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Stability Analysis of a Liquid Metal Cooled Fast Reactor

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Under specific transients, fast reactor cores often show significant deviation in their power distribution which leads to spatial instability. As a quantitative indication of these decoupling characteristics, the λ-mode eigenvalue separation has been frequently employed. The physical interpretation of eigenvalue separation provides a measure of the spatial neutronic coupling among various parts of a reactor and, hence is indicative of the space-time dynamic behaviour. In this paper the core-wide and regional stability of a Korean Prototype GEN-IV Sodium-cooled Fast Reactor (PGSFR) design is investigated using deterministic approaches. To calculate higher mode eigenvalues and associated eigenvectors the methodology of flux higher eigen-modes calculation was implemented into DIF3D 10.0 code and is thoroughly described in the paper. This specific DIF3D modification is denoted as DIFHH where the decontamination (or in some literature known as deflation) method was adopted as the simplest solution. In order to validate and demonstrate the performance of DIFHH code modification, the simple benchmark problem based on paper prepared by Mr. Obaidurrahman was chosen and investigated. The comparison of achieved trends and absolute values confirmed a favourable consistency between the reference and calculated results. The D/H ratio of the reactor core was identified as an indicator of the extent of core stability, therefore the present analyses include the investigation of eigenvalue separation and flux distribution of various core D/H ratios. The findings and the results are deeply discussed in the paper.

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