ATTACHMENT 41A

AP1000 SPECIFIC MAAP4.04 ANALYSES

Table 41A-1 (Sheet 1 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR AP1000 MAAP4.04 HYDROGEN ANALYSES

Accident Class 1A

Case Name	Initiating Event	Equipment Availability Assumptions										
		ADS				CMT	ACC	PRHR	Gravity Injection/ Recirc.	IGN	Cavity Flooding	Comments
		1	2/3	4	A/M							
1A-3	FW Failure	2	2+2	4	M	2	2	Failed	2/2	N	2	• Acc Seqs 20, 36, 39 • ADS @ core-exit temperature > 922 K (1200°F) + 20 min
1A-3a	FW Failure	0	2+0	0	M	2	2	Failed	2/2	N	2	• Acc Seqs 20, 36, 39 • ADS @ core-exit temperature > 922 K (1200°F) + 20 min
1A-4	FW Failure	2	2+2	4	M	Failed	2	Failed	2/2	N	N	• Acc Seq 28 • ADS @ core-exit temperature > 922 K (1200°F) + 20 min • Failure of CMT draining fails ADS, gravity injection/recirc. • Gravity injection is recovered when ADS-4 is manually activated
1A-4a	FW Failure	0	2+0	0	M	Failed	2	Failed	2/2	N	N	• Acc Seq 28 • ADS @ core-exit temperature > 922 K (1200°F) + 20 min • Failure of CMT draining fails ADS, gravity injection/recirc. • Gravity injection is recovered when ADS-4 is manually activated

The 1A hydrogen sequences may produce little core damage, even with the reduced availability of the CMTs, accumulators, and gravity injection. That is acceptable because they are core damage sequences recovered by operator action.

Table 41A-1 (Sheet 2 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR AP1000 MAAP4.04 HYDROGEN ANALYSES

Accident Class 1AP												
		Equipment Availability Assumptions										
		ADS										
Case Name	Initiating Event	1	2/3	4	A/M	CMT	ACC	PRIIR	Gravity Injection/ Recirc.	IGN	Cavity Flooding	Comments
1AP-3	2″ hot leg break to SG Compt	2	2+2	4	M	failed	2	Y	2/2	N	2	• Acc Seq 26, 30 • Failure to drain CMT fails ADS, gravity injection and recirc. • ADS @ core-exit temperature > 922 K (1200°F) + 20 min • Gravity Injection recovered when ADS-4 manually activated
1AP-4	2″ hot leg break to SG Compt	2	2+2	4	M	2	2	Y	2/2	N	N	• Acc Seq 38, 40 • ADS @ core-exit temperature > 922 K (1200°F) + 20 min • Gravity Injection recovered when ADS-4 manually activated

The 1A hydrogen sequences may produce little core damage, even with the reduced availability of the CMTs, accumulators, and gravity injection. That is acceptable because they are core damage sequences recovered by operator action.

Table 41A-1 (Sheet 3 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR MAAP4.04 HYDROGEN ANALYSES

Accident Class 3C												
		Equipment Availability Assumptions										
		ADS										
Case Name	Initiating Event	1	2/3	4	A/M	CMT	ACC	PRHR	Gravity Injection/ Recirc.	IGN	Cavity Flooding	Comments
3C-1	Vessel Rupture	2	2+2	4	A	2	2	N	2/2	N	N	• Acc Seq 5 • Large LOCA at belt of vessel into Cavity

Table 41A-1 (Sheet 4 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR MAAP4.04 HYDROGEN ANALYSES

Accident Class 3D

Case Name	Initiating Event	Equipment Availability Assumptions										
		ADS				CMT	ACC	PRHR	Gravity Injection/ Recirc.	IGN	Cavity Flooding	Comments
		1	2/3	4	A/M							
3D-1	Spurious ADS-4 (one valve)	0	0	0	N	0	2	N	0/0	N	2	• Acc Seq 3 • One 79 in^2 valve from hot leg to SG Compt • Failure to drain CMTs fails ADS, gravity injection/recirc.
3D-2	Spurious ADS-2 (two valves)	0	0	0	N	0	2	N	0/0	N	2	• Acc Seq 3 • Two 27 in^2 stage 2 ADS pzr to IRWST • Failure to drain CMTs fails ADS, gravity injection/recirc.
3D-3	DVI Line Break to PXS Compt	0	0	0	N	1	1	N	0/0	N	2	• Acc Seq 4 • Flood PXS compt through broken gravity injection line • No low CMT-2 signal
3D-5	2" hot leg break to SG Compt	0	2+0	0	A	2	2	Y	2/2	N	2	• Acc Seq (8), 9

Table 41A-1 (Sheet 5 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR MAAP4.04 HYDROGEN ANALYSES

Accident Class 3BR

Case Name	Initiating Event	Equipment Availability Assumptions										
		ADS				CMT	ACC	PRHR	Gravity Injection/ Recirc.	IGN	Cavity Flooding	Comments
		1	2/3	4	A/M							
3BR-1	DEGB cold leg to SG Compt	2	2+2	4	A	1	0	N	1/0	N	N	• Acc Seq 2,10 • Void vessel and reflood with gravity injection
3BR-1a	DEGB cold leg to SG Compt	2	2+2	4	A	2	0	N	0/0	N	N	• Acc Seq 2,10 • Void vessel and reflood with gravity injection

NB: If 1 CMT and 1/1 grav. inj./recirc. are available, there is no core degradation.

Table 41A-1 (Sheet 6 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR MAAP4.04 HYDROGEN ANALYSES

Accident Class 3BL

Case Name	Initiating Event	Equipment Availability Assumptions										
		ADS				CMT	ACC	PRHR	Gravity Injection /Recirc.	IGN	Cavity Flooding	Comments
		1	2/3	4	A/M							
3BL-1	2" LOCA hot leg to SG Compt	2	2+2	4	A	2	2	N	2/0	N	N	• Acc Seq 6,7 • ABB=0 after ADS-4 to prevent reflood through break • Fail gravity recirc.
3BL-2	DVI line break to PXS Compt	2	2+2	4	A	1	1	N	1/0	N	N	• Acc Seq 12 • No PXS flood

NB: for 3BL cases, N1SHRB(28) = 6 and N1SHRB(29) = 6 will be taken into account in the input files.

Table 41A-1 (Sheet 7 of 7)

SUMMARY OF SYSTEM ASSUMPTIONS FOR MAAP4.04 HYDROGEN ANALYSES

Accident Class 3BE

Case Name	Initiating Event	Equipment Availability Assumptions										
		ADS				CMT	ACC	PRHR	Gravity Injection/ Recirc.	IGN	Cavity Flooding	Comments
		1	2/3	4	A/M							
3BE-1	DVI line break to PXS Compt	2	2+2	4	A	1	1	N	0/0	N	2	• Acc Seq 1 • Flood PXS compt through broken DVI line
3BE-2	DVI line break to PXS Compt	2	2+2	4	A	1	1	N	0/0	N	2	• Acc Seq 1 • Do not flood PXS compt through broken DVI line
3BE-4	Spurious ADS-4 (1)	2	2+2	4	A	2	2	N	0/0	N	2	• Acc Seq 11
3BE-5	2″ break hot leg to SG Compt	2	2+2	4	A	2	2	N	0/0	N	2	• Acc Seq 15, 16
3BE-6	2″ break hot leg to SG Compt	2	2+2	4	A	2	2	N	0/0	N	1	• Acc Seq 15, 16
3BE-8	SGTR	0	2+0	0	A	2	2	Y	2/2	N	2	• Acc Seq 24
3BE-9	SGTR	2	2+2	4	A	2	2	Y	0/0	N	2	• Acc Seq 35

Table 41A-1 (cont.)

SUMMARY OF SYSTEM ASSUMPTIONS FOR MAAP4.04 HYDROGEN ANALYSES

List of abbreviations:

A: automatic
ACC: accumulator
ADS: automatic depressurization system
CMT: core makeup tank
DVI: direct vessel injection (safety injection)
FW: feed water
IGN: igniters
M: manual
N: off or failed
PRHR: passive residual heat removal
SG: steam generator
SGTR: steam generator tube rupture
Y: on
@: manual actuation per AFR-C.1

NB: All sequences defined in the above table will be used for H_2 mixing analyses (igniters off). They will also be used as a basis for H_2 burning analyses with the igniters on.

Table 41A-2

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 1A					
1A Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted (788 kg)	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
1A-3-ADS2	321	0.41	Early – None	22	116
1A-4-ADS2	278	0.35	Early – None	22	41

Table 41A-3

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 1A								
1A Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
1A-3-ADS2	0.64	0.36	< 0.01	1385	0.03	0.10	0.17	< 0.08
1A-4-ADS2	0.69	0.30	< 0.01	1105	0.04	0.10	0.17	< 0.10

Table 41A-4

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 1A								
1A Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
1A-3-ADS2	0.02	0.71	0.05	0.20	0.04	0.53	0.09	0.20
1A4-ADS2	0.05	0.24	0.14	0.18	0.05	0.26	0.14	0.18

Table 41A-5

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 1AP					
1AP Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
1AP-3	617	0.78	Early	19	637
1AP-4	471	0.60	Early	17	138

Table 41A-6

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 1AP								
1AP Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
1AP-3	0.54	0.47	< 0.01	2549	0.07	0.10	0.17	< 0.19
1AP-4	0.38	0.62	< 0.01	< 10 (12100s)	0.06	0.11	0.16	< 0.17

Table 41A-7

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 1AP								
1AP Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
1AP-3	0.06	0.58	0.07	< 0.38	0.06	0.69	0.05	0.59
1AP-4	0.08	0.47	0.09	0.29	0.03	0.75	0.04	0.29

Table 41A-8

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3Be					
3Be Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
3BE-1	465	0.59	Early	12	320
3BE-2	265	0.34	None	16	113
3BE-4	282	0.36	None	20	104
3BE-5	338	0.43	Early-Slow	50	187
3BE-6	392	0.50	Early-Slow	45	2314
3BE-8	325	0.41	None	15	163
3BE-9	468	0.59	None	120	106

Table 41A-9

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3Be								
3Be Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3BE-1	0.06	0.88	0.01	1.94	0.04	0.12	0.17	< 0.11
3BE-2	0.08	0.20	0.14	< 0.26	0.03	0.16	0.16	< 0.10
3BE-4	0.08	0.19	0.15	< 0.26	0.03	0.15	0.16	0.1 (< 0.08)
3BE-5	0.05	0.79	0.03	0.70	0.02	0.09	0.18	0.1 (< 0.06)
3BE-6	0.04	0.57	0.08	0.27	0.03	0.09	0.18	0.1 (< 0.07)
3BE-8	0.30	0.70	< 0.01	> 10 (152 200 s)	0.05	0.23	0.14	< 0.18
3BE-9	0.04	0.89	0.01	1.53 (159800 s)	0.04	0.15	0.16	< 0.13

Table 41A-10

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3Be								
3Be Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3BE-1	0.11	0.38	0.11	0.28	0.08	0.34	0.12	0.32
3BE-2	0.03	0 63	0.07	< 0.22	0.04	0.58	0.08	< 0.23
3BE-4	0.03	0.66	0.06	< 0.22	0.04	0.60	0.07	< 0.23
3BE-5	0.06	0.29	0.13	0.21	0.11	0.37	0.10	0.50
3BE-6	0.07	0.26	0.13	0.24	0.10	0.17	0.14	0.33
3BE-8	0.03	0.55	0.08	0.96	0.04	0.42	0.11	0.20
3BE-9	0.05	0.62	0.07	< 0.32	0.18	0.45	0.07	1.18

Table 41A-11

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3BR					
3BR Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
3BR-1	279	0.35	None	16	60

Table 41A-12

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3BR								
3BR Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{O2}	Eq. Ratio	X_{H2}	X_{ST}	X_{O2}	Eq. Ratio
3BR-1	0.07	0.10	0.17	< 0.21	0.06	0.13	0.16	< 0.17

Table 41A-13

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3BR								
3BR Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{O2}	Eq. Ratio	X_{H2}	X_{ST}	X_{O2}	Eq. Ratio
3BR-1	0.07	0.14	0.16	< 0.21	0.07	0.15	0.16	< 0.21

Table 41A-14

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3BL					
3BL Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
3BL-1	552	0.70	None	135	54
3BL-2	455	0.58	None	210	85

Table 41A-15

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3BL								
3BL Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3BL-1	0.04	0.95	< 0.01	15.73	0.05	0.39	0.11	< 0.19
3BL-2	0.02	0.78	< 0.01	1.95	0.05	0.16	0.16	< 0.15

Table 41A-16

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3BL								
3BL Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3BL-1	0.05	0.67	0.06	< 0.39	0.36	0.26	0.08	2.21
3BL-2	0.04	0.64	0.06	< 0.32	0.26	0.33	0.08	1.54

Table 41A-17

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3C					
3C Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
3C-1	307	0.39	Early	10	192

Table 41A-18

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3C								
3C Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3C-1	0.07	0.95	0.16	0.21	0.05	0.20	0.15	< 0.14

Table 41A-19

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3C								
3C Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3C-1	0.05	0.27	0.14	0.19	0.07	0.38	0.11	0.29

Table 41A-20

SUMMARY OF HYDROGEN GENERATION RESULTS MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3D					
3D Case Name	Mass of H2 Generated In-Vessel (kg)	Fraction of Active Clad Reacted	Core Reflood	H2 Generation Duration (min)	H2 Generation Rate (kg/min)
3D-1	264	0.34	None	15	138
3D-2	293	0.37	None	15	42
3D-3	588	0.75	None	45	792
3D-5	329	0.41	Late-Slow	20	76

Table 41A-21

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3D								
3Be Case Name	IRWST				Valve Vault			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3D-1	0.05	0.11	0.17	< 0.14	0.03	0.13	0.17	< 0.1 (< 0.08)
3D-2	0.67	0.33	< 0.01	> 10 (4151 s)	0.03	0.11	0.17	< 0.1 (< 0.09)
3D-3	0.09	0.10	0.16	< 0.26	0.05	0.15	0.16	< 0.15
3D-5	< 0.01	0.99	< 0.01	> 10 (19150 s)	0.06	0.17	0.15	< 0.17

Table 41A-22

SUMMARY OF EARLY COMPARTMENT GAS COMPOSITION RESULTS FOR MAAP4 HYDROGEN MIXING ANALYSES

Accident Class 3D								
3D Case Name	CMT Room				SG Room			
	X_{H2}	X_{ST}	X_{02}	Eq. Ratio	X_{H2}	X_{ST}	X_{02}	Eq. Ratio
3D-1	0.03	0.61	0.07	< 0.18	0.03	0.62	0.07	< 0.18
3D-2	0.04	0.52	0.09	0.19	0.04	0.39	0.11	0.19
3D-3	0.23	0.27	0.11	1.01	0.20	0.22	0.11	0.85
3D-5	0.03	0.64	0.07	< 0.21	0.03	0.60	0.07	0.21

Table 41A-23

SEQUENCE 1A-3a

Description	Time (s)
Reactor scram	3.8
Main coolant pumps off	4020.7
Core uncovery	11160.3
Beginning of core relocation	21137
Accumulator water depleted	14074.9
PCS actuation	4020.7
ADS-1	N/A
ADS-2	13642.2
ADS-3	N/A
ADS-4	N/A
CMT actuation	4020.7
Cavity flooding actuation	1743.4
Open recirculation lines if IRWST is drained to low level	26587.4
PRHR actuation	N/A

Table 41A-24

SEQUENCE 1A-4a

Description	Time (s)
Reactor scram	3.8
Main coolant pumps off	4020.7
Core uncovery	4972.3
Beginning of core relocation	13654.6
Accumulator water depleted	7456
PCS actuation	4020.7
ADS-1	N/A
ADS-2	7048.6
ADS-3	N/A
ADS-4	N/A
CMT actuation	N/A
Cavity flooding actuation	N/A
Open recirculation lines if IRWST is drained to low level	–
PRHR actuation	N/A

Table 41A-25

SEQUENCE 1AP-3

Description	Time (s)
Reactor scram	149.1
Main coolant pumps off	165.7
Core uncovery	7447.6
Beginning of core relocation	14176.7
Accumulator water depleted	6738.3
PCS actuation	292
ADS-1	9274.9
ADS-2	9394.9
ADS-3	9514.9
ADS-4	9634.9
CMT actuation	N/A
Cavity flooding actuation	8582.6
Open recirculation lines if IRWST is drained to low level	13415.2
PRHR actuation	167.7

Table 41A-26

SEQUENCE 1AP-4

Description	Time (s)
Reactor scram	149.1
Main coolant pumps off	165.7
Core uncovery	9970.5
Beginning of core relocation	–
Accumulator water depleted	8929.7
PCS actuation	307.5
ADS-1	11894
ADS-2	12014
ADS-3	12134
ADS-4	12254
CMT actuation	165.7
Cavity flooding actuation	N/A
Open recirculation Lines if IRWST is drained to low level	11269
PRHR actuation	167.7

Table 41A-27

SEQUENCE 3D-1

Description	Time (s)
Reactor scram	5
Main coolant pumps off	5.3
Core uncovery	838.8
Beginning of core relocation	3472
Accumulator water depleted	372.3
PCS actuation	5.3
ADS-1	N/A
ADS-2	N/A
ADS-3	N/A
ADS-4	N/A
CMT actuation	N/A
Cavity flooding actuation	1489.9
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-28

SEQUENCE 3D-2

Description	Time (s)
Reactor scram	2.9
Main coolant pumps off	4.1
Core uncovery	2565.3
Beginning of core relocation	5825.8
Accumulator water depleted	1927.5
PCS actuation	N/A
ADS-1	N/A
ADS-2	N/A
ADS-3	N/A
ADS-4	N/A
CMT actuation	N/A
Cavity flooding actuation	3427.4
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-29

SEQUENCE 3D-3

Description	Time (s)
Reactor scram	20.5
Main coolant pumps off	25.3
Core uncovery	2275.6
Beginning of core relocation	7639.8
Accumulator water depleted	4227.9
PCS actuation	56.1
ADS-1	N/A
ADS-2	N/A
ADS-3	N/A
ADS-4	N/A
CMT actuation	25.3
Cavity flooding actuation	4767.8
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-30

SEQUENCE 3D-5

Description	Time (s)
Reactor scram	149.1
Main coolant pumps off	165.7
Core uncovery	5741.9
Beginning of core relocation	9942.5
Accumulator water depleted	3949.5
PCS actuation	307.5
ADS-1	N/A
ADS-2	3767
ADS-3	N/A
ADS-4	N/A
CMT actuation	165
Cavity flooding actuation	6871.7
Open recirculation lines if IRWST is drained to low level	15987.2
PRHR actuation	167.7

Table 41A-31

SEQUENCE 3BL-1

Description	Time (s)
Reactor scram	149
Main coolant pumps off	165.3
Core uncovery	25779.2
Beginning of core relocation	31272.2
Accumulator water depleted	2511.1
PCS actuation	289.6
ADS-1	2043.7
ADS-2	2163.7
ADS-3	2283.7
ADS-4	2945.3
CMT actuation	165.4
Cavity flooding actuation	N/A
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-32

SEQUENCE 3BL-2

Description	Time (s)
Reactor scram	20.5
Main coolant pumps off	25.3
Core uncovery	38424.7
Beginning of core relocation	54174.3
Accumulator water depleted	901.9
PCS actuation	55.9
ADS-1	617.2
ADS-2	737
ADS-3	857
ADS-4	1594
CMT actuation	25.3
Cavity flooding actuation	N/A
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-33

SEQUENCE 3C-1

Description	Time (s)
Reactor scram	0.1
Main coolant pumps off	0.6
Core uncovery	6
Beginning of core relocation	1544.8
Accumulator water depleted	302.9
PCS actuation	0.645
ADS-1	555.5
ADS-2	675.5
ADS-3	795.5
ADS-4	1312.5
CMT actuation	0.6
Cavity flooding actuation	N/A
Open recirculation lines if IRWST is drained to low level	–
PRHR actuation	N/A

Table 41A-34

SEQUENCE 3BR-1a

Description	Time (s)
Reactor scram	0.2
Main coolant pumps off	0.7
Core uncovery	12.7
Beginning of core relocation	5155.3
Accumulator water depleted	N/A
PCS actuation	0.7
ADS-1	372.3
ADS-2	492.3
ADS-3	612.3
ADS-4	1131.5
CMT actuation	0.7
Cavity flooding actuation	N/A
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-35

SEQUENCE 3BE-1

Description	Time (s)
Reactor scram	20.5
Main coolant pumps off	25.3
Core uncovery	2479.4
Beginning of core relocation	–
Accumulator water depleted	901
PCS actuation	56
ADS-1	615.7
ADS-2	735.7
ADS-3	855.7
ADS-4	1594.2
CMT actuation	25.3
Cavity flooding actuation	3359.3
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-36

SEQUENCE 3BE-2

Description	Time (s)
Reactor scram	20.5
Main coolant pumps off	25.3
Core uncovery	2476.8
Beginning of core relocation	5892.5
Accumulator water depleted	901.4
PCS actuation	56.1
ADS-1	616.4
ADS-2	736.4
ADS-3	856.4
ADS-4	1594.4
CMT actuation	25.3
Cavity flooding actuation	25.28
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-37

SEQUENCE 3BE-4

Description	Time (s)
Reactor scram	5
Main coolant pumps off	5.3
Core uncovery	2295.5
Beginning of core relocation	5612.8
Accumulator water depleted	371.5
PCS actuation	5.3
ADS-1	659.6
ADS-2	779.6
ADS-3	899.6
ADS-4	1416
CMT actuation	5.3
Cavity flooding actuation	3156.5
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-38

SEQUENCE 3BE-5

Description	Time (s)
Reactor scram	149.1
Main coolant pumps off	165.2
Core uncovery	3816
Beginning of core relocation	7557.9
Accumulator water depleted	2514.5
PCS actuation	289.3
ADS-1	2047.4
ADS-2	2167.4
ADS-3	2287.4
ADS-4	2946
CMT actuation	165.2
Cavity flooding actuation	4792.3
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-39

SEQUENCE 3BE-6

Description	Time (s)
Reactor scram	149.1
Main coolant pumps off	165.7
Core uncovery	3816
Beginning of core relocation	7523.8
Accumulator water depleted	2511.5
PCS actuation	287.8
ADS-1	2043.6
ADS-2	2163.6
ADS-3	2283.6
ADS-4	2283.6
CMT actuation	165.7
Cavity flooding actuation	4793.2
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	N/A

Table 41A-40

SEQUENCE 3BE-8

Description	Time (s)
Reactor scram	164.9
Main coolant pumps off	181.7
Core uncovery	149178.3
Beginning of core relocation	157707.5
Accumulator water depleted	112312
PCS actuation	11515.3
ADS-1	N/A
ADS-2	144811.2
ADS-3	–
ADS-4	N/A
CMT actuation	181.7
Cavity flooding actuation	151996.8
Open recirculation lines if IRWST is drained to low level	160690
PRHR actuation	183.4

Table 41A-41

SEQUENCE 3BE-9

Description	Time (s)
Reactor scram	164.9
Main coolant pumps off	181.7
Core uncovery	148640
Beginning of core relocation	159243.2
Accumulator water depleted	112312
PCS actuation	11515.3
ADS-1	144571.2
ADS-2	144691.2
ADS-3	144811.2
ADS-4	145192
CMT actuation	181.7
Cavity flooding actuation	151241.9
Open recirculation lines if IRWST is drained to low level	N/A
PRHR actuation	183.4

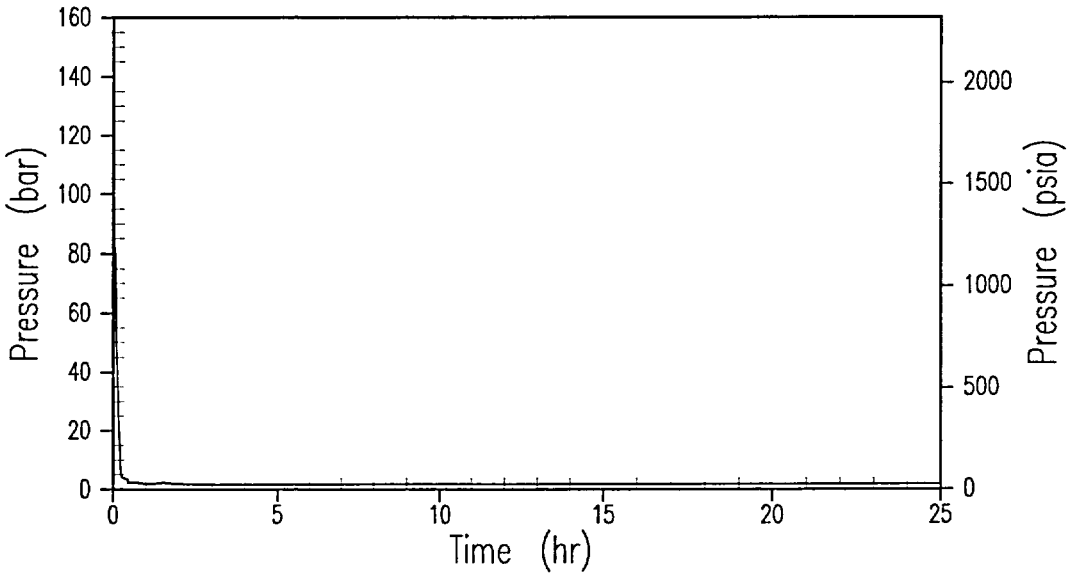

Figure 41A-1

Case 3BE-1: Reactor Coolant System Pressure DVI Line Break for Containment Water Level

