A Pin Power Reconstruction Method for CANDU Reactor Cores

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Abstract

A reconstruction method has been developed for recovering pin powers from CANDU core calculations performed with the coarse-mesh finite-difference diffusion approximation and single-assembly lattice calculations. The homogeneous intra-nodal distributions of group fluxes are efficiently computed using polynomial shapes constrained to satisfy the nodal information approximated from the node-average fluxes. The group fluxes of individual fuel pins in a heterogeneous fuel bundle are determined using these homogeneous intra-nodal flux distributions and the form functions obtained from the single-assembly lattice calculations. The pin powers are obtained using these pin fluxes and the pin power cross sections generated by the single-assembly lattice calculation. The accuracy of the reconstruction schemes has been estimated by performing benchmark calculations for partial core representation of a natural uranium CANDU reactor. The results indicate that the reconstruction schemes are quite accurate, yielding maximum pin power errors less than ~3 %. The main contribution to the reconstruction error is made by the errors in the node-average fluxes obtained from the coarse-mesh finite-difference diffusion calculation; the errors due to the reconstruction schemes are less than 1 %.