Validation of SPACE for Steam Generator Tube Rupture Accident Using SMART-ITL Experimental Data

2021. 10. 21.

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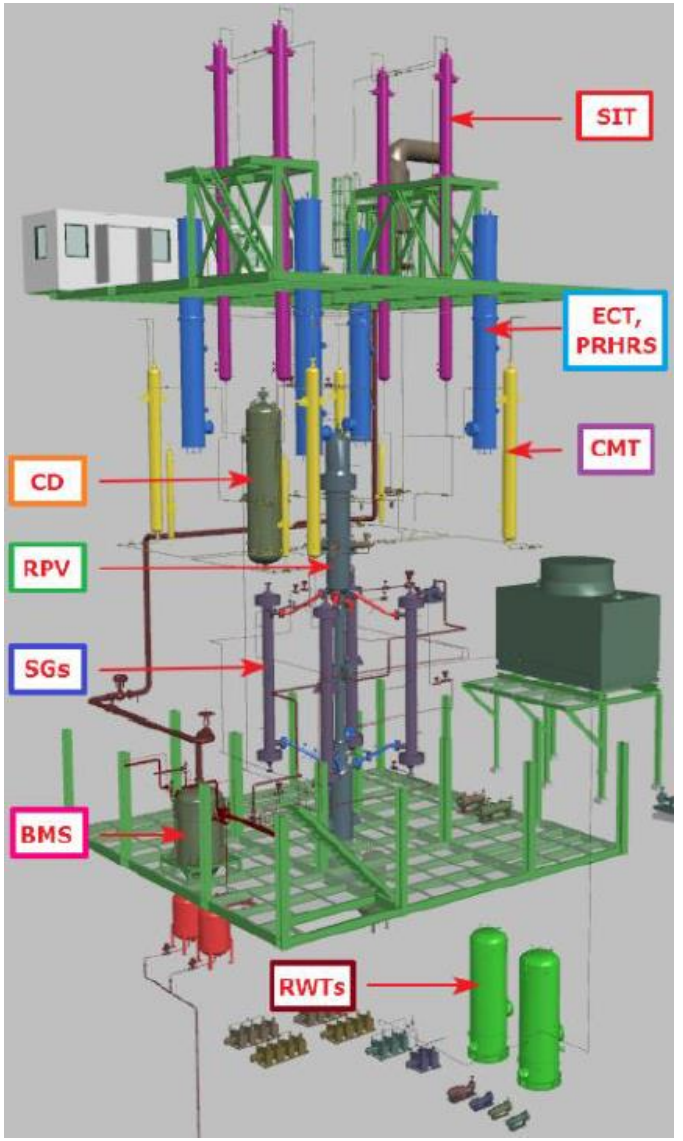
Contents

Introduction

- SGTR is an important accident in view of the radioactive material release to the secondary system.
- As a single helical tube of the steam generator is ruptured, the coolant of the Reactor Coolant System (RCS) is discharged to secondary side of SMART-ITL through ruptured tube, and mixed with a fluid in secondary system.
- In this study, SGTR is modeled by an opening value, break nozzle, and two pipe components that directly connect the primary side of steam generator and steam line.
- SPACE calculations for the SGTR accident are validated using SMART-ITL experimental data.