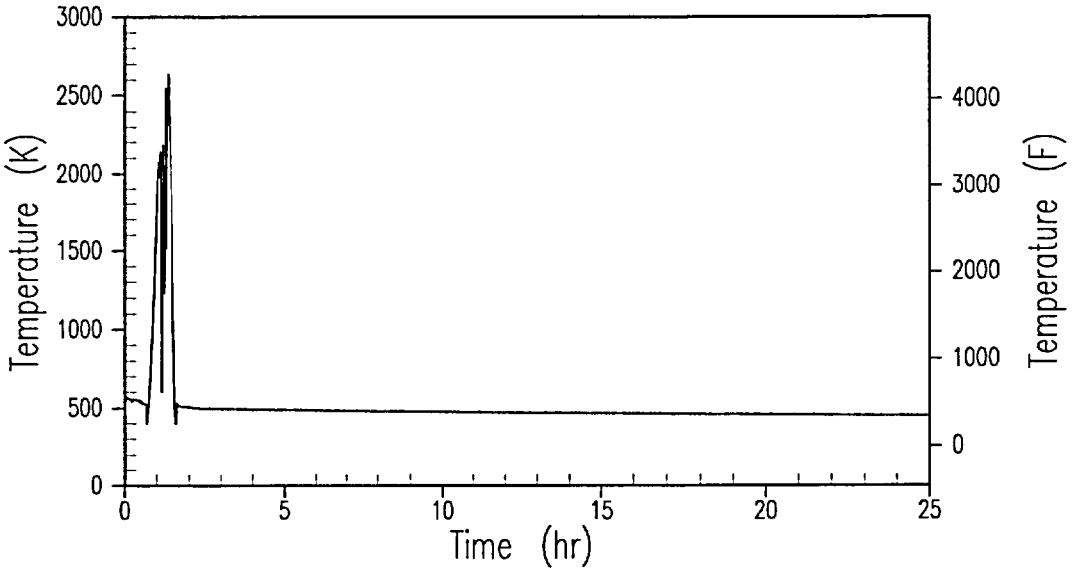

Figure 41A-2

Case 3BE-1: Core-Exit Gas Temperature DVI Line Break for Containment Water Level

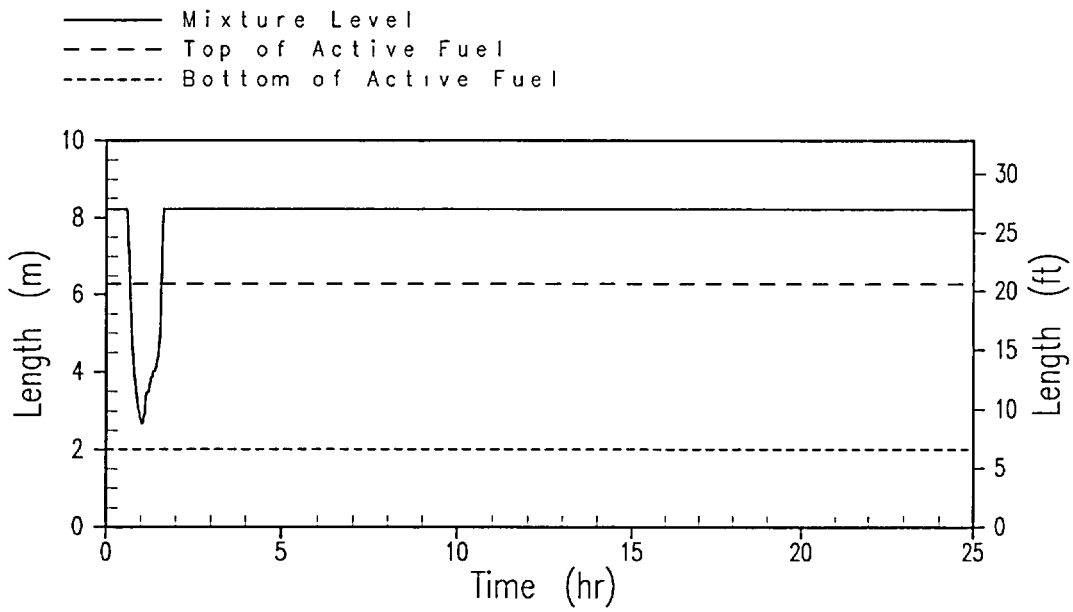

Figure 41A-3

Case 3BE-1: Reactor Vessel Mixture Level
DVI Line Break for Containment Water Level

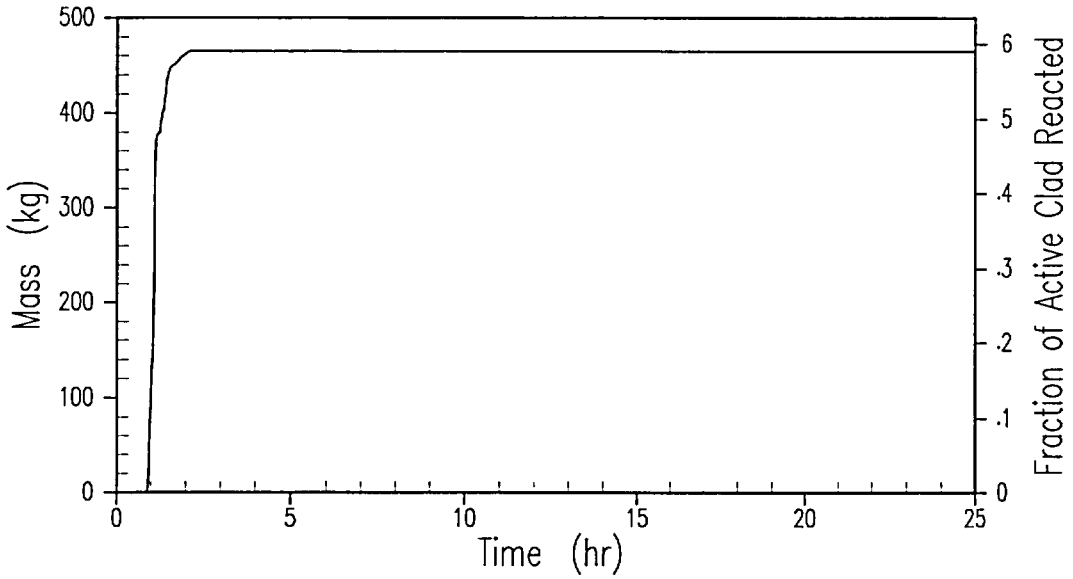

Figure 41A-4

Case 3BE-1: Hydrogen Generated In-Vessel
DVI Line Break for Containment Water Level

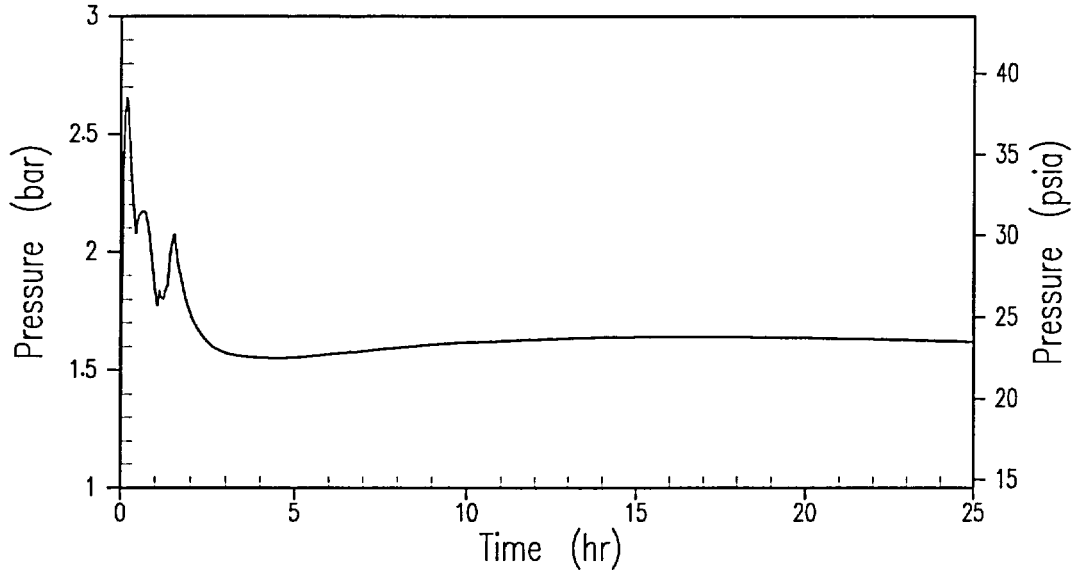

Figure 41A-5

Case 3BE-1: Containment Pressure
DVI Line Break for Containment Water Level

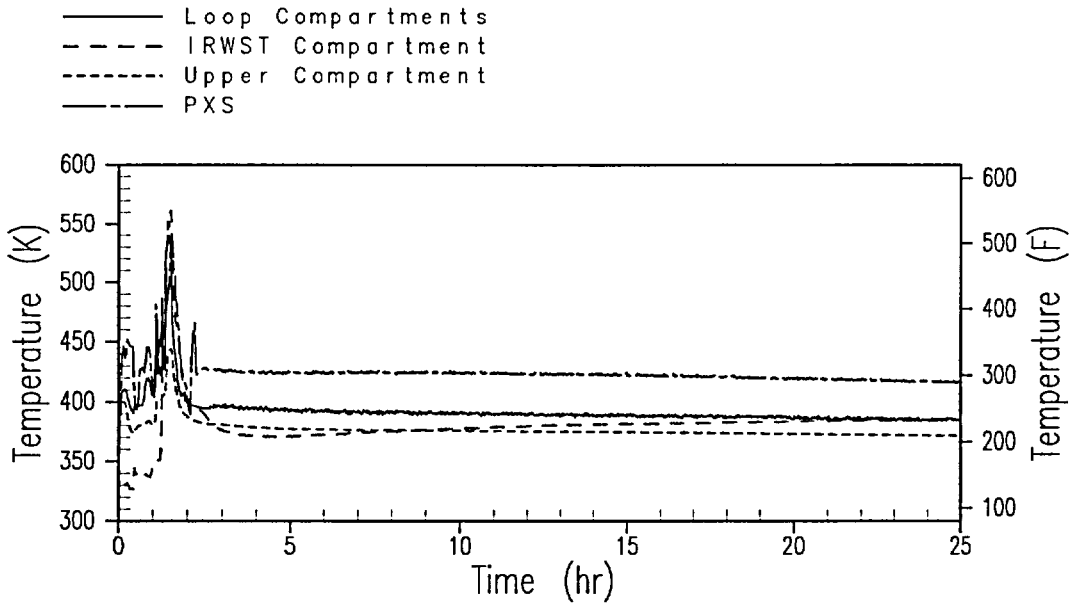

Figure 41A-6

Case 3BE-1: Containment Gas Temperature
DVI Line Break for Containment Water Level

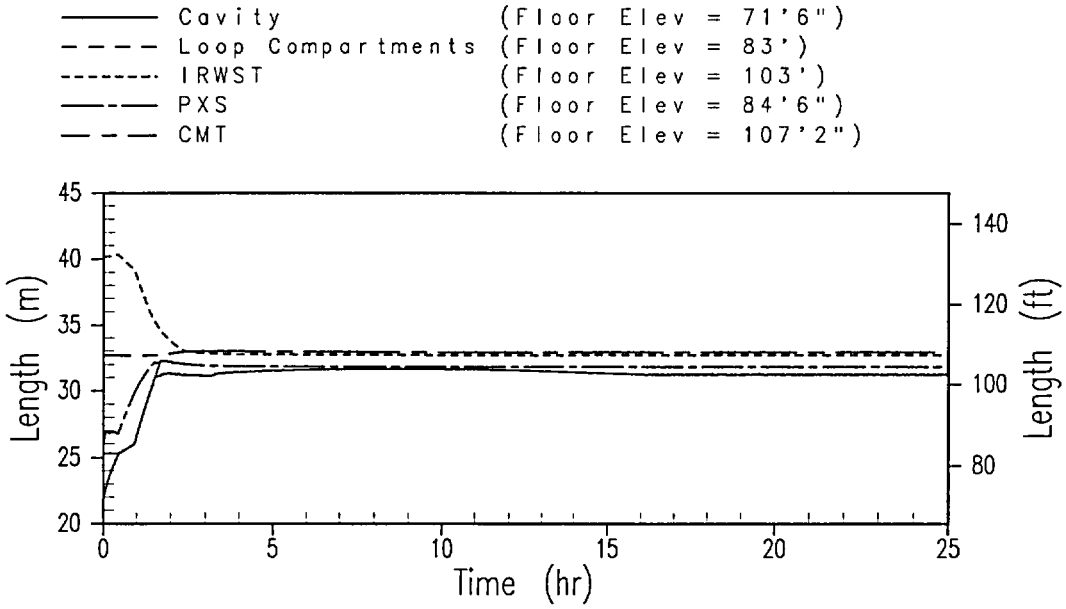

Figure 41A-7

Case 3BE-1: Containment Compartments Water Level
DVI Line Break for Containment Water Level

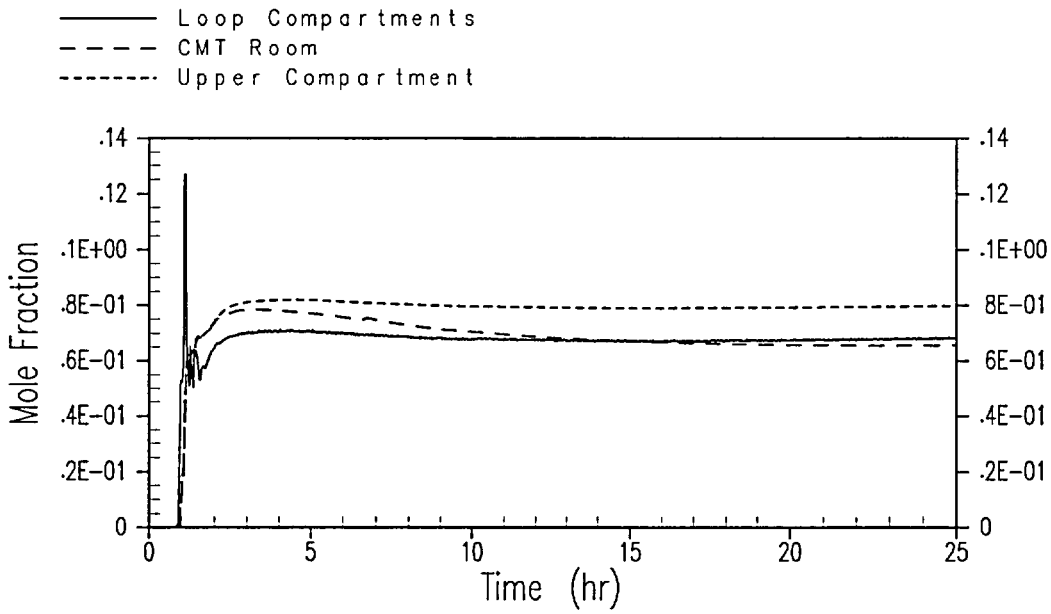

Figure 41A-8

Case 3BE-1: Well-Mixed Compartment Hydrogen Concentration
DVI Line Break for Containment Water Level

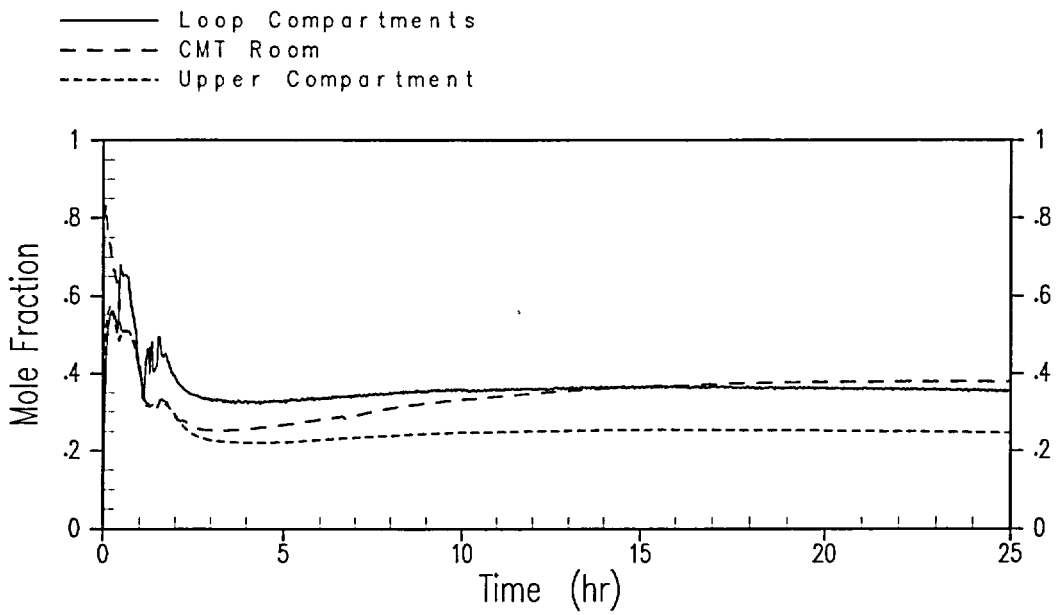

Figure 41A-9

Case 3BE-1: Well-Mixed Compartment Steam Concentration DVI Line Break for Containment Water Level

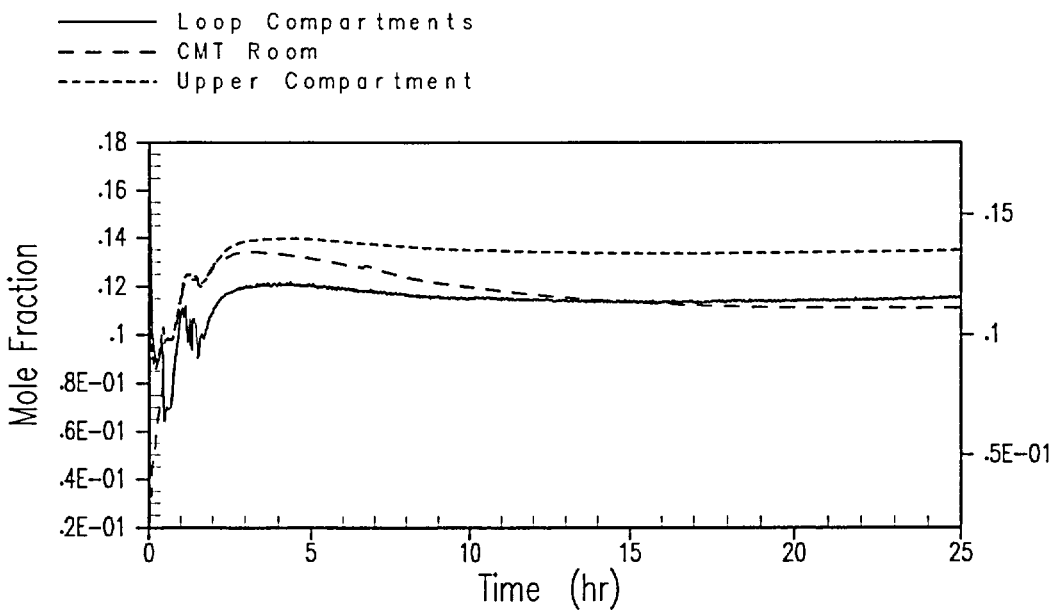

Figure 41A-10

Case 3BE-1: Well-Mixed Compartment Oxygen Concentration DVI Line Break for Containment Water Level

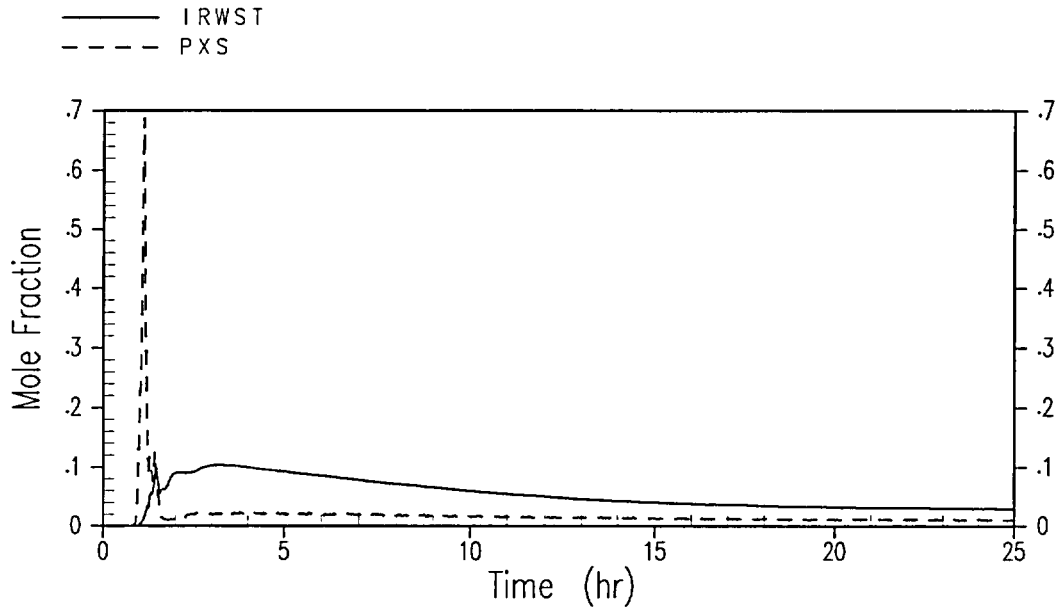

Figure 41A-11

Case 3BE-1: Confined Compartment Hydrogen Concentration DVI Line Break for Containment Water Level

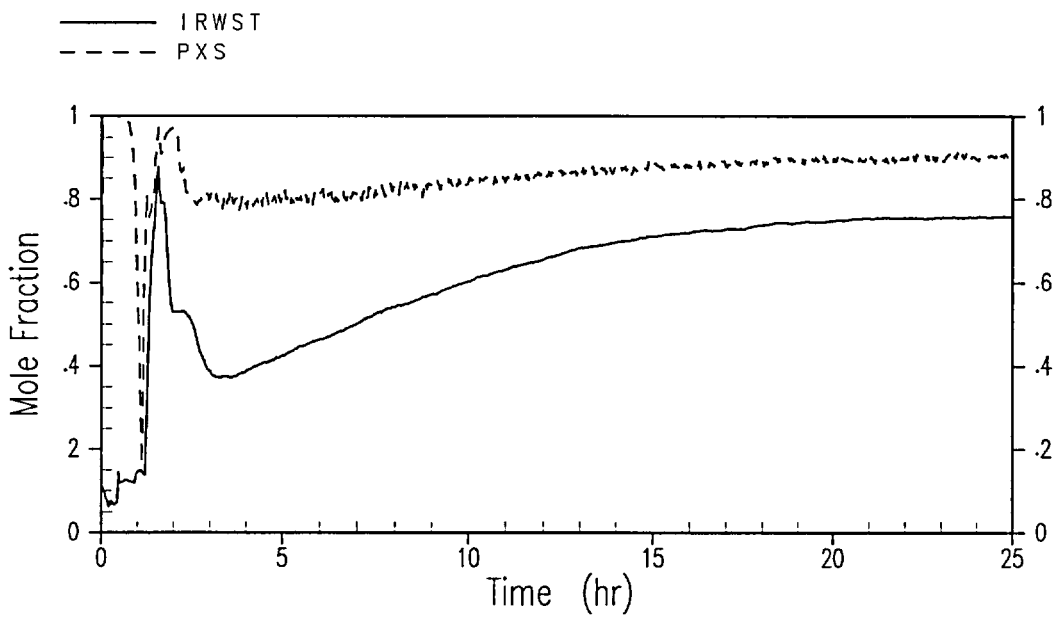

Figure 41A-12

Case 3BE-1: Confined Compartment Steam Concentration DVI Line Break for Containment Water Level

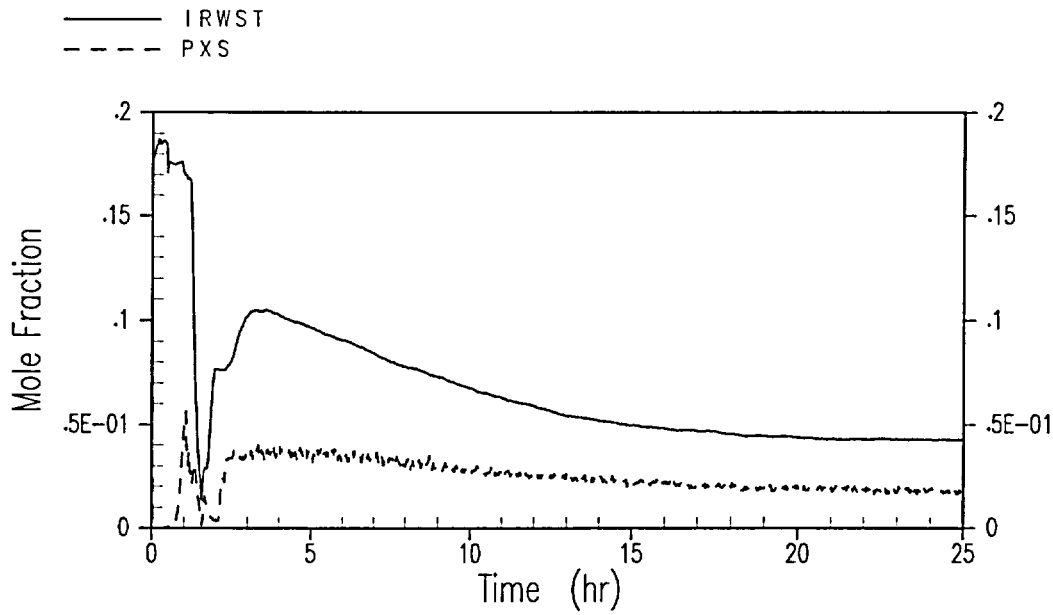

Figure 41A-13

Case 3BE-1: Confined Compartment Oxygen Concentration DVI Line Break for Containment Water Level

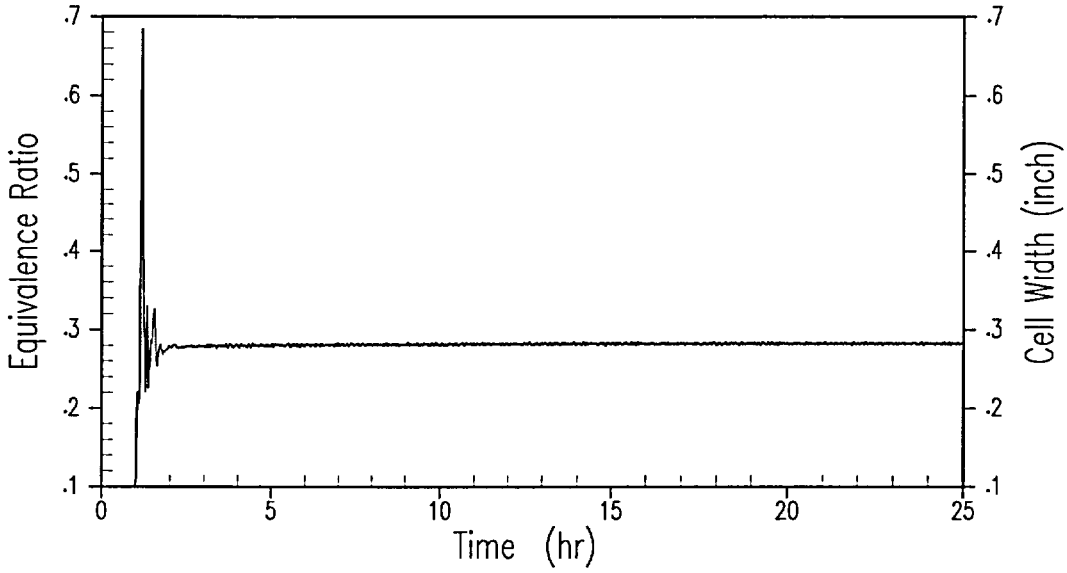

Figure 41A-14

Case 3BE-1: Equivalence Ratio in SG Room DVI Line Break for Containment Water Level

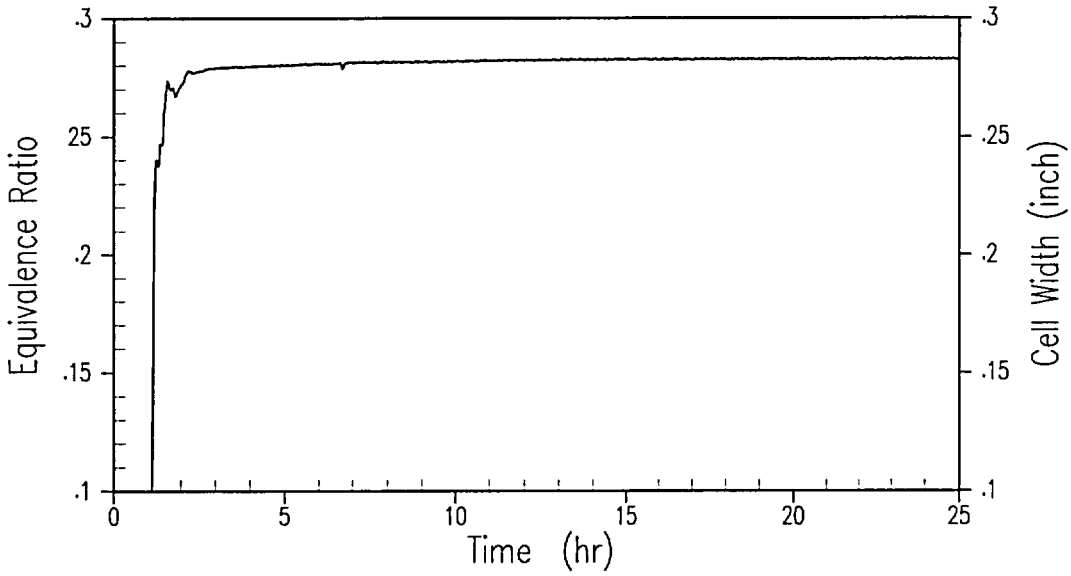

Figure 41A-15

Case 3BE-1: Equivalence Ratio in CMT Room DVI Line Break for Containment Water Level

