Steady state analysis of VISTA with TASS/SMR

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1. Introduction

The TASS/SMR code, the revised version of the TASS(Transient And Setpoint Simulation) code, was developed by KEARI to design the SMART plant and to evaluate safety characteristics of that.

The VISTA(Experimental Verification by Integral Simulation of Transient and Accidents) operated in high temperature and high pressure conditions is an thermal-hydraulic experimental facility of KAERI. It is designed to verify the performance and safety issues of the SMART pilot plant.

- Volume ratio (VISTA : SMART-P) 1:96
- Height ratio 1:1

Recently, "Evaluation of the Thermal-Hydraulic System Analysis Code for SMART-P" project was started to evaluate the TASS/SMR. And this study is performed as the part of that project. We have modeled the VISTA experiment system, and performed steady state analysis.

2. Modeling VISTA

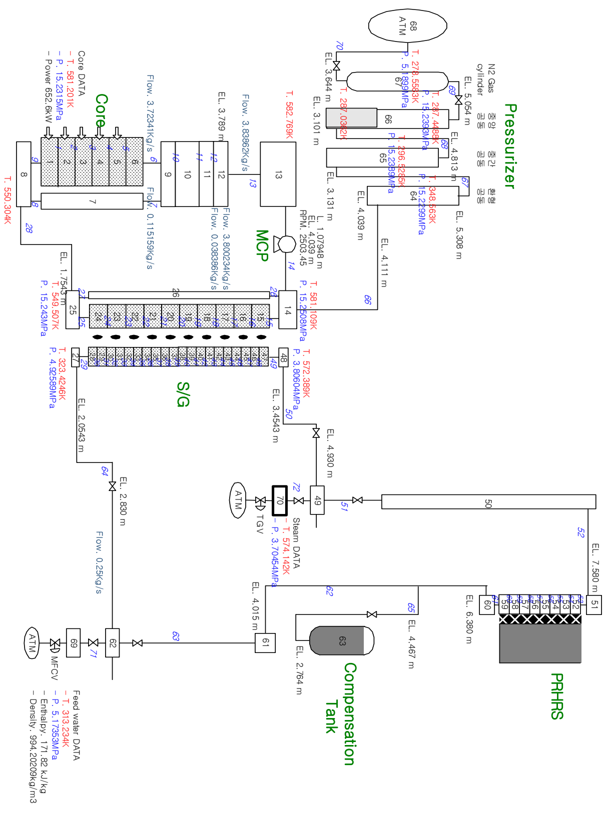

Figure 1. Modeling VISTA

2.1. Main Variables

At the design stage of VISTA, core power, flow rate and pump RPM were intended to 682.29kW, 19.2m^3/hr and 3600RPM. But there were some changes in actual experimental condition at the implementation stage. Main differences between design and experiments stage are heat loss and ΔP. In experimental condition,

- Core Power: 725.5kW
- Flow rate of primary loop: 19.6m^3/hr (≈3.8386kg/s)
- Pump RPM: 2503.45rpm

Core power was increased and main coolant pump RPM was decreased to compensate heat loss and ΔP.

In modeling condition, core power is set up to 652.6kW, considering there is no heat loss condition in our model. Flow rate of primary loop, Pump RPM and ΔP of each components are the same as experimental condition.

2.2. Other components: Core, PRHR, Secondary system

TASS/SMR has its own neutronics and core simulation models. But, VISTA uses electronic heating rods to simulate the fuel rods, so such models are replaced with manual power input model.

VISTA has no turbine, so steam flow is released to atmosphere and feed water supply system is continuously operated during experiments.

PRHRS(Passive Residual Heat Removal System) plays an important role in simulating natural circulation feature of VISTA. But in steady state experiments, PRHRS is not operated.

3. Results

3.1. Heat balance

Figure2 shows the results of heat balance between the primary and the secondary parts in steam generator calculated by TASS/SMR. The lower line is heat loss of primary system, and the upper dotted line is heat supply of secondary system.

