INVESTIGATION OF THE PROCESSES IN THE SPENT FUEL DURING INTERIM STORAGE IN IGNALINA NPP

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Ignalina Nuclear Power Plant in Lithuania operated two units of the RBMK-1500 type reactors, which were shut down in 2004 and 2009. Following the shutdown, ~22000 spent nuclear fuel (SNF) assemblies remain in Lithuania. Currently, all SNF is in dry storage, and it will be at least 50 years. Further, SNF should move to the final repository, which location is not yet decided.
Each RBMK fuel assembly consists of two 3.5 m fuel bundles placed in the reactor core during operation. After spending time in the spent fuel pool, these assemblies are processed in a hot cell, separated, and placed into casks for further storage or transport to the dry storage. Analyzing spent nuclear fuel composition and behavior is essential for assessing nuclear safety, including radiation shielding and thermal performance during storage.
In the framework of an IAEA coordinated research project “Spent Fuel characterization” (T13018), numerical models for the RBMK-1500 fuel assembly and fuel rod were created for the respective SCALE and TRANSURANUS codes. These models were validated, optimized, and subsequently used to obtain results for the decay heat of spent fuel over a 100-year period following discharge from the reactor, which is relevant for interim fuel storage. In this analysis, decay heat calculated by SCALE code was used as linear heat rate input for TRANSURANUS calculations. The TRANSURANUS fuel rod modelling demonstrated a reasonable agreement in temperature responses when compared with previously performed benchmarks using FEMAXI-6 and RELAP5-3D computational codes. The validated model was utilized to identify correlations and relationships among various parameters affecting fuel rod conditions and structural changes during both operational and storage stages. Furthermore, an additional analysis was conducted to examine the burn-up effect on the axial power profile caused by changes in coolant density and its impact on the thermal-mechanical characteristics of the fuel rod under interim storage conditions.

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