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Containment Pressure and Distribution of Fission products for SMART-100 under the SLOCA with ERVC and Spray using MELCOR1.8.6

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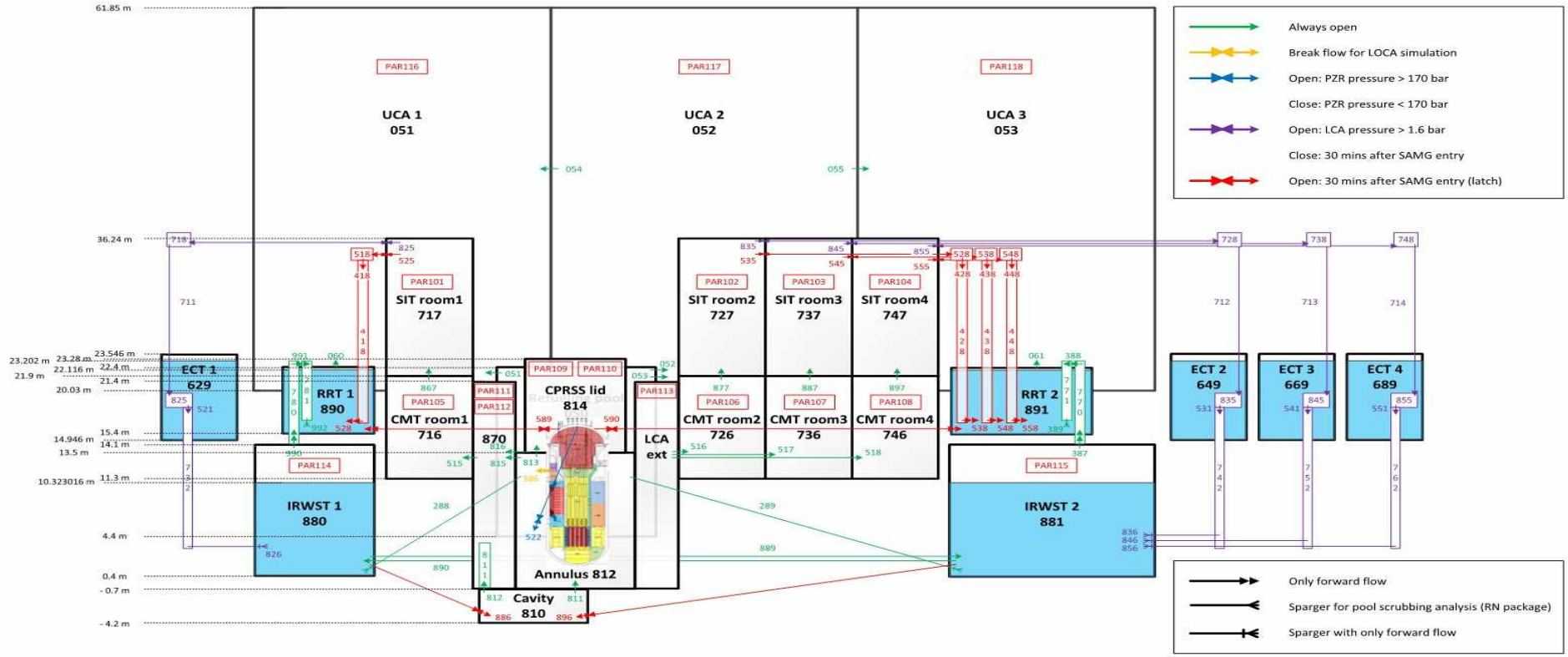
Assumptions

- SLOCA occurs at zero second !
- All PRHRs, PSI system are not function
- SRV discharges to the bottom of Mid-CPRSS
- CPRSS can vent to IRWST through Pressure discharge line, depending on the difference of their pressures
- If the pressure of LCA is greater than 1.6 bar, SIT building vent to IRWST through ECT-HX tubes. (if not, close)
- **ADS starts vent to RRT** directly & **path from SIT-BD to RRT opens** at **30 min after SAMG condition**
- **The Size of diameters for the path from SIT-BD to RRT were modified to 6 inch**
- At 30 min after SAMG condition**, the vent from SIT-BD to IRWST through ECT will be closed.**
- ERVC was activated from two IRWSTs to the cavity at 30 min after SAMG condition
- Detail injection axial levels into the pool in IRWST and RRT are not determined yet.
- Design basis leak rate from the containment was modeled .
- Calculation was performed up to ~300000 sec (3.47 day)
- **LCA was subdivided into 5 CVs, heat structures in CPRSS was included and new flow path from Lid was included**
- **LCA was blocked against the ingression of water from ERVC**

