The Prediction of TASS/SMR-S Code for the Natural Circulation at VISTA Facility

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1. Introduction

The Transients And Setpoint Simulation/System-integrated Modular Reactor-S (TASS/SMR-S) code that was developed by the Korea Atomic Energy Research Institute (KAERI) is used to calculate the performance evaluation and safety analysis for System Integrated Modular Advanced Reactor (SMART) [1]. TASS/SMR-S code is applied an analysis of Design Basis Accident (DBA) that include transient phenomena of SMART and Small Break loss of Coolant Accident (SBLOCA). So far, TASS/SMR-S code was validated for the main issues. [2-5].

In this study, TASS/SMR-S is validated by using the natural circulation experiment for power variation that is one of thermal-hydraulic experiments using Verification by Integral Simulation of Transients and Accidents (VISTA).

2. Calculation of Steady State Using VISTA Data

The power variation experiment of the operational occurrences natural circulation characteristics is consistent with boundary condition of VISTA facility. Figure 1 shows the nodalization for VISTA facility.

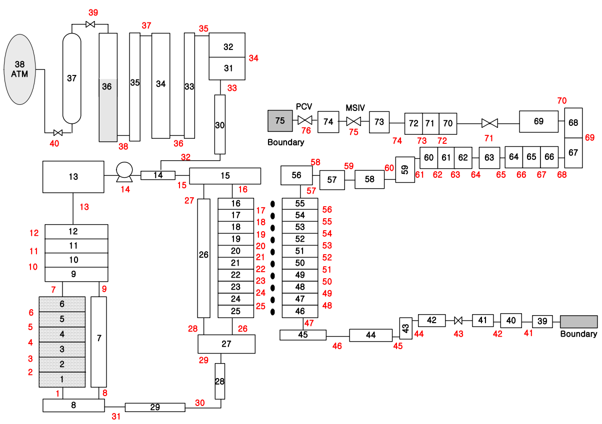

Fig. 1. Nodalization for VISTA Facility by using the TASS/SMR Code

The initial value is established to consider heat loss that it compare core power with heat transfer at SG.

The steady state was calculated to use several options so that simulation system moment could fit to the experimental data. In post-calculation, the used options are stopped and the steady state condition is obtained.

Figure 2 shows the primary flow rate of steady state. The initial state of transient is changed the natural circulation at 200 second after the flow rate is remain steady.

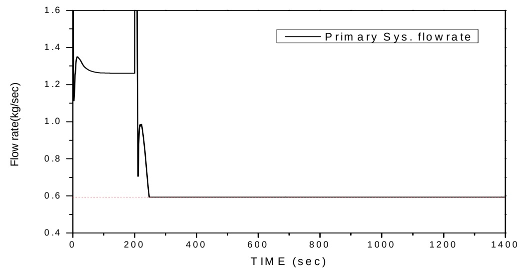

Fig. 2. Primary Flowrate of Steady State

3. Calcuration of TASS/SMR-S Code for Natural Circulation Validation

3.1. Increase in Core Power

The flow rates of the primary and secondary system are shown in Figure 3, 4. The calculated flow rates at the primary and secondary system are predicted well by the TASS/SMR-S code.

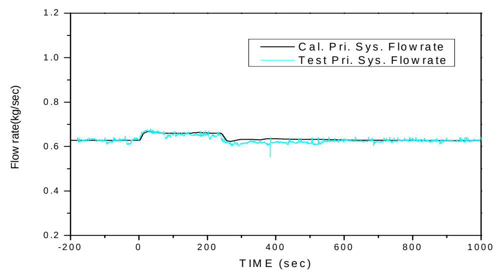

Fig. 3. Primary Flow rate in power variation

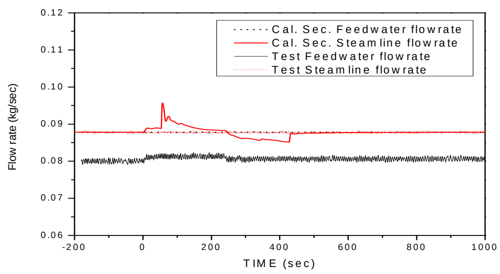

Fig. 4. Secondary Flow rate in power variation

The fluid temperatures at the inlet and outlet of primary side of the SG cassette are shown in Figure 5. The calculated fluid temperatures at the primary side are similar to the experimental data by the TASS/SMR-

S code. However, the calculated temperatures at the primary side are lower than those of the experimental data in power variation. The experimental data and calculation data is shown in Table I.

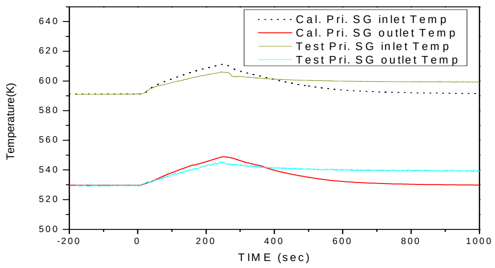

Fig. 5. Fluid temperature of the Primary SG Inlet/outlet in core power increase

Table I: Comparison of Result reached Steady Stated in Core Power Increase Test

Parameter	Test value	Cal. value	Error %
Pri. Press. (MPa)	15.198	14.898	1.97
Pri. Flow (kg/s)	0.6203	0.6270	1.09
SG inlet Temp. (K)	599.23	591.54	1.28
Sec. Press. (MPa)	3.760	3.758	0.029
Sec. SG outlet Temp.(K)	515.48	519.85	0.84
dP at MCP (kPa)	1.44	1.44	0.0

3.2. Decrease in Core Power

The fluid temperatures at the inlet and outlet of primary side of the SG cassette are shown in Figure 6. The calculated fluid temperatures at the primary side are similar to the experimental data by the TASS/SMR-S code. However, the calculated temperatures at the primary side are higher than those of the experimental data in power variation. The experimental data and calculation data is shown in Table II.

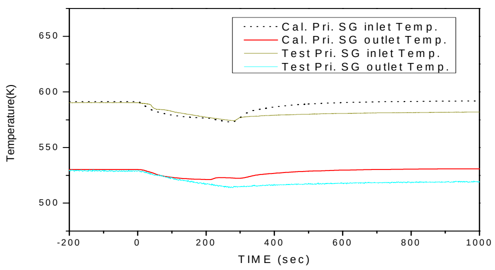

Fig. 6. Fluid temperature of the Primary SG Inlet/outlet in core power decrease

Table II: Comparison of Result reached Steady Stated in Core Power Decrease Test

Parameter	Test value	Cal. value	Error %
Pri. Press. (MPa)	13.605	14.724	8.22
Pri. Flow (kg/s)	0.6308	0.5934	5.92
SG inlet Temp. (K)	582.24	591.82	1.64
Sec. Press. (MPa)	3.754	3.758	0.1
Sec. SG outlet Temp.(K)	515.39	519.84	0.86
dP at MCP (kPa)	1.44	1.44	0.0

4. Conclusion

In this study, the core power variation experiments have been validated by using the TASS/SMR-S code to investigate the thermal-hydraulic characteristics in the VISTA facility. For the transient, the external heat loss was assumed to be constant. Reactor Coolant System (RCS) and heat structure of secondary system are not considered in TASS/SMR-S code.

According to the analysis results, the major thermal hydraulic parameter, including the pressures at the inlet positions of the primary and secondary side, and the heat transfer rates through the SG cassette, are predicted well by the TASS/SMR-S code.

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