Contribution ID: **232** Type: **ORAL**

Extension to Heavy Liquid Metal coolants of the validation database of the ANTEO+ sub-channel code

Monday 26 June 2017 15:50 (20 minutes)

Among the numerous numerical methods available for preliminary design verification purposes, the sub-channel one has historically been the reference, thanks to its ability to cover the scale between CFD and system codes which is the one of particular interest for the core designer. Recently, the sub-channel code for liquid metal applications ANTEO+ has been developed by ENEA and a comprehensive validation performed, covering all the salient aspects of the fuel assembly thermal-hydraulic analysis like pressure drops, sub-channel and outer clad temperatures. Due to the database available at the time, the focus for the sub-channel temperatures validation was mainly related to sodium and sodium eutectics coolants. Thanks to the increasing interest in heavy liquid metal coolants for fast reactor applications, numerous experimental activities have been very recently performed (CLEAR-S, SEARCH) and many are still ongoing, enabling the extension of the previous ANTEO+ validation database so to make this tool even more persuasive for Generation IV reactor concepts applications and mostly to estimate the uncertainty to recon to the code results. In the present work, ANTEO+ validation against the most recent experiments with heavy liquid metal coolant is presented: several tens of new experimental points have been considered in this campaign, covering a broad range of configurations which spans over the one of anticipated interest. The results of this validation activity have confirmed the good predictive ability of the code, notably when compared to other state of the art tools. Some criticalities have also emerged, especially to what concerns the sub-channels and pins close to the wrapper, which significantly modifies their thermal field; this has a particular impact on the Nusselt number, highlighting the lack, in the open literature, of a reliable correlation for the outer row of pins.

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Session Classification: 6.2 Thermal Hydraulics Calculations and Experiments

Track Classification: Track 6. Test Reactors, Experiments and Modeling and Simulations