Nodalization of SMART100 for MELCOR



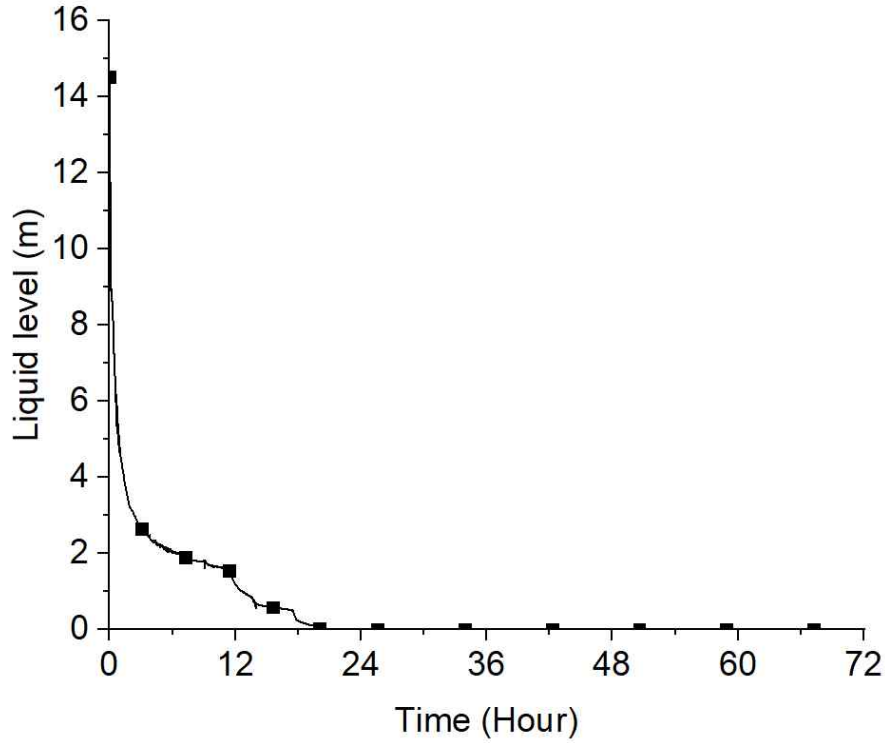
SBLOCA with ERVC
Sequence summary Table

* PSI (SIT, CMT), PRHR are not working.

