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Thermal Hydraulic Investigation of EBR-II Instrumented Subassemblies during SHRT-17 and SHRT-45R Tests

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Experimental Breeder Reactor (EBR-II) was a U-Pu-Zr metal-alloy fuelled liquid-metal-cooled fast reactor, extensively used for conducting safety experiments. EBR-II was heavily instrumented to measure sodium flows and temperatures at various locations in the primary circuit including the temperature distribution inside the subassemblies (SA). Several transient tests were conducted on the reactor to improve the understanding of thermal hydraulics and neutronics of fast reactors. The shutdown heat removal tests (SHRT-17 & SHRT-45R) conducted in 1984 and 1986 demonstrated mechanisms by which fast reactors can survive severe accident initiators with no core damage. In order to utilize the data recorded during these tests and facilitate computer code validation, IAEA has initiated a coordinated Research Project (CRP) wherein 19 organizations representing eleven countries participated. Several participants simulated parts of the primary heat transport system using CFD codes. Amongst theses studies, the sub-channel/CFD analysis of the instrumented SA (XX09 & XX10) are very important. XX09 was a 61-pin (59 fueled) SA with helically wound spacer wire over each pin and XX10 was a 19-pin non-fuelled SA without spacer wire. The instrumented SA are additionally cooled by a small amount of thimble flow around the SA. These SA were instrumented with wire wrap thermocouples, flow meters (below the core) and thermocouples at the SA inlet and outlet. Participants used sub-channel analysis codes and CFD codes for predicting the thermocouple temperatures at various locations. It is seen that the CFD studies are computationally intensive and transient studies could not be continued for long duration. The core top and SA top temperatures predicted by the sub-channel analysis codes and CFD codes are in reasonably good agreement with the measured values. The temperature distributions at the middle of the core predicted by CFD codes are in closer agreement with the measured values as compared to the predictions by sub-channel studies. The studies brought out the importance of thimble flow, inter-subassembly heat transfer, the effect of spacer wire and the power distribution inside the SA. The full length paper gives modeling details of the SA with various codes and the comparison of the results obtained.

"Track 3: Fast Reactor Safety": EBR-II Benchmarks Invited Session

Country/Int. Organization

INDIA

Authors: Dr BATES, Ethan (TerraPower); Mr UPPALA, Partha Sarathy (Indira Gandhi Centre for Atomic Research)

Co-authors: Dr DEL NEVO, Alessandro (ENEA); Dr MOISSEVTSEV, Anton (Argonne National Laboratory); Mr TRUONG, Bao (TerraPower); Mr SU, Guanghui (XJTU); Prof. MOCHIZUKI, Hiroyasu (U-Fukui); Dr STEMPNIEWICS, Marek (NRG); Dr HIROAKI, Ohira (JAEA); Dr SUMNER, Tyler (Argonne National Laboratory)

Presenter: Mr UPPALA, Partha Sarathy (Indira Gandhi Centre for Atomic Research)

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