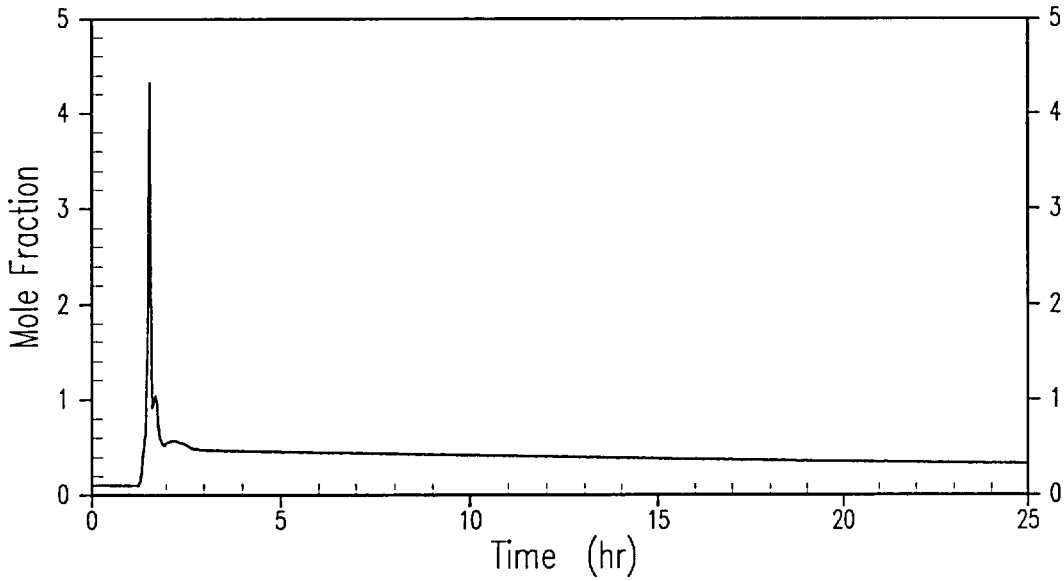

Figure 41A-16

Case 3BE-1: Equivalence Ratio in IRWST DVI Line Break for Containment Water Level

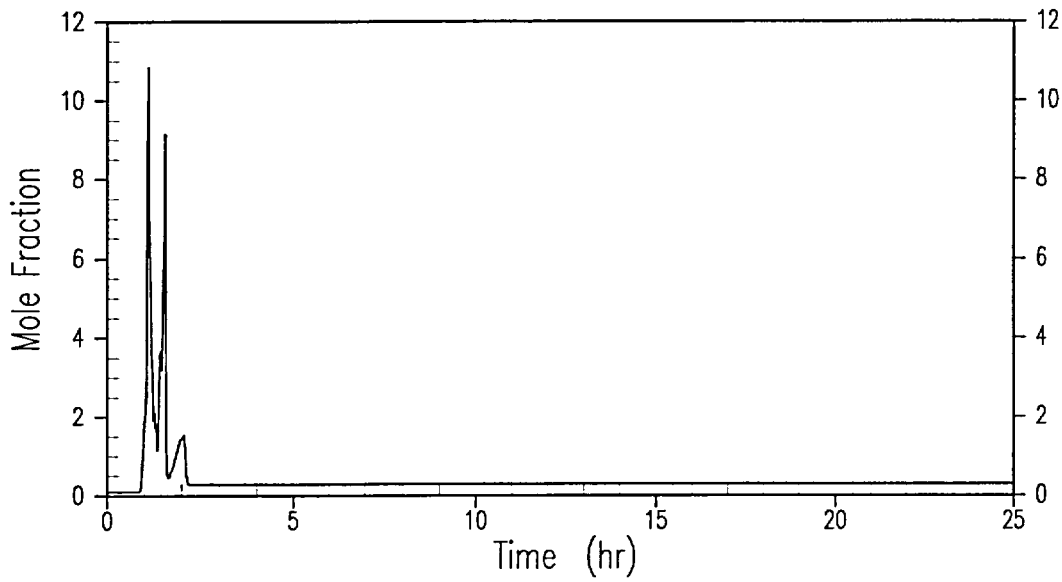

Figure 41A-17

Case 3BE-1: Equivalence Ratio in PXS DVI Line Break for Containment Water Level

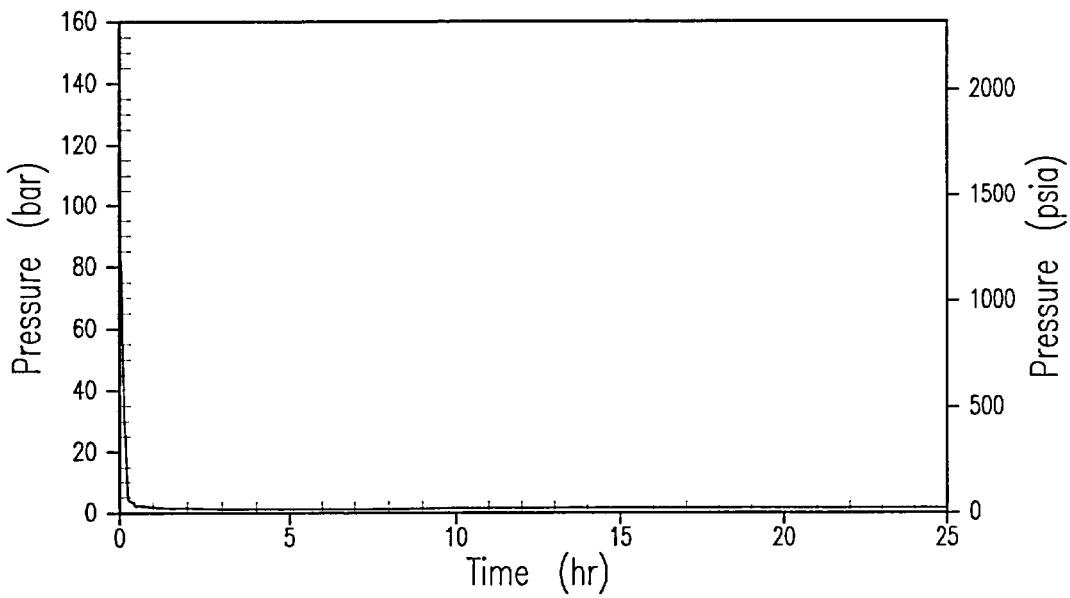

Figure 41A-18

Case 3BE-2: Reactor Coolant System Pressure DVI Line Break with Failed Gravity Injection and No PXS Flooding

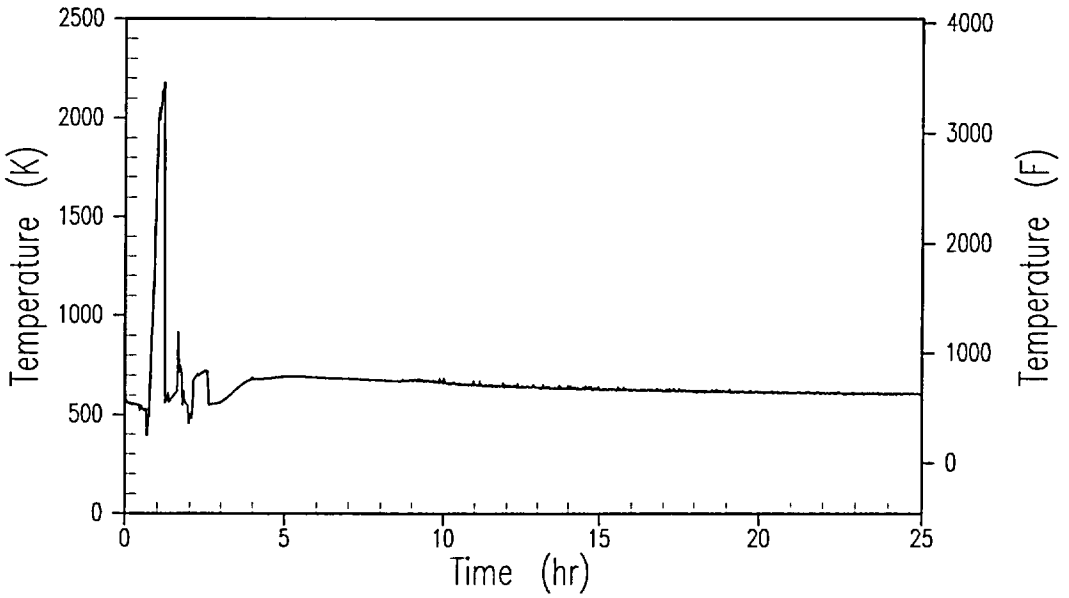

Figure 41A-19

Case 3BE-2: Core-Exit Gas Temperature
DVI Line Break with Failed Gravity Injection and No PXS Flooding

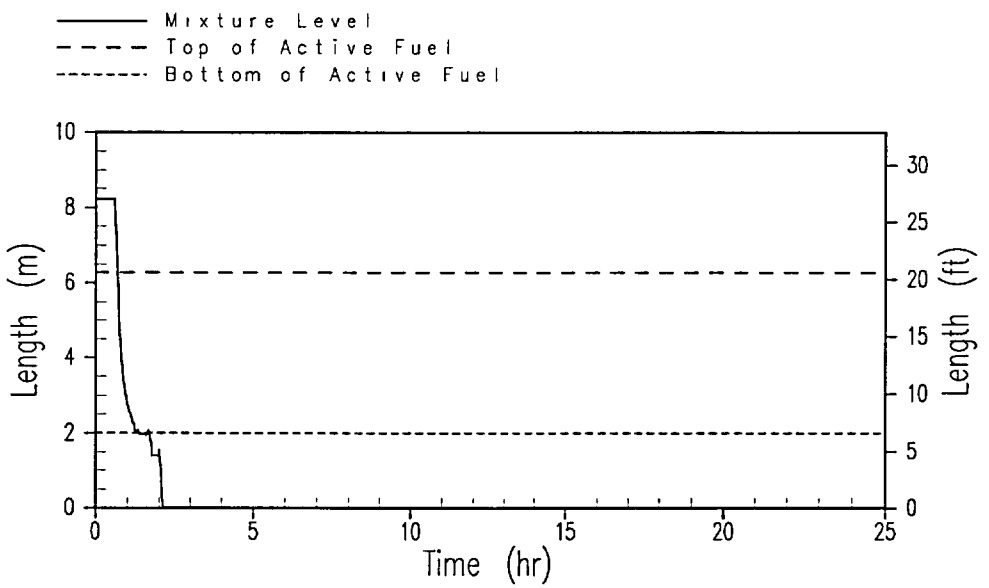

Figure 41A-20

Case 3BE-2: Reactor Vessel Mixture Level
DVI Line Break with Failed Gravity Injection and No PXS Flooding

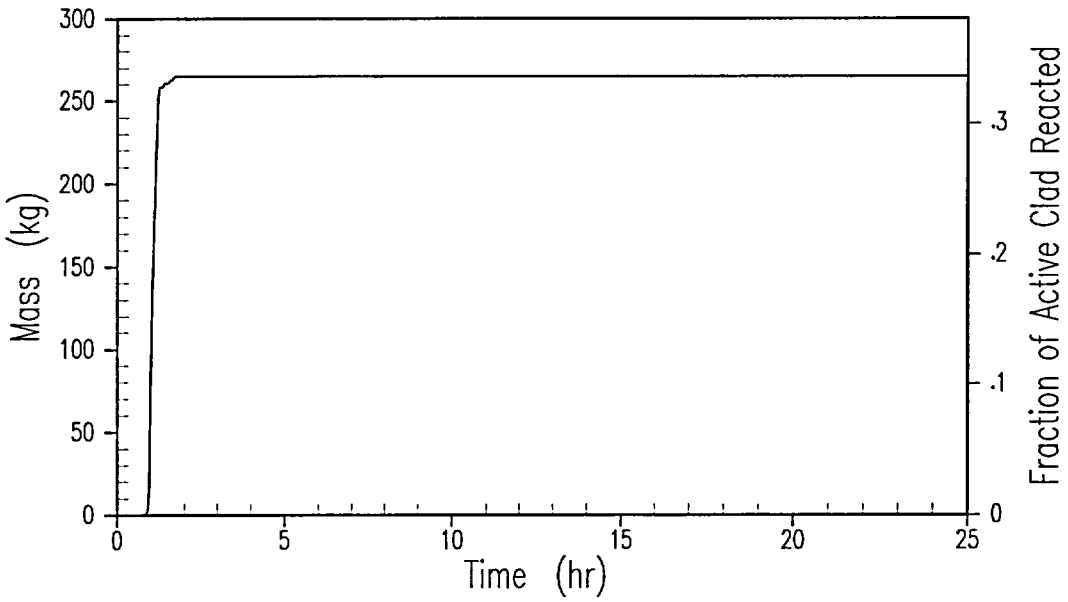

Figure 41A-21

Case 3BE-2: Hydrogen Generated In-Vessel DVI Line Break with Failed Gravity Injection and No PXS Flooding

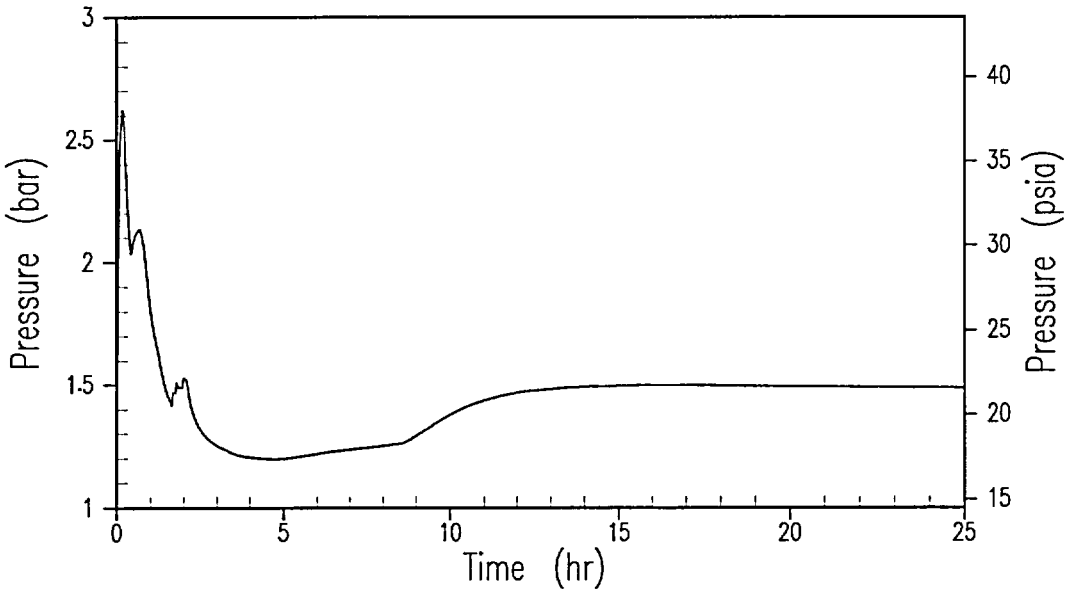

Figure 41A-22

Case 3BE-2: Containment Pressure DVI Line Break with Failed Gravity Injection and No PXS Flooding

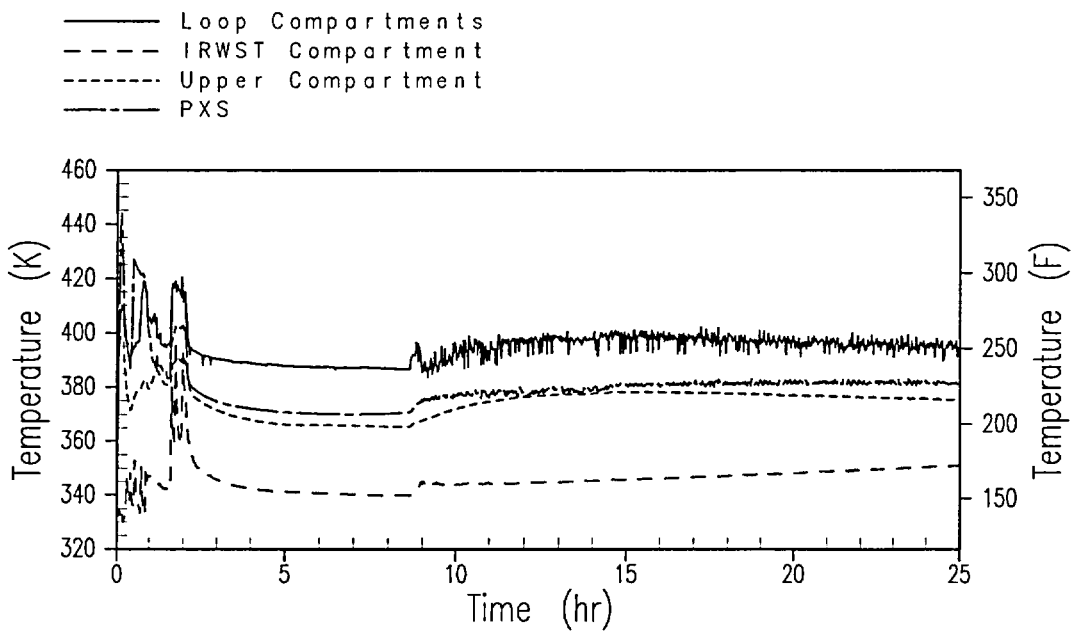

Figure 41A-23

Case 3BE-2: Containment Gas Temperature
DVI Line Break with Failed Gravity Injection and No PXS Flooding

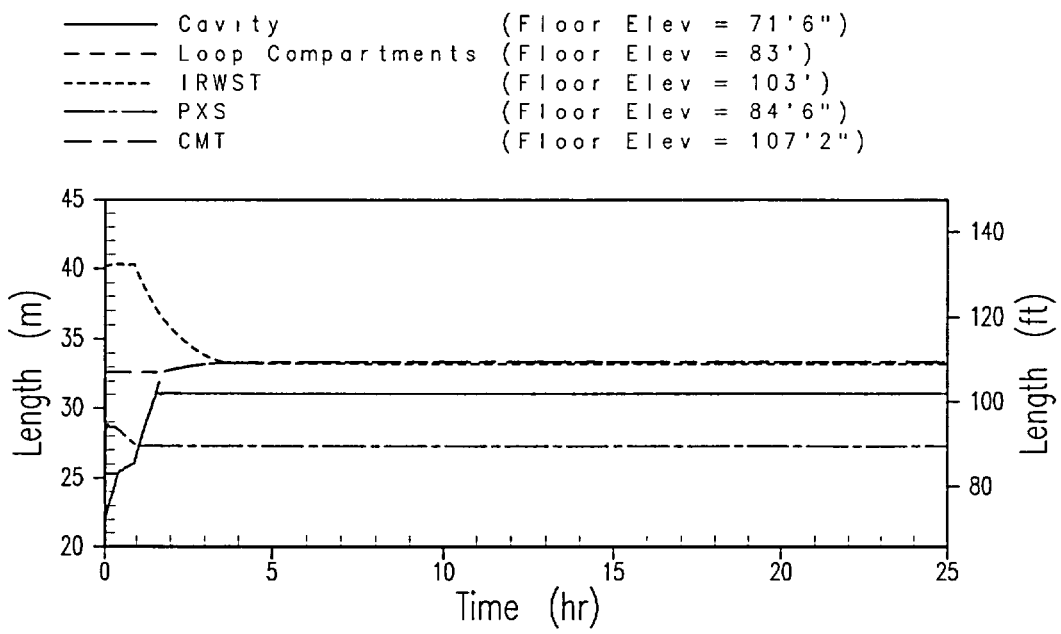

Figure 41A-24

Case 3BE-2: Containment Compartments Water Level
DVI Line Break with Failed Gravity Injection and No PXS Flooding

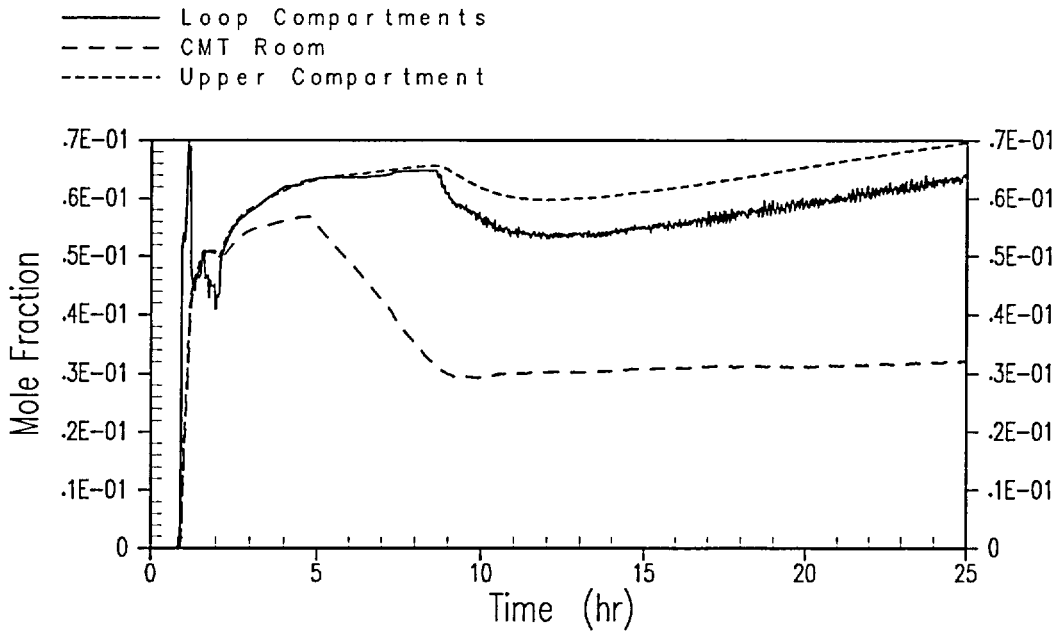

Figure 41A-25

Case 3BE-2: Well-Mixed Compartment Hydrogen Concentration DVI Line Break with Failed Gravity Injection and No PXS Flooding

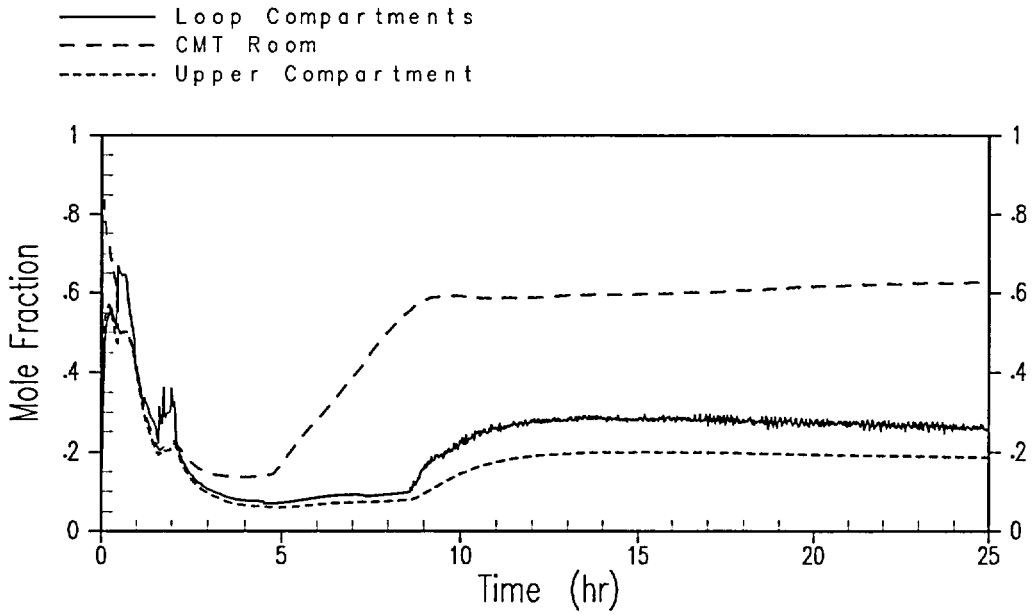

Figure 41A-26

Case 3BE-2: Well-Mixed Compartment Steam Concentration DVI Line Break with Failed Gravity Injection and No PXS Flooding

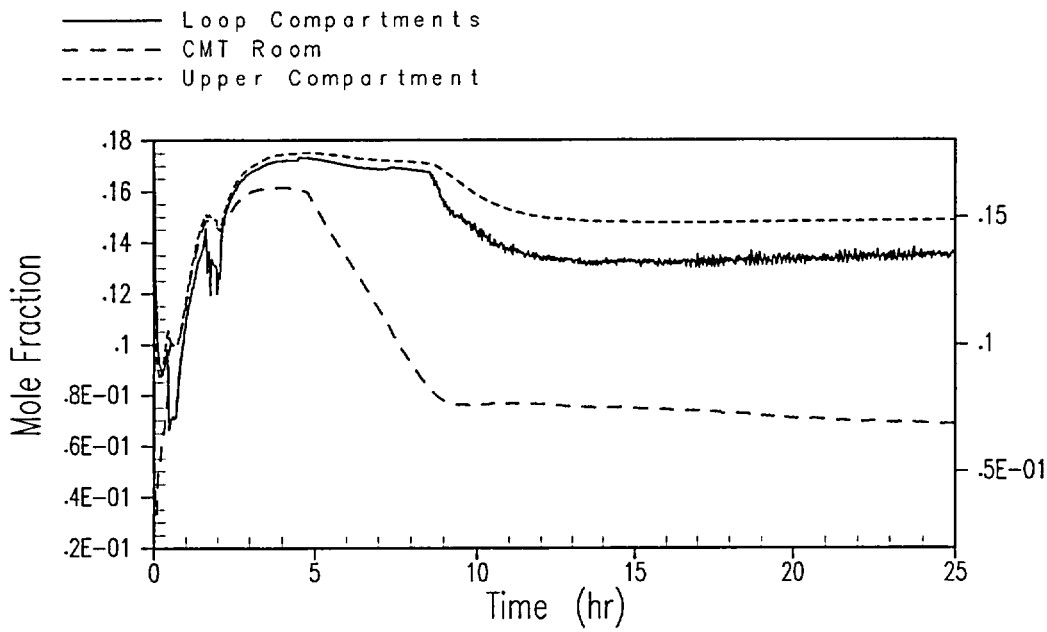

Figure 41A-27

Case 3BE-2: Well-Mixed Compartment Oxygen Concentration DVI Line Break with Failed Gravity Injection and No PXS Flooding

