
METALS AND STRENGTH
ANALYSIS

Modern Problems Concerned with Ensuring Safe Operation of Heat-Generating and Mechanical Equipment in Extending Its Lifetime

V. F. Rezinskikh[†] and E. A. Grin'

All-Russia Thermal Engineering Institute, Avtozavodskaya ul. 14/23, Moscow, 109280 Russia

Abstract—The problem concerned with safe and reliable operation of ageing heat-generating and mechanical equipment of thermal power stations is discussed. It is pointed out that the set of relevant regulatory documents serves as the basis for establishing an efficient equipment diagnostic system. In this connection, updating the existing regulatory documents with imparting the required status to them is one of top-priority tasks. Carrying out goal-oriented scientific research works is a necessary condition for solving this problem as well as other questions considered in the paper that are important for ensuring reliable performance of equipment operating for a long period of time. In recent years, the amount of such works has dropped dramatically, although the need for them is steadily growing. Unbiased assessment of the technical state of equipment that has been in operation for a long period of time is an important aspect in solving the problem of ensuring reliable and safe operation of thermal power stations. Here, along with the quality of diagnostic activities, monitoring of technical state performed on the basis of an analysis of statistical field data and results of operational checks plays an important role. The need to concentrate efforts taken in the mentioned problem areas is pointed out, and it is indicated that successful implementation of the outlined measures requires proper organization and efficient operation of a system for managing safety in the electric power industry.

Keywords: thermal power station, equipment, safety, reliability, lifetime, diagnostics, technical state, regulatory documents, scientific investigations, monitoring

DOI: 10.1134/S0040601513010072

According to a number of key indicators referred to in the Federal Law “About Industrial Safety of Hazardous Production Facilities” No. 116-FZ of July 21, 1997, thermal power stations (TPSs) fall into the category of hazardous production facilities. However, since the management of power stations and of the electric power industry as a whole had clear understanding of the importance of matters concerned with safe and uninterrupted operation of TPSs well before the adoption of this law, they had given much attention to this problem for many years. The fact that the importance of matters concerned with ensuring reliable and safe operation of the main equipment of TPSs (among other things, in view of its ageing) is steadily growing is also beyond question.

The major part (more than 80%) of the equipment installed at enterprises of the Russian electric power industry was put in operation in the period from 1960 to 1985; hence, by now it has been in operation from 30 to 50 years. By 2010, around 50% of the generating capacities installed at TPSs had worked out their fleet life, and by 2015 this figure will exceed 65%. For example, by now, around 70% of the total number of turbines and around 80% of the drums used in high-

pressure boilers have worked out their fleet life. Another typical feature is that the fraction of equipment operating in load following modes is increasing, whereas the amounts in which planned repairs and maintenance of equipment are carried out tend to decrease. It should be recognized that equipment that has worked out its assigned service life will continue to operate for a long period of time. Activities aimed at extending the lifetime of ageing equipment involve the need of paying special attention to such equipment and checking whether the requirements for carrying out its diagnostics and repair are complied with. We know from various sources that failures of such critical components as drums of high-pressure boilers [1] and elements of feedwater pipelines and high-temperature steam lines have recently occurred. Figure 1 shows one “fresh” example of this sort, namely, the failed bend of a turbine’s steam line with a size of $\varnothing 273 \times 32$ mm (diameter \times thickness). This failure occurred as a result of the metal lifetime becoming exhausted through the high-temperature creep mechanism. Such accidents and failures of power equipment connected with them inflict essential damage to the owner and, what is more important, may lead to undesirable social consequences (inflicting harm to the health and life of the power station personnel).

[†] Deceased.