INVESTIGATIONS ON NEUTRONIC COUPLING ASPECTS OF THORIUM FUELED AHWR

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ABSTRACT

Large sized nuclear reactors are preferred to achieve economy of scale in power production. However large sized reactor core are neurotically decoupled and they could show spatial instability, i.e., they might undergo unintentional deviation in power distribution under certain transients. Degree of neutronic decoupling depends on the core dimensions, shape (H/D ratio), power levels, degree of asymmetric reactivity insertion etc. This complex phenomenon can be easily analyzed using eigenvalue separation (EVS) methodology [1].

Indian Advanced Heavy Water Reactor core is a large sized core which may behave in a neurotically decoupled manner under selected reactivity transients. In the present study, an effort has been made to understand the neutronic coupling aspects of AHWR core. Higher harmonics of neutron diffusion equations have been estimated using the method of mode subtraction [1]. The eigenvalue separation for different modes has been calculated as a function of core size and shape and it has been compared with other systems like PHWRs and PWRs. It has been found that smaller H/D ratio in case of AHWR leads to small EVS in azimuthal mode, making this mode spatially more unstable compare to axial mode. Magnitude of allowable asymmetric reactivity perturbations have also been obtained based on respective EVS estimates. Findings show that minor azimuthal perturbations in AHWR may lead to spatially unstable situation and consequent safety concerns however axial asymmetric reactivity perturbations of similar magnitude have no significant impact on spatial stability and safety.