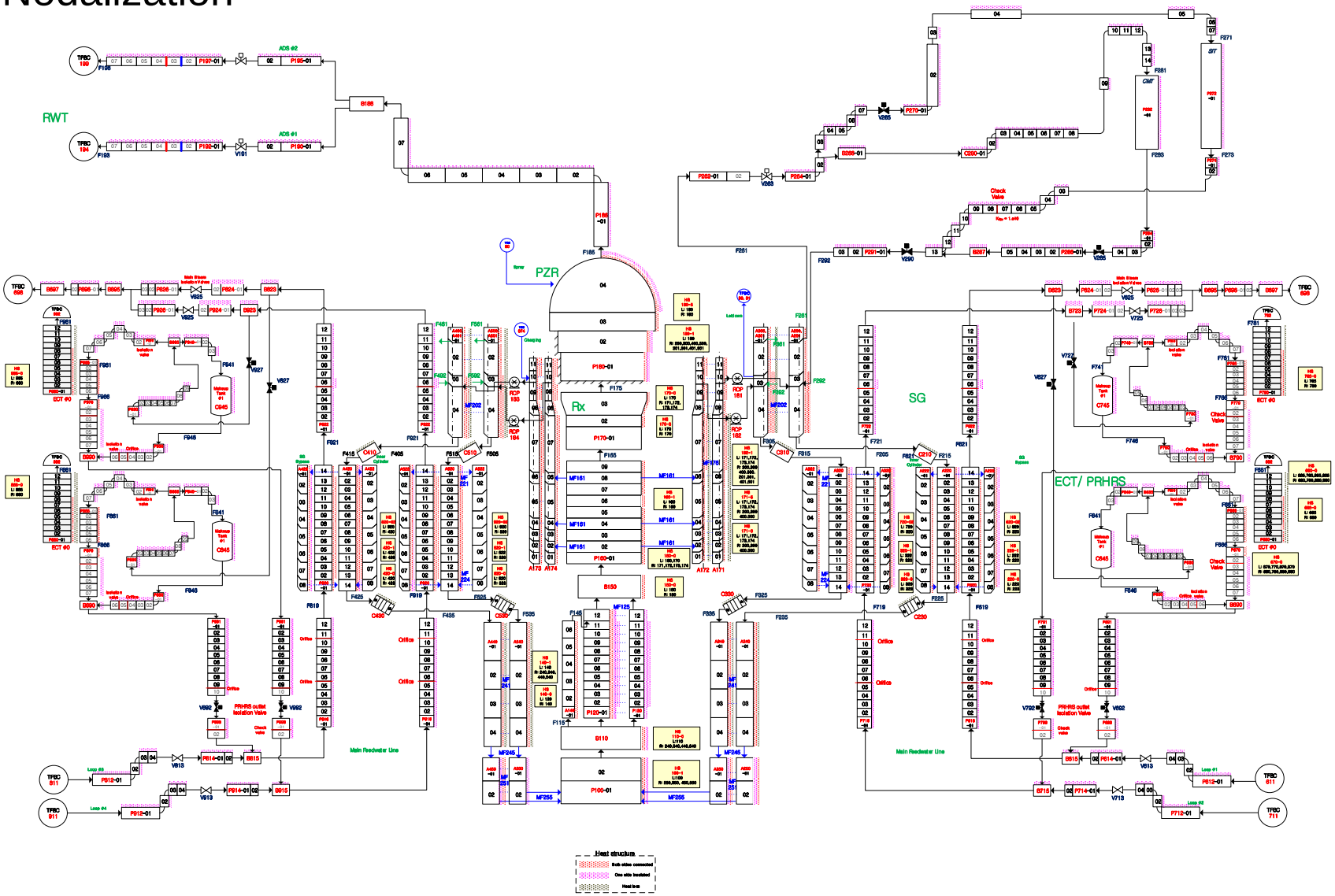


Major Sequence of Event of SGTR

Event	Set point	Time (s)	Instrumentation
Arrival of Steady State	-	0	
Break	-	0	OV-BS6B-01 Open PP-CHG1-01 Start FCV-CHGS1-02 Open
Arrival of LPL set point	Low PZR level = 45%	1471	
Generation of LPL reactor trip signal	LPL + 1.1 s		
Control rod insertion	LPL + 1.6 s	1473	
Generation of: - PRHRAS - CVCS isolation actuation signal	LPL + 1.45 s		
Generation of CMT actuation signal	PRHRAS + 1.45 s		PP-CHG1-01 Stop FCV-CHGS1-02 Close
Initiation of CMT injection	CMTAS + 1.45 s	1523/1475/ 1476/1475	
PRHRS valve open MSIV/FIV close	PRHRAS + 5.0 s	1478 1478/1492	OV-PR1,2,3,4-03 Open OV-MF1,2,3,4-01 Close OV-MS1,2,3,4-01 Close PP-MF-01Stop
Test terminated	RCS temperature = 488 K		Safety shutdown condition

