensity of failures and the failure flow parameter of the energy equipment are in the first place among the reliability indicators. When the efficiency of operation depends primarily on the duration of operation, then the average operating time before failure is the main indicator [4–6].

Durability is the ability of the object to perform the required functions before reaching the limit state under the established maintenance and repair system. Service life is the calendar duration of operation during which the object will not reach its limit state. Resource is the total earnings during which the object will not reach the limit state. In connection with the wide-scale use of energy equipment in the technological processes of agricultural production, increasing its durability becomes important and depends on the correct choice of its nomenclature, the number and placement of reserve (spare) elements, rational organization of operational and planned maintenance of energy equipment. Repair ability is the ability of an object to be adapted to maintain and restore a state in which it is able to perform the required functions with the help of maintenance and repair [7]. For the quantitative characteristic of reliability, there are single, complex, calculated, experimental indicators of operational reliability.

The purpose of this research is to develop methods and means of diagnosing the vibration state and resource of the responsible nodes of power units and their use to assess the damage and resource of the most stressed elements and nodes of turbo machines and power equipment to increase the reliability and safety of their operation.

Automated systems for diagnosing the vibration state of turbine units provide: simultaneous determination of vibration parameters at controlled points; continuous, parallel collection and registration of vibration parameters of rotors, supports and main technological parameters of the power unit; analysis of the compliance of the vibration of rotors and supports with current regulations; preventing the development of abnormal situations; spectral, harmonic, correlation, statistical analysis of vibration characteristics; formation of trends of controlled values, shaft and support trajectories and their amplitude-phase-frequency characteristics; expert assessment of the development of dangerous defects.

Control and diagnostics of the vibration state of the turbine unit are carried out in different modes of its operation: shaft rotation, start-up, coasting, idling, load, operation under load. In case of increased vibration of the unit, a probability assessment of the development of defects is performed based on the characteristic vibration signs of their presence: cracks in the rotor; violation of the connection of the rotors and misalignment of the supports; imbalances of rotating elements of the shaft pipeline; rotor deflections; violation of the stability of the movement of the rotors in sliding bearings and hooking of the rotor to the stator. Equipping high-power turbine units with automated systems allows to prevent the development of emergency situations, increase the safety of operation of turbo units, preserve their technical and economic indicators and slow down the resource's operation in all operating modes, including rapid start-ups. Thus, preventing the development of just one emergency situation fully pays for the costs of equipping the unit with these systems.

A comprehensive approach to the collection and processing of information on the reliability of power equipment is proposed, as

well as a method of determining the main elements that regulate the reliability of a specific unit based on statistical analysis of data on the operation of steam turbine installations. Reliability analysis is based on information about damage caused by equipment failure, damage detected during planned equipment repairs, as well as data on equipment malfunctions that were detected during the operation of steam turbine installations. The following are used as initial information: equipment failure reports, repair documentation, reporting operational documentation, information obtained by technological monitoring systems, as well as information obtained by the method of expert evaluations from technical specialists engaged in the operation and repair of steam turbine equipment at power plants.

Methods for calculating the vibrational and thermal stress state of elements and structures of power machines have also been created [8–10], taking into account experimental data on the thermomechanical properties of materials.

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