1.5.22. SCIENTIFIC BASES FOR DIAGNOSTIC SYSTEMS OF HEAT CONTROL

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This report contains results of the work on solving complex optimization problems of diagnostic systems of heat control including control technology, diagnostic test set, training of experts, maintenance carried out by the operating personnel (NDT inspectors), diagnostic methods intended to better safety of operation and energy efficiency of different industrial objects such as potentially dangerous engineering devices, buildings and structures, units of electric power supply and housing and public utilities.

Better reliability and efficiency of operation within the whole required operating time of objects in different industrial sector is one of the urgent problems not only for Russia but also for other countries. This problem can be solved only upon complex diagnostic of objects which present possibility of emergency situations resulting in financial and even human losses. Problem of technical reliability is attended with the necessity of power supply and ecologic protection.

As a result of sophistication of technologies and structures as well as increasing depletion of key assets a number of technogenic accidents and catastrophes. More than 60% of them are caused by deviations of their technical characteristics or operating modes from the standard values.

For instance, in 2006 the highest number of fires was registered in the housing sector. Their share of the total number amounted to 72.3%, and of financial damage – 44.6%.

Violation of installation and operation rules of electrical equipment was the cause of every fifth fire (19.2%), and damage accounted for 31.5% of total financial damage in the country. The most inflammable components of the buildings electric installations are power lines that cause 40% of all fires and inflammations relating to the electric equipment and power devices that is why their up-to-date diagnostic is very important.

One of the urgent problems of modern industry is its energy efficiency. For example, in Moscow in 2006 total consumption of fuel was equal to 24,963 ths. TFOE including the major part – in housing and public utilities (with population) – 50.8% and in industry – 21.1%.

Present capacity of energy efficiency for the heat energy and electrical power as well account for 25 – 30%. Capacity of energy efficiency for different sectors varies between 6% and 8% (electrical transport) up to 40 – 45% (housing sector). Economy can be provided due to new constructive solutions (for instance, application of innovative materials and technologies of cladding structures) and optimization of objects' operating standards before up-to-date monitoring.

Diagnostic problems of technical condition and characteristics of energy efficiency of the enlisted objects can be solved by non-destructive inspection methods, and by thermal method in particular. But correct application of this method requires complex approach and shall include the following activities having the joint final task (insurance of technical, energetic and environmental protection), one strategy, and complying with the principle of conceptual unity:

– global tasks of safety insurance of operation of different units used by people in their life activity;

– examination of the object under control and definition of requirements to the object;
– analysis of possible defects and their criticality;
– definition of informative settings of critical defects of the physical field;
– control feasibility study, selection of methods or set of methods of non-destructive inspection and diagnostics;
– parameter optimization of equipment and defect identification;
– elaboration of defect detection methods, definition of their operating parameters and evaluation of quality factors of the object under control;
– elaboration of non-destructive inspection and diagnostic technologies: creating of control procedures, development of the procedures created on the samples and real objects, further certification with metrological examination of the results received in terms of compliance of the stated parameters with the values obtained in fact;
– personnel training for diagnostic, evaluation of the personnel's qualification and certification;
– authorization of companies (or their departments) for non-destructive inspection and diagnostics by their accreditation in the selected Assessment system;
– fulfillment of works on non-destructive inspection and diagnostics of different objects in compliance with the elaborated procedure;
– quality evaluation of the work of non-destructive inspection personnel in terms authenticity of measurements, reliability of results, feasibility and completeness of conclusions for defect detection of the object under control and evaluation of its technical condition, selection of the most qualified personnel for diagnostics;
– correction of control and diagnostics technologies on the basis of the best expert's work results;
– issue of the finding for the technical condition of the object under control.

Performance of this measures – from examination of the object under control in terms of evaluation of quality factors and possibility of heat control application by the existing soft hardware to optimization of the operating personnel performance – will help to solve the technical condition diagnostics of the heat-generating (heat-consuming) objects and their energy efficiency. It is the basis for resources forecasting and safety operation insurance (technical, energetic and environmental protection) of the objects in different industrial sectors, power generation, construction industry, and transport.