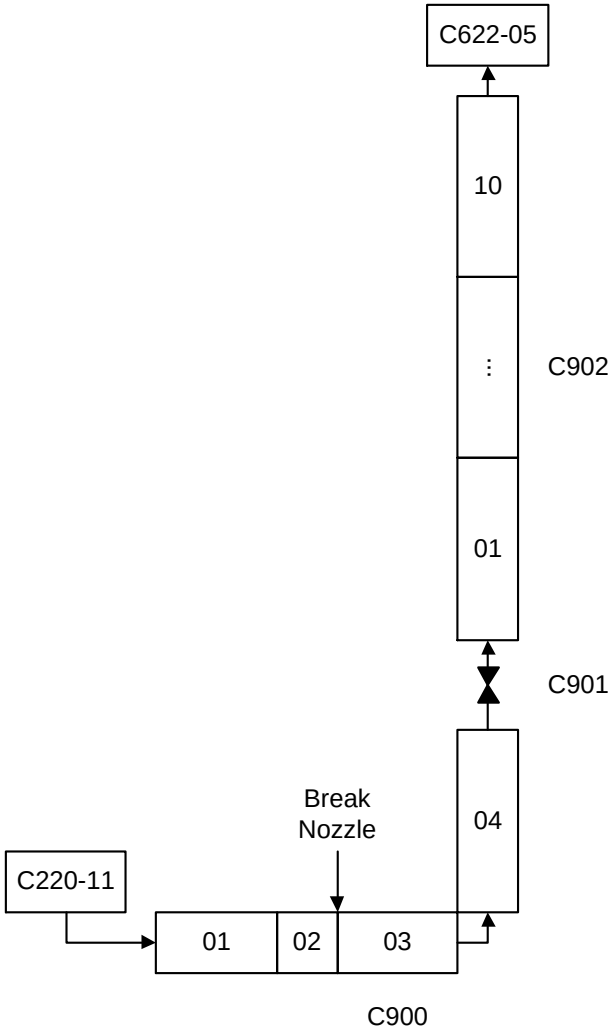
Validation Results

- Nodalization

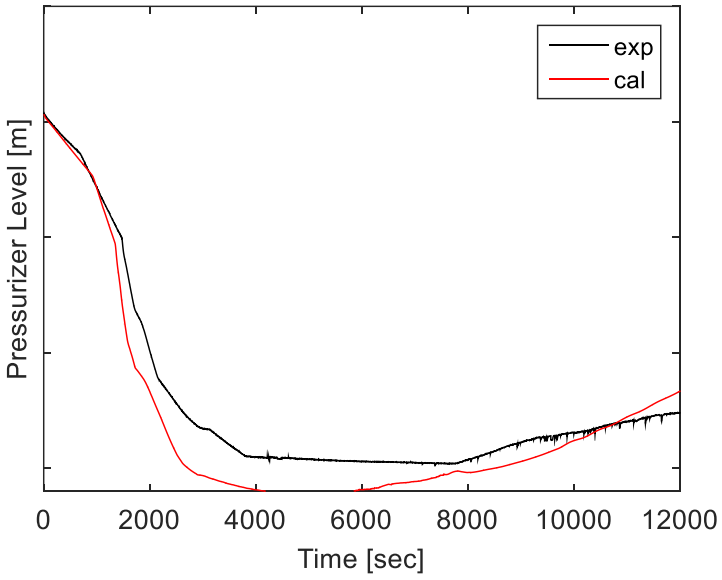


Validation Results

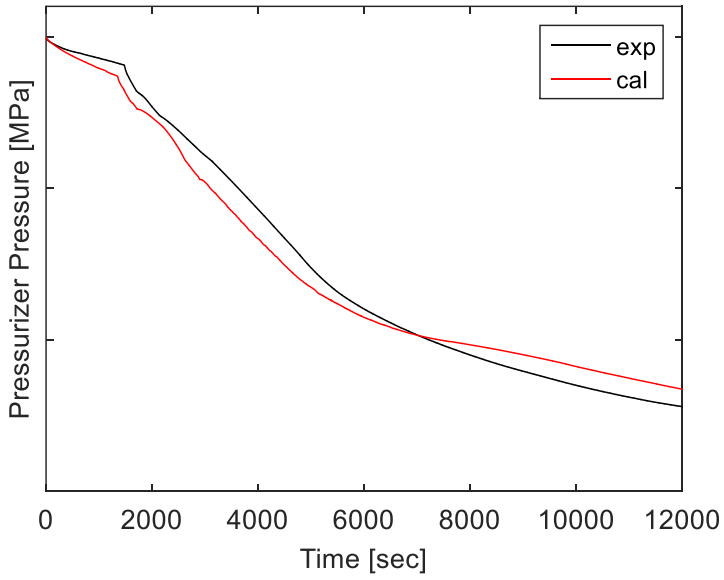
- Break Line Modeling for SGTR



Validation Results

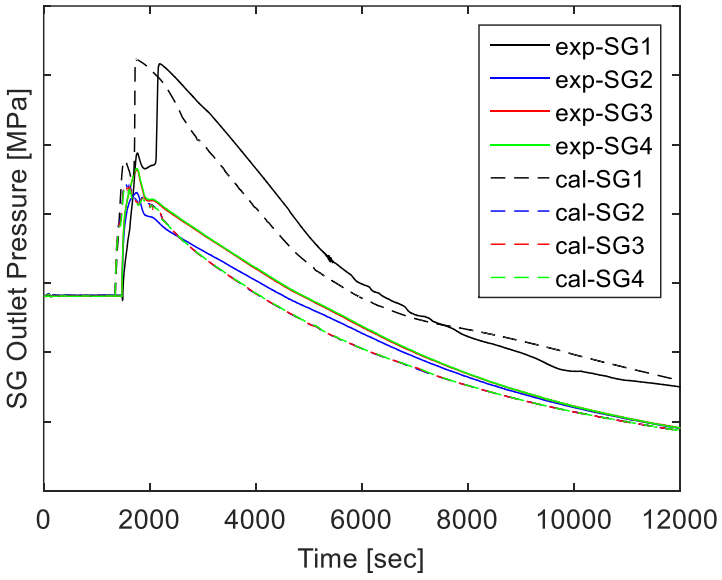


Comparison of Pressurizer Level

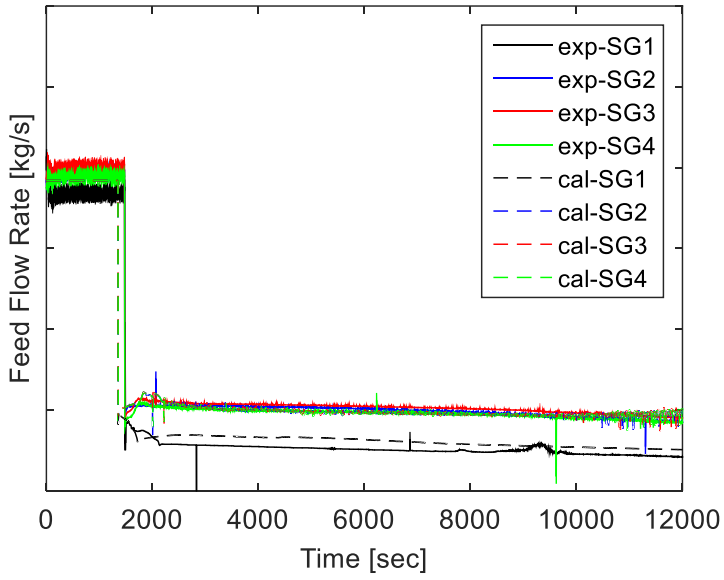


Comparison of Pressurizer Pressure

Validation Results

