A Preliminary Study on the Containment Integrity following BIT Removal for Kori NPP Unit 3,4

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1. Introduction

The Boron Injection Tank (BIT) is to provide high concentrated boric acid to the reactor in order to mitigate the consequences of postulated Main Steam Line Break accidents (MSLB). Although BIT plays an important role in mitigating the accident, high concentration of 20,000ppm causes valve leakage, pipe clog, precipitation and continuous heat tracing have to be provided. This paper is for the feasibility study of containment integrity using CONTEMPT code for BIT removal of Kori Nuclear Power Plant (NPP) Unit 3, 4.

2. Code Verification

COPATTA code is used for the containment pressure and temperature prediction in Final Safety Analysis Report (FSAR) of Kori NPP 3, 4. In this study CONTEMPT code will be used. Both COPATTA and CONTEMPT codes are using Tagami equation which is applicable during the forced convection period. The maximum heat transfer coefficient depends on the energy, volume and the time. Tagami equation can be expressed as

$$h_{\max} = 72.5\left(\frac{Q}{t\ V}\right)^{0.62} \qquad (1)$$

where, Q : Total released energy
V : Volume of the containment
t : Decompression time

Decompression time t is defined as the time from start of accident to end of blowdown in CONTEMPT code. Differently from this, decompression time t in COPATTA code is the time from start of accident to the first peak pressure. But it is demonstrated that two codes are compatible [4, 5].

3. Containment Evaluation

3.1 Analysis condition

To simulate the BIT removal, three cases are selected as Table 1. Reduced boron concentration of 2,450ppm is the same concentration of Refueling Water Storage Tank. The sensitivity study for containment integrity is performed to the two power levels of 0% and 102% for the full Double Ended Rupture (DER) with Diesel Generator Failure.

Table 1 Analysis cases for BIT removal

	Boron Concentration (ppm)	Volume (m^3)
Basecase	20,000	3.4
Case 1	2,450	3.4
Case 2	0	3.4
Case 3	0	0.0

3.2 Core Power analysis

Fig 1 and Fig 2 show core power for changed boron concentration. Quantity of boron gives a direct effect to change of core power. Case 2 is the highest core power because only water is injected without any boron..

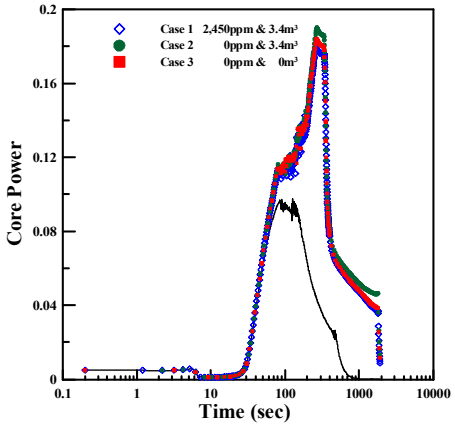

Figure 1. Core power during the MSLB (0%, full-DER)

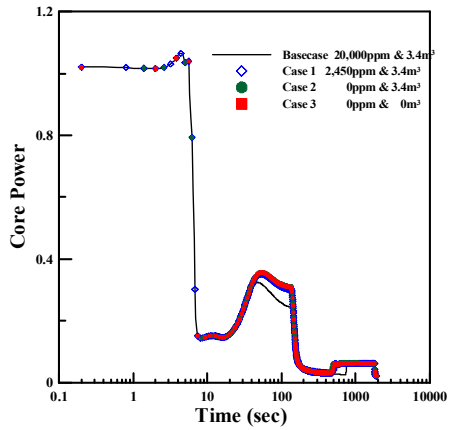

Figure 2. Core power during the MSLB (102%, full-DER)

Fig 1 and Fig 2 show that increase of core power for boron quantity starts within 100 seconds and power is increased significantly in 1000 seconds.

3.3 Containment analysis

Fig 3 and Fig 4 show predicted pressure and temperature curve using CONTEMPT code from core power. Peak pressure with BIT removal is below a design pressure. Though the peak pressure is slightly higher than basecase, overall containment integrity is not sensible for the change of boron quantity. The primary reason is that spray system is actuated within 100 seconds because the pressure is reached at Hi-3 pressure.

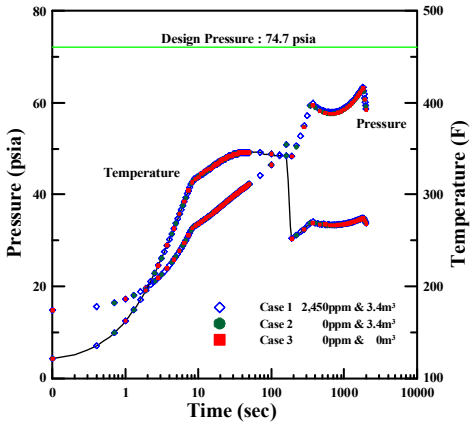

Figure 3. Containment peak pressure and temperature (0%, full-DER)

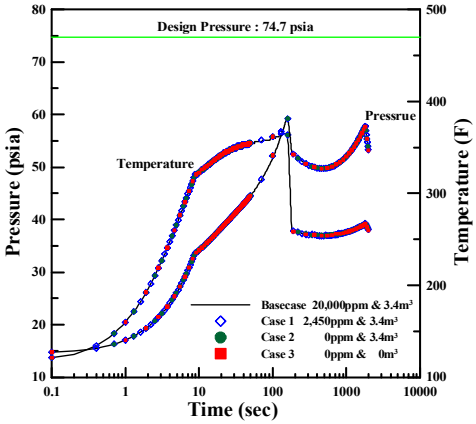

Figure 4. Containment peak pressure and temperature (102%, full-DER)

4. Conclusions

In this paper, change of boron concentration of BIT makes an impact on core power but containment integrity is not sensitive. The results show that the deactivation of BIT is plausible for success.

REFERENCES

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