Assessment of Core Status of TEPCO's Fukushima Daiichi Nuclear Power Plants

(97) Assessment of SAMPSON/DCA Heat Transfer Models between relocated molten core and RPV lower head wall

*Alexandre Ezzidi[1], Chiaki Kino[1], Masao Chaki[1] and Masanori Naitoh[1]

[1]Institute of Applied Energy (IAE)

In the frame of SAMPSON code model assessment and validation work, stand-alone analysis is performed with Debris Cooling Analysis module (DCA) in order to verify and evaluate corium to lower head heat transfer models. In this analysis, an in-vessel cooling experiment is simulated in DCA module and the calculation results are compared with the experimental data. According to this comparison result, model improvements should be performed in future work.

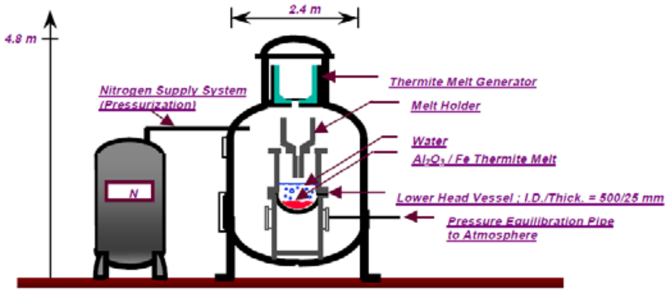
Keywords: Severe Accident, In-Vessel Retention, Gap Cooling, Lower Head Failure, Molten Core Relocation, SAMPSON

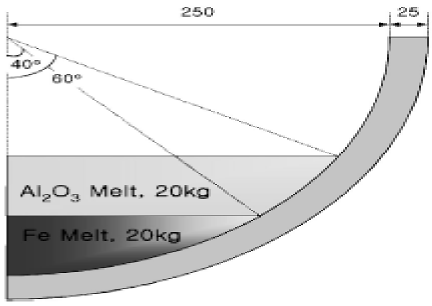
1. Introduction

Since TMI-2 severe accident, the In-Vessel Retention (IVR) of molten core is considered as the best procedure of Severe Accident Management Guidelines (SAMG) in maintaining the integrity of the reactor pressure Vessel (RPV) during a severe accident. The success of this procedure can be evaluated in Level-2 Probabilistic Safety Analysis (PSA). To understand the cooling mechanisms involved in the IVR phenomena, many experimental and analytical studies have been performed and provided useful insights through which several physical models have been developed in severe accident codes [1]. The objective of the present study is to investigate and assess the IVR related physical models and their effectiveness in DCA Module of SAMPSON code.

2. Analytical Method

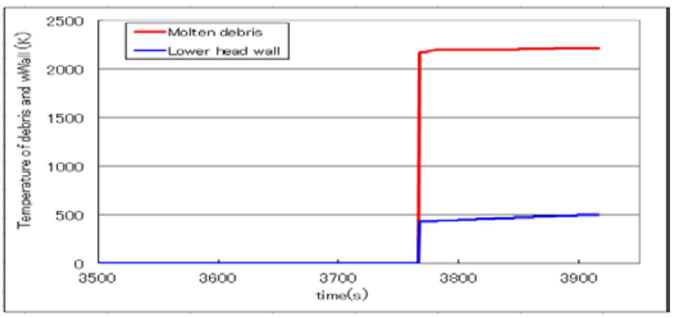
LAVA-1 Test of SONATA-IV experimental program [2] was selected for the present DCA assessment study. Simulation of LAVA-1 Test is then performed in DCA Module for a stand-alone analysis. Prior to the analysis, in addition to the construction of DCA input deck, boundary condition input data are made for SAMPSON Modules THA, MCRA, CVPA and FPRA. In the latter, the value 0 is used for fission products as simulating material was used in the experiment. In the simulation analysis, 1-region model was used for the molten material as in the test. The following Figure shows the experimental Facility with a configuration of the melt inside lower head.

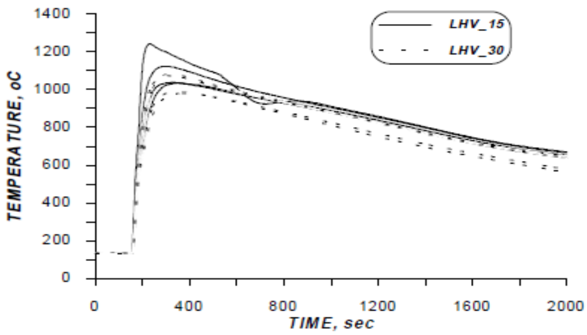




3. Results and Future Works

Using the current heat transfer models in DCA the obtained temperature increase of the lower head wall is underestimated as shown in Figure below in comparison with Test result. Consequently, detailed investigation is needed in which heat transfer models between molten material and lower head wall, probably should be improved in DCA module of SAMPSON code.





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