東京電力福島第一原子力発電所炉内状況把握の解析・評価
(94) SAMPSON コードによる福島第一原子力発電所 3 号機の長時間の感度解析

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

(94) Long term sensitivity analysis of Fukushima Daiichi Unit 3 by the SAMPSON code

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In current Japanese national project we have organized all the available information in order to clarify the known condition of the power plant. Based on such information a best estimate current condition of the plant has been proposed in which MCCI played a major role in the accident determining the large hydrogen generation for the explosion of Unit 3 and Unit 4. Uncertainties remain on the modality of lower head failure and debris discharge as well as on the possibility of water injection during the MCCI. The present paper shows results of sensitivity analysis on the above mentioned parameters.
Keyword：Fukushima Daiichi Nuclear Power Plants, Severe Accident, MCCI, SAMPSON

1. Introduction

It is accepted within the Japanese estimation that debris was discharged ex-vessel and MCCI onset generating flammable gases leading to the explosion of the reactor building (68 h from scram). For this reason it is expected that the debris is discharged before this time when the PCV pressure starts increasing at 58 h. The pressure behavior before this time from around 53 h can be indicative to evaluate the modality of lower head failure therefore a sensitivity analysis is considered at this time. Subsequently it is important to consider whether during the MCCI progression water was effectively being injected and whether the water injection has an influence on the pressure increase.

2. Results

In this work two cases are considered. The first one (red line in Figure 1 a) assumes that the lower head fails by creep rupture at around 54 h and water is discharged while debris remain inside the lower head. Thereafter water injection is assumed null in the same calculation. The second case (blue line in Figure 1 a) assumes that head flange leakage increases at 54 h and water injection resumes at around 60 h. The first case presents a relatively slow pressure decrease compared to the measurements while assuming a head flange leakage presents a comparable good agreement. Both calculations show a fast pressure rise at the time of debris discharge and a relatively low pressure increase compared to the measurements even though the wet case tends to show a faster pressure rise. In both calculations around 60% of the total mass showing that MCCI starts eroding in the region close to the sump. Until around 90 h there is almost no effect on the erosion pattern computed by the two cases.

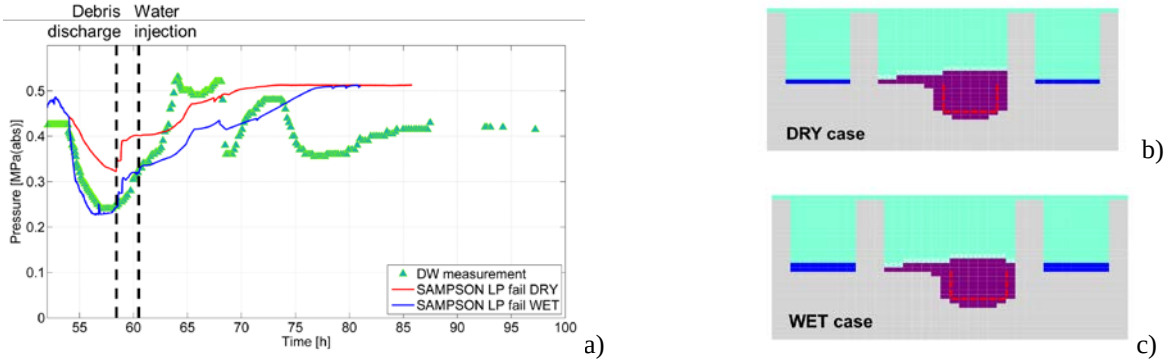

Figure 1 a) DW pressure sensitivity analysis results, b) dry case concrete ablation, c) wet case concrete ablation.

3. Conclusion

The SAMPSON code was applied to the accident of the Fukushima Daiichi Unit 3 and sensitivity analysis was applied for the modality of the lower head failure and water injection during the MCCI period. From the results we can infer that it is likely that head flange increased leakage started at around 54 h and that debris is discharge into the lower head at a relatively lower rate. It is likely that around 60% of debris mass is discharged into the pedestal and that water injection was not negligible in order to reproduce the relatively quick pressure rise. IAE is currently continuing the calculations to evaluate the conditions of the plant later in the accident.

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