THE STUDY OF COMPUTER PROGRAMS FOR CALCULATING THERMAL-HYDRAULIC PROCESSES IN NPP STEAM GENERATORS FOR IT'S AUTOMATED TECHNOLOGICAL PROCESS CONTROL SYSTEMS

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Thermal and hydraulic calculations of steam generators are the first main calculations at the stage of their design, which provide initial information for further calculations of strength and technical-economic indicators. According to the degree of detail of the information obtained, thermal and hydraulic calculations of steam generators should be divided into preliminary, one-dimensional, two-dimensional, and three-dimensional. In order to create a unified program that includes various modifications of thermal and hydraulic calculations, a complex of software modules is usually developed, from which, using a control program, the exact set of programs needed to solve a given specific task can be assembled. A positive aspect of the modular organization of programs is the possibility of their rapid correction when the purpose and detail of the calculations change by modifying the initial data in the modules or replacing them. Let us consider the methods of mathematical modeling of thermal and hydraulic processes in NPP steam generators and modular programs for their calculations in a one-dimensional formulation using the example of steam generators with countercurrent or cocurrent mutual movement of the heat carrier and the working fluid (or with equivalent multi-pass movement), thermal and hydraulic calculations are largely reduced to the calculation of a single steam-generating channel. In modern mathematical models, in the case of a one-dimensional calculation formulation of the problem, heat exchange and hydraulic processes in the steam-generating channel are described, mainly, by a set of the following dependencies: heat balance equation in the steam-generating channel, heat transfer equation; equations for determining pressure and hydraulic resistances in the steam-generating channel along the paths of the heat carrier and the working fluid; the dependencies of the relationship between the temperatures of feedwater and steam with their enthalpies and pressures; dependencies that determine the values of the thermophysical properties of the heat carrier, working substance, and structural materials as functions of their temperature, dependencies for calculating heat transfer coefficients on both sides of the heat carrier and working substance as functions of their determining parameters in the steam-generating channel. These dependencies determine the solution of the one-dimensional problem of thermal and hydraulic calculations of horizontal and vertical NPP steam generators.

The design of NPP steam generators is a complex process that requires a systematic approach and the use of modern computational technologies. Carrying out variant calculations allows obtaining optimal characteristics of steam generators, ensuring their efficiency and reliability.