



Seminarium Zakładu Energetyki Jądrowej i Analiz Środowiska (UZ3)
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Cross-verification of a Reactor Cavity Cooling System model between MELCOR and CFD

Abstract:

This work aimed to verify a MELCOR model of the Reactor Cavity Cooling System (RCCS) by conducting Computational Fluid Dynamics (CFD) simulations. The development of a passive heat removal system design falls under the category of safety systems, which require guaranteed functionality and verification during the licensing process for the construction and operation of nuclear reactors, both under normal operating conditions and during accident scenarios. In the High-Temperature Gas-cooled Reactor (HTGR), the containment structure differs from typical Light Water Reactors (LWRs) and is typically designed to be non-leak-tight confinement. Therefore, the RCCS plays a crucial role as a safety function, aiming at residual heat removal to maintain fuel temperature below a limit (set at 1600°C) during an accident scenario with increased fission product release probability. The purpose of this work was to develop a methodology for modelling such systems and identify critical flow phenomena and challenges to be faced. CFD model sensitivity analysis was performed, and discrepancies between MELCOR and CFD were explained. The observed output quantities were temperatures of system components and heat flux distribution between radiation and convection. Differences in solid bodies' temperatures between MELCOR and CFD were in the range of 10 K. In the studied case, the mesh density and turbulence model had negligible influence on temperatures.

Serdecznie zapraszamy
Mariusz Dąbrowski, Tomasz Kwiatkowski

Bio:

Maciej Szudarek is an assistant professor at Warsaw University of Technology, Institute of Metrology and Biomedical Engineering. His research interests include computational fluid dynamics and flow metrology. During his postdoctoral fellowship at the National Centre for Nuclear Research in 2023, he worked on CFD modelling of the Reactor Cavity Cooling System.