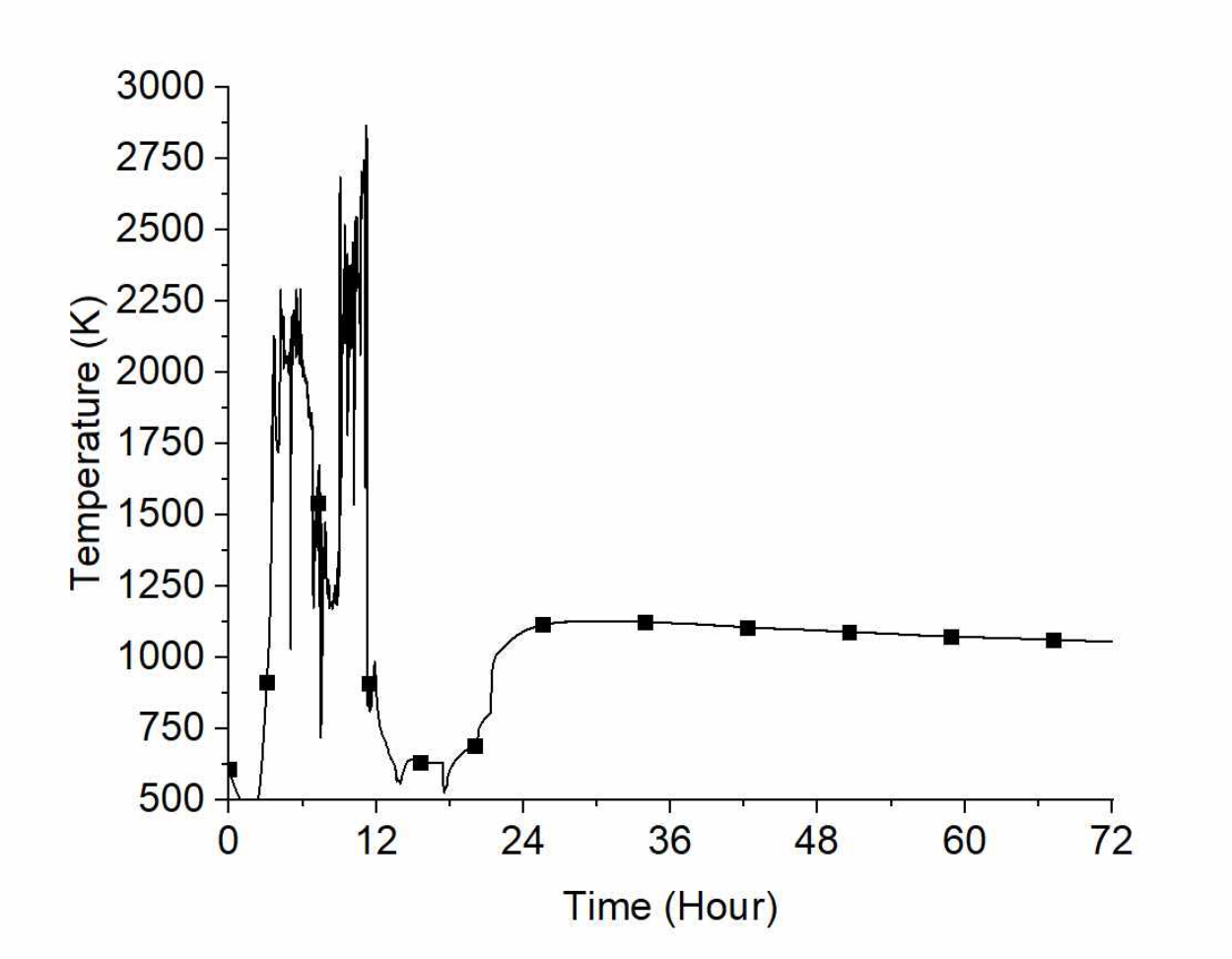
Events	Time (seconds)
SBLOCA occurrence	0
CSL valve open (P_{LCA} > 1.6 bar)	44
Reactor core, RCP, and MFWP trip	150
Core top exposure	1,081
Core bottom dry-out	8,631 (2.3 hours)
Oxidation start	10,800 (3.0 hours)
Candling start	11,800 (3.2 hours)
CSL valve close	
Valve on pipe line from SIT room to RRT open	
ADS pipe line valve open	12,040 (3.3 hours)
CFS pipe line valve open	
(30 minutes after SAMG* entry)	
Massive corium relocation to lower head	28,250 ~ 30,350 (7.8 ~ 8.4 hours)
Lower plenum dry-out	65,557 (18.2 hours)
Massive corium relocation to lower head	92,300 (25.6 hours)
RRT pool boiling start	210,300 (58.4 hours)
Reactor vessel failure by creep rupture	N/A
Molten-Core Corium Interaction start	N/A

