TEMPERATURE CHARACTERISTICS OF SUPERHEATER- SEPARATORS IN NUCLEAR POWER PLANT UNITS WITH THE CAPACITY OF 1000 MW

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One of the most urgent problems in the design and operation of turbines for saturated steam of the second circuit of WWER-1000 power units equipped with wet steam turbines of K-1000-60 / 1500-2 (K-1000-5.9 / 25) type is to reduce moisture content in the flow part of the low-pressure turbine cylinders (LPC). A high value of steam humidity (low dryness $x < 0.88$) leads to a significant decrease in the internal efficiency of the low-pressure turbine (internal efficiency), erosion and corrosion of the turbine blade surface which can negatively affect the reliability and safety of the operation of both the turbine unit and the nuclear power unit as a whole.

To separate moisture from the steam flow after a two-line high-pressure cylinder (HPC) of the turbine and increase its temperature (overheating) before entering the two-line LPC in the turbines K-1000-60/1500-2 type of various modifications for nuclear power units with a WWER-1000 reactor superheater-separator (SHS-1000) located in four buildings are used. Each case of the superheater-separators is a vertical cylindrical apparatus consisting of a louver type separator and two stages of the superheater in the form of surface-type heat exchangers located in the lower part of the case. After the HPC turbine with the degree of dryness $x = 0.88$ (at the nominal operating mode) wet steam enters the inlet annular chamber, from which it is distributed through the inlet manifolds of the separator and sent to the louvered sheets, where moisture is separated and flows as a separator stream into the separator-collector (SC).The steam dried in the separator to the degree of dryness $x \geq 0.999$ (at the nominal operating mode) enters the annulus of the first stage of the superheater (SH-1), where it is additionally dried and partially overheated by the heating steam from the first selection of the HPC. The condensate of the heating steam SH-1 is sent to the condensate collector CC-1. The final superheating of the steam is carried out at the second stage of the superheater (SH-2) by the heating steam from the collector for supplying "fresh" steam to the HPC. Its condensate is sent to the condensate collector CC-2.

The main characteristics by which the efficiency of the power plant, and, therefore, the efficiency, reliability and safety of the power unit can be evaluated, are the temperature characteristics of the plant as an important part of the set of operational (energy) characteristics of power units with WWER.

The steam temperature after SHS depends on the parameters of the heating and heated steam at the inlet to the overheating stage, the flow rate of the heated steam, the heat exchange surface area and the features of heat exchange processes in these surfaces, one of which is that the temperature of the heating steam at the inlet and outlet of the overheating stages (in the form of condensate) has the same value.

The temperature characteristics of SHS-1000 at nominal and partial operating modes of a 1000 MW nuclear power unit have a significant impact on the change in its main indicators: electric power N and specific heat consumption q.

The analysis of the influence of the temperature characteristics of the SHS at partial operating modes of the power unit on its main performance indicators N and q showed that the influence of SH-1 parameters decreases with the decrease in "fresh" steam consumption, and the influence of SH-2 parameters increases.

The abovementioned determines the relevance of constructing adequate mathematical models of the dependences of the temperature change of the heated steam in the SHS-1000 stages on the operating mode (electrical load) of a 1000 MW nuclear power unit in order to determine correctly temperature values.