Sensitivity analysis on the MSLB scenario for LCO condition of APR1400 using CAP code

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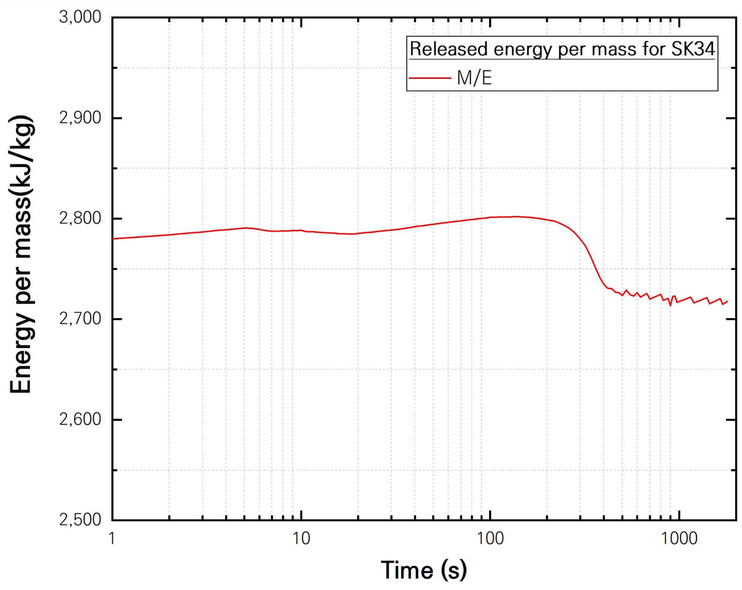
Introduction

☐ Containment pressure and temperature are most important factor to maintain the containment integrity and these factors are defined as the Limiting Conditions for Operation (LCO) in Technical Specification (TS). According to this document, the containment pressure and average air temperature are limited during normal operation to preserve the initial conditions assumed in the accident analyses for a Loss of Coolant Accident (LOCA) or Main Steam Line Break (MSLB). According to the TS document, the containment pressure should be maintained below the 1.0 psig and containment temperature below the 48.9 ˚C (≈ 120 ˚F) during normal operation..

☐ During actual normal operation, the containment air temperature may be locally high due to the air cooling equipment failure or hypothetical abnormal conditions. In this paper, a sensitivity analysis was performed using CAP code to confirm the results on the overall pressure and temperature conditions in case the dome is relatively high temperature condition.

Method



☐ Released energy per mass for reference plant

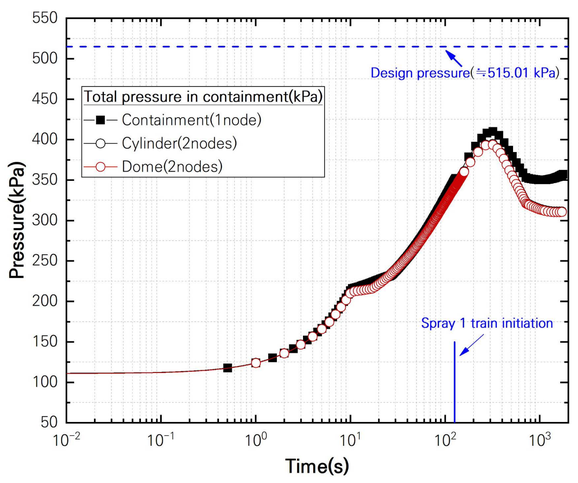
☐ Mass & Energy data : MSLB (102 % power) + CSS 1 train fail
☐ Locally high temperature condition : 335.75 K at dome
☐ Spray Initiation time: 93.0 s , 126.0 s

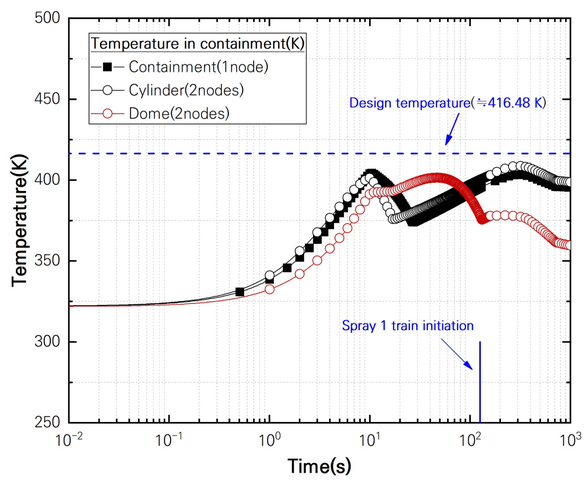
Initial conditions	Parameter	1 node	2 nodes (Dome, Cylinder)
Containment	Volume	88,575 m³	C: 63,555 m³ D: 25,020 m³
	Pressure	111 kPa	
	Temp.	322.05 K (≈ 48.9 °C)	
	Humidity	5 %	
Environment	Temp.	322.04 K (≈ 48.89 °C)	

