1.12.27. PROSPECTS OF APPLICATION OF AUTOMATED SYSTEMS FOR NONDETSRUCTIVE TESTING OF THERMAL MECHANICAL EQUIPMENT OF THERMAL POWER PLANTS

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Introduction. Automation of control processes for thermal power plant (TPP) equipment is one of the prospective direction of production activity. Diversity of test objects, wide range of electromagnetic parameters, surface states (including curvature), flaw detection criteria and RD (ruling document) requirements makes it very difficult to achieve such a task.

For many dozens of years, activity direction related with development of automated non-destructive testing systems functions and develops successfully in the UralVTI. Some of them are discussed below.

Automated testing system "AKVO-2" for downcomer openings of high-pressure boiler barrels. In Russia, large park of high-pressure boiler barrels is operated. With systematic inspection of barrels, various defects are detected in them like cracks near pipe openings, on the surface of shells and bottoms, in main welded joints, in the places of welding of separation devices, etc. Below, system of automated testing of the barrel pipe openings for the presence of surface operational cracks in them is discussed.

Starting from 1980's, mechanized semi-automatic devices for eddy-current testing of opening surface, detection and determination of crack location and parameters are developed and applied in the UralVTI along with the manual testing. During long period of time, such a device was applied for the first time for inspection and testing of downcomer openings of the TGM-84 boiler (st. no. 11) at Ufimskaya TPP-4. Performed work has resulted in more precise determination of the main parameters of barrel metal resistance to crack development.

Constant improvement of mechanical and electronic parts of automated testing system for barrel downcomer openings has resulted in creation of automated opening testing complex "AKKO-2". Original mechanical assemblies and modern electronic units are applied in this device. Complex provides 100% scanning of barrel opening surface by means of eddy-current laid-on probe (ECLP) with recording of testing results to personal computer (PC).

Automated complex "ROTOR-K" for testing turbine rotors from the part of axial channel. Turbine rotor is one of the important elements of the modern TPP. Considerable static and dynamic loads affect it in the process of operation. Therefore, it is important to detect timely defect in the rotor metal. Under applicable RD's, turbine rotors must be subjected to inspection from the part of axial channel following operation during the respective term. Complex "ROTOR-K" developed in the UralVTI is intended for automated testing of turbine rotors from the part of axial channel and allows performance of visual, eddy-current and ultrasonic testing, as well as measurement of residual strain.

Application of specially designed eddy-current flaw detector is a distinctive feature of this complex. Flaw detector provides formation of exciting signal and reception of informational signal from ECLP, as well as extraction of valid data in various forms (amplitude, phase and combined). It allows "impeding factors" to be tuned out by means of automatic transfer of origin of coordinates of complex plane.

Ultrasonic testing (UST) is performed in immersion option of ultrasound introduction. UST scanning module contains 2 pairs of PEP's installed in special carriages for insonification of rotor metal under "tandem" scheme. Possibility of tandem base varying, allows operator to set required threshold of sensitivity to the crack depth and detect reliably cracks developed from the outer rotor surface.

Visual scanning module (SM) contains video-camera of standard TV-resolution, which in combination with eddy-current SM allows testing zone to be observed and images of defects detected under eddy-current method to be obtained.

Diameter measurement module is built on the basis of high-accuracy laser triangular distance finders and provides contactless measurement of channel diameter along the rotor length.

Automated complex "GIB-3M" for testing bends of non-heated boiler pipes from part of their inner surface. The complex GIB-3M is designed for testing water circulator and downcomer pipes and their bends from the part of inner surface under visual and eddy-current methods. Availability of flexible link between transport and scanning mechanisms provides device movement along straightforward and bent sections of a pipeline. Special mechanism provides unobstructed transit of carriage with a probe through backing ring of welded joint. Due to this fact, complex can move in pipeline from barrel to collector and perform visual and eddy-current testing of their surface. Complex is entered into pipe from the part of barrel through downcomer opening. There is no need in thermal insulation and cleaning of pipeline bends surface.

Testing in production conditions has shown operability of complex and reasonability of its application for testing.

Automated complex "COLLECTOR-1" for testing collectors from the part of inner surface. Currently, standard endoscopes are applied for visual inspection of the collector's inner surface. Limitation of testing zone (besides the set of drawbacks inherent to any manual method) should be referred, first of all, to the drawbacks of this method.

Developed complex "COLLECTOR–1" allows 100% visual inspection of the collector inner surface to be performed. Complex is located into collector through one of tubes. Track drive provides movement of device along the whole collector. Special controlled arm makes it possible to orientate video-camera randomly and to obtain image and photo of tested section.

Conclusion. All discussed automated systems are applied successfully in practice. More than 300 rotors were tested by means of the complex "Rotor-K". At the same time, new developments are carried out in the Institute, including systems of automated testing of such TPP equipment elements as blade system of turbine rotor and bends of live steam lines.