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Coupled thermal-hydraulic and neutronic deterministic safety analysis for the HTGR SMR research demonstrator HTGR-POLA.

Poland facing energy transformation considers large-scale PWRs, as well as SMRs. SMRs can be seen as a potential electricity supply and beyond, i.e. district heating, industrial process heat, and for hydrogen production.

For past few years National Centre for Nuclear Research, Poland (NCBJ) has been involved in several High Temperature Gas-cooled Reactor projects: national (Gospostrateg-HTR, HTR-MEiN) and European (Gemini Plus, Gemini for Zero Emission).

Consequently, the small-scale, prismatic type, research HTGR of 30 MWt - named HTGR-POLA, is considered to be built at the NCBJ's site. Its main mission is to serve as a demonstrator of HTGR technology for Polish industry.

In this paper, for the reference HTGR-POLA plant design, the capability of coupled neutronics/thermal-hydraulics (N/TH), and its impact on the reactor safety performance during selected Design Basis Accidents (DBA) will be investigated. The introduced capability of a coupled N/TH phenomena for the reactor core over the whole fuel cycle is a promising method, due to its possibility of approximation and identification of the most relevant safety issues without the need for introduction of over conservative assumptions. The results of the calculations for the coupled Serpent-MELCOR 2.2. codes will be presented, from the selected accident groups representing various types of Postulated Initiating Event (PIE) for HTGRs. The calculations performed, were accompanied by the sensitivity study of the chosen parameters, evaluated as most impactful on the safety and design acceptance criteria established (the Safety Systems and Components - SSCs design parameters and Polish high level requirements). The presented results were a supporting means for the Probablistic Safety Analysis of the HTGR-POLA reactor for the assessment of the accident consequences and considerable part of the Preliminary Safety Analysis Report (PSAR), which is a requirement included in the legal framework of newly built Nuclear Power Plants (NPPs) and research reactors in Poland.

Country OR International Organization

Poland

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Confirm that the work is original and has not been published anywhere else

YES

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