

Секція 4. ТЕХНОЛОГІЇ ВИРОБНИЦТВА, ОБСЛУГОВУВАННЯ ТА РЕМОНТУ ЕНЕРГОСИСТЕМ, ЕНЕРГЕТИЧНОГО ОБЛАДНАННЯ ТА ЗАСОБІВ АВТОМАТИЗАЦІЇ

UDC 621

DEVELOPMENT OF AN APPROACH TO ASSESSING RELIABILITY OF POWER EQUIPMENT

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Improving equipment repairs and maintenance based on the analysis of its damage is one of the effective ways to increase reliability and reduce operating costs [1, 2]. One of the important conditions for changing the existing approaches to equipment repair should be the exclusion of a large number of unscheduled repairs caused by the low reliability of individual equipment components. The experience of operation and repair allows us to identify design flaws inherent in specific equipment sizes. The generalization of such data is used by manufacturers when developing new equipment or reconstructing existing equipment.

An analysis of reliability research papers [3, 4] showed that most papers contain information on failures that occurred during operation, while a small number of papers provide information on damage detected during repair. Given the imperfection of the information collection system, some of it may not be reflected in official documents (on failures and defects detected during the repair process) There is no generalized information on the causes of equipment damage; there is insufficient information on turbine auxiliary equipment. There is virtually no information on damages summarized by operation and repair data. It is necessary to collect and analyze information on all equipment of the turbine unit using data from official statistics on failures, data on damage detected during repairs, information from operating and maintenance personnel. The reliability analysis of all equipment should be performed using a unified approach. Based on this analysis, it is necessary to identify the elements that limit and determine the reliability of turbine equipment.

The aim of the study is to develop an approach to improving the reliability of power equipment based on statistical analysis of power plant operation data.

The physical life of equipment is limited only by the condition of the metal and welded joints. The results of the statistical analysis show that the largest

contribution to the overall damageability of power equipment is made by the destruction of welded structures. At the same time, the comparison of the safety factors for long-term strength and damage statistics shows a complete absence of any connection. It is emphasized that the existing methods of reliability research both in our country and abroad increasingly do not meet the requirements of practice and the level of production technology, since forecast estimates and actual values of reliability indicators often and significantly diverge.

Statistical research methods are most often used. In this case, the methodology for obtaining the final results on the reliability of products in accordance with the probabilistic (statistical) theory is as follows. Product failure statistics are obtained from testing or operation. Then, using known statistical criteria of agreement, the most appropriate model of distribution of random variables developed in probability theory (exponential, normal, Weibull, logarithmic, etc.) is selected and accepted as a theoretical model of probability distribution of failure-free operation (reliability model), based on which the required quantitative reliability indicators are determined. The reliability of systems is assessed by calculating the probabilities of the serviceable states of elements.

The statistical methods of reliability assessment included in the main regulatory materials are not effective enough in assessing the reliability of new highly reliable or single products in operation, i.e. where there are few or no failure statistics. Reliable information can be obtained by studying the mechanical and chemical properties and some physical parameters of products that characterize the technical condition of the latter, using probabilistic methods. In this case, the methodology for establishing quantitative reliability indicators based on the study of certain physical parameters characterizing the technical condition of products is to identify the kinetic laws of degradation processes (building mathematical models of degradation processes) and determine the analytical relationship of these laws with reliability indicators. It is of fundamental importance to reveal failure mechanisms and their impact on the reliability of products. The models obtained with this approach are incomplete, and the extension of the results of the model obtained in this way, even to a similar object, but in a different mode, can only be of a qualitative nature.

An integrated approach to collecting and processing information on the reliability of power equipment is proposed, as well as a methodology for determining the main elements governing the reliability of a particular unit based on statistical analysis of turbine plant operation data. Reliability analysis is based on information about the damage that caused equipment failures, damage detected during scheduled equipment repairs, as well as data on equipment malfunctions detected during the operation of turbine units. The initial information used is the following: equipment failure reports, repair documentation, operational reporting documentation, information obtained by process monitoring systems, as well as information obtained

by expert assessments from technical specialists involved in the operation and repair of turbine equipment at power plants.

Based on the analysis of information on damage in the operating conditions of the equipment, a methodology for improving the reliability of turbine components and auxiliary equipment that limit the reliability of the turbine installation, analyzing their effectiveness, and developing proposals for improving the repair is proposed. Reliability analysis is based on information about the damage that caused equipment failures, damage detected during scheduled equipment repairs, as well as data on equipment malfunctions detected during the operation of turbine units. The following information is used as initial information: equipment failure reports, repair documentation, operational reporting documentation, information obtained by process monitoring systems, as well as information obtained by expert assessments from technical specialists involved in the operation and repair of steam turbine equipment at power plants.

The aim of this work corresponds to the priority directions of equipment development and allows further improvement of equipment based on solving problems of optimal design of structural elements [5].

Conclusions

An integrated approach to the collection and processing of information on the reliability of power equipment is proposed, as well as a methodology for determining the main elements that regulate the reliability of a particular unit based on statistical analysis of power equipment operation data.

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