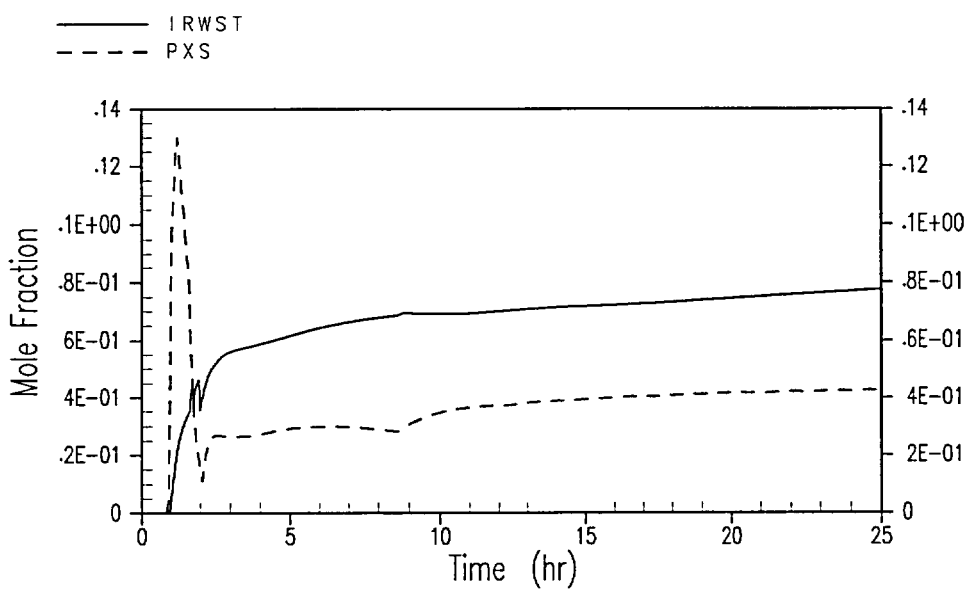

Figure 41A-28

Case 3BE-2: Confined Compartment Hydrogen Concentration DVI Line Break with Failed Gravity Injection and No PXS Flooding

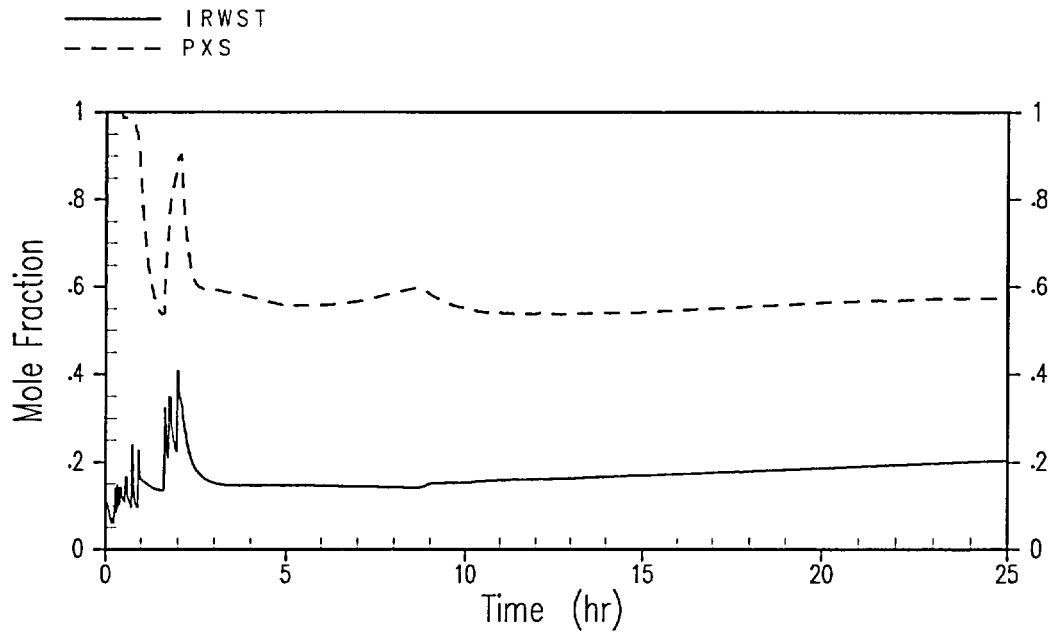

Figure 41A-29

Case 3BE-2: Confined Compartment Steam Concentration
DVI Line Break with Failed Gravity Injection and No PXS Flooding

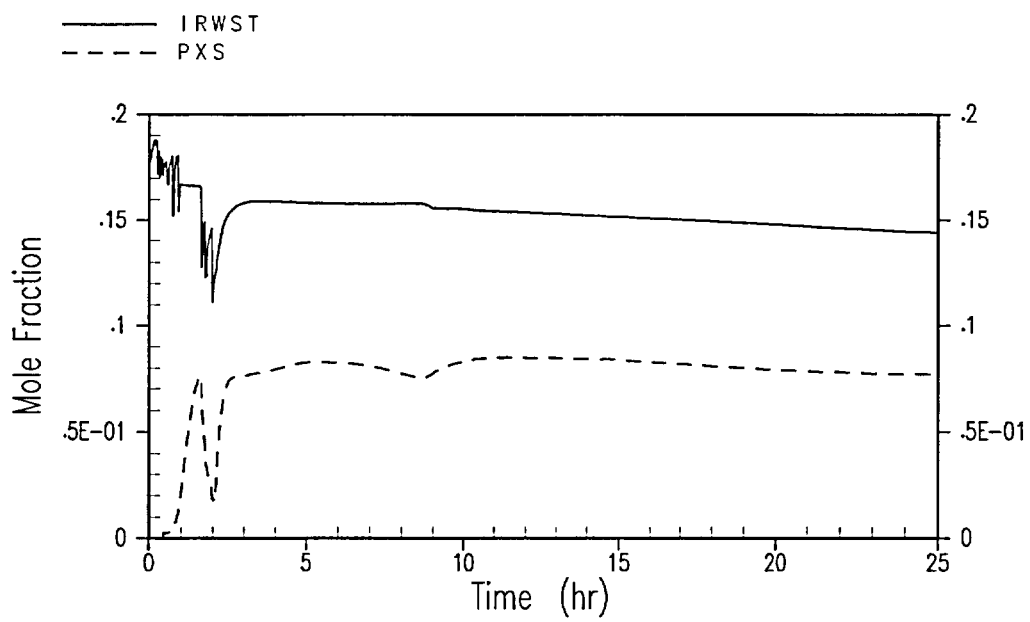

Figure 41A-30

Case 3BE-2: Confined Compartment Oxygen Concentration
DVI Line Break with Failed Gravity Injection and No PXS Flooding

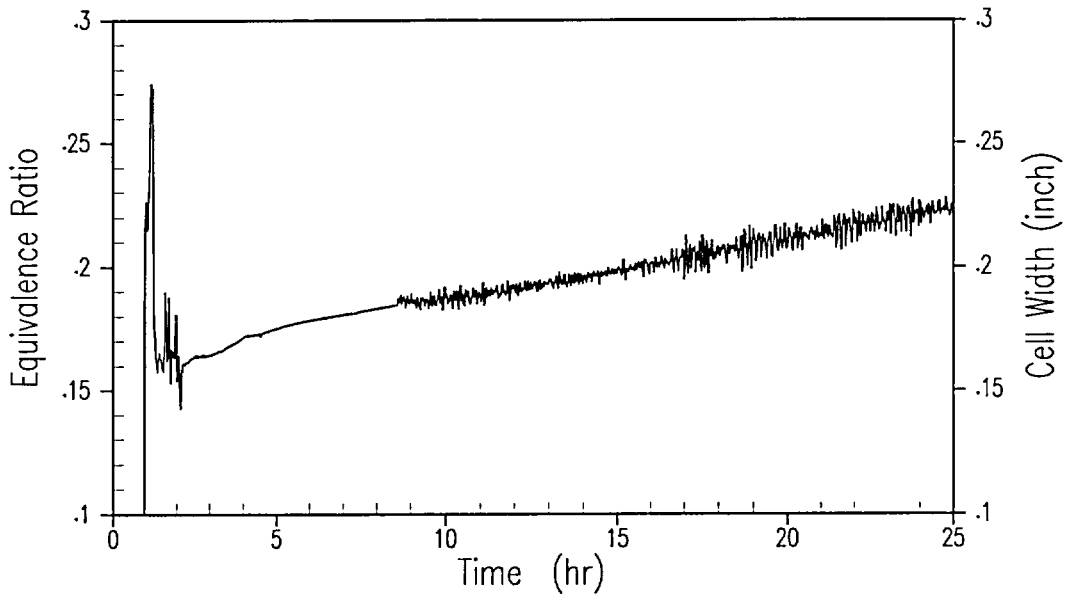

Figure 41A-31

Case 3BE-2: Equivalence Ratio in SG Room
DVI Line Break with Failed Gravity Injection and No PXS Flooding

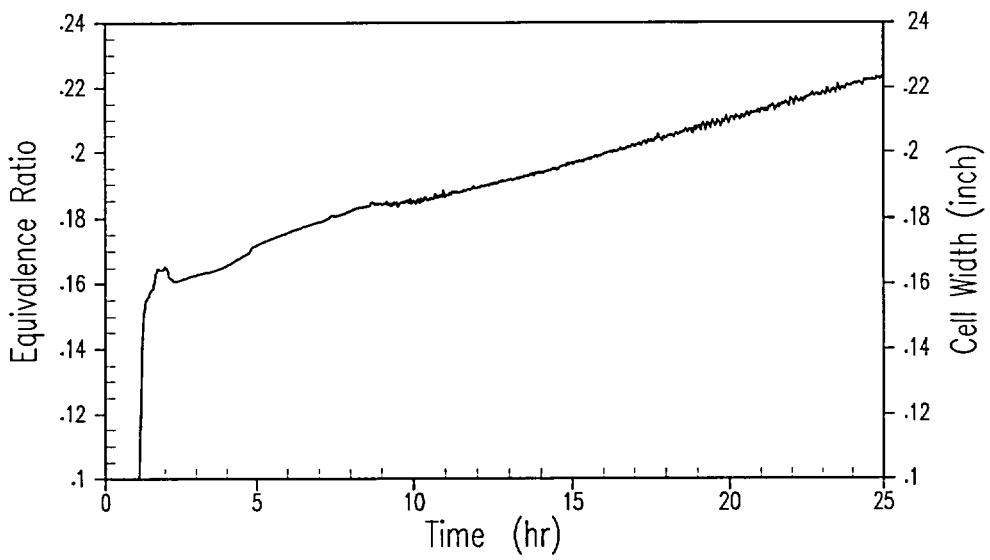

Figure 41A-32

Case 3BE-2: Equivalence Ratio in CMT Room
DVI Line Break with Failed Gravity Injection and No PXS Flooding

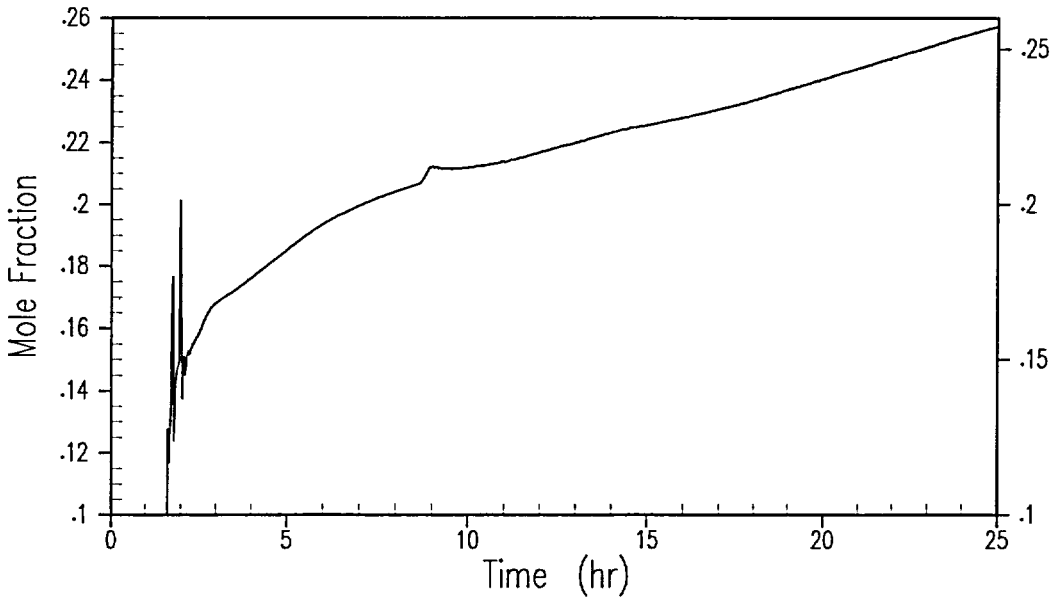

Figure 41A-33

Case 3BE-2: Equivalence Ratio in IRWST
DVI Line Break with Failed Gravity Injection and No PXS Flooding

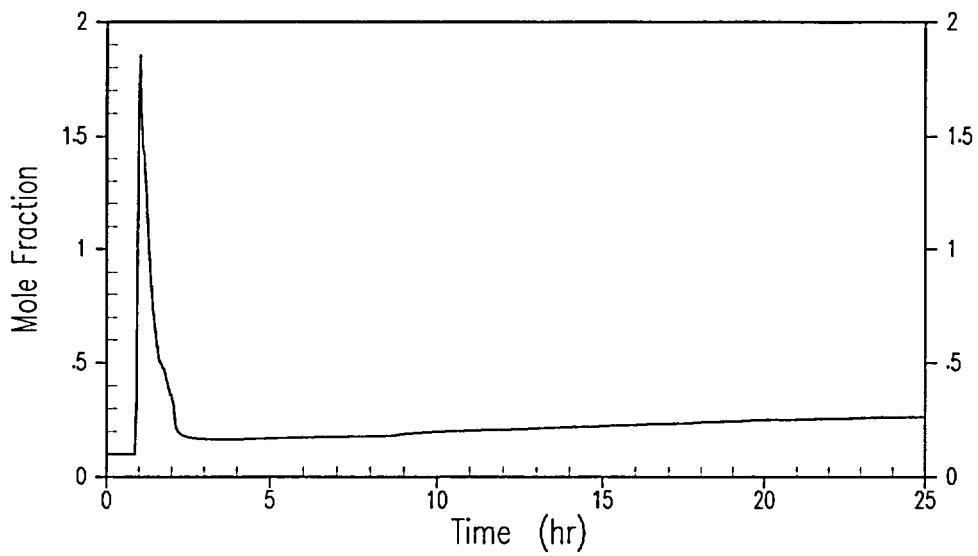

Figure 41A-34

Case 3BE-2: Equivalence Ratio in PXS
DVI Line Break with Failed Gravity Injection and No PXS Flooding

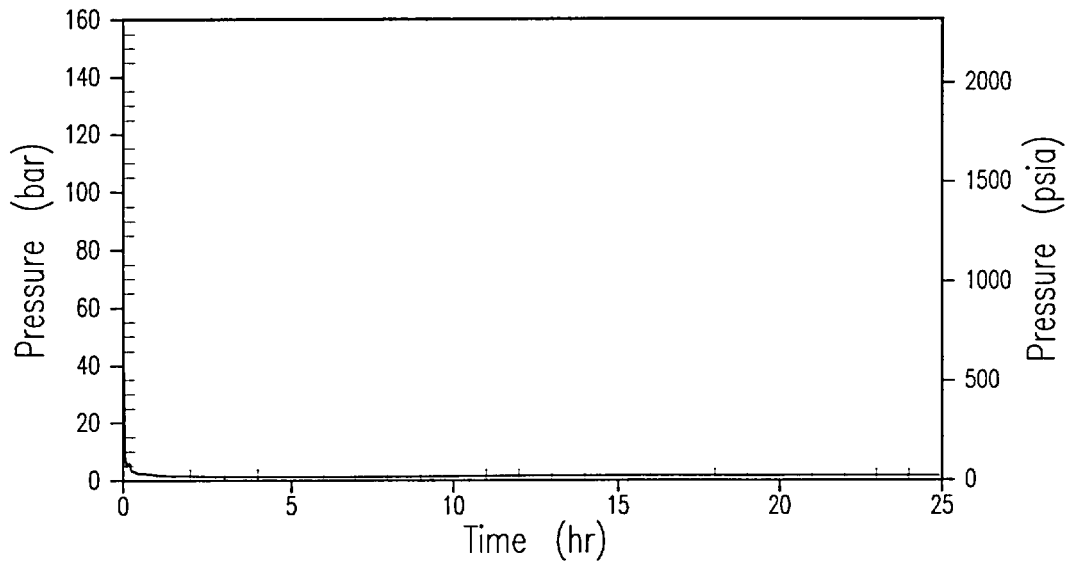

Figure 41A-35

Case 3BE-4: Reactor Coolant System Pressure Spurious ADS, Failed Gravity Injection

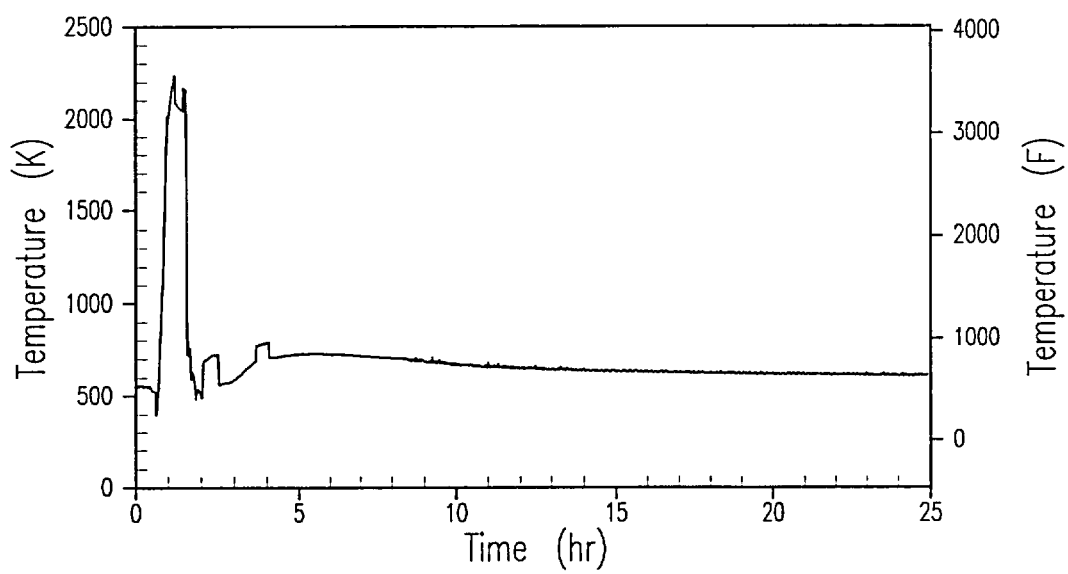

Figure 41A-36

Case 3BE-4: Core-Exit Gas Temperature Spurious ADS, Failed Gravity Injection

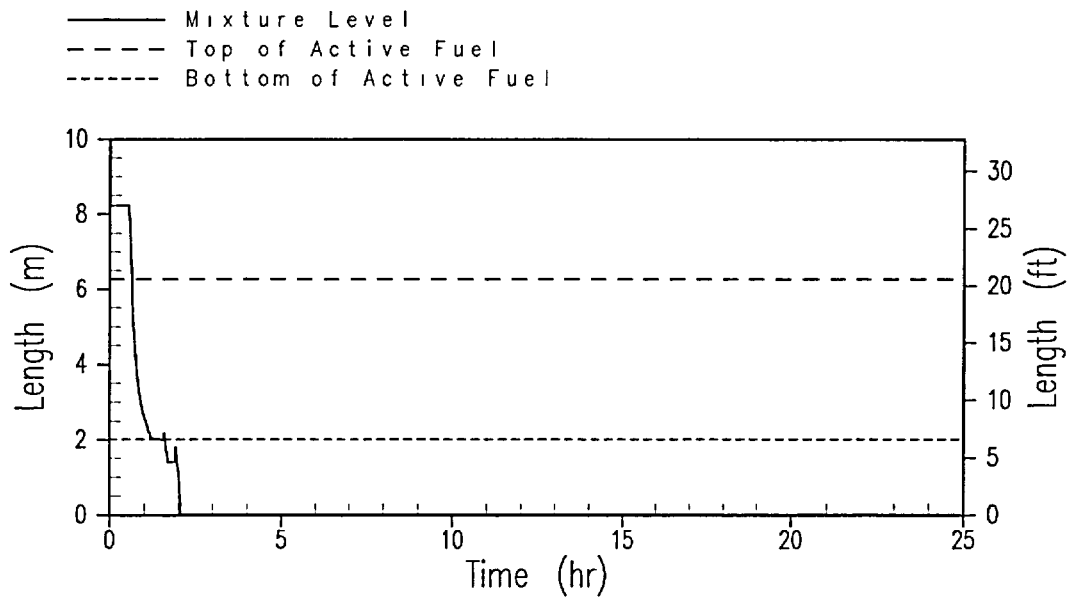

Figure 41A-37

Case 3BE-4: Reactor Vessel Mixture Level Spurious ADS, Failed Gravity Injection

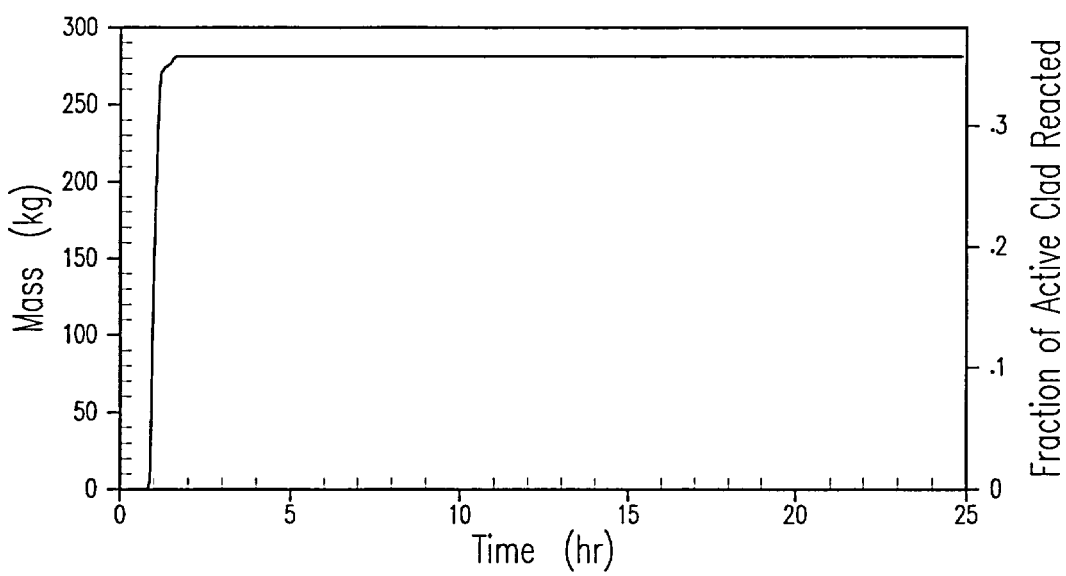

Figure 41A-38

Case 3BE-4: Hydrogen Generated In-Vessel Spurious ADS, Failed Gravity Injection

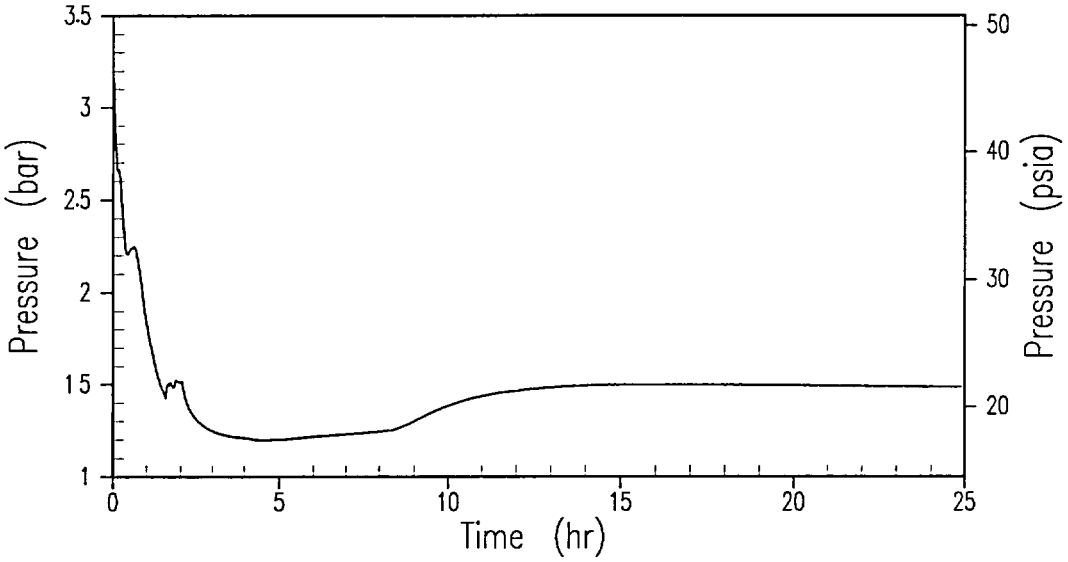

Figure 41A-39

Case 3BE-4: Containment Pressure Spurious ADS, Failed Gravity Injection

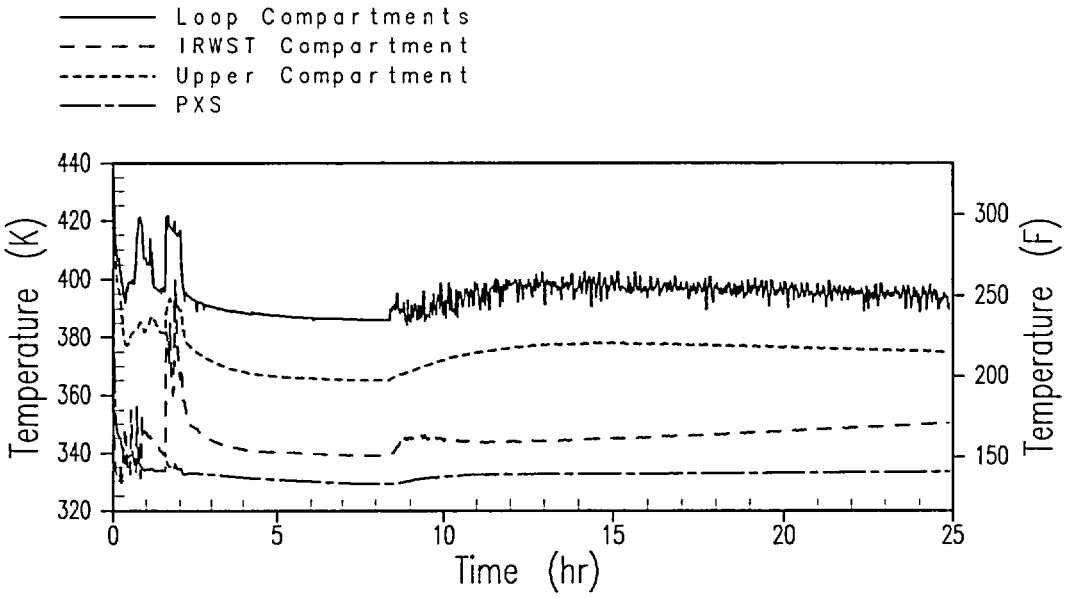

Figure 41A-40

Case 3BE-4: Containment Gas Temperature Spurious ADS, Failed Gravity Injection

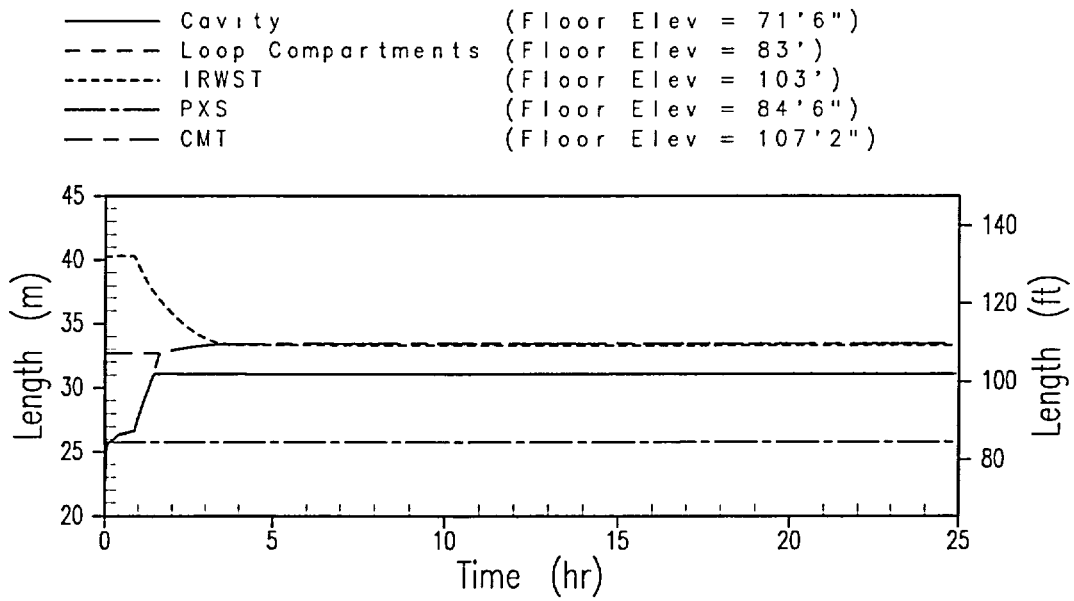

Figure 41A-41

Case 3BE-4: Containment Compartments Water Level Spurious ADS, Failed Gravity Injection

