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
(112) SAMPSON を用いた 1F 事故発生後３週間解析の最終評価結果（3 号機）

Assessment of Core Status of TEPCO's Fukushima Daiichi Nuclear Power Plants
(112) Final results of 3 weeks analysis using SAMPSON code (Unit-3)

* Marco Pellegrini[1], Chiaki Kino[1] and Masao Chaki[1],
([1] エネルギー総合工学研究所)

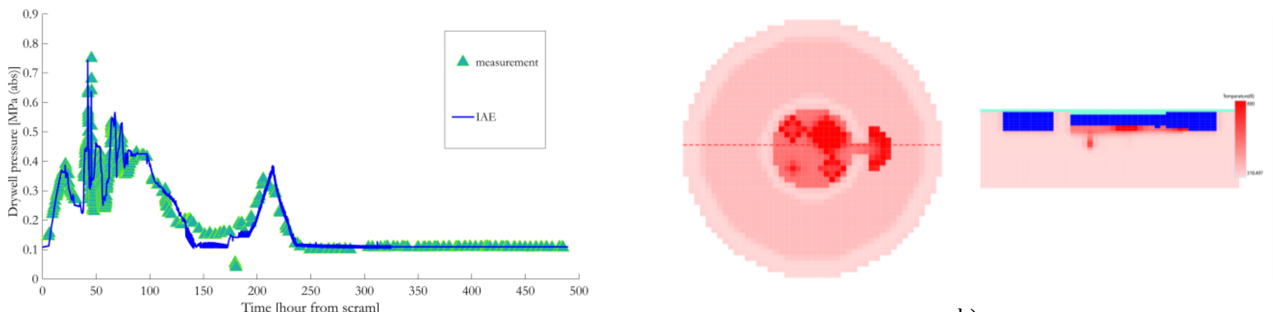
As participant in the project aimed at improving the understanding of Fukushima Daiichi (1F) NPP conditions, IAE has performed a comprehensive evaluation and analyses of the 1F units. At the beginning the accident scenario has been evaluated deeply among all the members of the project, subsequently the SAMPSON code has been applied to confirm assumed phenomena and clarify uncertain points. The analysis has confirmed that at Unit 3 a large portion of the core melted and relocated in the lower plenum. Thereafter, because of lack of cooling, RPV failed and subsequently debris was gradually transferred to the pedestal triggering the MCCI. It is estimated that a little amount of debris might have remained in the lower plenum while a considerable portion relocated to the pedestal with limited spread to the DW.
Keyword：Fukushima Daiichi Nuclear Power Plants, Severe Accident, MCCI, SAMPSON

1. Introduction

The fiscal year 2017 represents the last year of the project aimed at improving the understanding of Fukushima Daiichi reactor conditions. In this final year we have condensed all the experience gathered through SAMPSON analysis and modeling of the Fukushima Daiichi to provide a best estimate calculation that can reproduce as much as possible the measurements, explain the accident scenario and provide reliable estimations of the debris and FP distribution. The accident scenario was intensely analyzed together with other members of the project through deep investigation of the measurements and an adequate scenario with firmed points where consensus was reached and some points requiring additional clarification through the analysis, was drawn. In this work we will present the latest results of the computation regarding Unit 3 discussing the assumptions, uncertain topics as well as providing a rough picture of the debris distribution in the plant.

2. Results

In the SAMPSON prediction core degradation starts at around 38h in Figure 1 a), when the PCV pressure increases gradually. Thereafter ADS triggers and PCV pressure is reduced through the S/C area opening (42h). Two debris slumps occur at around 43h, small slump, and 45h, complete core debris relocation. In this calculation only the second large relocation is calculated and the SAMPSON code provides a relatively good agreement of the RPV pressure spike, as well as the PCV pressure. Thereafter the pressure rises after S/C vent closes (47h) because of debris quenching in the lower head as well as water leaking through the downcomer manhole. Sea water is continuously injected through the fire pump until the pressure in the PCV reached around 0.4MPa. Thereafter the pressure is maintained high through water draining from the downcomer quenching the debris. At the time when the RPV reached dry-out conditions, the pressure drops and lower head melts with sudden debris discharge (55h). In sensitivity calculations on the behavior of the MCCI we have realized that a continuous relocation does not reproduce the pressure signature. For this reason we have considered the possibility of discontinuous relocations assuming multiple and subsequent lower head failures. This assumption is found successful to reproduce the pressure trend. Eventually the pressure reaches around 0.5MPa, and the water injection is reduced to zero until, at the onset of water dryout (68h), the PCV pressure reduces to around 0.4MPa driven by drywell head flange leak and drywell leak. Because of this pressure reduction a certain amount of water is transferred from the S/C to the D/W where steam additionally starts to be generated pressure increases again. This process is repeated several times until the pressure is stabilized. At around 70 hours the conditions of the pedestal by the MCCI is presented in Figure 1 b) and c).



b)

a)

Figure 1 a) DW pressure results by the SAMPSON code, b) debris spread, c) vertical concrete ablation.

3. Conclusion

From the SAMPSON analysis of Unit 3 it is estimated that a large portion of the core melted and relocated to the lower plenum, which subsequently failed because of lack of cooling. While around small amount of debris is estimated to remain as solid debris in the lower head, a large portion is computed to be discharged gradually to the pedestal, where competing phenomena between gas generation and leak resulted in an oscillatory behavior of the PCV pressure signature which was well reproduced by SAMPSON.

－Acknowledgement－

This work has been financially supported by the Japanese government’s Ministry of Economy, Trade, and Industry. Technical support from the project team is greatly appreciated.