* **SAMG condition = Tcore-exit > 923.15 K**

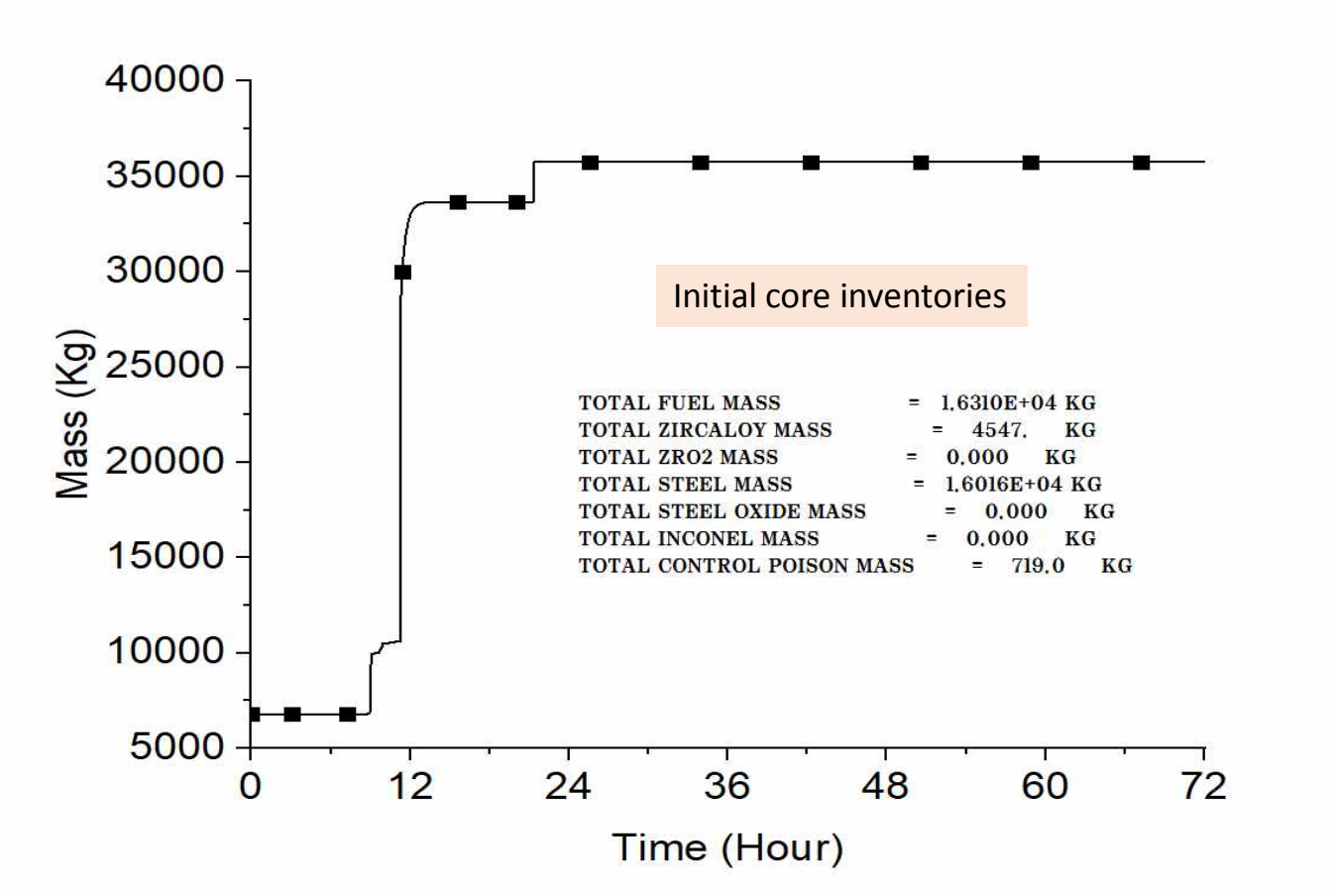
Collapsed Liquid Level in RPV during SBLOCA