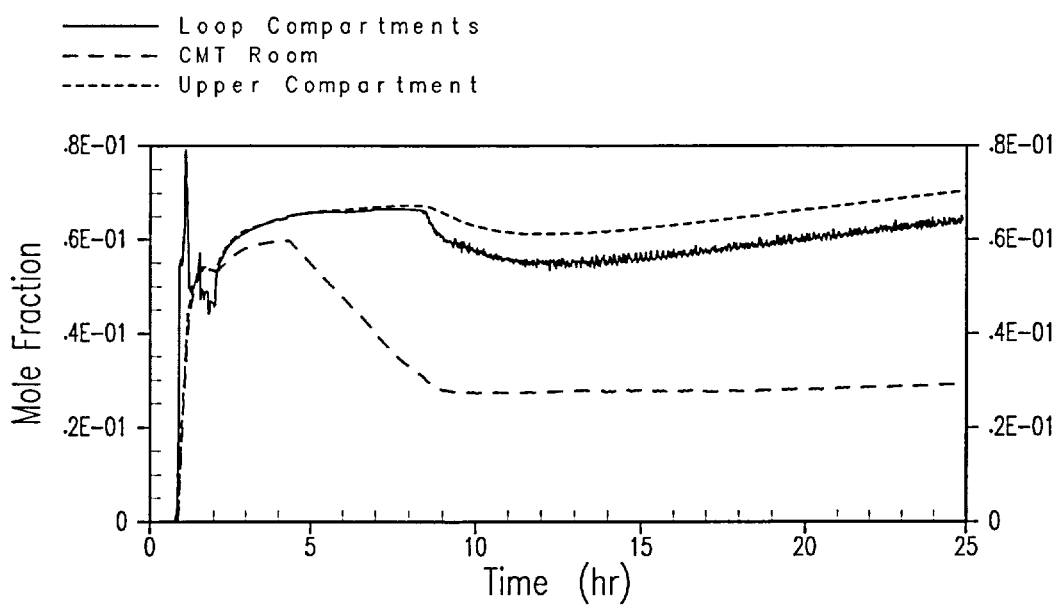

Figure 41A-42

Case 3BE-4: Well-Mixed Compartment Hydrogen Concentration Spurious ADS, Failed Gravity Injection

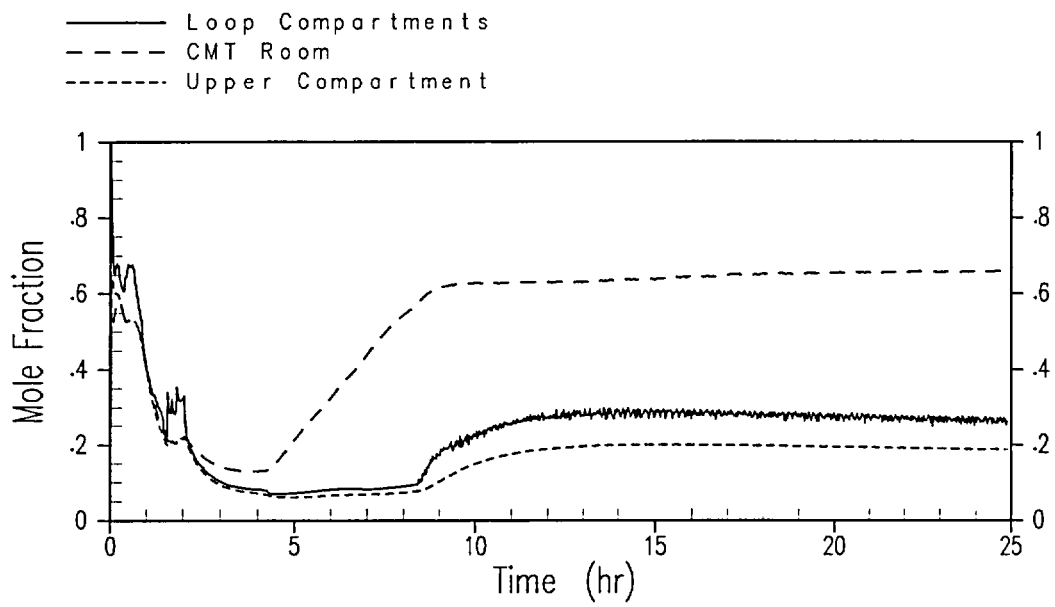

Figure 41A-43

Case 3BE-4: Well-Mixed Compartment Steam Concentration Spurious ADS, Failed Gravity Injection

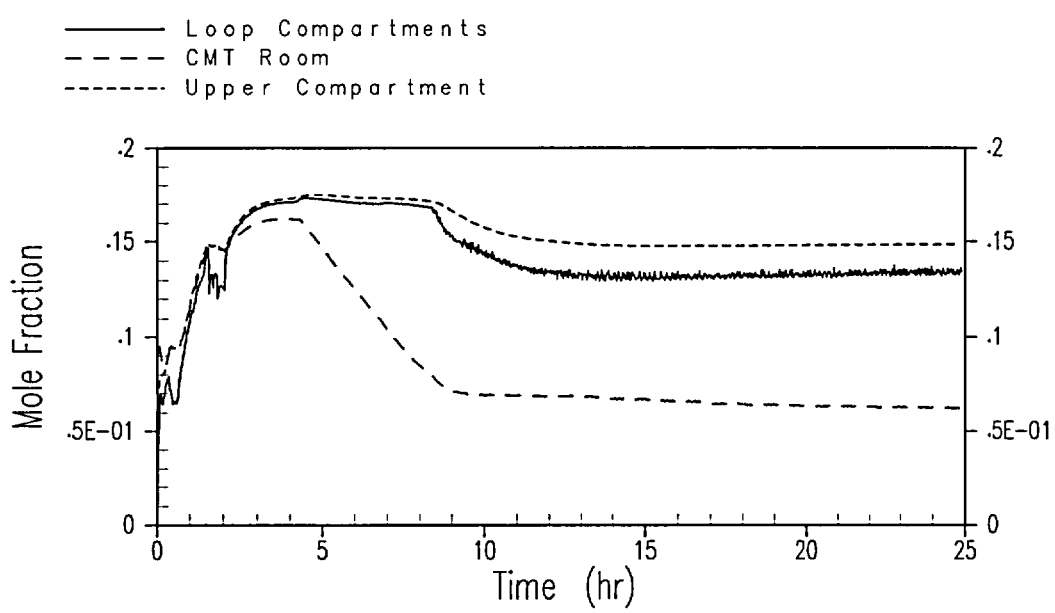

Figure 41A-44

Case 3BE-4: Well-Mixed Compartment Oxygen Concentration Spurious ADS, Failed Gravity Injection

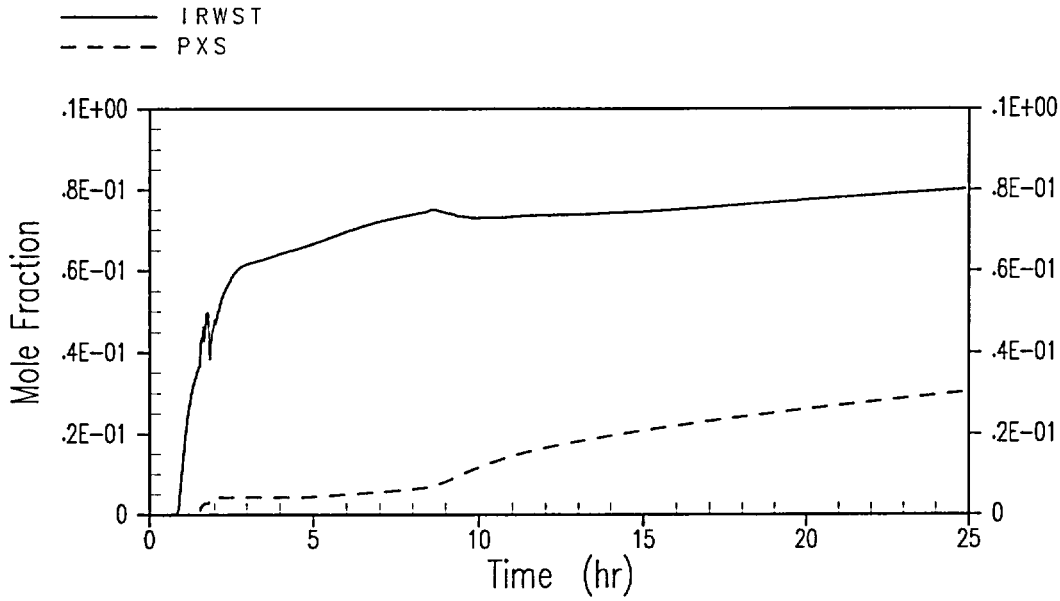

Figure 41A-45

Case 3BE-4: Confined Compartment Hydrogen Concentration Spurious ADS, Failed Gravity Injection

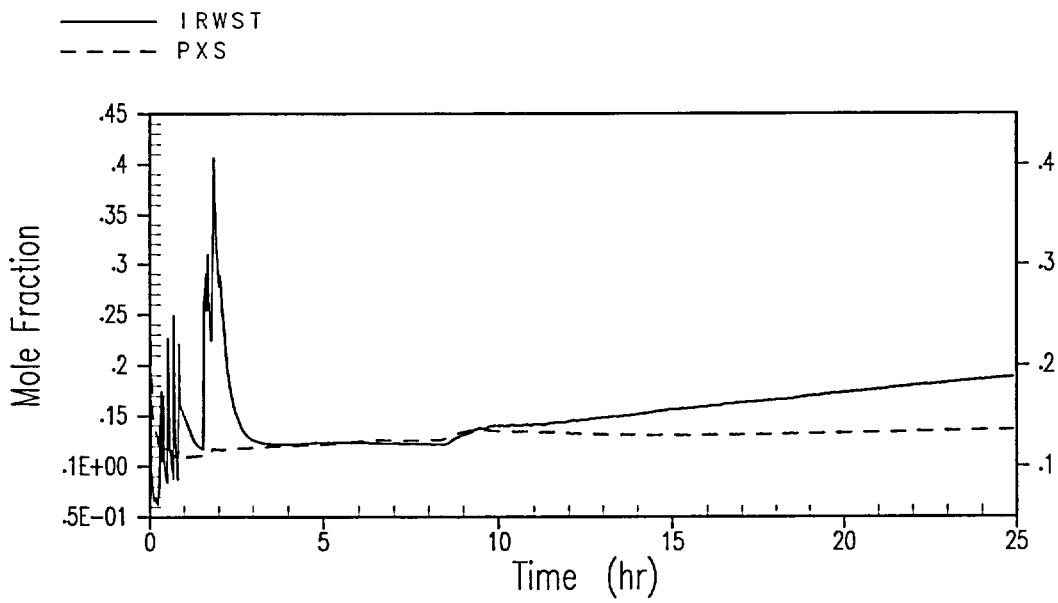

Figure 41A-46

Case 3BE-4: Confined Compartment Steam Concentration Spurious ADS, Failed Gravity Injection

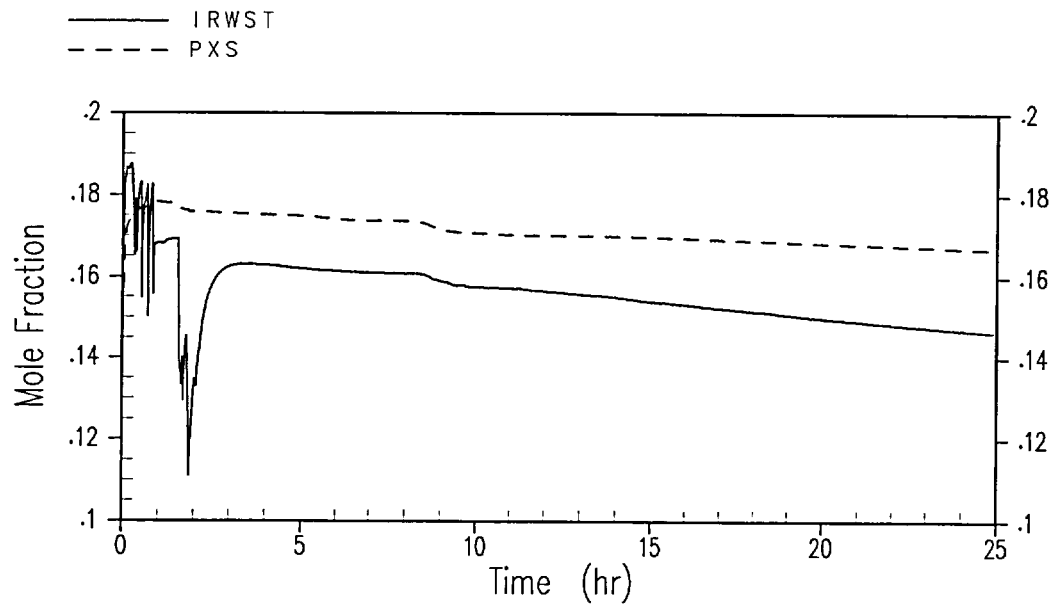

Figure 41A-47

Case 3BE-4: Confined Compartment Oxygen Concentration Spurious ADS, Failed Gravity Injection

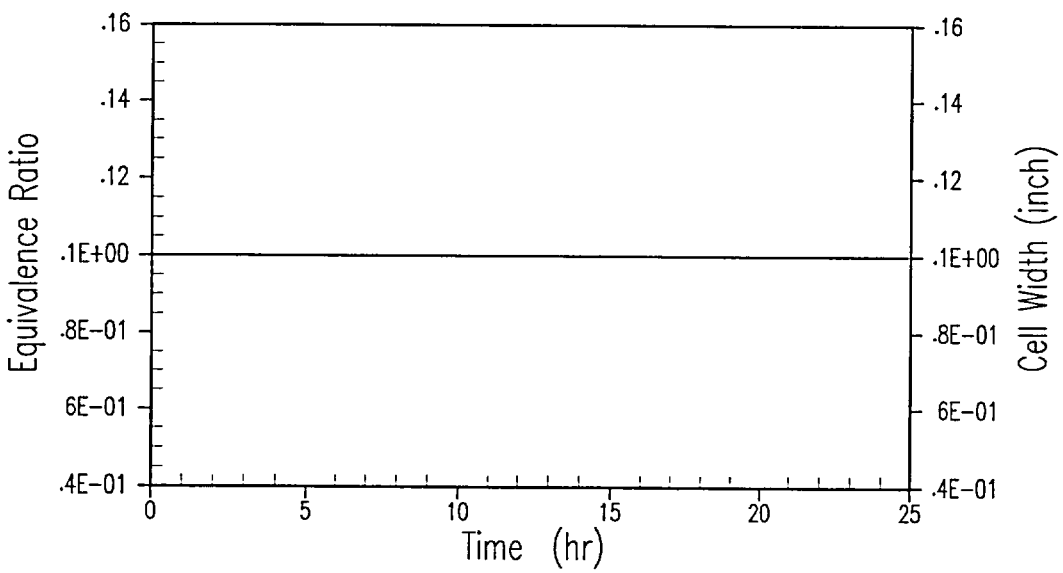

Figure 41A-48

Case 3BE-4: Equivalence Ratio in SG Room Spurious ADS, Failed Gravity Injection

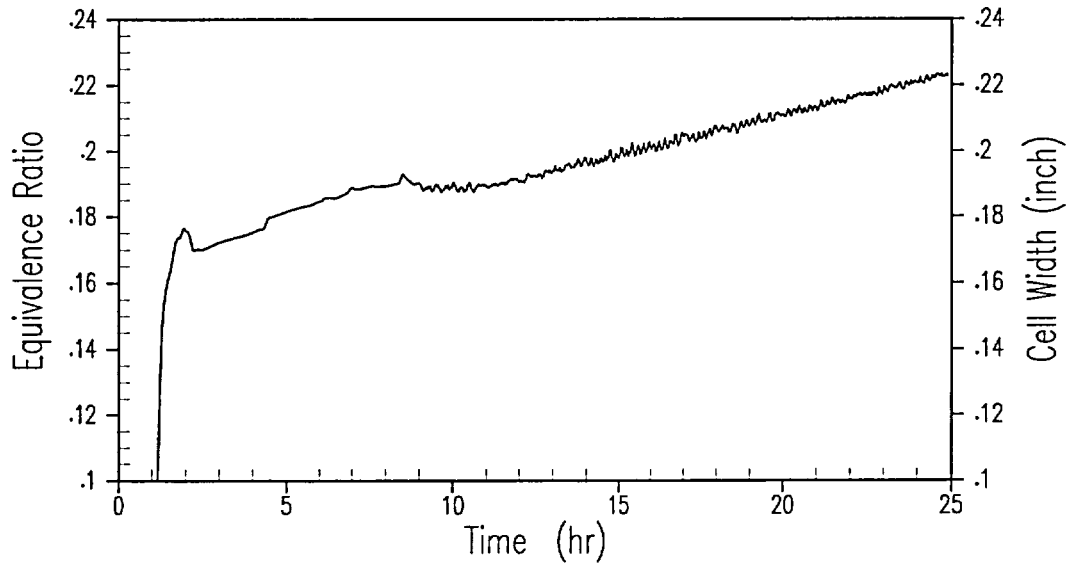

Figure 41A-49

Case 3BE-4: Equivalence Ratio in CMT Room Spurious ADS, Failed Gravity Injection

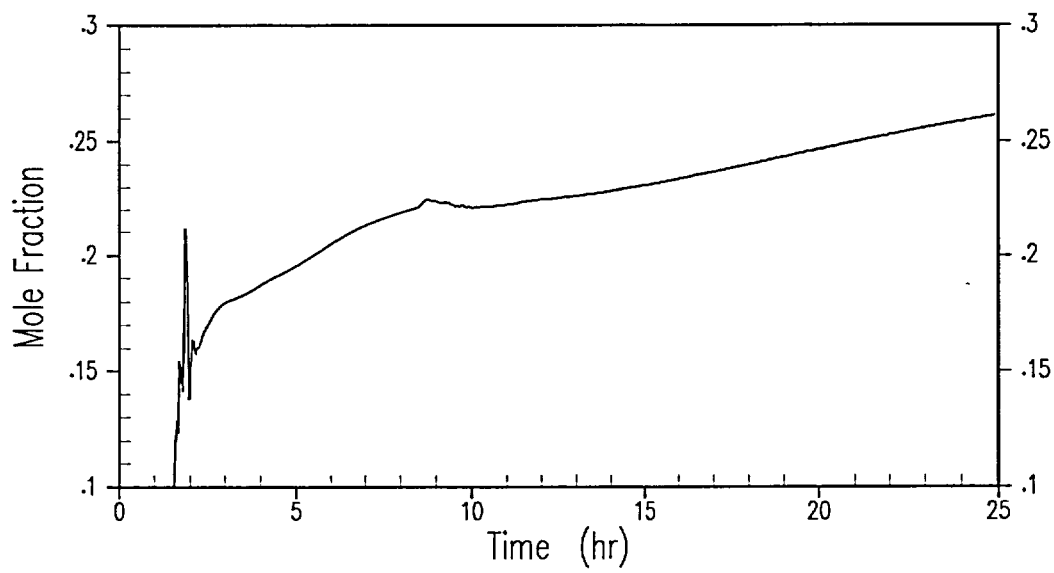

Figure 41A-50

Case 3BE-4: Equivalence Ratio in IRWST Spurious ADS, Failed Gravity Injection

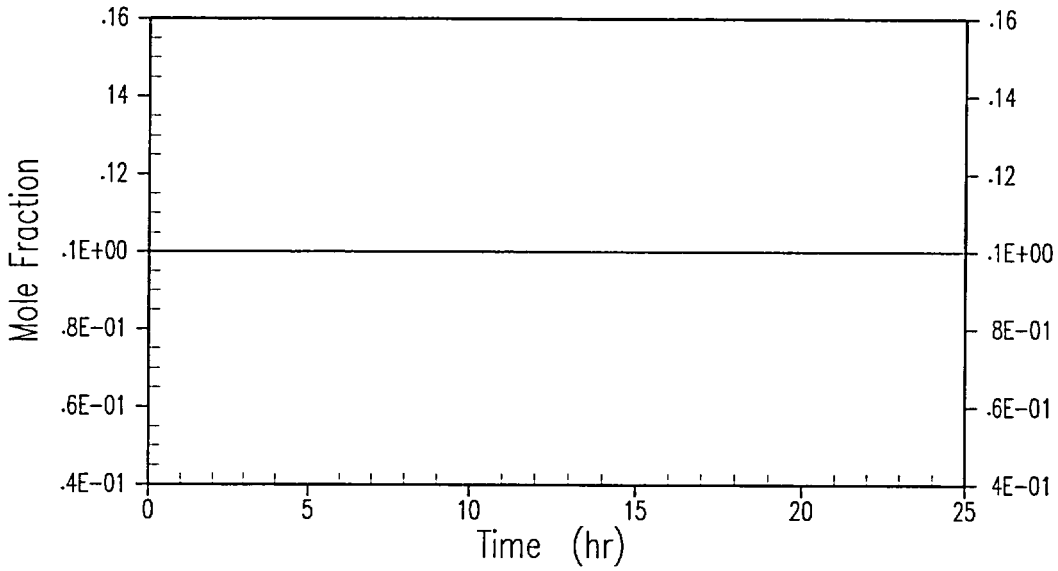

Figure 41A-51

Case 3BE-4: Equivalence Ratio in PXS Spurious ADS, Failed Gravity Injection

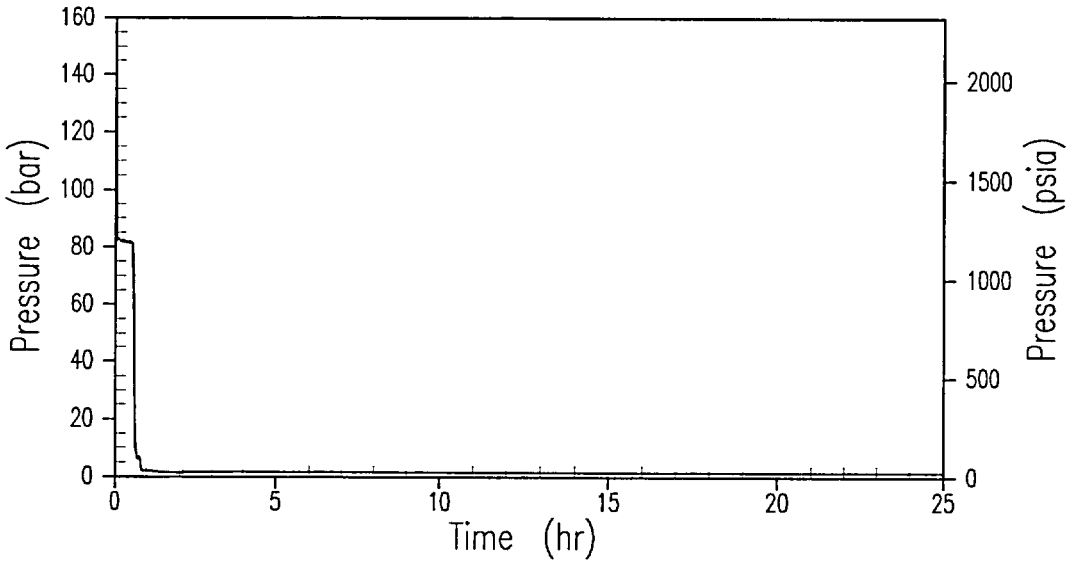

Figure 41A-52

Case 3BE-5: Reactor Coolant System Pressure SBLOCA with Failed Gravity Injection

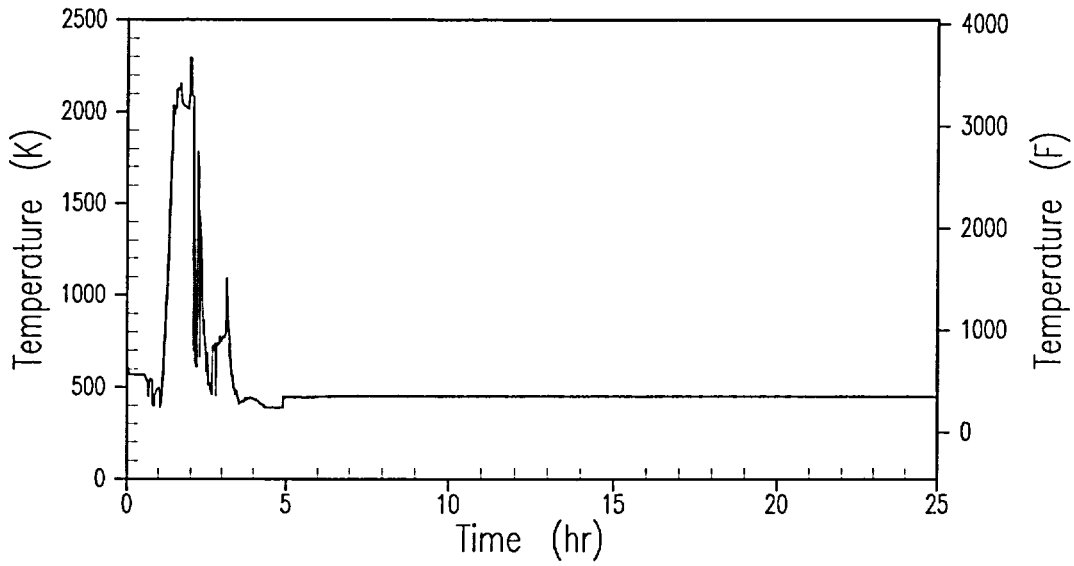

Figure 41A-53

Case 3BE-5: Core-Exit Gas Temperature SBLOCA with Failed Gravity Injection

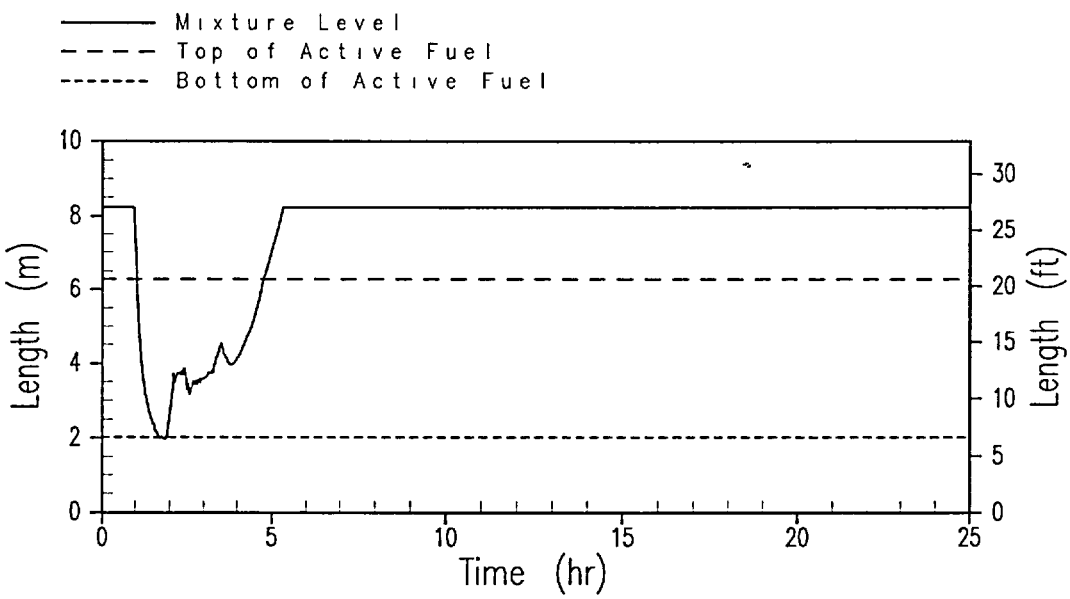

Figure 41A-54

Case 3BE-5: Reactor Vessel Mixture Level SBLOCA with Failed Gravity Injection

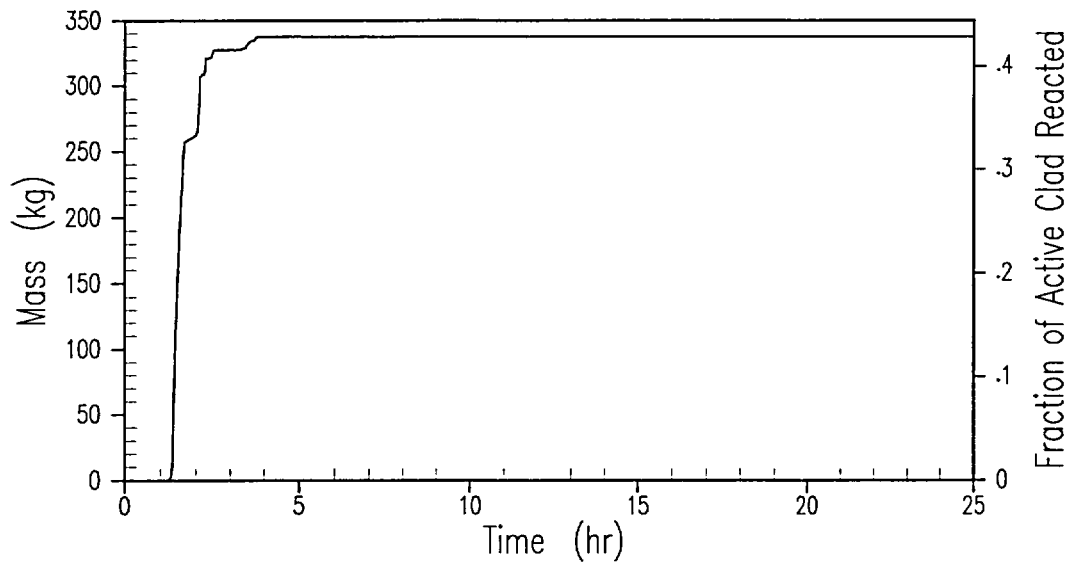

Figure 41A-55

Case 3BE-5: Hydrogen Generated In-Vessel SBLOCA with Failed Gravity Injection

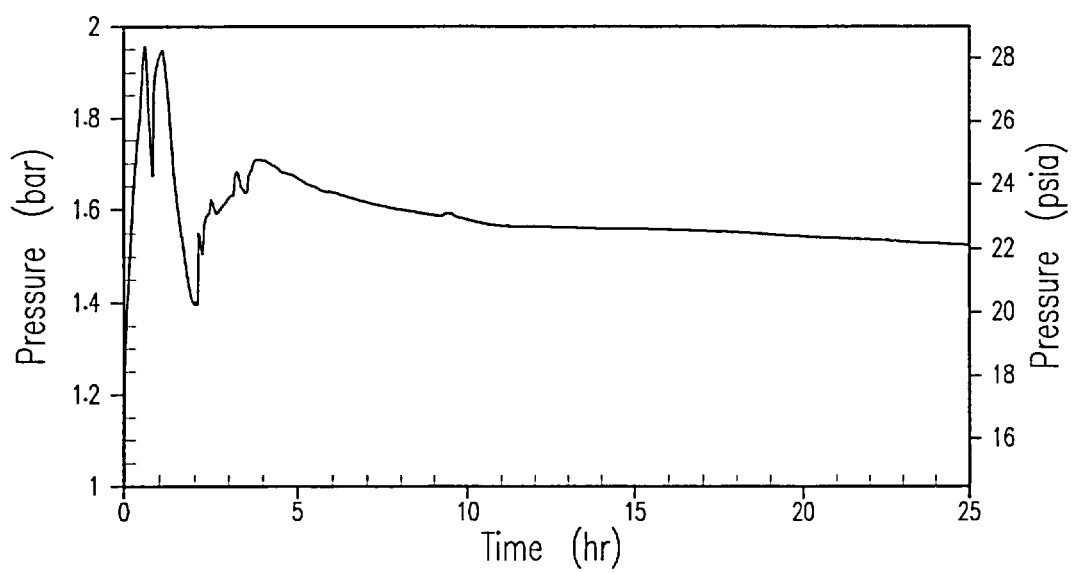

Figure 41A-56

Case 3BE-5: Containment Pressure SBLOCA with Failed Gravity Injection

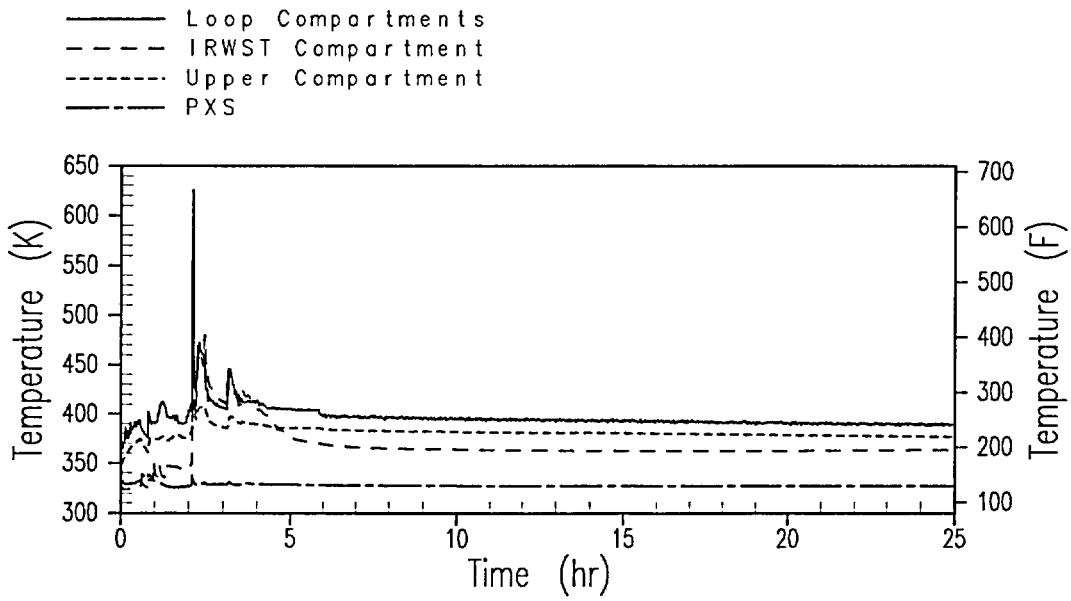

Figure 41A-57

Case 3BE-5: Containment Gas Temperature SBLOCA with Failed Gravity Injection

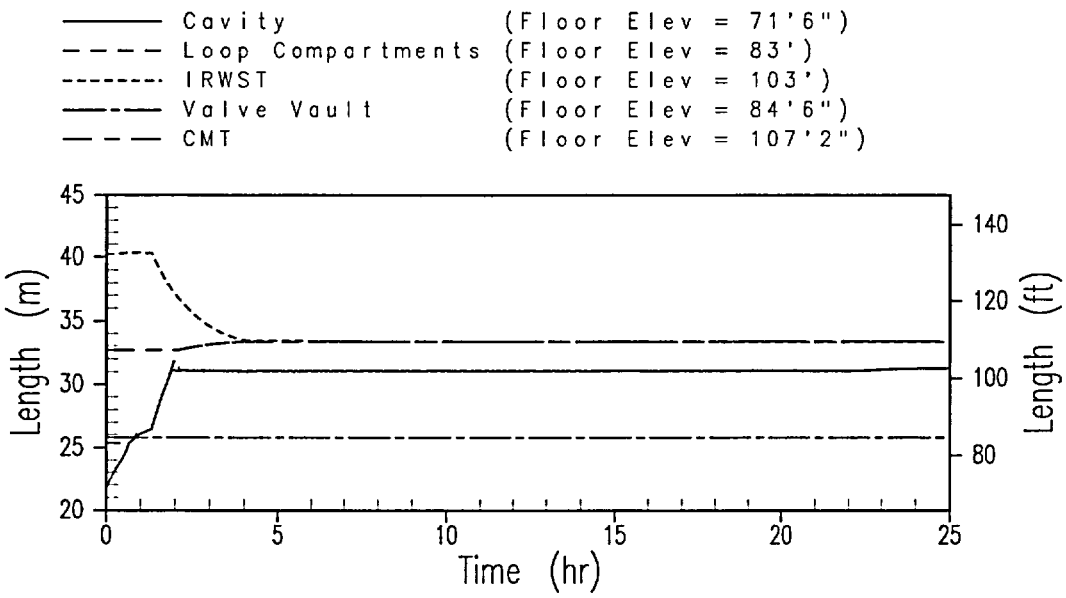

Figure 41A-58

Case 3BE-5: Containment Compartments Water Level SBLOCA with Failed Gravity Injection

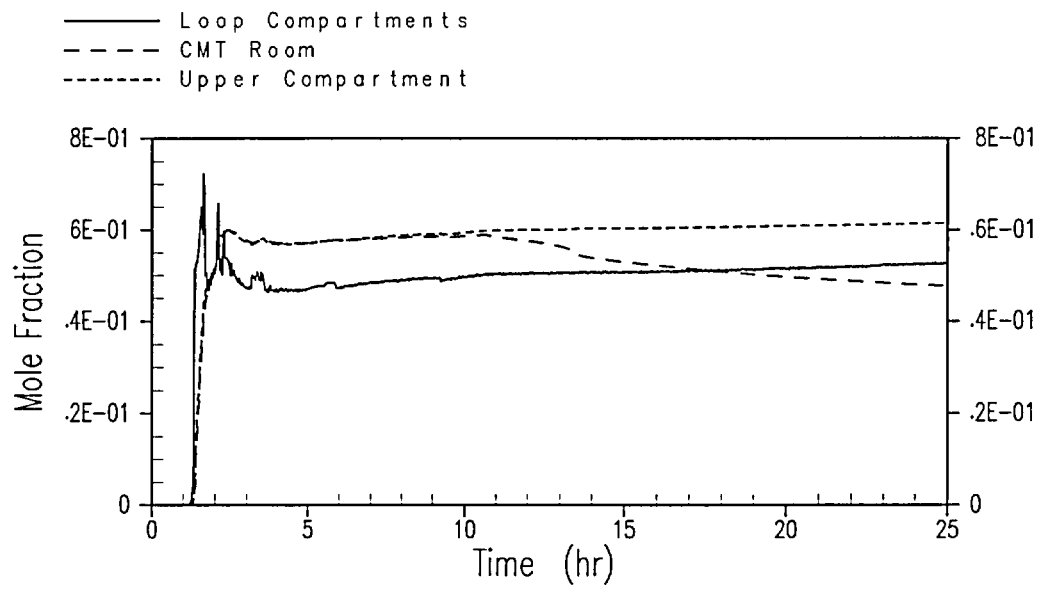

Figure 41A-59

Case 3BE-5: Well-Mixed Compartment Hydrogen Concentration SBLOCA with Failed Gravity Injection

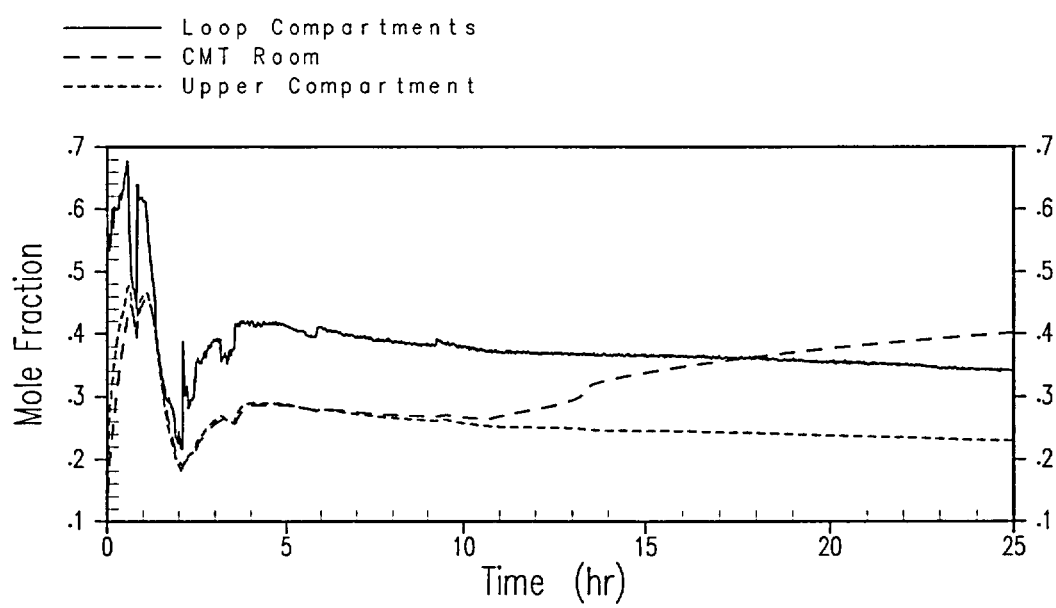

Figure 41A-60

Case 3BE-5: Well-Mixed Compartment Steam Concentration SBLOCA with Failed Gravity Injection

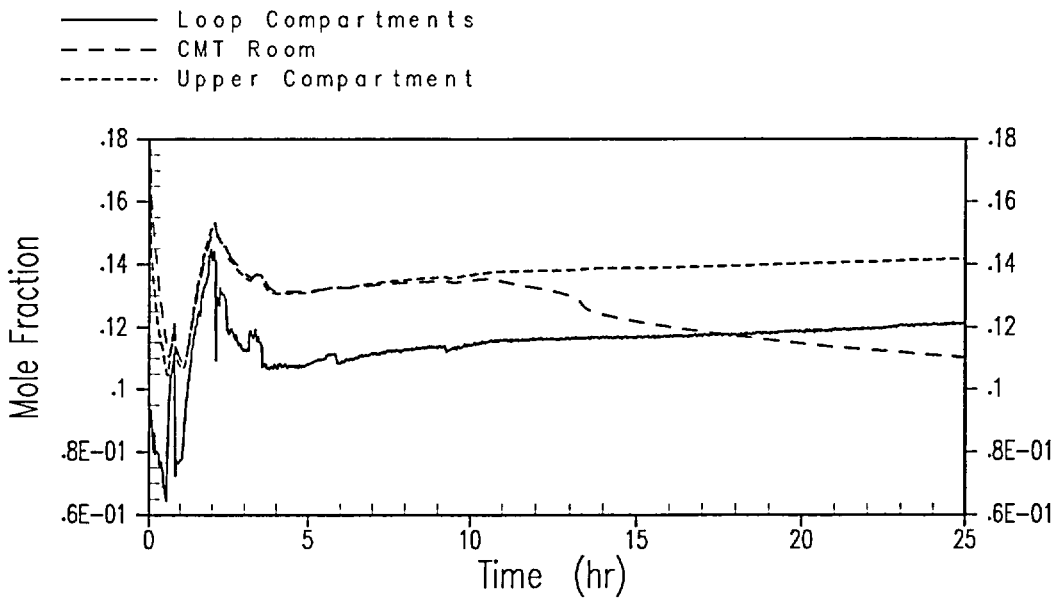

Figure 41A-61

Case 3BE-5: Well-Mixed Compartment Oxygen Concentration SBLOCA with Failed Gravity Injection

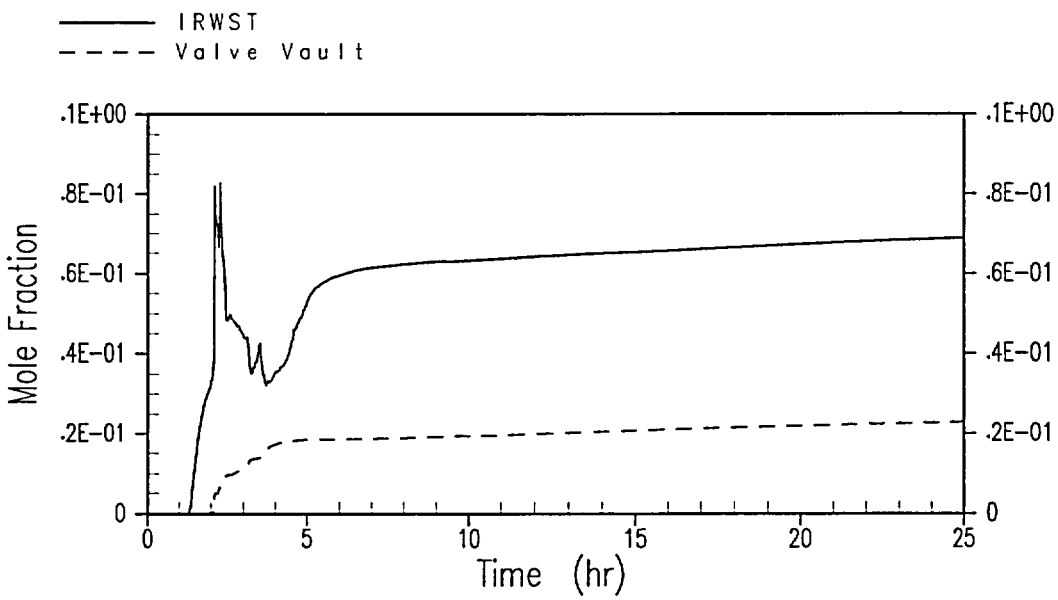

Figure 41A-62

Case 3BE-5: Confined Compartment Hydrogen Concentration SBLOCA with Failed Gravity Injection

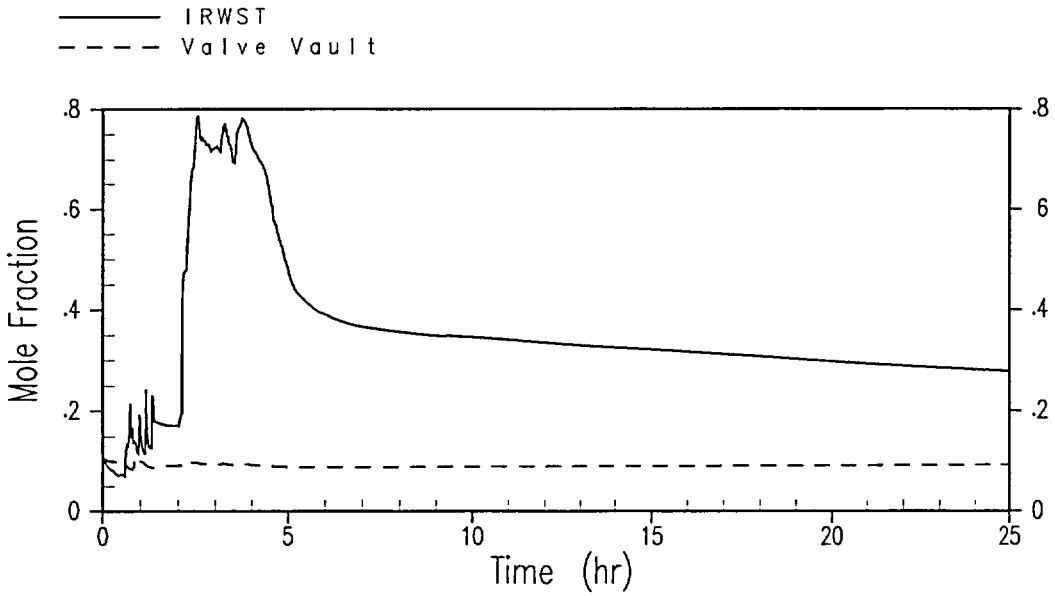

Figure 41A-63

Case 3BE-5: Confined Compartment Steam Concentration SBLOCA with Failed Gravity Injection

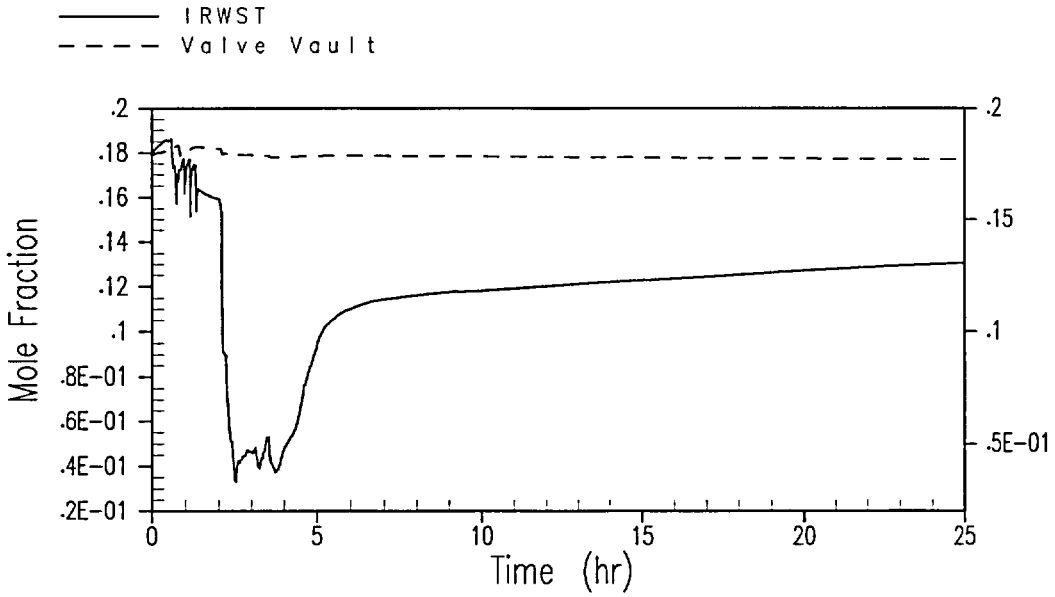

Figure 41A-64

Case 3BE-5: Confined Compartment Oxygen Concentration SBLOCA with Failed Gravity Injection

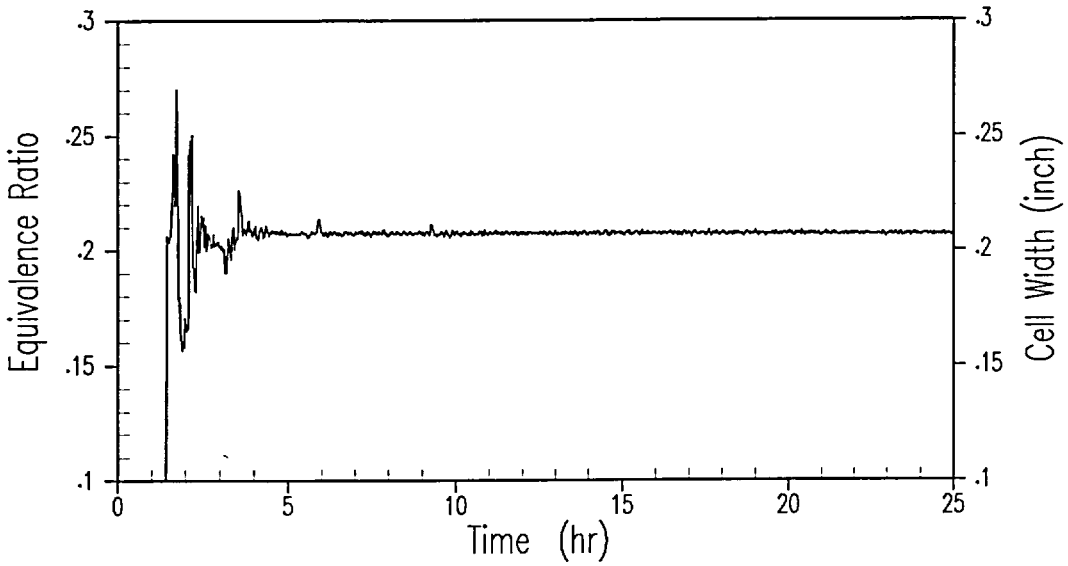

Figure 41A-65

Case 3BE-5: Equivalence Ratio in SG Room SBLOCA with Failed Gravity Injection

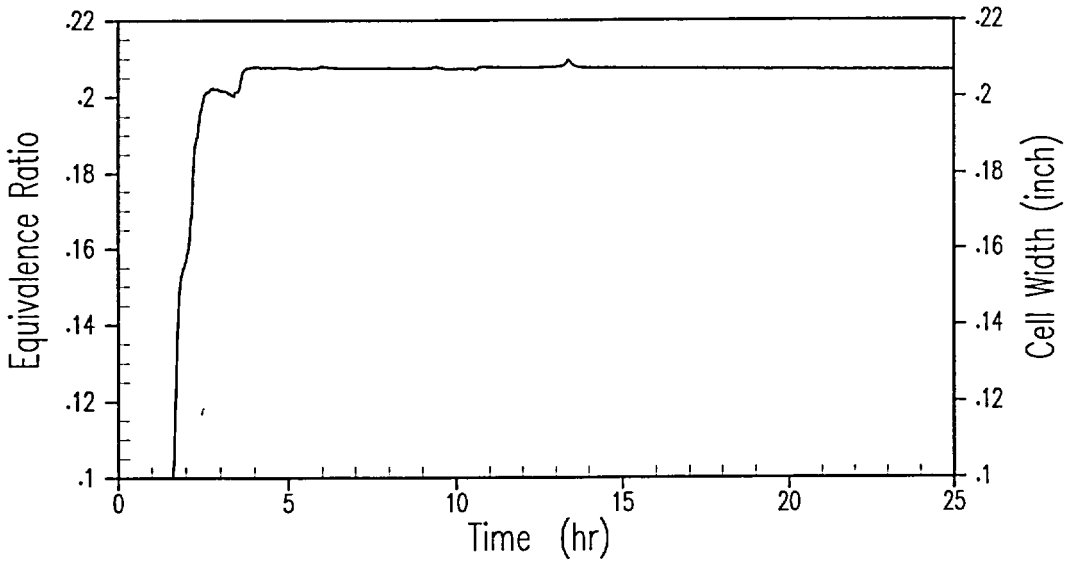

Figure 41A-66

Case 3BE-5: Equivalence Ratio in CMT Room SBLOCA with Failed Gravity Injection

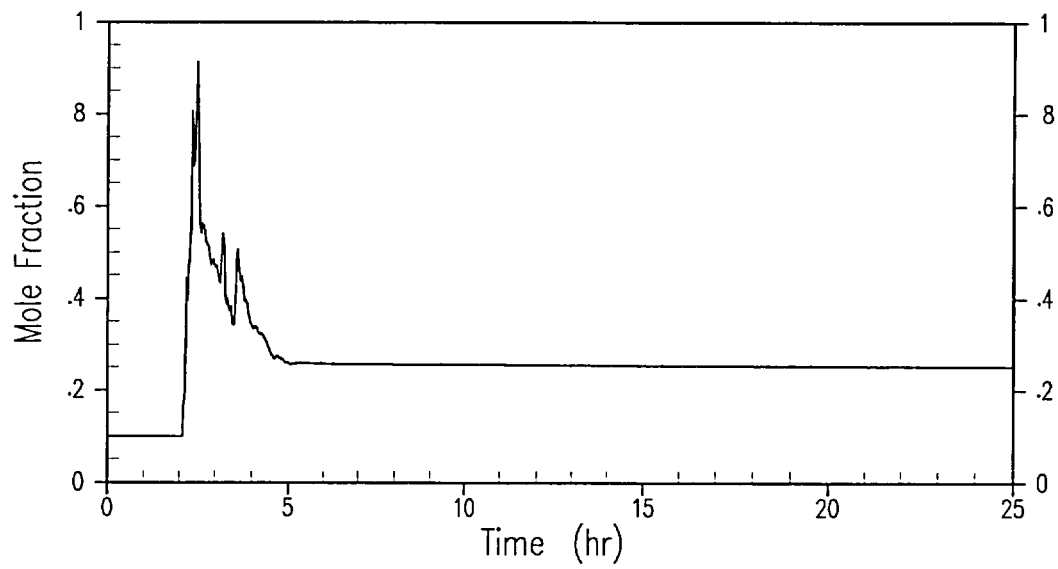

Figure 41A-67

Case 3BE-5: Equivalence Ratio in IRWST SBLOCA with Failed Gravity Injection

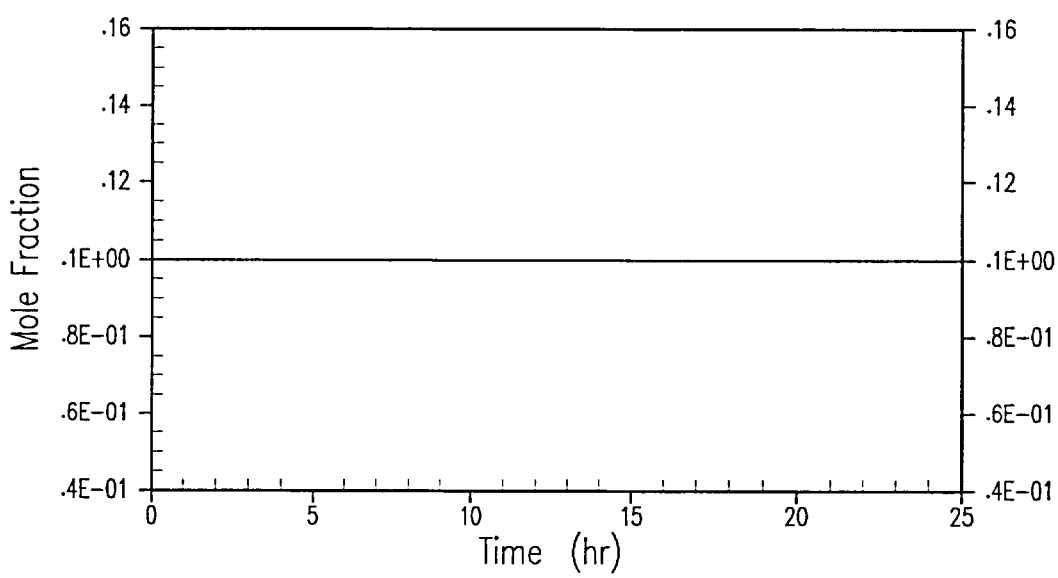

Figure 41A-68

Case 3BE-5: Equivalence Ratio in PXS SBLOCA with Failed Gravity Injection

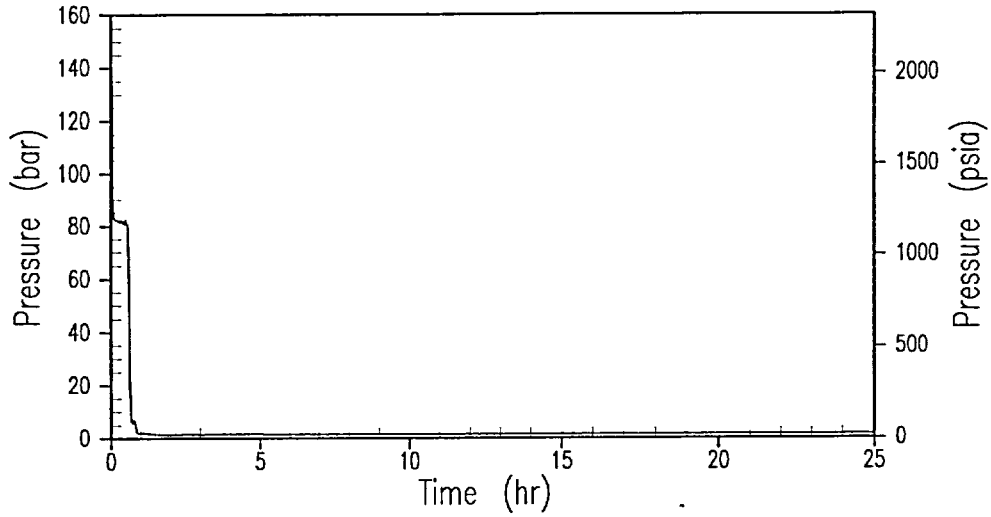

Figure 41A-69

Case 3BE-6: Reactor Coolant System Pressure SBLOCA with Failed Gravity Injection

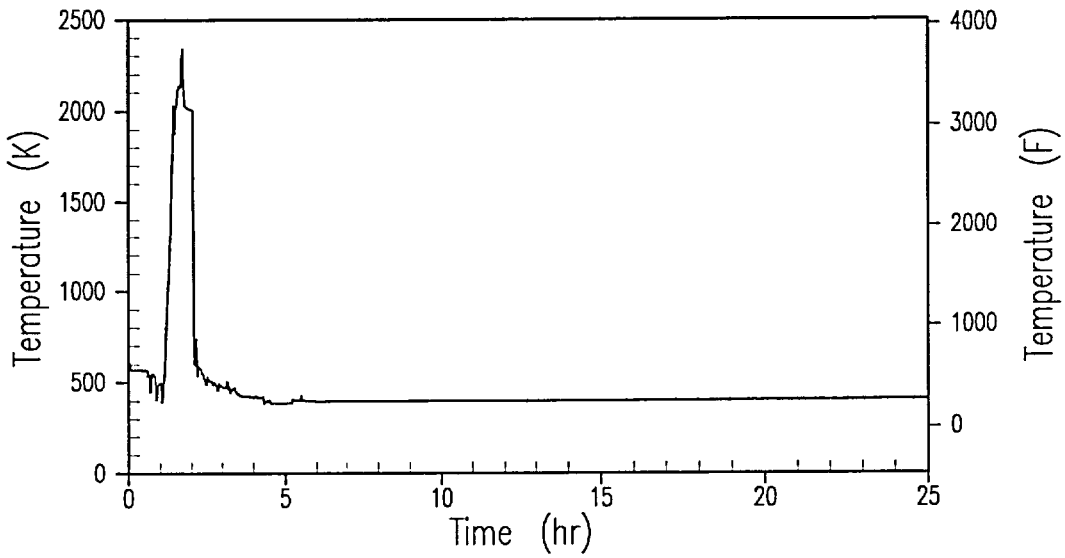

Figure 41A-70

Case 3BE-6: Core-Exit Gas Temperature SBLOCA with Failed Gravity Injection

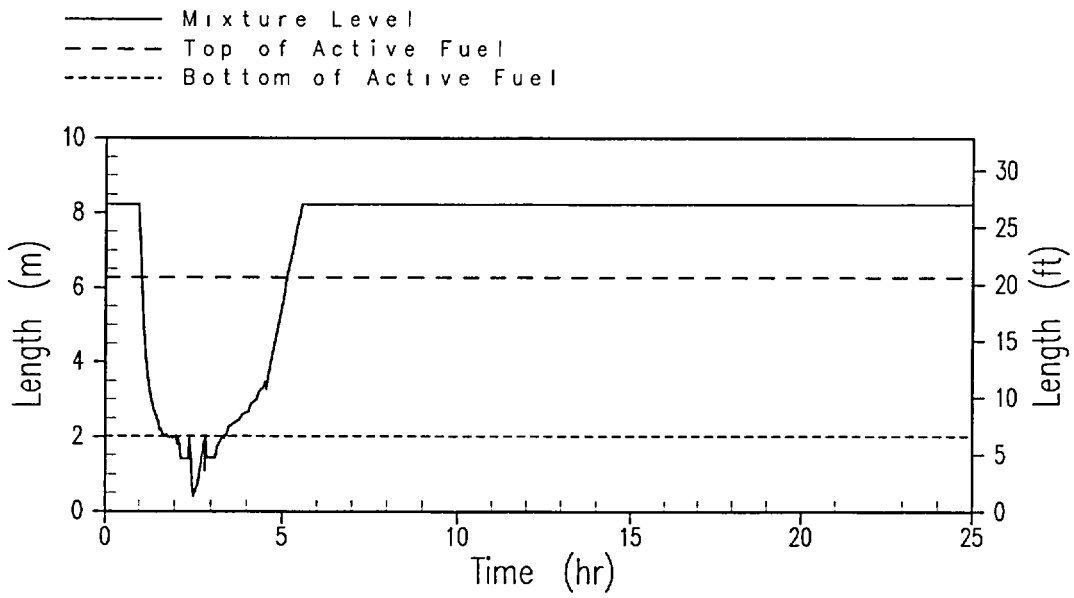

Figure 41A-71

Case 3BE-6: Reactor Vessel Mixture Level SBLOCA with Failed Gravity Injection

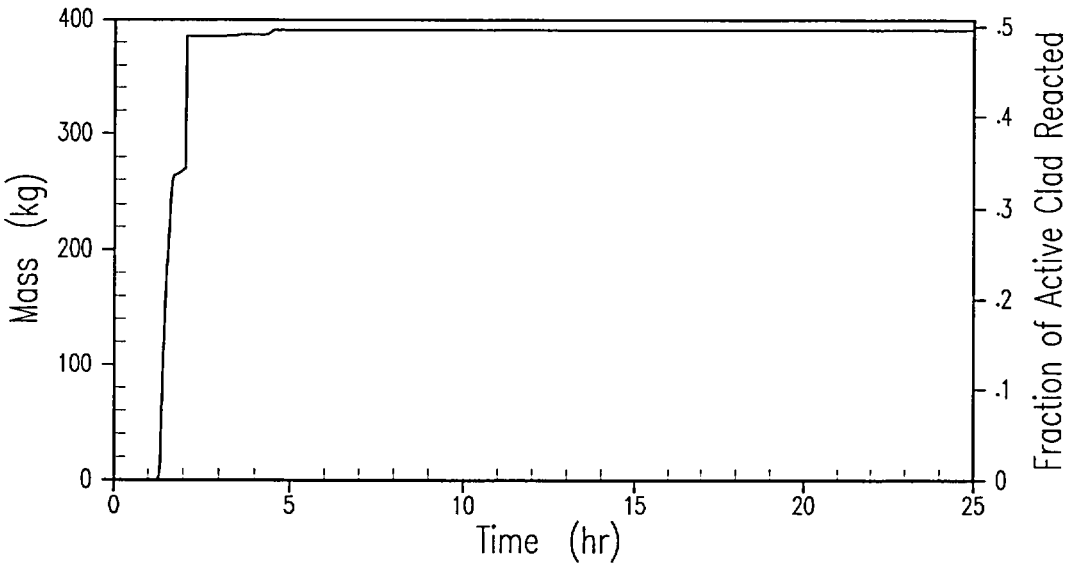

Figure 41A-72

Case 3BE-6: Hydrogen Generated In-Vessel SBLOCA with Failed Gravity Injection

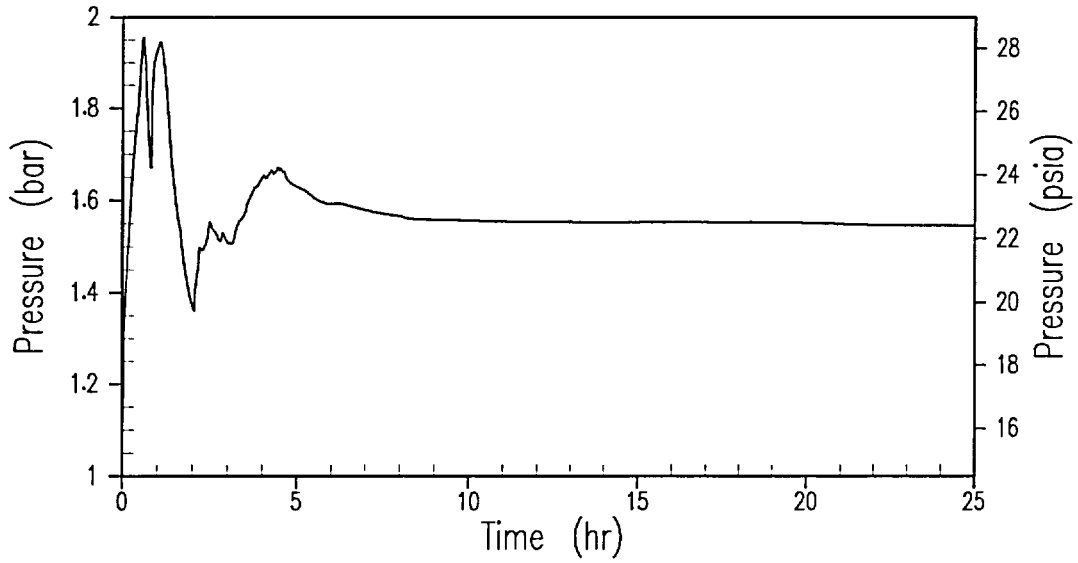

Figure 41A-73

Case 3BE-6: Containment Pressure SBLOCA with Failed Gravity Injection

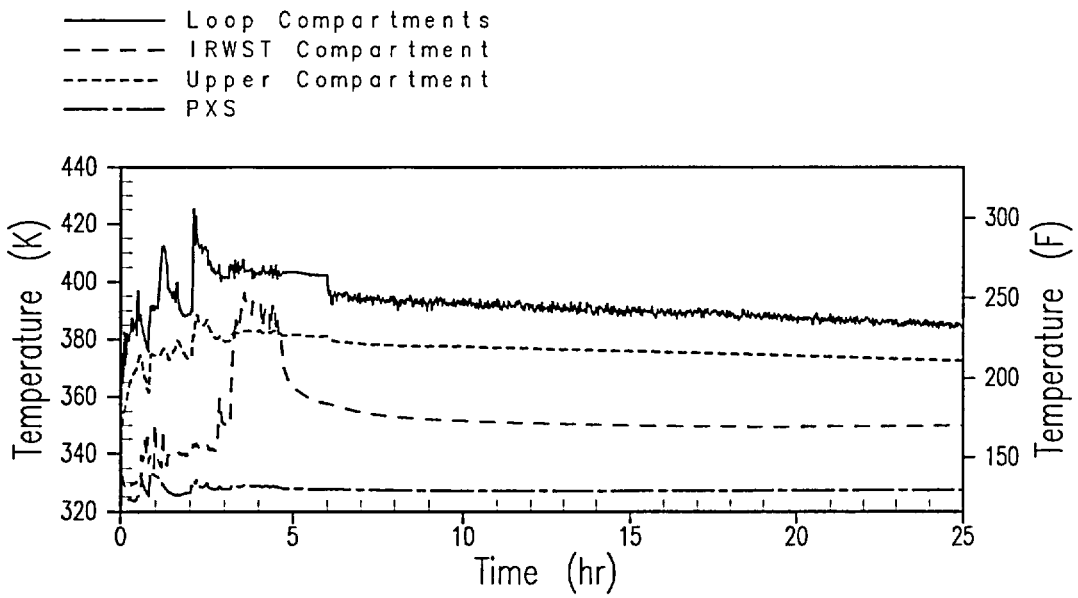

Figure 41A-74

Case 3BE-6: Containment Gas Temperature SBLOCA with Failed Gravity Injection

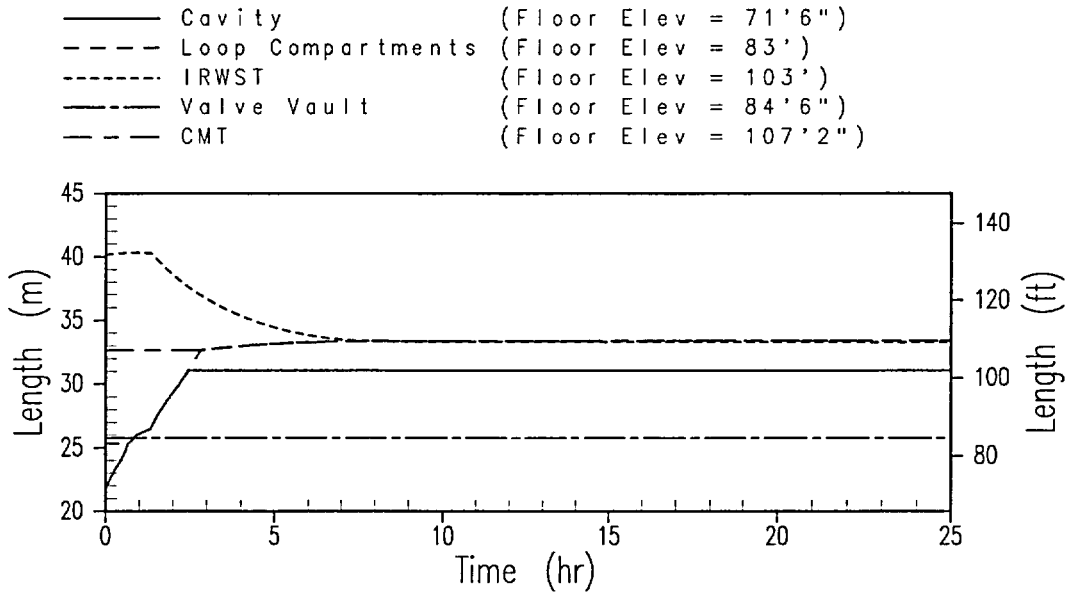

Figure 41A-75

Case 3BE-6: Containment Compartments Water Level SBLOCA with Failed Gravity Injection

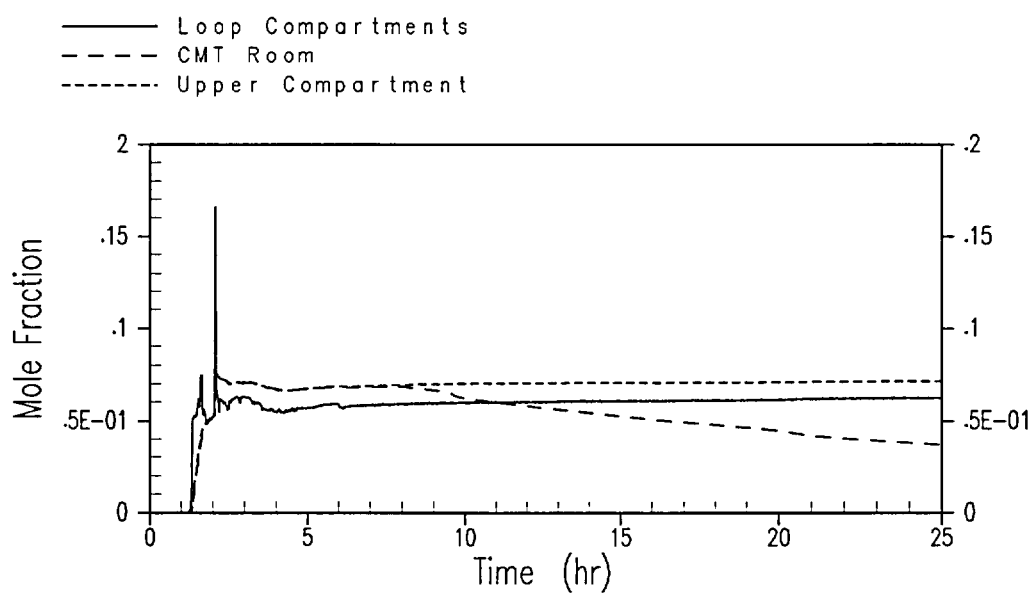

Figure 41A-76

Case 3BE-6: Well-Mixed Compartment Hydrogen Concentration SBLOCA with Failed Gravity Injection

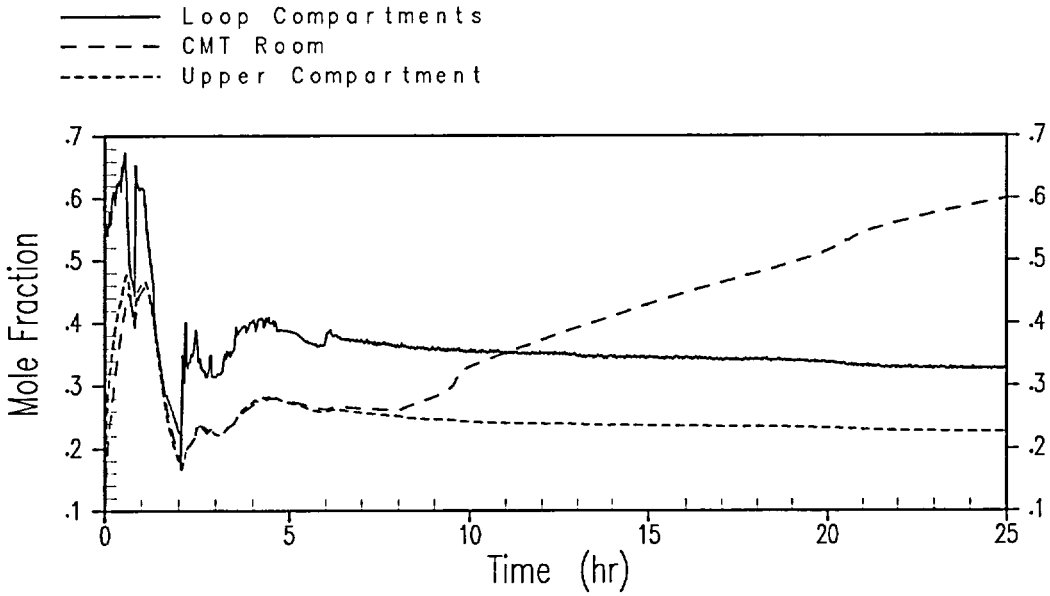

Figure 41A-77

Case 3BE-6: Well-Mixed Compartment Steam Concentration SBLOCA with Failed Gravity Injection

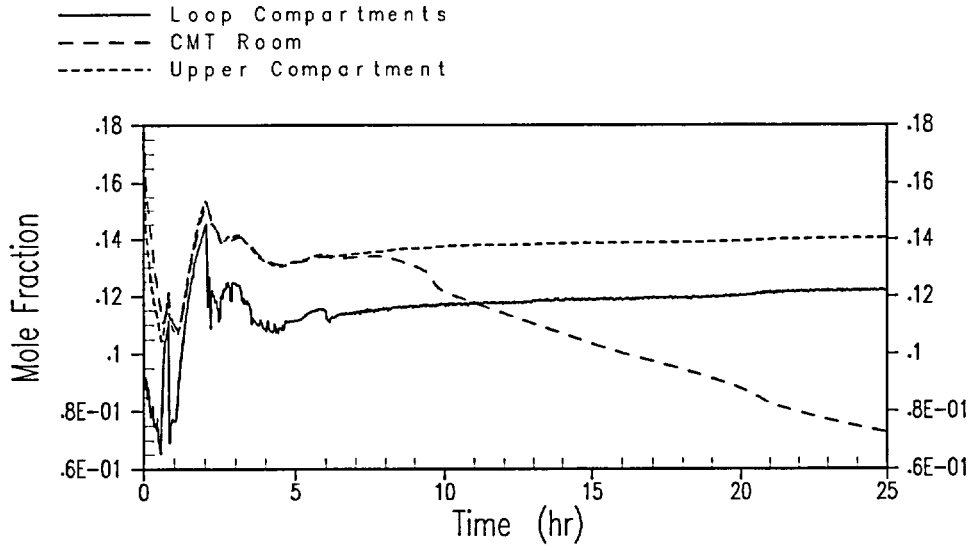

Figure 41A-78

Case 3BE-6: Well-Mixed Compartment Oxygen Concentration SBLOCA with Failed Gravity Injection

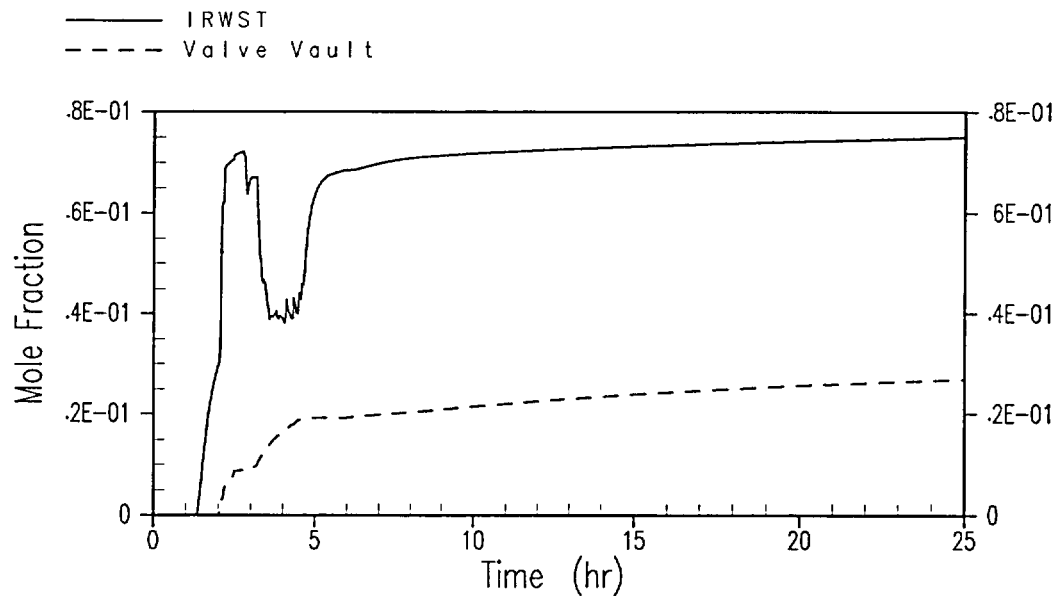

Figure 41A-79

Case 3BE-6: Confined Compartment Hydrogen Concentration SBLOCA with Failed Gravity Injection

