

ANALYSIS OF A GERMAN BWR CORE WITH TRACE/PARCS USING DIFFERENT CROSS SECTION SETS

Christoph Hartmann^{1,2}, Victor H. Sánchez¹ and Wolfgang Tietsch²

¹Karlsruhe Institute of Technology (KIT) – Institute for Neutron Physics and Reactor Technology (INR), Eggenstein-Leopoldshafen, Germany

²Westinghouse Electric Germany GmbH, Mannheim, Germany

eMail: Christoph.Hartmann@kit.edu

Abstract

Coupled Thermal-hydraulic/Neutron-kinetic (TH/NK) simulations of Boiling Water Reactor transients require well validated and accurate simulation tools as well as appropriate cross sections (XS) libraries depending on the individual thermal hydraulic state parameters. Problem-dependent XS-sets for 3D core simulations are being generated mainly by well validated, fast running and user-friendly lattice codes such as CASMO and HELIOS. At research institutions and universities, alternative tools to the commercial ones with full access to the source code as well as moderate cost are urgently needed. The SCALE6 system is being developed and improved for lattice physics calculations of real core loading of Light Water Reactors (LWR). It represents a promising alternative to the commercial lattice codes. At Karlsruhe Institute of Technology (KIT) a computational route based on SCALE6/TRITON/NEWT for BWR core loading is under development. The generated XS-data sets have to be transformed in PMAXS-format for use in the reactor dynamic code PARCS. This task is performed by the module GenPMAXS being developed and tested at the Michigan University.

To verify the computational route, a BWR fuel assembly depletion problem was calculated by PARCS and compared to the CASMO results. Since the SCALE/TRITON XS-file does actually not contain all required neutronic data, FORTRAN routines have been developed to incorporate the missing data e.g. the yields of Iodine, Xenon and Promethium into the XS-data sets in the PMAXS-format. The comparison of the results obtained with PARCS (using the corrected PMAXS file) and CASMO for the depletion problem exhibited a good agreement. Consequently, this approach was followed for the generation of a complete XS-set for a real BWR core to be used in subsequent transient analysis. Then 3D neutronic and thermal hydraulic core model were elaborated for a TRACE/PARCS analysis. The thermal hydraulic model is based on the 3D VESSEL-component. The neutronic model consists of a radial node per fuel assembly and 26 axial elevations. In this paper, the modeling issues as well as the main results obtained with TRACE/PARCS will be presented and discussed in detail. Furthermore the verified 3D core model will be incorporated into a plant model for the simulation of transients where the neutron kinetics and the core thermal hydraulics are in tight interaction.

Keywords: Neutronics/Thermalhydraulics Coupling, Lattice Codes, TRACE/PARCS, TRITON, NEWT, SCALE6