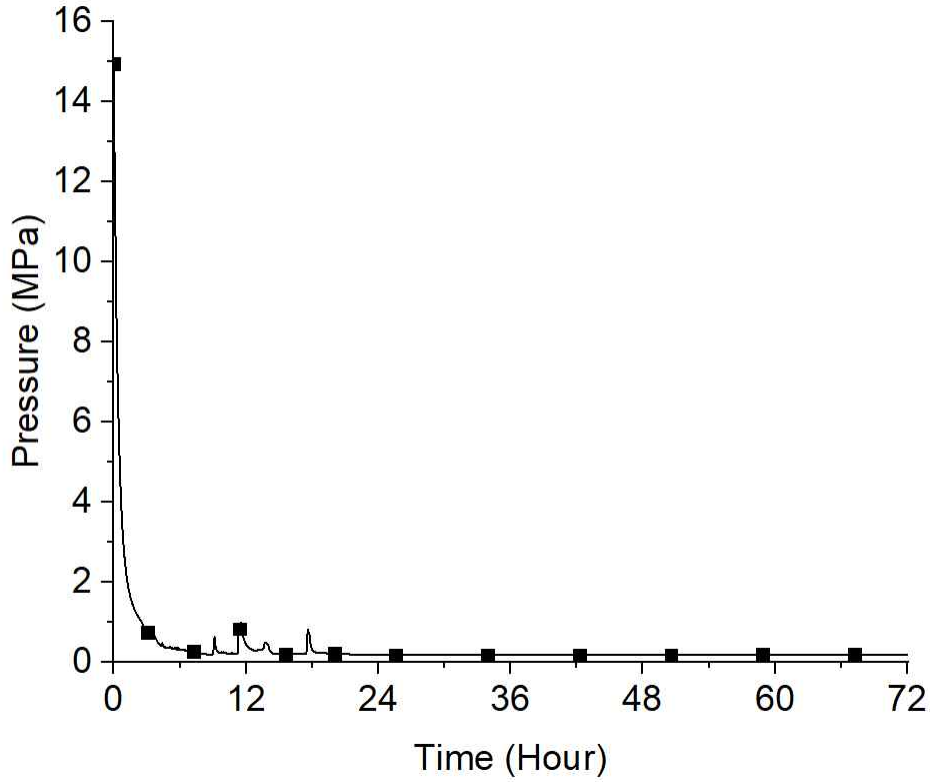
Temperature of Core Exit Region



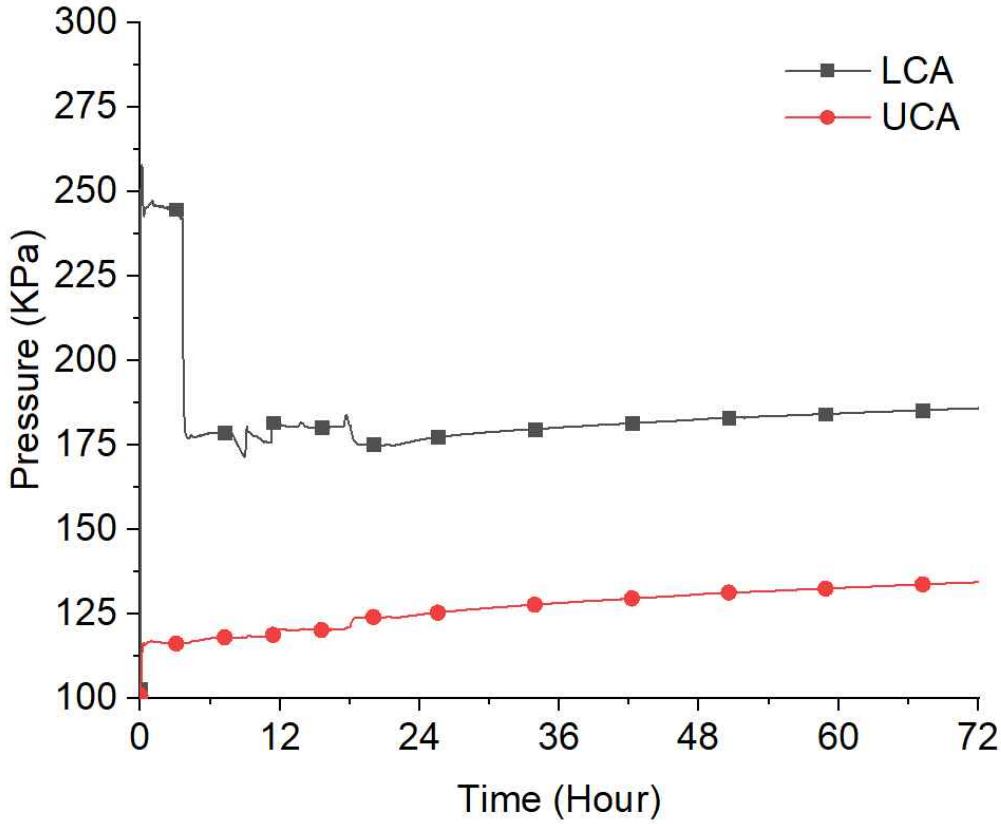
Mass of relocated-corium into Lower Plenum



