APR1400 MSLB accident analysis using the SPACE code

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1. Introduction

KHNP has attended the ATLAS DSP-03 program managed in KAERI and KINS since 2012. This DSP-03 has 3 topics. Among them, KHNP performed about investigation on scaling capability of facility data. The purposes of this topic are similarity analysis between ATALS and NPP, scaling different. Analysis ranges are ATLAS and APR1400 analysis. Analysis code used SPACE. For scaling analysis, comparative analysis performed about main component geometry data between two models. And add modeled the steam lines including break. This study presents SPACE results of the APR1400 MSLB accident for scaling-up analysis of ATLAS SLB-GB-02 test[1].

2. Methods and Results

In this section some of the techniques used to analysis the APR1400 MSLB accident. The techniques include a SPACE nodalization, boundary condition, set point pressures, steady and transient results.

2.1 APR1400 modeling

The APR1400 model used a SPACE LBLOCA model. This model is used in SPACE Code Topical Report[2]. The APR1400 nodalization shown in Figure 1.

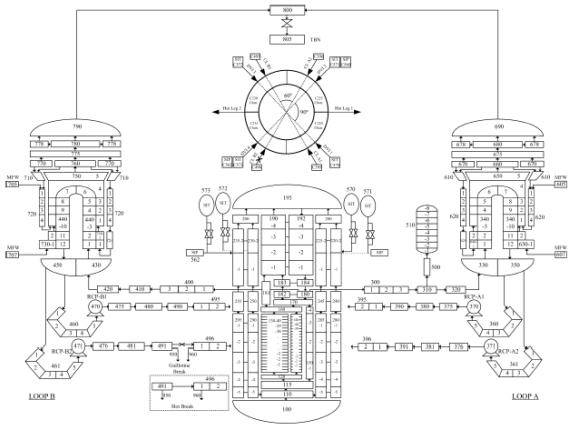

Fig. 1. APR1400 nodalization.

At this nodalinzation, steam line changed the ATLAS model. The ATLAS nodlaization shown in Figure 2.

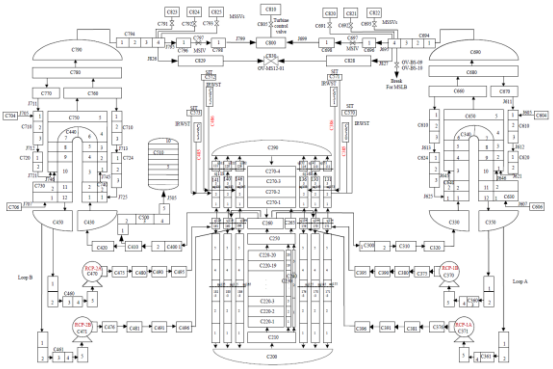

Fig. 2. ATLAS nodalization.

The APR1400 steam line scaled-up a ATLAS steam line include break.

2.2 Analysis Method

The results of APR1400 analysis are compared with ATLAS analysis results using SPACE. The APR1400 analysis values are scaled-down at ATLAS values for direct comparison. So, these results can different a little to ATLAS test results.

2.3 Boundary Condition

All boundary conditions are same the ATLAS conditions, but some APR1400 conditions are scaled-up. For example, core power times 203.6, flow times 203.6, time times 1.414[3, 4]. These boundary conditions are shown in Figure 3~5.

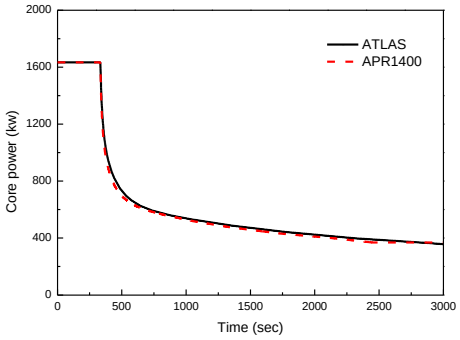

Fig. 3. Core power

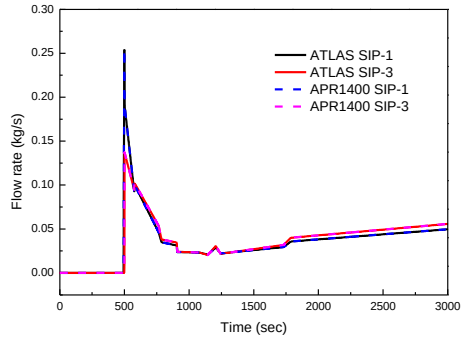

Fig. 4. Safety Injection Pump flow rate

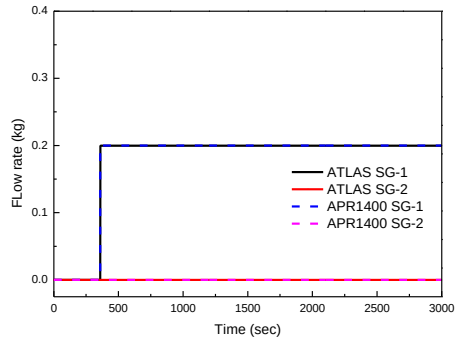

Fig. 5. Auxiliary feedwater flow rate

A table I is shown an event sequence[5]. After RCP trip start, a little difference time occur but APR1400 more match an event time than ATLAS.

