CAP V&V for Containment Experiments

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1. Introduction

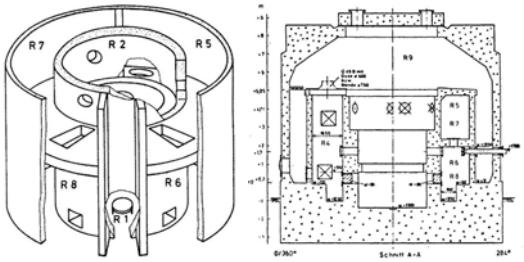
CAP code is now under verification & validation (V&V) and several containment related experiments were assessed. Before this experimental data V&V CAP has calculated fundamental phenomena and important phenomena including component performance. Through these calculations CAP was proofed to have the performance to conduct exact or reasonable computation [1, 2]. CAP code performance was also analyzed by comparing with other containment design code for maximum containment pressure/temperature (P/T), subcompartment P/T, minimum P/T, and combustion gas behaviors, and showed comparable results [3].

CAP V&V for containment related experiments is composed of 5 categories with the consideration of important phenomena; blowdown, distribution, intercompartment flow, condensation, and containment integral thermal hydraulic phenomena. For the V&V of 5 phenomena, famous experiments conducted in oversea were searched and data bases were constructed [4].

This paper discusses on the assessment of these experiments using CAP code. Detailed assessment results are attributed to reference 5.

2. Blowdown phenomena

Battelle-Frankfurt Model Containment (BFMC) test facility shown in Fig. 1 was selected for this phenomenon.



(a) Inner compartments (b) Cross-sectional view

Fig. 1. Layout of BFMC

Calculation results of D-1 test are present in this paper. D-1 test is a steam blowdown test and principal interest is the pressure difference between subcompartments. Nodalization of this problem is shown in Fig.2 and the calculation results are suggested in Fig. 3.

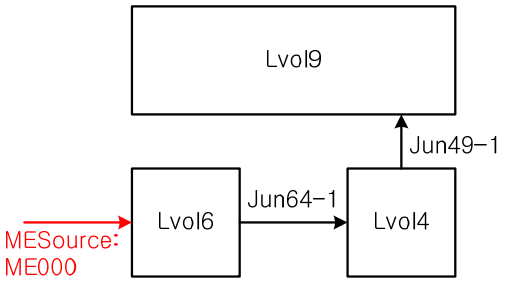


Fig. 2. Nodalization of BFMC D-1 test

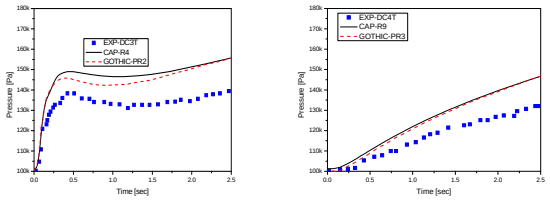


Fig. 3. Calculation results of BFMC D-1 test

Even though these results show some gap, CAP results are very similar to GOTHIC's ones. GOTHIC evaluation manual says that there seems difference in mass/energy (ME) source in the experiment.

3. Distribution phenomena

BFMC test 20 of hydrogen and nitrogen mixture gas injection for this phenomenon of noncondensable gas behaviors, is presented here. The nodalization is shown in Fig. 4, and the calculation results are suggested in Fig. 5. The results show excellent prediction capability.

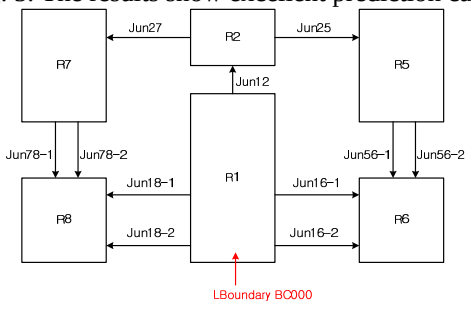


Fig. 4. Nodalization of BFMC test 6

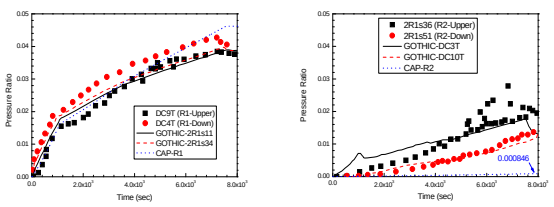


Fig. 5. Calculation results of BFMC test 6

4. Integral thermal hydraulic phenomena

HDR V44, whose CAP model is shown in Fig. 6, was selected for this calculation. Into the break room blowndown the ME is injected. The blowdown flow and enthalpy are typical break flow for the case of high energy and high pressure line break as shown in Fig. 7.