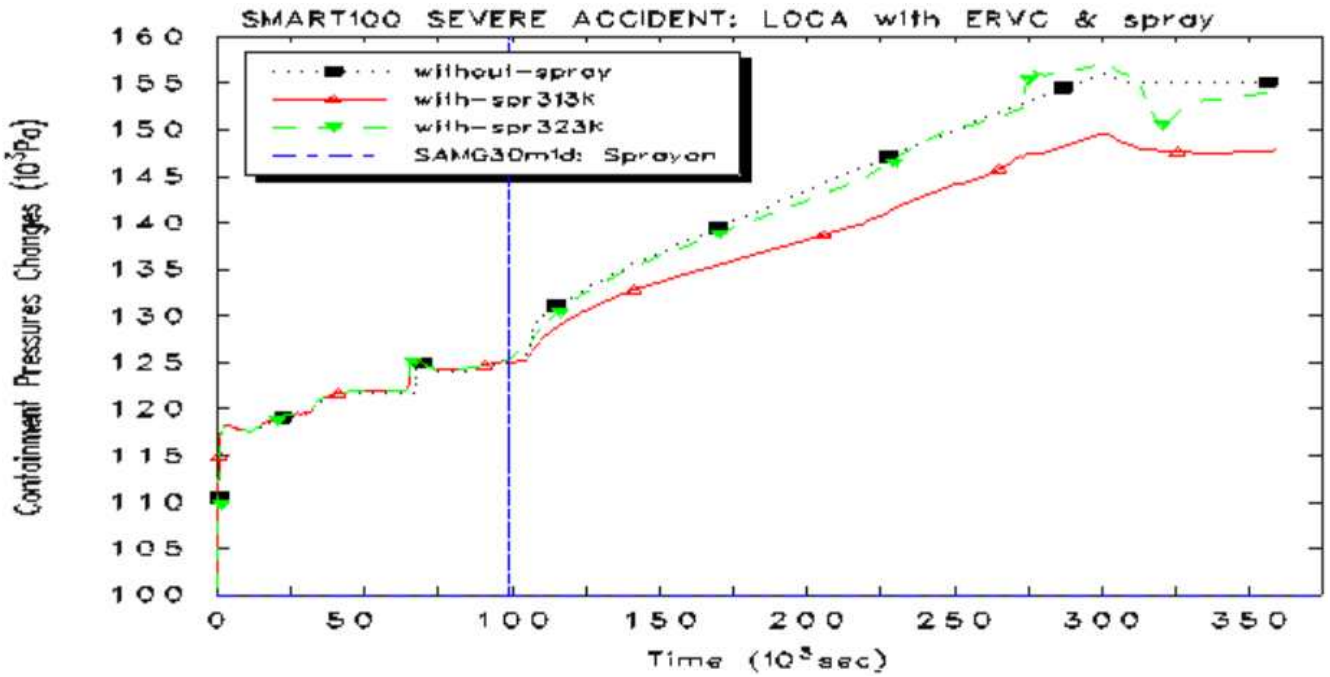
Reactor Pressure Vessel Pressures



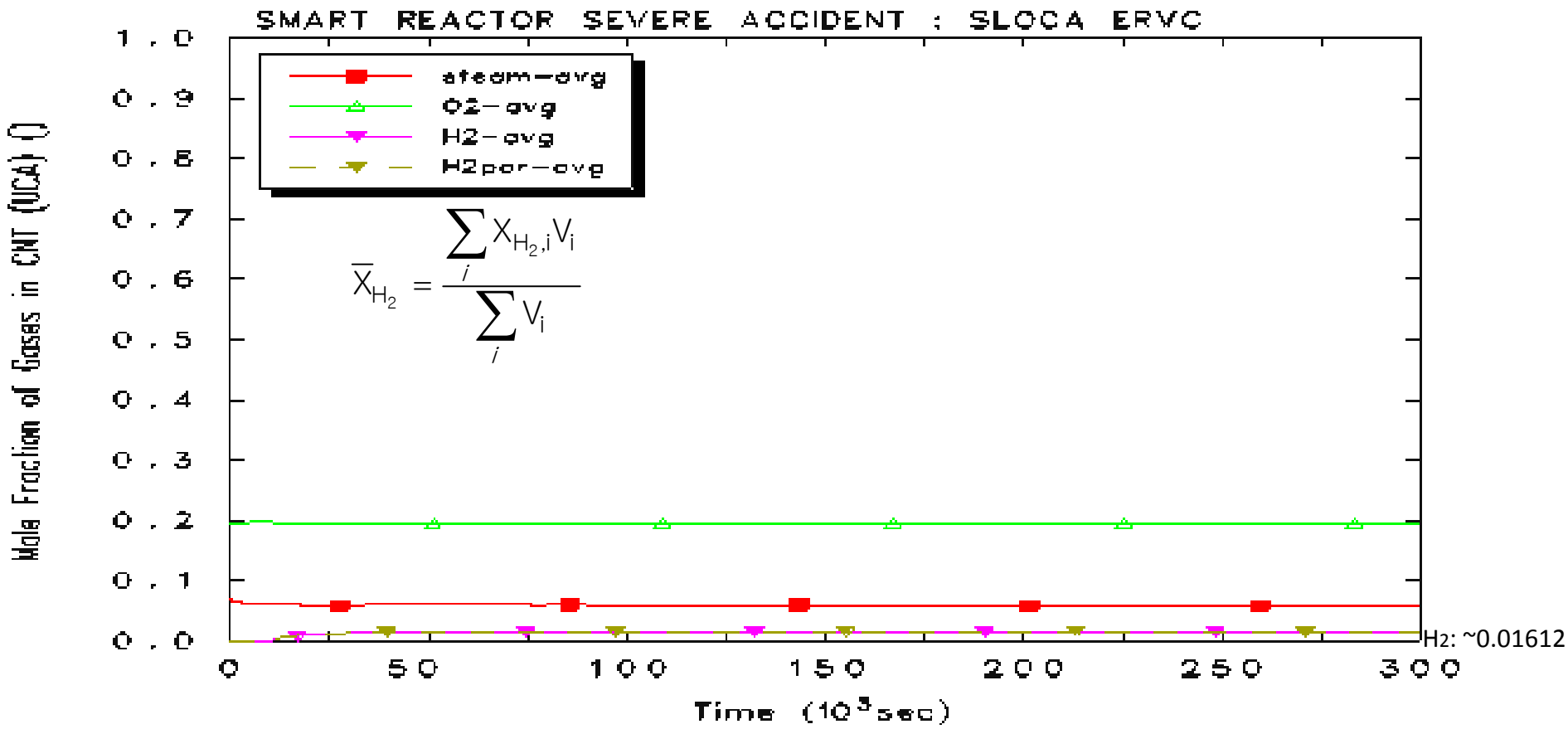
Containment Pressure during SBLOCA with ERVC



Containment Pressure Change by the Operation of Spray and its Droplet Temperature (323K, 313K)



Gas mole fraction in Containment



H_2: ~0.01612

Categorized spaces for the distribution of released fission product in SMART100

Type no.	Space
1	RPV (including primary side of SG and pressurizer)
2	LCA
3	Water tanks (IRWST, RRT, CMT, and SIT)
4	UCA
5	PRHRS loop, Secondary side of SG
6	CDL, loop from SIT room to RRT
7	Turbine
8	Environment

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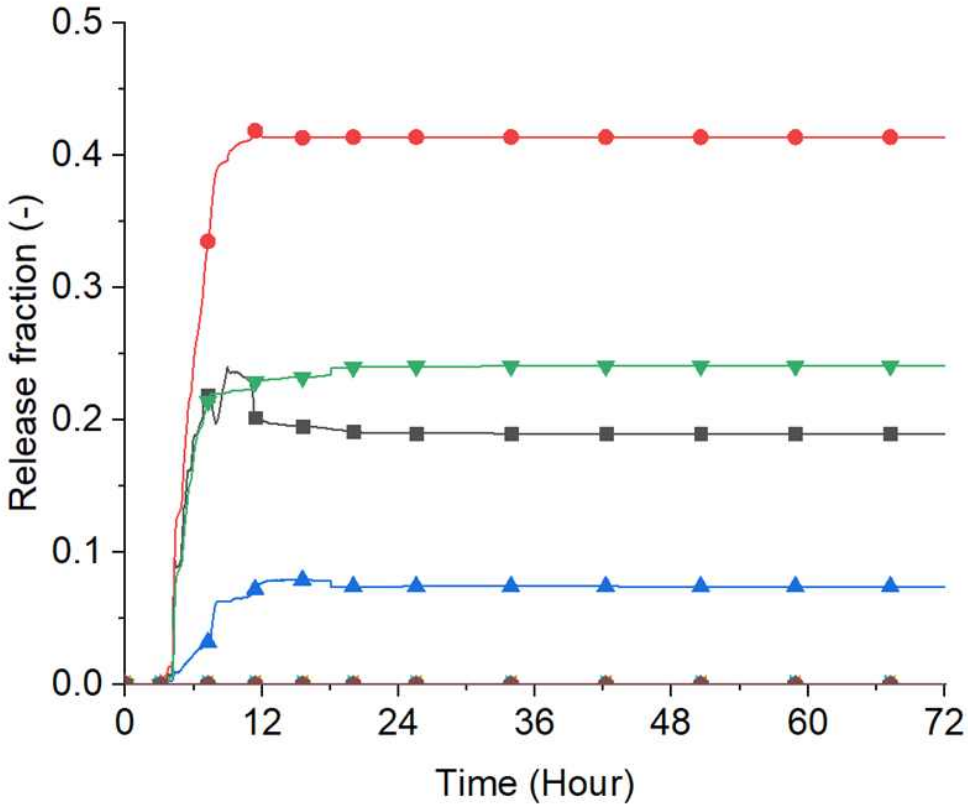
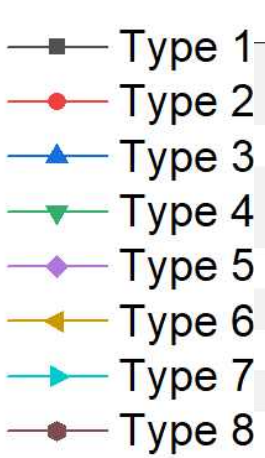
Release Fraction at 72 hrs after SBLOCA occurence

