Contribution ID: **37** Type: **not specified**

A burn-up module for application in fuel performance codes: methodology, verification and assessment for MOX fuel in thermal and fast neutron spectra

Tuesday 5 November 2019 11:00 (20 minutes)

The evolution of actinides within the nuclear fuel affects the power distribution and the thermal and mechanical material properties. In addition, the concomitant production of helium in the fuel matrix due to actinide alpha decays and nuclear reactions has a relevant impact on the whole fuel rod performance, since helium concurs to fuel gaseous swelling and gas release. For this reason, fuel performance codes (FPCs) need to incorporate predictive burn-up modules to account for the evolution of actinides under irradiation. State-of-the-art softwares dedicated to depletion calculation (e.g., SCALE, MONTEBURNS, SERPENT) require considerable computational time compared to FPCs, hindering their engineering application in fuel performance simulations. In this work, we propose a new burn-up module for application in FPCs. The burn-up module relies on average microscopic cross-section lookup tables generated via SERPENT high-fidelity calculations, and involves the solution of the (non) linear system of Bateman's equations for a selected subset of relevant actinides. We implemented the model in the SCIANTIX code, a 0D stand-alone fuel behavior code designed for the coupling with FPCs, effectively paving the way for the inclusion of the burn-up model in FPCs. We verified the results of the burn-up module in terms evolution of actinides and helium concentrations for MOX fuel (both thermal and fast reactor conditions) by comparing them with the high-fidelity results from SERPENT. Moreover, for assessment sake, we benchmarked the results of the new burn-up module with those of TUBRNP, the burn-up module currently used in the TRANSURANUS code. The methodology proposed in this work for the development and verification of a burn-up module, which we consider as one of the main outcomes of the work itself, is general and can be adopted for the analysis of any reactor/fuel combination.

Authors: CECHET, Alessandro (Politecnico di Milano); ALTIERI, Stefano (Politecnico di Milano); BARANI, Tommaso (Politecnico di Milano); COGNINI, Luana (Politecnico di Milano); LORENZI, Stefano (Politecnico di Milano); Dr PIZZOCRI, Davide (Politecnico di Milano); Prof. LUZZI, Lelio (Politecnico di Milano)

Presenter: CECHET, Alessandro (Politecnico di Milano)

Session Classification: Session 2