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Modeling of water chemical condition of secondary circuit of nuclear power plant with VVER

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Models of corrosion and mass transfer of corrosion products in the pipes of the condensate-feeding and steam paths of the secondary circuit of NPPs with VVER-1200 are presented. The mass transfer and distribution of corrosion products over the currents of the working medium of the secondary circuit were calculated using the physicochemical model of mass transfer of corrosion products in which the secondary circuit is regarded as a cyclic system consisting of a number of interrelated elements. The circuit was divided into calculated regions in which the change in the parameters (flow rate, temperature, and pressure) was traced and the rates of corrosion and corrosion products entrainment, high-temperature pH, and iron concentration were calculated. The models were verified according to the results of chemical analyses at Kalinin NPP and Tianwan NPP and iron corrosion product concentrations in the feed water at different NPPs depending on pH at 25°C (pH25) for service times $\tau \geq 5000$ h. The calculated pH values at a coolant temperature t (pHt) in the secondary circuit of NPPs with VVER-1200 were presented. The iron concentration in feed water is a function of time pHt and values of conductivity medium (H-cation). The calculation of the distribution of pHt and ethanolamine and ammonia concentrations over the condensate feed and steam circuits are given. The models are designed for developing the calculation codes. The project solutions of ATOMPROEKT satisfy the safety and reliability requirements for power plants with VVER-1200. The calculated corrosion and corrosion product mass transfer parameters showed that the model allows the designer to choose between the increase of the correcting reagent concentration, the use of steel with higher chromium contents, and intermittent washing of the steam generator from sediments as the best solution for definite regions of the circuit.

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