Sensitivity cases	Initial Temp. (K)		Spray Initiation Time (s)
	Cylinder	Dome	
1 node	322.05 K		126.0 s
2 nodes – BASE			
2 nodes – 62.6 °C	322.05 K	335.75 K	93.0 s
2 nodes – 93.0 s	322.05 K		

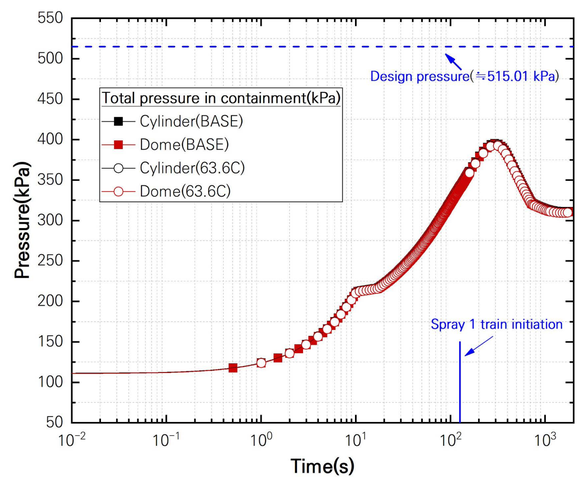
Results & Conclusion

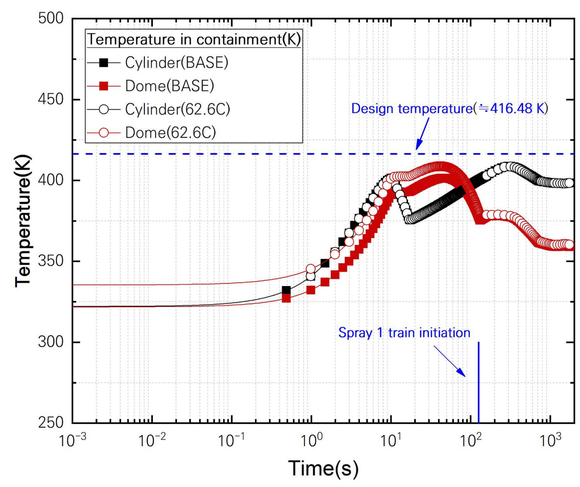
☐ Node sensitivity result



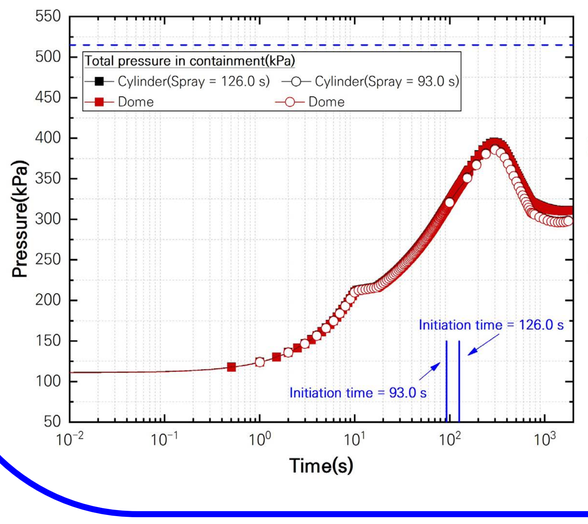


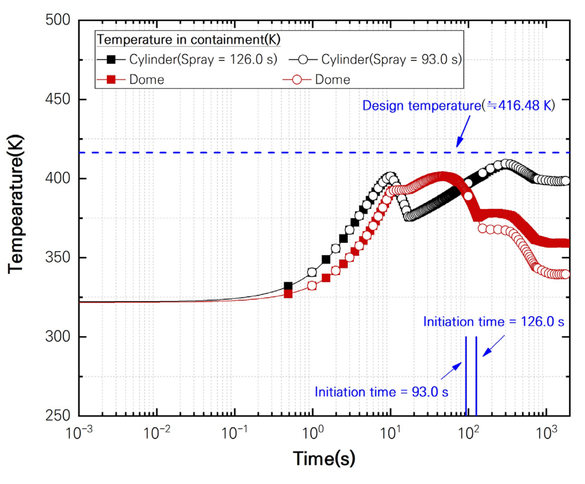
☐ Dome temp. sensitivity result





☐ Spray initiation time sensitivity result





☐ The pressure and temperature both one node and two nodes cases not exceed the design criteria when the initial condition was maximum value which is mentioned in TS document. When the dome temperature is locally high, the dome temperature is only higher than that of 2 nodes-BASE case. These results shows the local high temperature condition do not affect overall pressure and temperature conditions.

☐ the local high temperature condition do not have a significant effect on the containment integrity. Lastly, sensitivity results of spray initiation time shows the spray initiation time have an effect on the maximum pressure.