Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 10-11, 2007

Containment Pressure due to Steam Generations and MCCI

Sungmin Cho[a], Wonsang Jung[a]
a Korea Power Engineering Co., 360-9 Mabuk-dong, Giheung-gu, Yongin-si, Gyeonggi-do, 446-713, Korea
Quan Zhou[b]
b Fauske&Associates, LLC 16W070 West 83rd Street Burr Ridge, Illinois 60527, USA

1. Introduction

The Containment Filtered Vent System (CFVS) is considered as a mitigation system of severe accidents after the TMI-2 and Chernobyl accidents. It protects containment overpressurization associated with steam generation and Molten Corium Concrete Interaction (MCCI). The purpose of this calculation is to evaluate overpressurization of the reactor containment building due to steam generation and MCCI. This calculation also demonstrates using the MAAP code to simulate a sample CFVS design.

2. Methodology

Five types of accidents are analyzed in this calculation, namely, the large break LOCA, the medium break LOCA, the small break LOCA, the station blackout (SBO), and the total loss of feedwater (TLOFW). Each type of accident is investigated in detail for changes in containment pressure, and sensitivities of relevant model parameters. Specifically, the worst case for each type without venting in the containment is determined based on the peak containment pressure attained in 24 hours of the accident. Effects of containment venting through a filtered system on pressure and fission product release are studied using a scrubber sample design system. Sensitivities of model parameters key to corium-steam and corium-concrete interactions are examined for the representative cases without the containment venting with high containment pressures.

3. Calculation & Conclusion

For each case, the peak containment pressure always occurs at the end of the 24 hour transient. The containment pressurization is mainly caused by steaming in the cavity, because the concrete type in the cavity is Basaltic concrete, which has low content of CO_2 to release in the MCCI. Figure 1 shows containment pressurization histories from the scenarios with all safety injection tanks (SITs) actuated, representing the worst case of the five types. The SBO case (SBOCTN-4) combined with suppression of hot leg creep rupture, produces the highest peak containment pressure of about 8.705 bar.

The effects of the CFVS are studied with a sample input, which models the CFVS as a Venturi Scrubber system. As the CFVS is actuated, the containment pressures for the five cases are reduced from the maximum pressure at the actuation to much lower values, as shown in Figure 2.

Sensitivity studies are performed to understand the impact of uncertainties inherent in several model parameters related to ex-vessel debris cooling, MCCI, and steam explosion. These studies are carried out only for the dominant cases (SBO, TLOFW, and LB LOCA) without containment venting, which have high pressures. SBO model is the most dominant case among these accidents, and the result of SBO case summarized in Table 1 indicate that the investigated parameters have no significant impact on containment pressure in the duration of the simulated transients.

Figure1: Containment Pressure Histories of the Accident Scenarios with Four SITs Actuated.

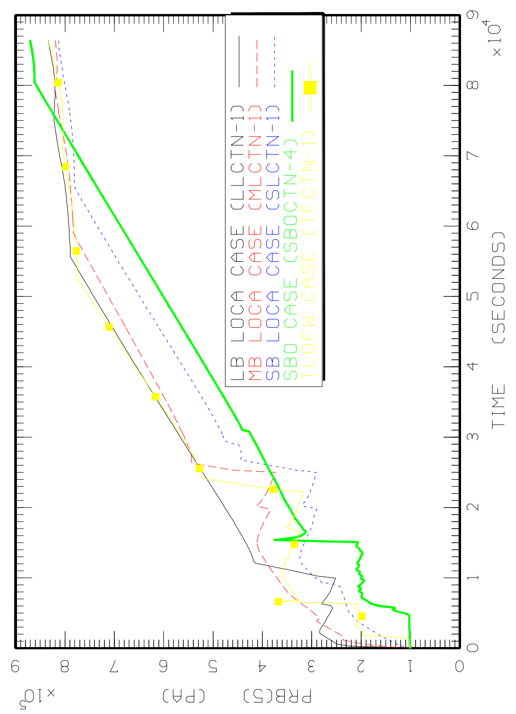

Figure 2: Containment Pressure Histories of the Accident Scenarios with CFVS Actuated at 6.0 bar.

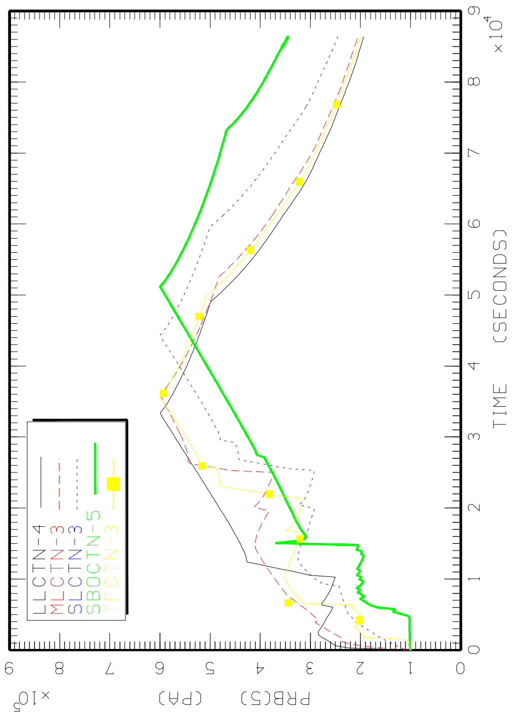

Table 1: Sensitivity Studies for SBO case.

Base Sequence	Variants	Parameter Changes	Max. PRB(5) in 24 hr (bar)
SBOCTN-4 (8.705 bar)	SBOCTN-41	FCHF=0.02	8.707
	SBOCTN-42	FCHF=0.0036	8.637
	SBOCTN-43	FCHF=0.15	8.724
	SBOCTN-44	FCHF=0.3	8.702
	SBOCTN-45	HTCMCR=5000, HTCMCS=5000, CDU=1	8.708
	SBOCTN-46	HTCMCR=1500, HTCMCS=1500, CDU=3	8.721
	SBOCTN-47	TDSTEX=10.0	8.706
	SBOCTN-48	TDSTEX=1.0	8.705
	SBOCTN-49	TDSTEX=0.1	8.705

REFERENCES

[1] Fauske & Associates, LLC, 2005, "MAAP 4.0.6 Transmittal Document," for Electric Power Research Institute by Fauske & Associates, LLC, Burr Ridge, IL.

[2] Mayinger, F., et al., 1976, "Examination of Thermal-Hydraulic Processes and Heat Transfer in a Core Melt," BMFT RS48/1, Institure for Verfahrenstechnik der T. U. Hanover.