Contribution ID: **280** Type: **Oral**

A probabilistic safety analysis of the first level safety of small modular reactors on the example of the SHELF-M reactor facility

The current report is dedicated to the issues of probabilistic safety analysis of the first level safety of small modular reactors on the example of a low-power nuclear power plant with a SHELF-M reactor facility.
Probabilistic safety analyses were conducted to determine the possibility of accident pathways and final outcomes, including the possibility of severe accidents.
In this report, the probability of a severe accident for the small modular reactor used in the SHELF-M reactor facility has been evaluated by considering the main technical concepts used in the SHELF-M reactor facility and the structural components of the reactor plant, a description of the main and auxiliary systems of the reactor unit has been provided. And the dominant contributors to the probability of a severe accident in case of exceeding the maximum design limits for the fuel and fuel cladding temperature have been presented in the report.
Based on the designed PSA Level-1 model, preliminary conservative calculations were carried out to identify dominant risk contributors, to evaluate sensitivity in relation to major design decisions and to elaborate recommendations to improve reliability at the system level and safety of the plant overall. The following initial events were shown to dominate the risk indicators:
- leading to loss of heat transfer medium by the first circuit;
- leading to a disruption of heat removal by the second circuit.
At the system and element level, the dominant contributors to plant non-reliability are: the hydraulic accumulator of the hydraulic distributor, the fittings of the feed water system, emergency core-cooling systems (ECCS), the check valves of the feed water system, and the valves of the equipment cooling system.
Implementation of the recommendations proposed based on the PSA-1 results into the SHELF-M design allowed to bring its probabilistic safety indicators in compliance with the regulatory requirements.

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YES

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Track Classification: Topical Group C: Safety, Security and Safeguards: Track 8: Demonstrating SMR's Safety Case