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UPDATING OSV AND CHF CORRELATIONS IN NUCIRC FOR PRESSURE TUBE DIAMETRAL CREEP

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Abstract

The NUCIRC code is a 1-D steady state code used to predict flow rates, pressure, temperature, and quality throughout the primary heat transport system (PHTS). The code allows the calculation of critical channel power, flow, pressure and temperature conditions over the full range of HTS operating conditions including refuelling operations, and the assessment of the impact of PHTS auxiliary system flows such as purification flows.

STERN Labs performed a series of experiments to assess the Critical Heat Flux (CHF) and post-dryout performances of 37-Element fuel under steady-state conditions. These experiments simulated twelve 37-element fuel bundles in light water for 0%, 3.3%, and 5.1% pressure tube diametral creep. In general, it was found that CHF decreases with increasing diametral creep.

New Onset of Significant Void (OSV) and CHF correlations were developed by L. Leung for light and heavy water using the experimental data from STERN Labs. The previous correlations were developed with only 0% and 3.3% pressure tube diametral creep. The new correlations were developed with 0%, 3.3%, and 5.1% pressure tube diametral creep, and thus are capable of capturing the effect of diametral creep on CHF in the range of interest for CANDU-typical conditions over the plant life.

The new correlations for OSV and CHF were implemented into the NUCIRC code. This paper discusses the implementation and verification of these correlations into NUCIRC.

Simulations of experiments in the STERN test rig were performed to show that NUCIRC reproduces the single-phase, two-phase, and CHF data from the STERN experiments. The NUCIRC code reproduced the two-phase ΔP with a bias of 0.05% and an uncertainty of ±2.03%. The dryout power data were reproduced quite well with a bias of 0.04% and an uncertainty of ±2.33%. Sensitivity calculations show that the code was able to predict smooth changes in CCP with increasing diametral creep, over the range of CANDU-typical pressure tube creep.

In summary, the new correlations in NUCIRC have been verified with experimental data and now can be used to predict CHF and dryout at higher levels of creep with improved accuracy.