Contribution ID: **14** Type: **ORAL**

Simulation of FFTF Individual Reactivity Feedback Tests with SAS4A/SASSYS-1 Code

Thursday 21 April 2022 11:28 (12 minutes)

The Fast Flux Test Facility (FFTF) at the Hanford site in Washington was a 400 MW thermal, oxide-fueled, liquid sodium cooled test reactor, built to assist development and testing of advanced fuels and materials for fast breeder reactors. FFTF operated from 1980 until 1992, providing the U.S. Department of Energy (DOE) with the means to test fuels, materials, and other components in a fast neutron flux environment. One of the FFTF passive safety demonstration tests simulating loss-of-flow conditions without scram (LOFWOS) is currently being analyzed by the international community under an IAEA coordinated research project. In preparation for the passive safety demonstration tests in Cycle 8C, a series of individual reactivity feedback tests were carried out in FFTF. The primary goal of these tests was to check the core reactivity feedbacks in a systematic fashion by subjecting the core to various conditions of power, flow, and inlet temperature. These tests were carried out in Cycle 8A and consisted of quasi-static steps, where after each change the reactor was held at steady-state conditions for a period of about one hour to adjust to new steady-state conditions. The entire Cycle 8A test campaign consisted of about 200 steps. Each step was designed to simulate and validate specific features and reactivity feedbacks of the FFTF core. There were seven types of these individual reactivity feedback tests, targeting fuel reactivity Doppler and axial expansion feedbacks, coolant density feedback, structure reactivity feedbacks such as core radial expansion, as well as integral tests, such as the power reactivity coefficient. The data from the FFTF individual reactivity feedback tests provides a unique opportunity for validation of reactivity feedback modeling in fast reactor analysis codes. SAS4A/SASSYS-1 is one such safety analysis code that was developed at Argonne for transient simulation of liquid metal-cooled fast reactors. The structure of these tests provides data for code validation in a systematic fashion by separating reactivity feedbacks as much as was practically achievable. The quasi-static nature of these tests also simplifies code validation by eliminating the transient effects. This paper presents the results of the application of the SAS4A/SASSYS-1 code to a number of FFTF individual reactivity feedback steps, and compares the code predictions with the test data. The SAS4A/SASSYS-1 results show overall good agreement with the test, but at the same time several model improvement options were identified in this work.

Country/Int. organization

United States of America

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Session Classification: 6.3 Multiscale and Multiphysics Calculations

Track Classification: Track 6. Modelling, Simulations, and Digitilization