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Identification of the Efficient Manufacturing Characteristics

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Abstract

This work deals with the issue of enhancing the efficiency of utilization of power generating resources at industrial enterprises. It is only possible to solve this task based on the optimization of operating modes of power generating equipment. Optimization of the equipment modes is performed using manufacturing characteristics which reflect model approximations of the processes of equipment in operation. It is expedient to emphasize the need to apply individual characteristics of specific units of equipment. One of the baseline approaches to building such characteristics is the use of method of generalized power balance. This work sets out the key provisions of this approach. It also describes the method of determination of optimal manufacturing characteristics of power generating equipment using the testing and operational data. This determination of characteristics is performed using the criterion of the minimum of mean-root square error with the optimal choice of weights. An example for determination of efficiency of operation of power generative equipment based on this method is provided in this work. The results of various studies suggest that the method developed enables to quickly identify reduction of efficiency indicators of power generating equipment using automated systems of manufacturing process management. At the same time, operating personnel receive the necessary information in order to made decisions on adjustment of operating modes. This approach will help enhance the efficiency of power generating equipment.

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1. Introduction

Enhancement of the efficiency of power generation is currently one of the main challenges for large-scale industrial enterprises. The said problem is especially topical due to the requirement to implement energy saving activities at such enterprises. The thing is that reduction of power consumption promotes and enhances competitiveness of power generation companies, both on the domestic market and on international markets. Under such conditions it is crucial to be able to manage power generation processes and energy savings processes. The problem of enhancing the efficiency of power generation has been studied by the following authors [1-10].

Management of power generation processes at industrial enterprises is based on using automated management systems. Such automated management systems are multilayered distributed systems which gather significant volumes of information about power generation processes at the respective companies. They are designed to ensure management both at the level of operational dispatch management, and at the level of optimization of operating processes and technical and economic planning.

The level of operational dispatch management of power generation processes has been well developed and understood [11-15]. The level of optimization of operating processes, despite its ample theoretical base, still deserves a more practical aspect of its implementation. The point is that when operating complex and technologically-intense production processes, it is difficult to solve multiple and combined optimization problems using the exhaustive search method. The priority issues are identification and optimal rating of manufacturing characteristics of power generation process equipment. It is expedient to solve such problems by way of intellectual analysis of operational data. The methods of intellectual analysis of data are recommended to use within management systems of industrial enterprises [16-21]. However, as applied to the energy saving problem this approach has not been sufficiently studied. This implies that this work is rather topical.

2. The key provisions of the analysis of power balance

The main task of enhancing the efficiency of power generation is to maximize the output of electric energy and to reduce the volume of fuels consumed. This problem may only be solved based on the optimization of operating modes of power generating equipment.

This optimization of operating modes can be performed using the advanced methods of analysis of operation of power generation equipment by way of determination of optimal modes and implementation of the same as regulatory schedules for the relevant operating modes. In case of a typical approach, this problem can be solved by application of the methods of optimization of operating procedures based on the application of statistical averages and normative models. This helps decrease the efficiency of application of the methods of optimization of operating modes of a specific unit of equipment, the characteristics of which may be significantly different than the average- and normative characteristics.

The problem of optimization of power generating equipment operating modes can be normally solved by way of using power (energy) characteristics. The characteristics reflect certain model views about the processes of equipment operation. To solve the problem of optimization, it is necessary to apply individual features and characteristics of a specific unit of equipment. The point is that characteristics of such piece of equipment – due to its past repairs and operational factors – may be significantly different than the initial characteristics and they are individual in nature.

Evaluation of individual power generation equipment characteristics may be performed using thermo technical testing. However, such tests are normally quite complex and expensive. This work proposes to determine individual power characteristics of power generation equipment based on the relevant operational data.

One of the baseline approaches to building power characteristics during operation is the application of the generalized power balance method. The main provisions of this method are outlined below.

Specific units of equipment can be viewed as power hubs. Power flows are converged and diverge in these hubs. According to the energy conservation law, a power balance equation may be developed for each hub: