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Thermal Hydraulic Study of Steam Generator of PGSFR

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In Prototype Gen-IV Sodium cooled Fast Reactor (PGSFR), integral once-through type, counter-flow shell-and-tube heat exchanger with straight vertical tubes was adopted for steam generators. Reliable operation of the steam generators has been a key issue through operating experience of foreign sodium cooled fast reactors because it is one of the most important components deciding the plant availability and reliability. Non-uniformity in sodium flow and temperature distributions might cause mechanical integrity problems such as tube buckling and tube-to-tube sheet junction failure in straight tubes. This work reports thermal hydraulic study on the sodium flow at the inlet plenum and the temperature distribution in the sodium-side of the PGSFR steam generator based on multidimensional numerical analysis. Optimization of porosity of distributers for achieving circumferentially uniform flow at the inlet plenum was carried out with the STAR-CCM+ CFD package. Then, the multidimensional sodium temperature distribution at tube bundle region was also calculated by the STAR-CCM+ CFD package. The heat flux from the sodium-side to the water-side was estimated using 1-D in-house code and supplied as boundary conditions at tube walls in the multidimensional CFD simulation. Iterative calculations between the STAR-CCM+ and 1-D in-house code were successfully conducted to acquire the radial and axial sodium temperature distributions under normal operation condition. The thermal hydraulic analysis results would be provided as input data to evaluate the mechanical structure integrity of the steam generator of the PGSFR.

Country/Int. Organization

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