The development of Evaluation method of SFP Local Temperature in the Carepool

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1. Introduction

During the normal and accident conditions, the Comprehensive Analyzer of Real Estimation for spent fuel POOL (Carepool) would be calculated bulk temperatures and criticality of a spent nuclear fuel pool (SFP). The Carepool provides an estimation of the time to boil/fuel uncovering by thermal-hydraulics calculations, and criticality evaluation by Helios code. The Carepool would be very useful for operator of nuclear power plant and trainee who have responsibility for the SFP operation[1]. The SFP bulk temperature was calculated by basic heat balance equation using the heat load of previous discharged spent nuclear fuel. The SFP local temperature was calculated by 3D CFD tools until just now[2]. The CFD tools excelled for calculation of SFP thermal-hydraulic behavior, but a lot of computing power are used. Therefore, simplified code with improved computational speed is needed. In this research, simplified code developed to evaluate maximum local temperature in SFP with the Carepool.

2. Methods and Results

2.1 The Carepool Model

The geometry of SFP of Hanul unit 2 nuclear power plant was selected to create a 1D nodal and 3D CFD model to carry out the simulations. For the purpose of safety, the location of maximum local temperature and temperature distribution in SFP have been evaluated. Figure 1 shows the Carepool windows to simulate of the time to boil and fuel uncovering.

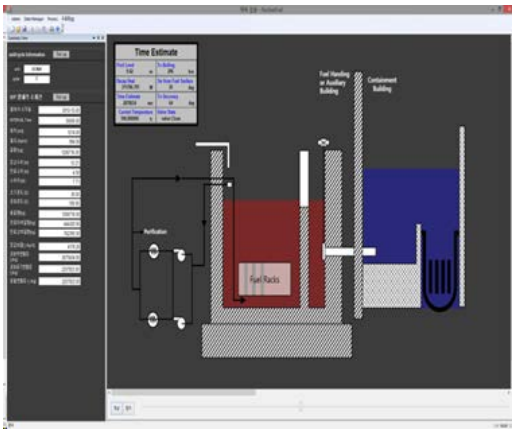

Fig. 1.The Carepool to simulate of the Time to Boil/Fuel Uncovering

2.2 3D CFD and Simplified Model

The calculation geometry of SFP of Hanul Unit 2 is schematically shown in Fig. 2. For simplicity without sacrificing too much accuracy, it can be treated as a rectangular domain. The pool is 496.06 in long, 314.96 in wide and 472.44 high. There are two inlets of cooling water located at the middle of both side on wide direction, and four outlets located at the top of the same walls. The region of fuel assemblies in the pool fills the bottom region of SFP with a height of 170.75 in. The fuel region is elevated to have its lower end 6.25 in above the pool bottom.

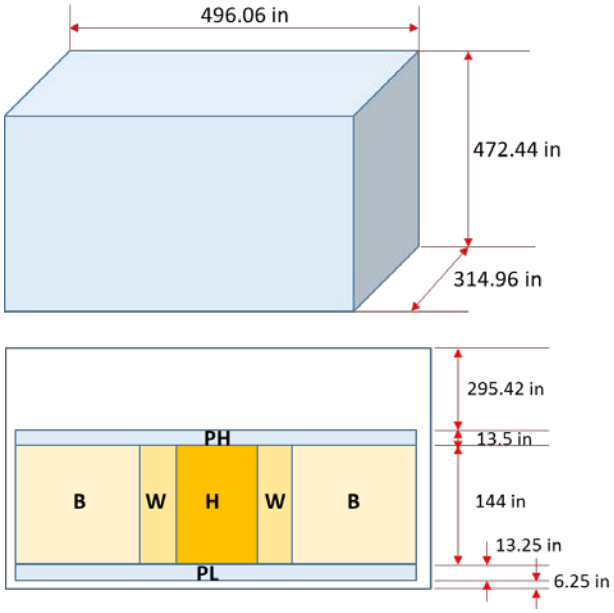

Fig. 2. Characteristics of fuel stored and heat generation region of SFP.

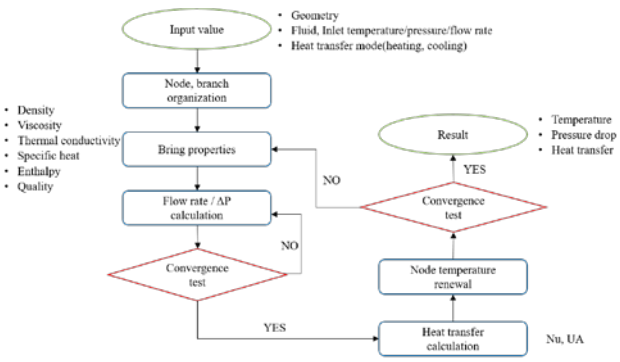

Fig. 2. Flowchart for Simplified Calculation Program.

3. Conclusions

In this research, local maximum temperature was calculated by 2D CFD tools and simplified code using nodal simulation and draw a compare with 3D CFD results. From among the computation results, the current configuration of spent fuel racks and cooling systems in a SFP of Hanul Unit 2 has an enough cooling capability to meet the licensing regulations under normal operation conditions. Because, 3D CFD results has highest local temperature that are satisfy temperature criteria.

REFERENCES

[1] Y. Kim, Development of Integrated Analyzing and Training simulator for Spent Nuclear Fuel Pool, CAREPool, Proceedings of the KNS 2015 spring meeting.
[2] UST&D, Spent Fuel Pool Thermal hydraulic Report of Ulchin 2, 2003.