Simulation of LOFA Experiment with TASS/SMR-S Code.

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1. Introduction

SMART is a 330MWt advanced integral PWR designed by KAERI for seawater desalination and electricity generation. TASS/SMR-S code is developed to analyze Design Basis Accident(DBA) that include transient phenomena of SMART and Small Break loss of Coolant Accident(SBLOCA). Verification work using basic problem, separate effect test and integral effect test is needed to confirm a capability of TASS/SMR-S code and to evaluate an applicability of the code for SMART[1,2]. An integral effect test loop, VIST facility, is constructed to verify the performance and safety issues of an integral type reactor. Several performance tests were performed at VISTA facility.
In this paper, TASS/SMR-S code is validated using a VISTA experimental data. Experimental results (H-LOFA-100H-T) of a complete loss of coolant flow accident[3] are used to simulate TASS/SMR-S code.

2. Methods and Results

2.1 TASS/SMR-S code description

TASS/SMR-S code has been developed with domestic technologies to analyze the thermal hydraulic performance of an integral reactor, SMART, under a full range of operating conditions[4]. TASS/SMR-S code consists of conservation equations related to the mixture mass, non-condensable gas mass, mixture energy and the mixture momentum.

2.2 Experimental Facility

VISTA facility is a thermal hydraulic scaled down experimental facility to verify the performance and safety issues of the reference plant[5]. VISTA facility consists of the primary system, the secondary system, the passive residual heat removal system and the auxiliary system and its schematic diagram is shown in Fig. 1.

2.3 Analysis Modeling

All of VISTA systems including the primary system, the secondary system and the PRHRS are represented by 117 nodes and 125 flow-paths. The inlet location of a feed-water flow and the exit location of a steam flow are modeled as a flow boundary and a pressure boundary, respectively.

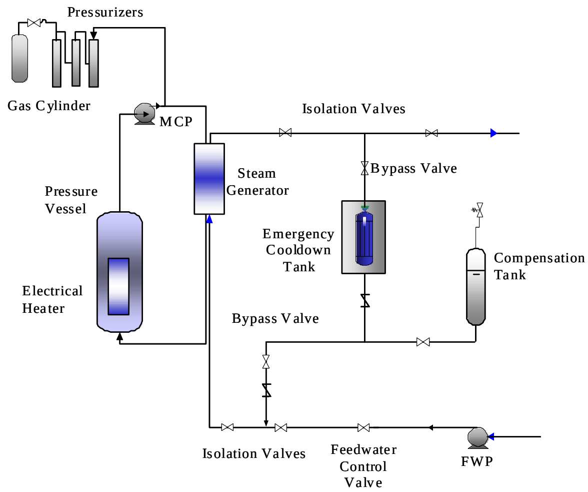

Fig. 1 Schematic diagram of VISTA facility.

2.4 Analysis Methods

To calculate the steady-state, the initial thermal hydraulic parameters are used to the mean value of the initial 100 seconds at H-LOFA-100H-T experimental. In the simulation for H-LOFA-100H-T experimental, a heat loss is not considered through the primary and secondary system. The steady-state conditions are simulated by using the inlet and outlet enthalpies at the steam generator secondary side and the secondary steam flow. It is used to 695.0 kW.

TASS/SMR-S code predicts well the initial conditions of the H-LOFA-100H-T test as shown in Table I.

Table I. Initial Conditions

Parameter	Exp Value	Cal Value
Pri. Power(kW)	695	695
Pri. Pressure(MPa)	15.09	15.08
Core Exit Temperature(K)	584.9	585.0
Core Flow(kg/s)	4.14	4.14
Steam Flow (kg/s)	0.251	0.251
Steam Generator Inlet Pressure (MPa)	5.15	5.15

2.5 Analysis Results

Transient begins to start with the MCP stop after the steady-state maintains by 111 seconds. A Normalized coast-down curve for the main coolant pump is made by using the PRHRS-P-R1 experimental data.

Fig. 2 shows the primary flow rate. The primary flow rate is reduced rapidly since the main coolant pump is coast-down. Generally, TASS/SMR-S code predicted that the primary flow rate is quite similar to experiment data. However, the phenomenon of rapidly increasing flow and an oscillatory flow is not predicted properly when the heater power is turned off.

Fig. 3 shows the secondary flow rate. The secondary flow is similar to the primary flow behavior. The secondary flow keeps a natural circulation flow of 8% of the initial secondary flow. The secondary flow is well predicted for whole transient by TASS/SMR-S code.

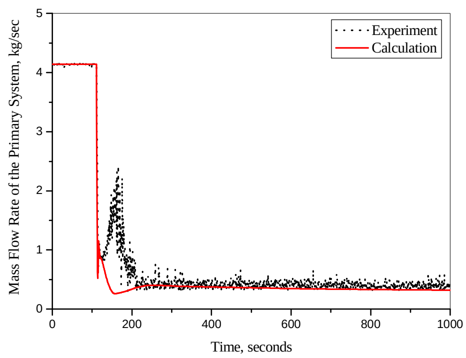

Fig. 2 Primary Flow

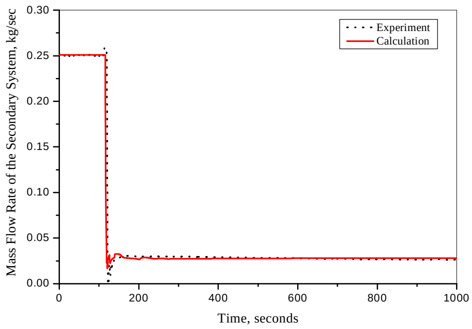

Fig. 3 Secondary Flow

Fig. 4 shows the coolant temperature change at the primary steam generator inlet and outlet. The coolant temperature at the steam generator inlet and outlet is sharply decreased at the beginning of the transient because a cold coolant from the pressurizer is getting into the entrance of the steam generator.

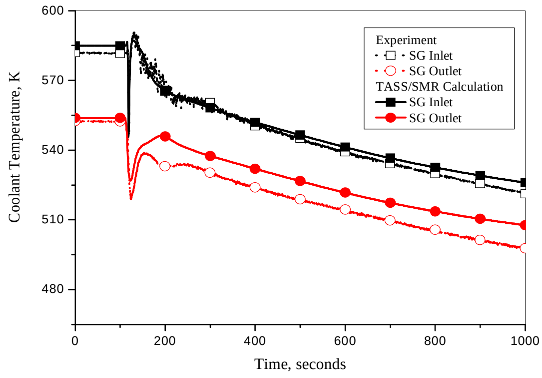

Fig. 4 Primary Steam Generator In/Outlet Temperature

3. Conclusions

TASS/SMR-S code verification work is by using LOFA experimental data which is one of safety related design basis accident. The major thermal hydraulic parameters are well predicted by TASS/SMR-S code.
From the results of the transient calculation, the overall thermal hydraulic behavior which includes the flow, pressure, coolant temperature is predicted reasonably by the code. However, the code under-predicts slightly the heat transfer at the condensate heat exchanger which is a final heat sink for VISTA facility.

Acknowledgements

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