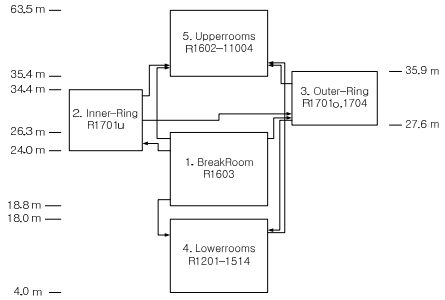


Fig. 6. Nodalization of HDR V44

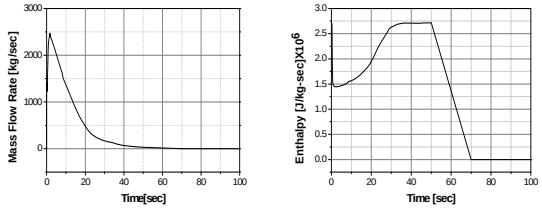


Fig. 7. Blowdown of HDR V44

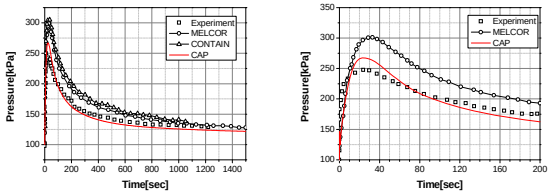


Fig. 8. Pressures in upper room and break room

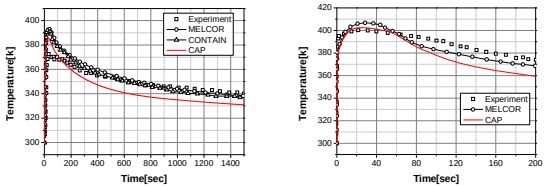


Fig. 9. Temperatures in upper room and break room

Calculation results shows that the pressure was excellently predicted and the temperature showed slight under prediction. The results were also compared with the prediction by MELCOR and CONTAIN. The pressure prediction by CAP was better than that by the two codes, and the temperature by CAP was lower than that by the two codes.

5. Intercompartment flow and condensation

For the V&V of intercompartmenr flow PANDA test was selected. Among several tests Phase E is the concern of this assessment. The test is to investigate the behavior of systems while the air is injected into the closed drywell during 1800 sec. The assessment is now undergoing and the results will be presented in meeting.

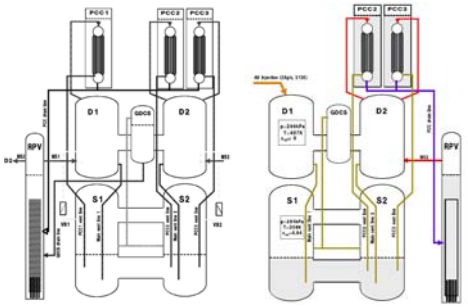


Fig. 10. Outline of PANDA test facility and phase E

For the V&V of condensation TOSQAN test was assessed. Vessel of the facility is presented in Fig. 11, and noded as Fig. 11. Blowdown information is given in Fig. 12.

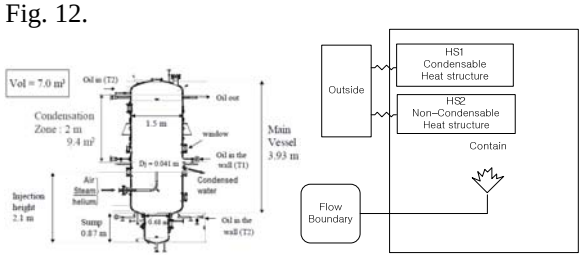


Fig. 11. Vessel of TOSQAN and its nodalization

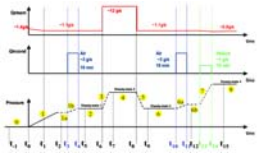


Fig. 12. Blowdown information

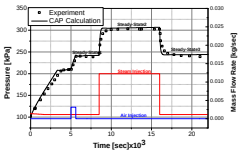


Fig. 13. Pressure Result

Prediction by CAP showed excellent performance as shown in Fig.13.

3. Conclusions

Several important tests on containment thermal hydraulic phenomena were assessed using CAP and CAP showed reasonable prediction results.

REFERENCES

[1] Yeon Joon Choo, et al., CAP Test Report of Basic Phenomena, FNC Technology Co., 2010, S06NX08-C-1-TR-003 Rev00
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[5] Su Hyun Hwang et al., CAP Test Report of Demonstration Test (I), FNC Technology Co., 2012, S06NX08-C-1-TR-006 Rev00