Contribution ID: **23104** Type: **Paper**

A CFD Approach to Mimic the Molten Corium-Concrete Interaction Phenomena: Effects of the Thermal Boundary Conditions

Tuesday, 14 November 2023 09:20 (20 minutes)

In the event of a severe nuclear accident resulting in a core meltdown, the molten corium which is a mixture of the molten fuel, cladding, and structural elements, originating in the reactor core could penetrate through the reactor pressure vessel to interact with concrete structure underneath. This research paper presents the numerical modeling of molten corium concrete interaction. The complex phenomena of molten corium concrete interaction and melting of concrete are simplified by considering multi-region with the change in phases taking place only within each predefined region with the assumption that corium is a homogenous mixture of molten nuclear fuel, cladding, thermo-hydraulic and structural element. This study presents the use of the OpenFoam a Computational Fluid Dynamics (CFD) simulator where a new solver is developed to model the molten corium concrete interaction, its melting, solidification, and concrete ablation for the first time. Two sets of experimental data are used to validate the developed solver and demonstrate the thermal modeling and heat transfer capabilities of the developed solver for concrete ablation under severe conditions. We analyzed different boundary conditions and found that they had a pronounced effect on mitigating ablation and reactor integrity in case of a nuclear accident. In addition, the water-cooled boundary condition was found to be the controlling boundary condition to mitigate concrete ablation. The concrete ablation mechanisms during MCCI are very case-dependent on the concrete solidus, liquidus, and ablation temperatures.

Speaker Bio

Primary authors: KHURSHID, Dr. Ilyas (Khalifa University); Prof. AFGAN, Imran (Khalifa University); Prof. ADDAED, Yacine (Khalifa University)

Presenter: KHURSHID, Dr. Ilyas (Khalifa University)

Session Classification: Day 2 Parallel Session - I : Thermal-Hydraulics

Track Classification: Nuclear Thermal-hydraulics