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**Development of Hot Channel Factors for Pin-Type Fuel in an Annular
Geometry**

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ABSTRACT

The PLTEMP/ANL code uses hot channel factors (HCFs) to account for the effect of fuel assembly manufacturing tolerances and reactor modeling/operational uncertainties on the calculated safety margins. The development of HCFs is relatively well established for research reactors utilizing plate-type fuel. However, work is still needed to establish methods for properly accounting for uncertainties in other non-typical fuel bundle geometries.

Analytical expressions for HCFs for pin-type fuel in an annular configuration are derived which account for the effects of design uncertainties, reactor operation uncertainties, and manufacturing tolerances. The HCF equations were verified by several methods, including comparisons with CFD models that explicitly included uncertainties for a hypothetical fuel assembly design.

The CFD method was further utilized to determine equations describing uncertainties related to asymmetries in the fuel assembly. It is shown that in some pin-bundle designs the flow asymmetries can have a significant impact on the overall HCFs to the extent that they dominate the safety margins.