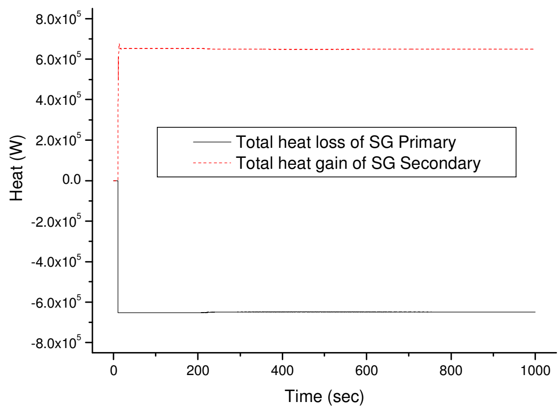

Figure 2. Heat balance of SG

3.2. Flow rate of primary loop

There is a bypass flow path (modeled by path 7 in figure1) in the VISTA core component, through which 3% of primary flow passes. In figure 4, upper line shows flow rate of core and lower dotted line shows flow rate of bypass path. Initial flow condition(in time=0) is setting up as experimental condition so that this result has reasonable stability.

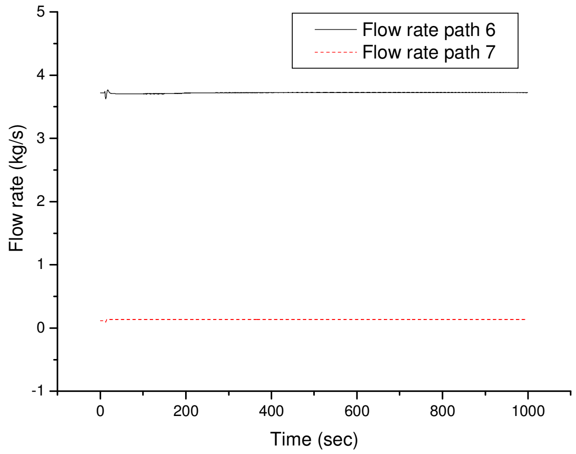

Figure 3. Flow rate of primary loop

3.3 Pressure drop of primary loop

Figure 4 shows the pressure drop of the primary system. The experimental value(represented by dotted line) is 21kPa, which is measured as pressure difference between pump suction and discharge pipe.

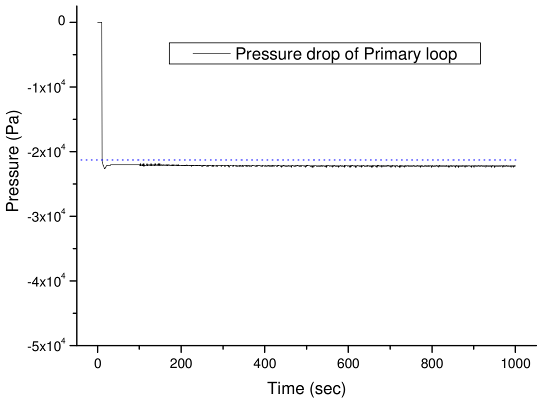

Figure 4. Pressure drop of primary loop

3.4 Pressure drop of secondary loop

Figure 3 shows the pressure drop of the secondary system. Two dashed lines of figure3 represent the experimental value of inlet/outlet pressure of SG secondary. Although slightly lower pressure is shown, difference of inlet/outlet pressure is extensively matched with experimental value. The pressure distribution of secondary system should be calibrated in detail by analysis of characteristics of pressure drop.

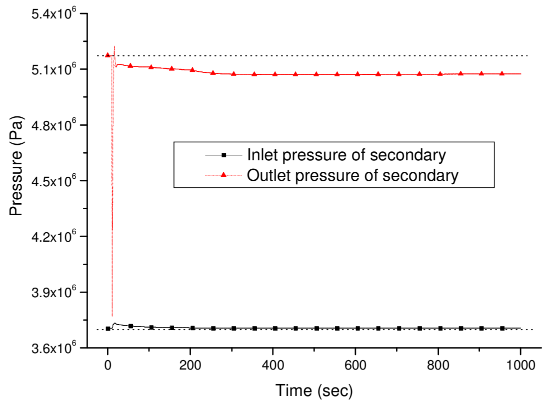

Figure 5. Pressure drop of secondary loop

4. Conclusions

The steady state calculation of VISTA was performed by TASS/SMR code and overall results show the similarity with the experimental data. Several variables such as pressurizer level, pressure drop and temperature of another components are to be studied more concretely considering specific characteristics of VISTA facility.

Supplementary analysis will be performed with experimental data of core power(725kW) when heat structure model of TASS/SMR is completed.

Based on these steady state analysis results, natural circulation experiment will be simulated by TASS/SMR.

Acknowledgement

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