

Preliminary Calculation of Outside Containment Compartment Temperature using GOTHIC code

KYUNGHO NAM^{a*}

^aKorea Hydro & Nuclear Power Central Research Institute., 70, Yuseong-daero 1312beon-gil, Yuseong-gu, Daejeon, Korea

*Corresponding author: khnpkhn@gmail.com

***Keywords :** outside containment, HELB, EQ, envelop curve, GOTHIC code

1. Introduction

In the Framatome type Nuclear Power Plant, the following systems are classified as the High Energy Line System(HELS).

- Reactor Coolant System (RCP)
- Normal Feedwater System (ARE)
- Auxiliary Feedwater System (ASG)
- Steam Generator Blowdown System (APG)
- Auxiliary Steam Distribution System (SVA)
- Hot Water System (SES)
- Boron Recycle System (TEP)
- Liquid Waste Treatment System (TEU)
- Main Steam System (VVP)
- Steam Dump to Atmosphere (GCT)

These systems are designed with a system pressure of 20 bar (275.4 psig) or more, or fluid temperature of 100°C (212°F), and they were designed to cope with High Energy Line Break (HELB) at the construction licensing stage.

In Korea, in order to develop the pressure and temperature envelop curve for Environmental Qualification (EQ) for outside containment components, temperature and pressure evaluation have been performed using COMPARE-MOD1A code which is verified to U.S.NRC.

In this paper, one of the high energy line components of Hanul units 1 and 2 was selected and the preliminary calculation was performed using GOTHIC code which is commonly used for containment analysis, to confirm the code properly derives the calculation results.

2. Methods and Results

2.1 Selection of Target Components Outside Containment

In this paper, the L016 room in electrical building which the piping of Hot Water System (SES) passes was selected. This component is one of the compartments that requires environmental qualification because the cables of measuring instruments or major devices passes along with pipes. This compartment takes the form of an ‘ $\sqcap$ ’ shape corridor through which cables and pipes passes.

2.2 Modeling method using GOTHIC code

The initial condition and node information are described in table I and II, respectively. And, nodding diagram is shown in figure I. the initial condition was determined according to FSAR and node information and diagram are determined by design documents. The break flow by SES high energy line is about 122 kg/s and energy is about 87,475 kJ/s. The mass and energy inputs were modeled by flow boundary condition option and break flow was simulated to be released into node.

Table I: Initial conditions

Initial conditions	Value
Pressure	101.325 kPa (1 atm)
Temperature	318.15 K (45 °C)
Humidity	10 %

Table II: Node information

Node No.	Flow area (m²)	Height (m)	Net Free Volume (m³)
L016-1	74.8	3.25	194.5
L016-2	20.8		54.0
L016-3	44.0		114.3
Aux.building	Atmosphere condition		

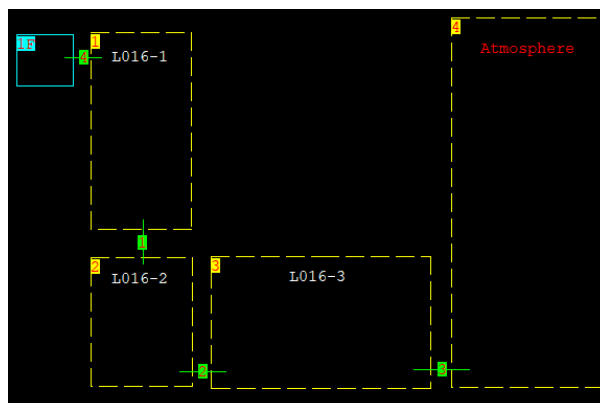


Fig. 1. Nodding diagram of L016 component.

2.3 Calculation Result

The calculation result using GOTHIC code is shown in figure 2. As shown in figure, it can be seen the temperature rapidly rises up to about 10 seconds after break occurs, and then the temperature converges around 100 °C without a significant change. Figure 3 shows the temperature calculation result using COMPARE-MOD1A code and table 3 compares calculation results of COMPARE-MOD1A and GOTHIC codes. As shown in table 3, it was confirmed that the maximum temperature results of the COMPARE-MOD1A code was almost the same.

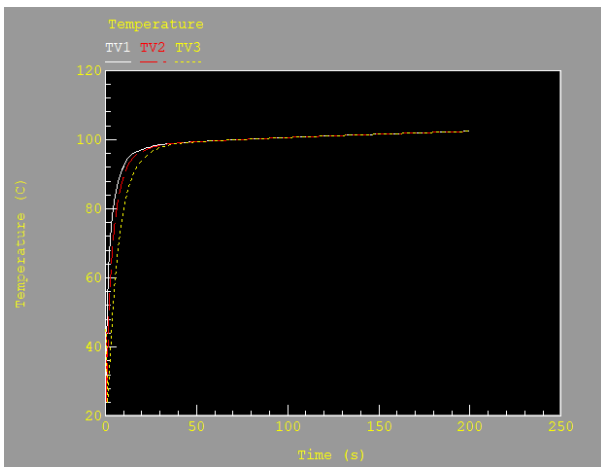


Fig. 2. L016 compartment temperature calculation result using GOTHIC.

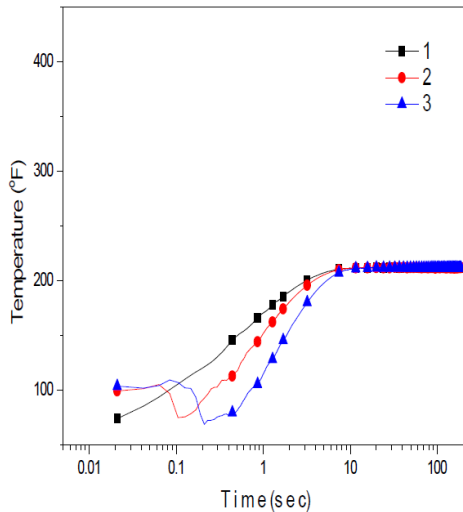


Fig. 3. L016 compartment temperature calculation result using COMPARE-MOD1A.

Table III: Maximum temperature comparison result

Node	COMPARE-MOD1A	GOTHIC
L016-1	100.1	100.6
L016-2	100.2	
L016-3	100.1	

3. Conclusions

In this paper, the preliminary calculation of compartment temperature for outside containment was performed using GOTHIC code. The one of the high energy line which is classified in FSAR chapter 3 was selected and the compartment that this high energy line passes through was selected. The calculation result is compared with that of COMPARE-MOD1A which is used for outside containment analysis of FSAR. As a result of comparing the calculation result, the temperature calculation results were almost the same. Through this, it was concluded that the temperature calculation of the outside containment compartments using the GOTHIC code was appropriate.

REFERENCES

- [1] KHNP, Final Safety Analysis Report for Hanul unit 1 and 2, Chapter 3.
- [3] KEPCO E&C, BOP Accident Analysis and Environment Condition Determination for Uljin unit 1 and 2, 2011.