class	Type-1	Type-2	Type-3	Type-4	Type-5	Type-6	Type-7	Type-8
Cs (2)	0.22	0.459	0.112	0.261	0.0	1.7E-4	0.0	2.59E-5
Ba (3)	4.93E-3	6.0E-3	3.36E-3	2.51E-3	0.0	6.11E-7	0.0	2.05E-7
Te (5)	0.298	0.387	0.102	0.235	0.0	1.38E-4	0.0	2.35E-5
Mo (7)	2.81E-2	7.15E-2	5.8E-2	9,94E-3	0.0	1.07E-5	0.0	1.23E-7
CsI(16)	0.168	4.03E-1	0.1	0.252	0.0	1.24E-4	0.0	2.52E-5

Release Fraction of fission product class 16 (CsI) during SBLOCA





Type no.	Space
1	RPV (including primary side of SG and pressurizer)
2	LCA
3	Water tanks (IRWST, RRT, CMT, and SIT)
4	UCA
5	PRHRS loop, Secondary side of SG
6	CDL, loop from SIT room to RRT
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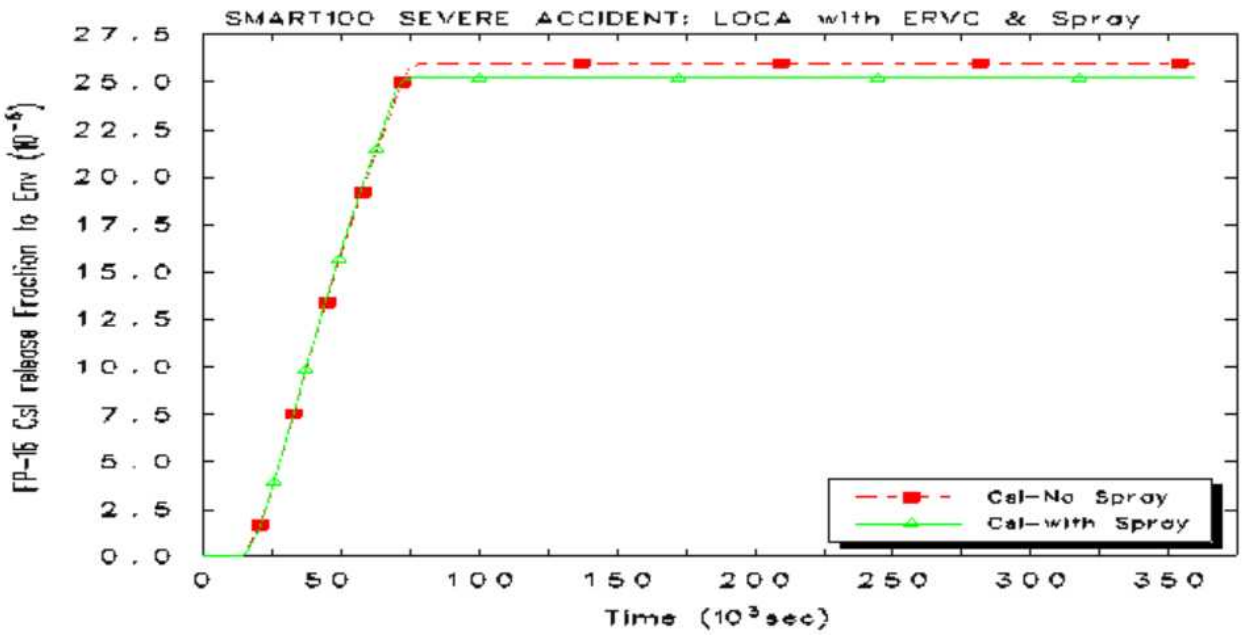
CsI release fraction to the environment depending on the operation of backup spray.



Summary of the results

- Release fraction of volatile fission product such as Cs, Te, CsI to the environment by the rate of design leak rate are in the order of minus five to ten but the less volatile fission product such as Ru Ce La, U are in the order of minus ten to ten or less.
- Consequently, the amount of fission product release to the environment during the SBLOCA with ERVC and the backup spray was shown as negligible.
- In case of the operation of backup spray, the important parameter to control the containment pressure was the temperature of the spraying droplet. Therefore, it is necessary to equipped with the system that can control the temperature of spraying droplet.
- In case of spraying with 313 K of droplet temperature, the containment pressure continues to increase up to 1.49 bar with maximum. Thereafter, the pressure was stabilized at near 1.475 bar.

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