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Impact of the irradiation of an ASTRID-type core during an ULOF with SIMMER-III

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Innovative Sodium-cooled Fast Reactors (SFRs) are currently investigated in the ESNII+ European project. The goal of the WP6 "Core safety"of this project is to support the development of the ESNII roadmap as well as the implementation of the ESNII deployment strategy and licensing of the ESNII systems by identifying the experimental and theoretical R&D activities which are necessary for improving the present designs, as well as the existing methods, tools and databases for static and transient safety analysis of the ESNII critical reactor cores.

One of the main issues of the WP6 "Core safety"of the ESNII+ project is to assess the behavior of the ESNII core (ASTRID-like core) in severe accidents at a representative stage, ie. the end of equivalent cycle (EOC), as the sodium voiding effect is less favorable at this moment. Consequently, the SIMMER-III code system (coupled thermohydraulics, pin mechanics and neutronics) is used as it can represent the accident up to an advanced core degradation. However, it has been developed to perform neutronics calculations at the beginning of life (BOL, without irradiation), and a new methodology needs to be implemented to perform neutronics calculations at the EOC.

The aim of this paper is to present the difference of behaviors of the ESNII+ core at BOL and EOC, so as to highlight the importance of the irradiation in the accident scenario. Thus, a new methodology developed in the framework of the ESNII+ project to perform neutronics calculations at EOC is presented. Then, Unprotected Loss Of Flow (ULOF) calculations, with a 30s primary flow-rate halving time, are performed at BOL and EOC. The sodium boiling and the pin degradation happen earlier at EOC, but the core degradation is slow in both calculations and there are no power excursions.
Despite less favorable feedback coefficients at EOC, and thanks to its heterogeneous geometry, the ESNII+ core in ULOF with a 30s halving time, does not lead, with the given hypotheses, to a power excursion.

Country/Int. Organization

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