Table I: Event Sequence

Event	Exp.	ATLAS	APR1400
Break open	303	303	303
MFIS	303	303	303
LSGP	310	309.37	309.9
RCP trip	311	310.37	311.32
MSIS	315	320.41	326.91
Decay power start	322	321.44	333.97
Aux. feed	364 / 361	359.94	382.63
SIP	505	488.93	565.9

2.4 Overall Thermal-Hydraulic Behaviors

All most results are similar to ATLAS analysis values except primary and secondary pressures. The ATLAS has heat loss at secondary system, but the APR1400 don't have heat loss[6]. So, secondary pressure doesn't recover to ATLAS results, and primary pressure more decrease than ATLAS analysis value. Each other results are shown in Figure 6~12. The transfer function of the voltage sensitive preamplifier was specified based on the manufacturer's published bandwidth characteristics.

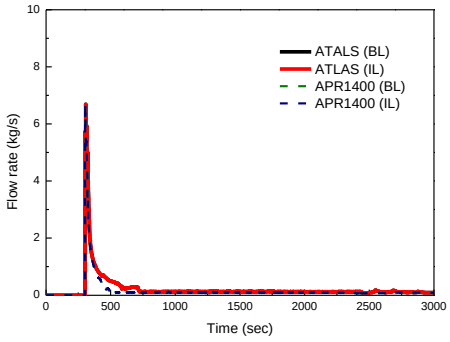

Fig. 6. Break flow rate.

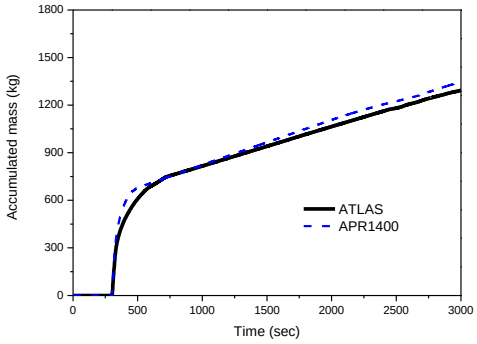

Fig. 7. Accumulated break flow rate.

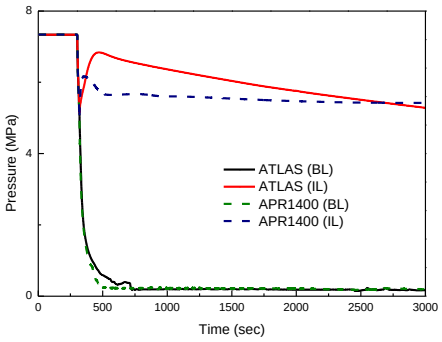

Fig. 8. Steam generator pressure.

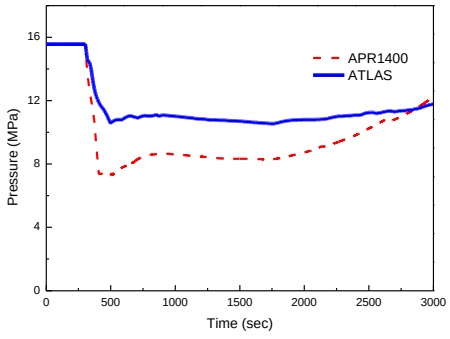

Fig. 9. Pressurizer pressure.

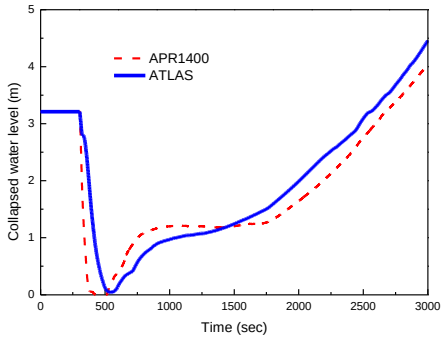

Fig. 10. Pressurizer water level.

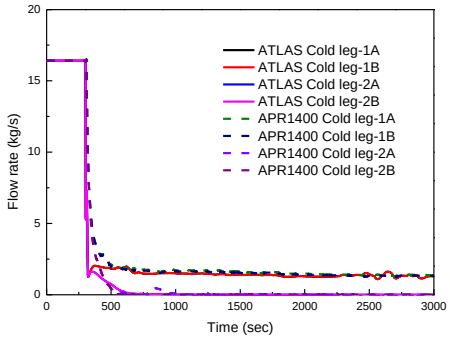

Fig. 11. Cold leg flow rate.

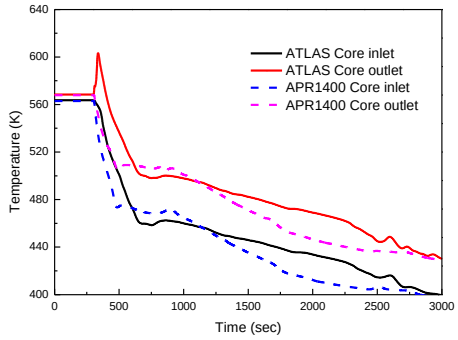

Fig. 12. Core temperature.

3. Conclusions

This study is the APR1400 MSLB accident analysis using the SPACE code to verify a scalability of ATLAS. The verification is used the SPACE code, analysis the ATLAS and APR1400, and then compare two results directly. Almost results are similarity to each other, except the system pressure. It is due to heat loss. Later, trip set points modify and if compare analysis results along an event sequence, it could find a more accurate scalability distortion.

Acknowledgments

This work was performed within the program of the Third ATLAS Domestic Standard Problem (DSP-03), which was organized by the Korea Atomic Energy Research Institute (KAERI) in collaboration with the Korea Institute of Nuclear Safety (KINS) under the National Nuclear R&D Program funded by the Ministry of Education (MOE) of the Korean government. The authors are as well grateful to the Third ATLAS DSP-03 Program participants: KAERI for the experimental data and to the Council of the Third DSP-03 Program for providing the opportunity to publish the results.

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