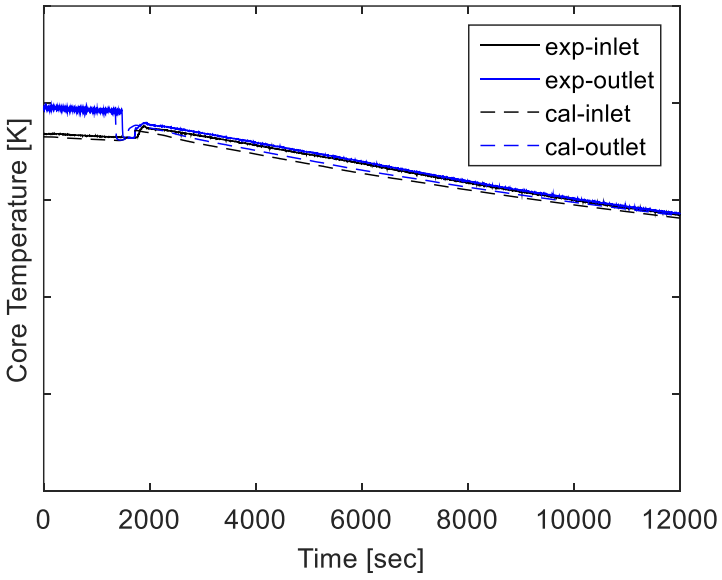


Comparison of SG Outlet Pressure

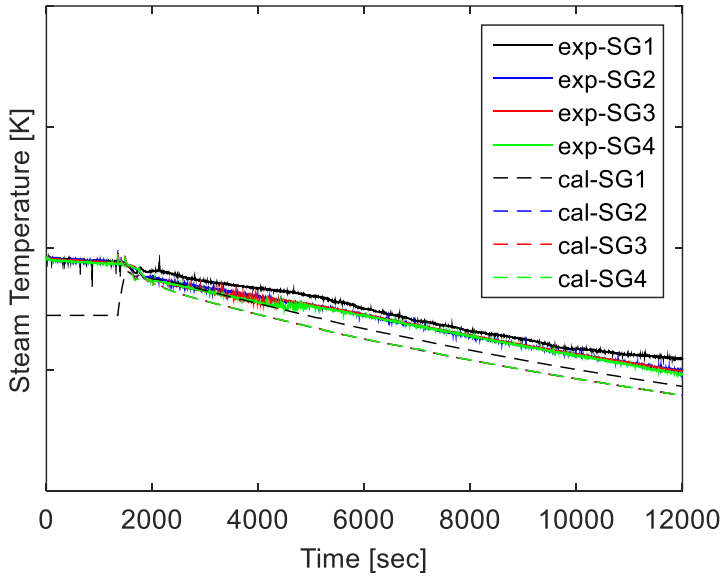


Comparison of Feed Flow Rate

Validation Results

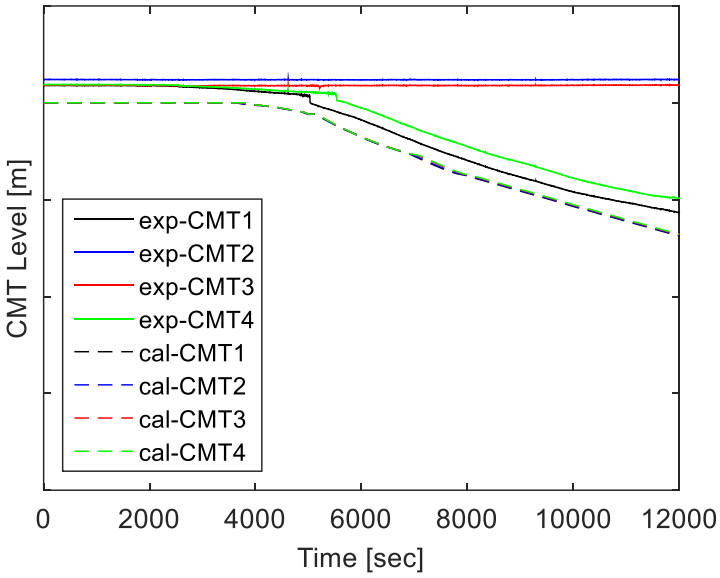


Comparison of RCS Temperature

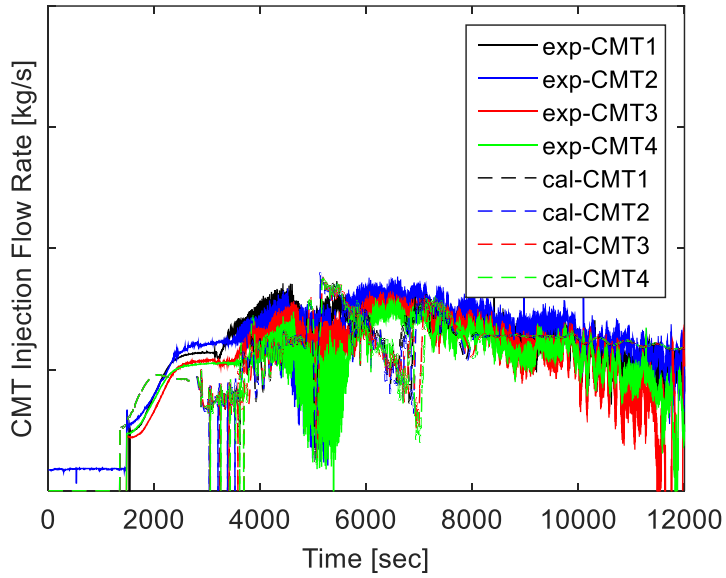


Comparison of Steam Temperature

Validation Results



Comparison of CMT Level



Comparison of CMT Injection Flow Rate

Summary

- Validation of SPACE for SGTR accident was performed using SMART-ITL experimental data.
- In this study, SGTR was modeled by an opening value, break nozzle, and two pipe components that directly connected primary side of steam generator and steam line.
- It was shown that SPACE predicted system pressure and temperature well, which highly depended on discharge rate in earlier phase and cooldown rate in long term period.