PROTECTIVE COATINGS FOR ACCIDENT TOLERANT FUEL CLADDING: IMPACT OF INNER-SIDE CHROMIUM COATING ON REACTOR NEUTRONIC PERFORMANCE

Rofida Hamad Khlifa 1,\*, Nicolay N. Nikitenkov1

1. Tomsk Polytechnic University, Tomsk, Russia

[\*rofida@tpu.ru](mailto:*rofida@tpu.ru)

Using Protective coatings on Zirconium based claddings is one of the proposed near-term solutions to enhance tolerability of LWRs fuel in accidental scenarios. an inner-side coating will further enhance cladding protection from oxidation and secondary hydrogenation in LOCA conditions, following clad burst and leakage of coolant into their inside part . Coatings are expected to work within the same designs of current LWRs, therefore; it’s crucial to study the effects of their introduction into those systems. This study investigates reactor’s Neutronic behavior upon applying a thin film of chromium on the inner side of nuclear fuel cladding. Neutronic calculations performed using Monte Carlo probabilistic code MCNPX. The model used is based on VVER-1200 single fresh fuel assembly with an enrichment of 4.5%. The code firstly validated by applying coatings with different thicknesses on the external side of cladding, and the recorded reactivity deviation compared with similar published results. The model is then modified and an interior chromium coating applied with four different thicknesses 10, 15, 20, 30 and 40 µ, the deviation of the multiplication factor from reference case is calculated for each thickness, in addition to radial flux and temperature coefficients. Results also compared to outer side chromium coating. A small deviation in reactivity was observed; increasing with the coating thickness, but still remains smaller than the case of applying same thickness on the exterior side of cladding, this finding emphasis the impact of decreasing moderation due introduction of coating rather than neutrons absorption by it. Results also showed that the presence of the inner chromium coating has negligible impact on the overall flux. Temperature reactivity coefficients showed some fluctuations between less negative for coating thicknesses 10µ, 30 µ and more negative for 15, 20 and 40 µ but generally small and the overall still within the design values for VVER-1200 reactor at the beginning of the cycle (BOC).