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

(81) Ex-vessel phenomena analysis of the accident in the Fukushima Daiichi nuclear power station Unit 1 using DSA-CVPA modules of SAMPSON

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Abstract

The aim of this work is to perform a detailed analysis on the impact of the molten corium spreading and concrete ablation after the RPV failure on the PCV pressurization in the Fukushima Daiichi unit 1. In order to carry out this studies different cases were simulated varying the corium mass discharged and the pouring time using DSA1 and CVPA modules of SAMPSON.

Keywords: MCCI, gas generation, PCV pressurization, spreading

1. Introduction

The early loss of core cooling for the unit 1 during the accident at Fukushima Dai-ichi caused major fuel damage. Although full details are not yet available, it is expected the failure of the RPV, molten fuel relocation onto the PCV floor and MCCI phenomena [1]. The impact of the corium spreading and MCCI on the PCV pressurization was poorly studied and only using running codes which do not take into account the spreading of the debris and the real geometry of the PCV bottom part. The DSA1 is the debris spreading analysis module of the severe accident code SAMPSON [2], which models corium natural convection, heat transfer and concrete erosion in three dimension. The DSA1 module was coupled with CVPA the containment module to study the PCV thermal-hydraulic response during the late phase of the accident.

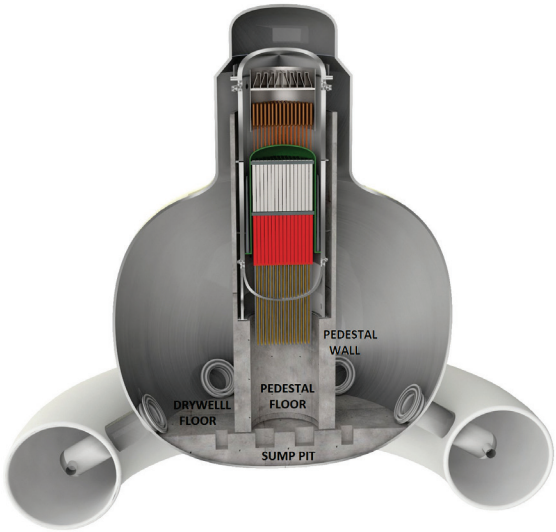

Fig.1 BWR MARK-I PCV floor configuration

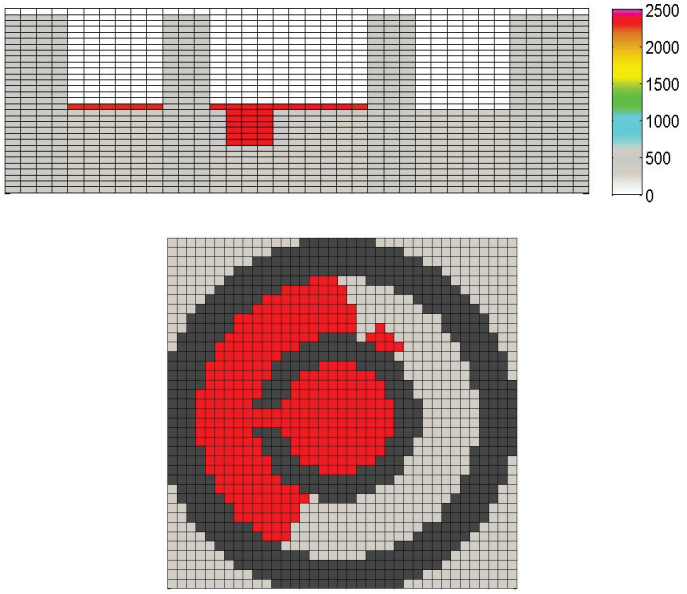

Fig. 2 Top view and cut view of the DSA1 floor nodalization

2. Results and discussion

To evaluate the thermal-hydraulic response of the PCV to the MCCI and corium spreading, several simulations assuming different quantity of poured molten corium to the PCV floor, different mass flow rate and RPV failure time were performed. The results obtained have pointed out that the main parameters affecting the pressurization and concrete ablation are the following: cavity geometry (pits), spreading area, corium composition and total mass. It is important to mark that the ablation rate in axial direction depends only on the RPV failure time and not on the total corium mass discharged, if the total corium mass discharged is able to fill the pit sumps in the pedestal floor.

3. Acknowledgment

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4. References

[1] The Evaluation Status of Reactor Core Damage at Fukushima Daiichi Nuclear Power Station Units 1 to 3 http://www.tepco.co.jp/en/nu/fukushima-np/images/handouts_111130_04-e.pdf