Contribution ID: **336** Type: **Poster**

Tube inlet orifice design of a once-through steam generator considering operation strategies

A numerical study is conducted for a thermal-hydraulic performance analysis and secondary side screw-type tube inlet orifice design of a once-through steam generator (OTSG). Various tube-plugging conditions and power levels are considered, and the secondary coolant inlet temperature is adjusted to maintain a constant level of thermal power. Comprehensive numerical solutions are acquired to evaluate the thermal-hydraulic performance and minimum orifice length of the OTSG under various operating conditions. The results obtained show that constant thermal power can be maintained by properly adjusting the secondary coolant inlet temperature with variation of the steam outlet superheat degree and secondary coolant pressure drop when the OTSG operates at a high power level. The lowest power level results in the highest minimum orifice length, and non-plugged condition practically limits the orifice length criterion. This OTSG performance and orifice length are compared with those when the secondary coolant flow rate or secondary coolant outlet pressure is controlled for constant thermal power operation. The secondary coolant outlet pressure control operation with the highest secondary coolant pressure provides the smallest tube inlet orifice size and it accordingly results in the lowest hydraulic pumping power through the orifice. The orifice size is almost unchanged with respect to the constant thermal power operation strategy when the secondary coolant control parameter is the inlet temperature or flow rate because both schemes provide nearly identical secondary coolant pressures.

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Track Classification: Topical Group A: SMR Design, Technology and Fuel Cycle: Track 1: Design and Technology Development of SMRs