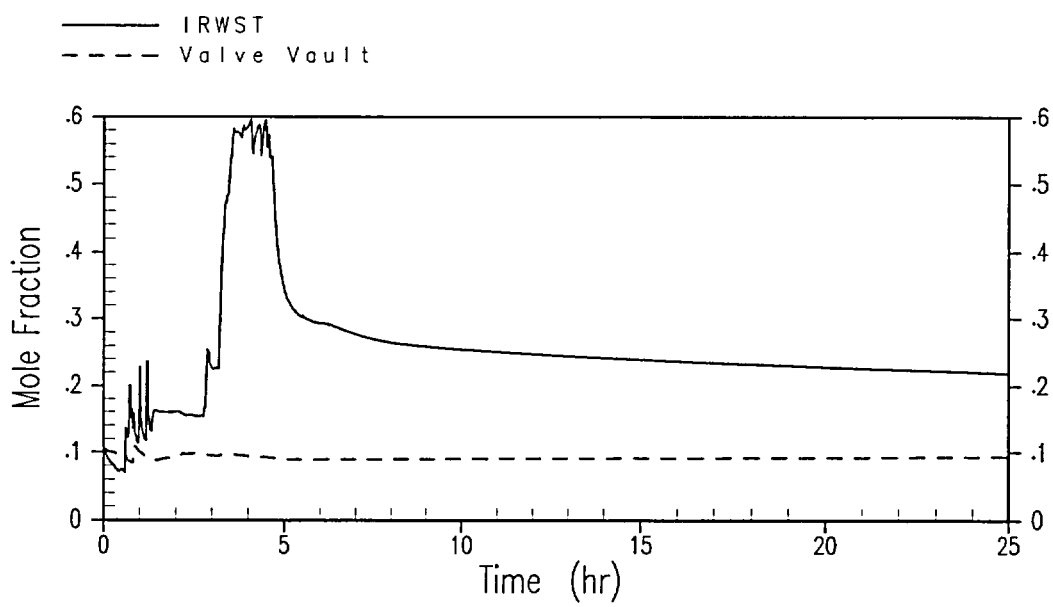

Figure 41A-80

Case 3BE-6: Confined Compartment Steam Concentration SBLOCA with Failed Gravity Injection

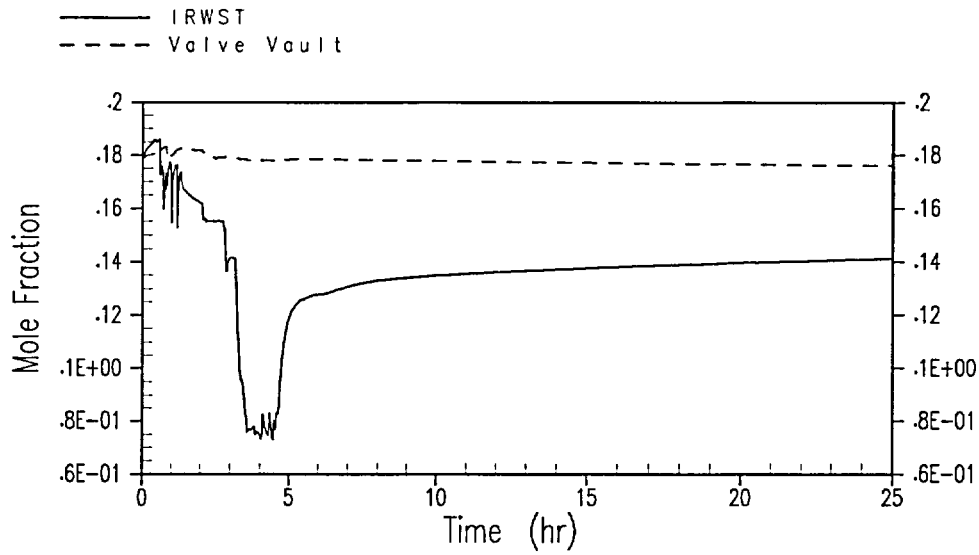

Figure 41A-81

Case 3BE-6: Confined Compartment Oxygen Concentration SBLOCA with Failed Gravity Injection

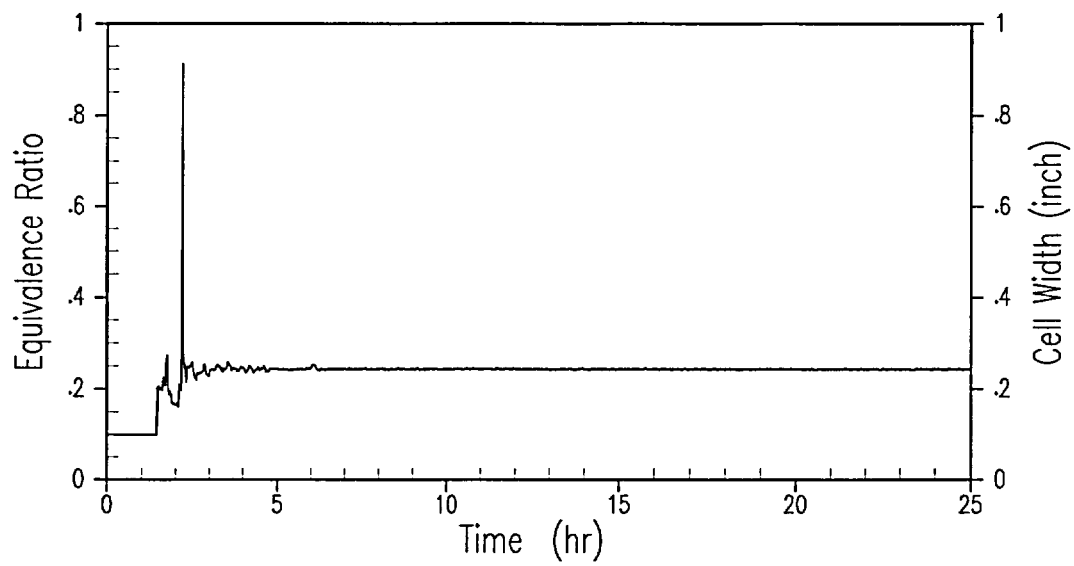

Figure 41A-82

Case 3BE-6: Equivalence Ratio in SG Room SBLOCA with Failed Gravity Injection

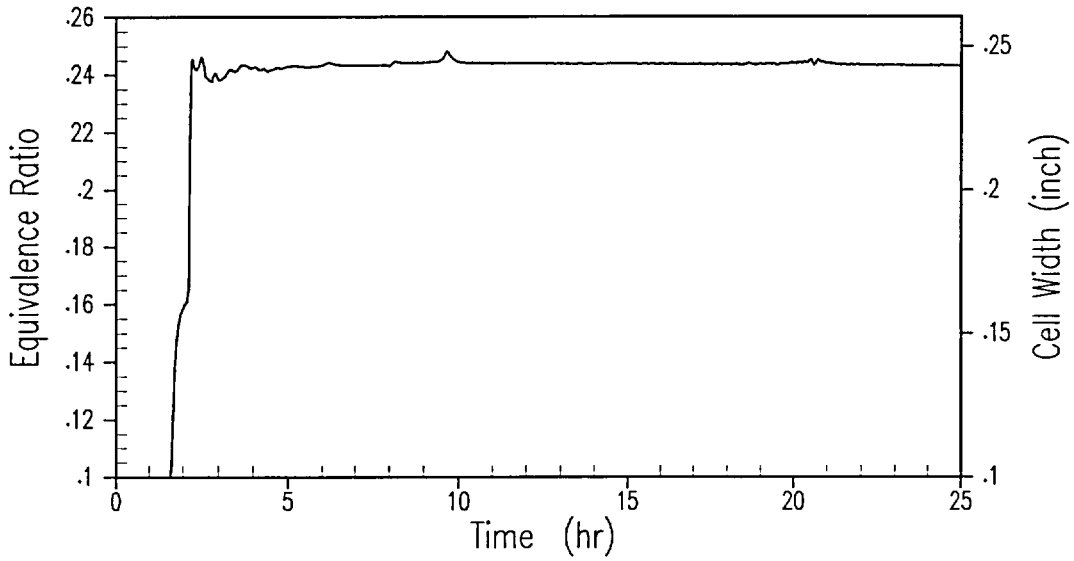

Figure 41A-83

Case 3BE-6: Equivalence Ratio in CMT Room SBLOCA with Failed Gravity Injection

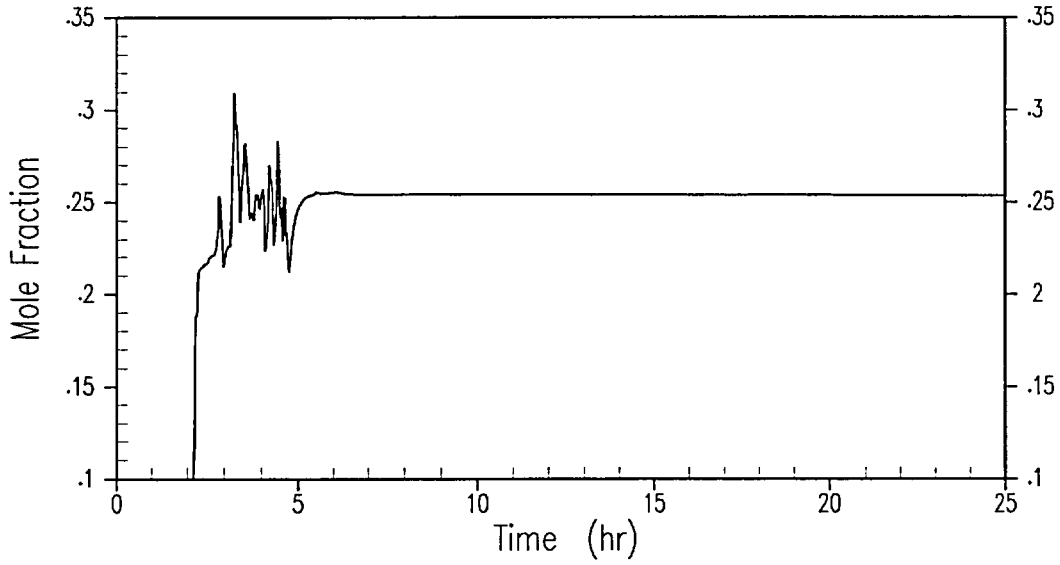

Figure 41A-84

Case 3BE-6: Equivalence Ratio in IRWST SBLOCA with Failed Gravity Injection

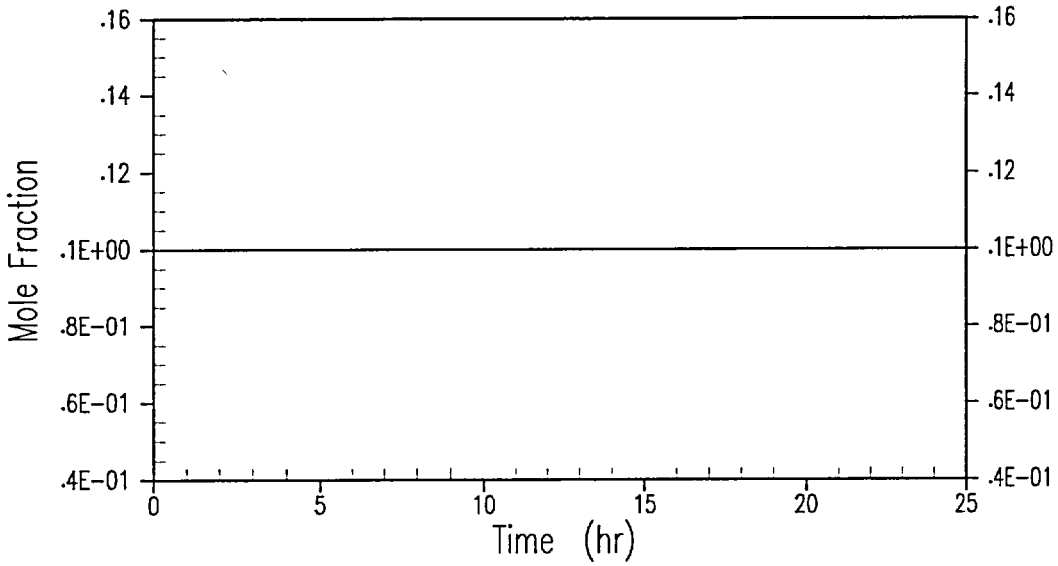

Figure 41A-85

Case 3BE-6: Equivalence Ratio in PXS SBLOCA with Failed Gravity Injection

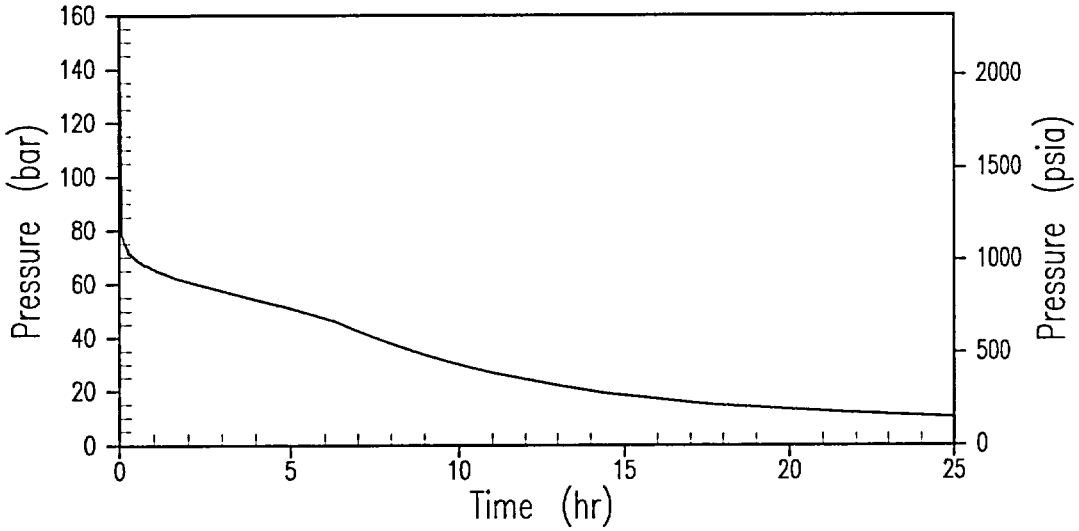

Figure 41A-86

Case 3BE-8: Reactor Coolant System Pressure SGTR

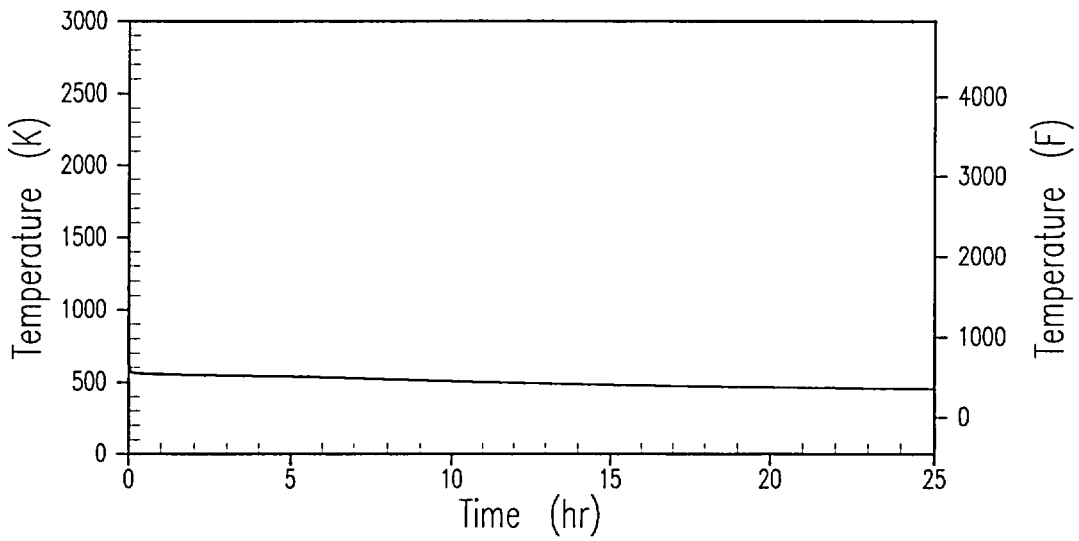

Figure 41A-87

Case 3BE-8: Core-Exit Gas Temperature SGTR

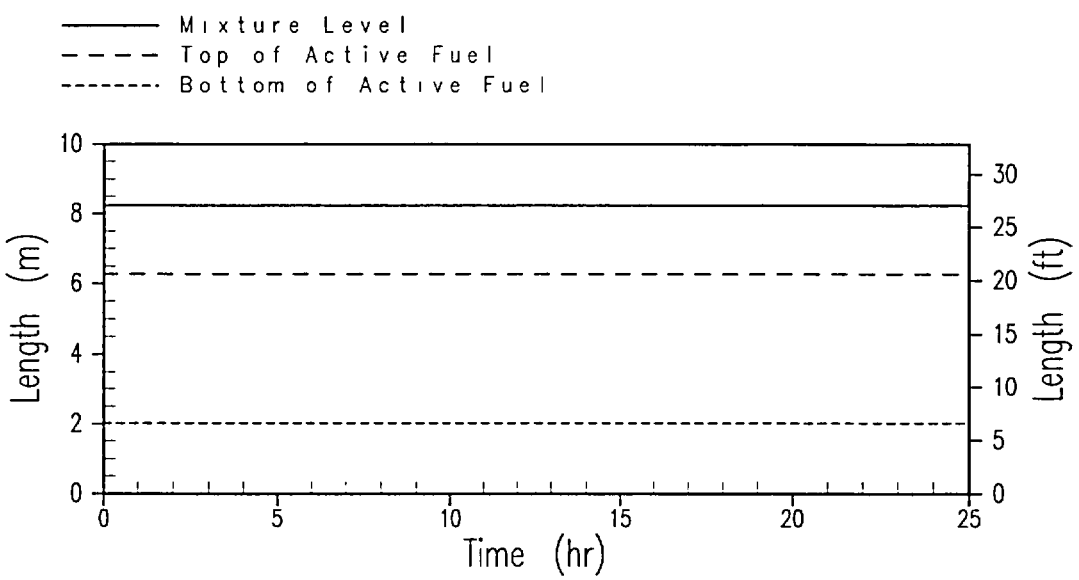

Figure 41A-88

Case 3BE-8: Reactor Vessel Mixture Level SGTR

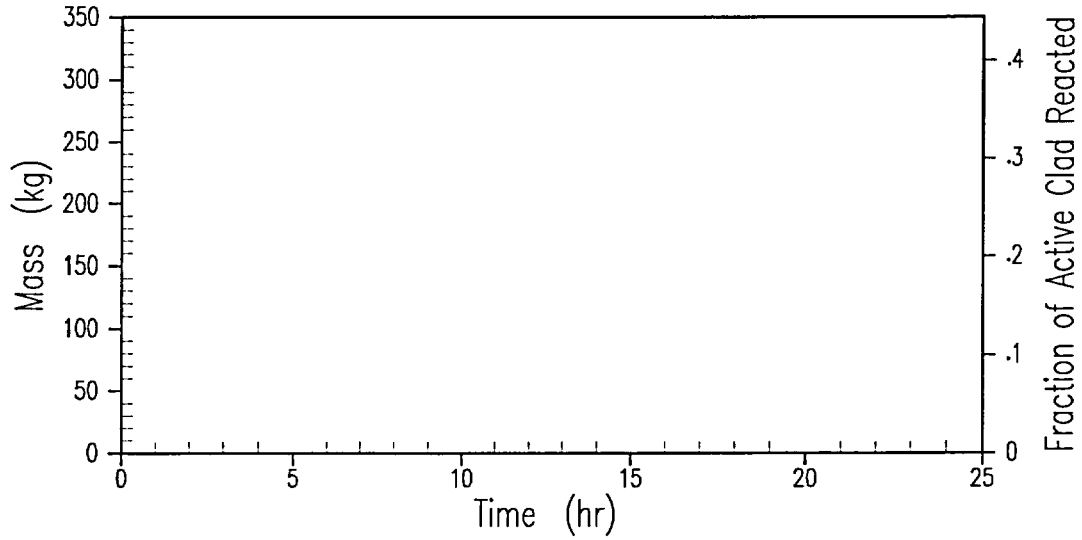

Figure 41A-89

Case 3BE-8: Hydrogen Generated In-Vessel SGTR

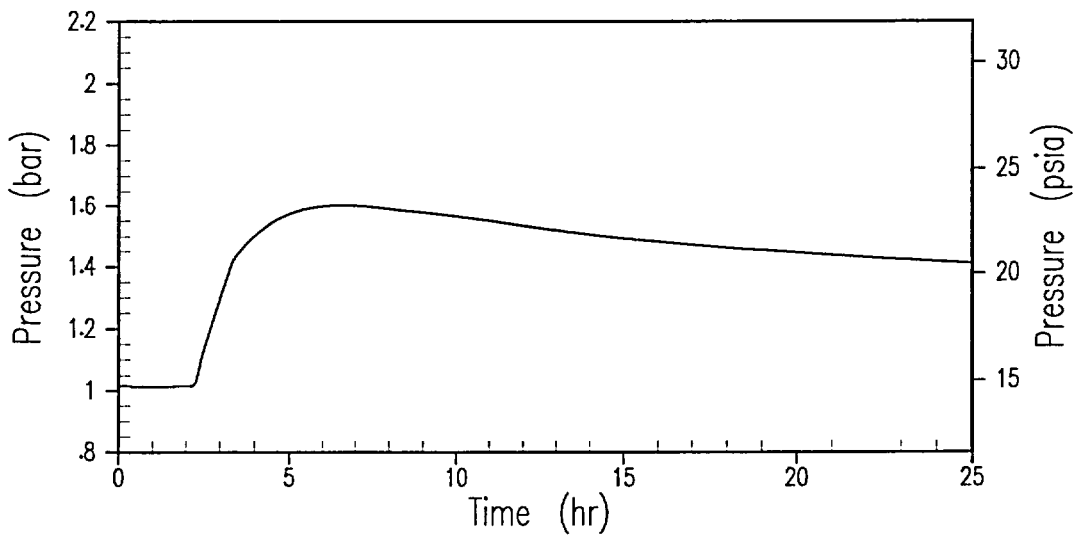

Figure 41A-90

Case 3BE-8: Containment Pressure SGTR

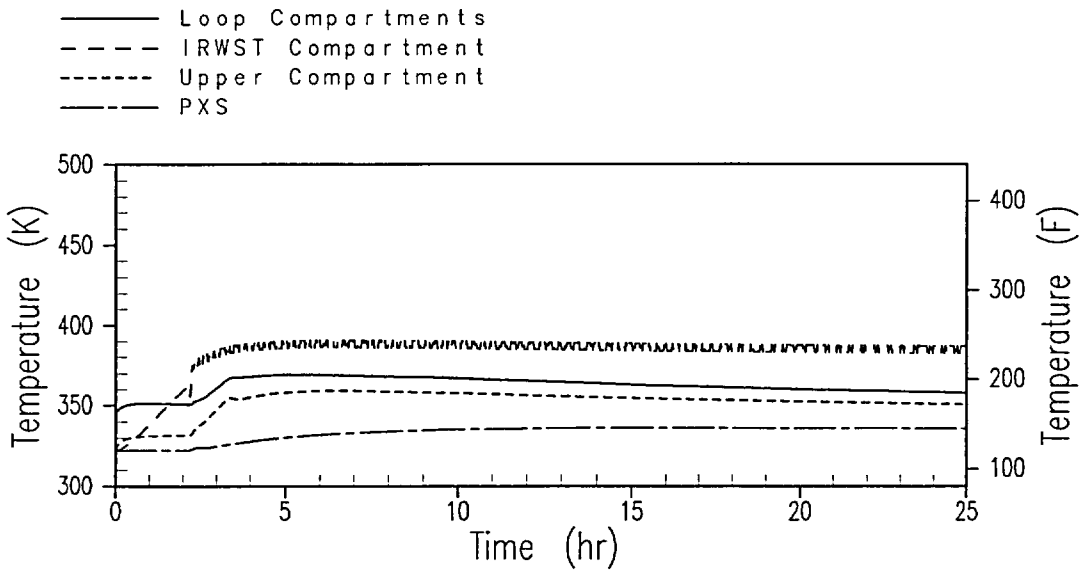

Figure 41A-91

Case 3BE-8: Containment Gas Temperature SGTR

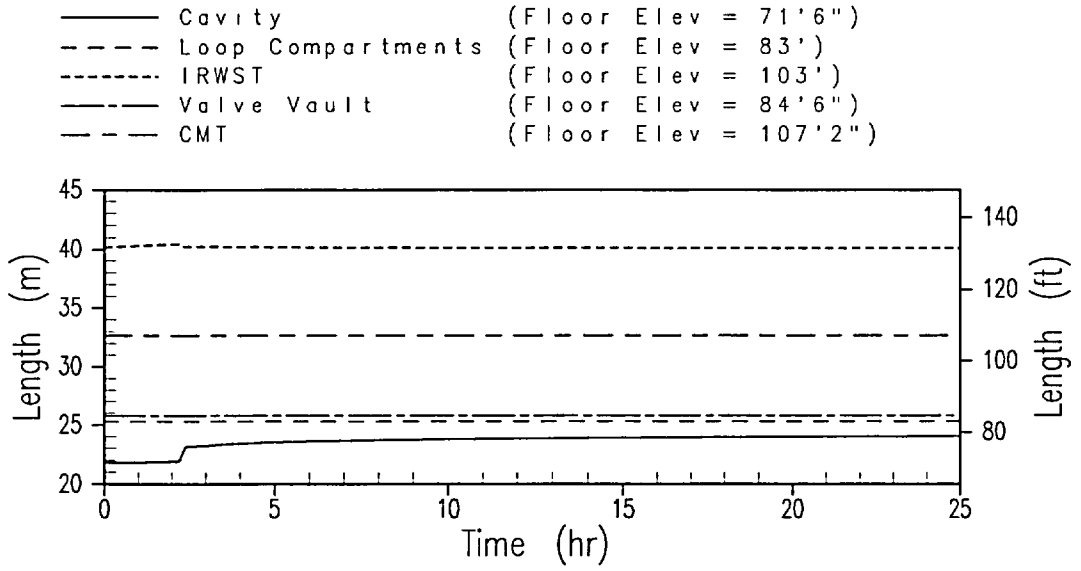

Figure 41A-92

Case 3BE-8: Containment Compartments Water Level SGTR

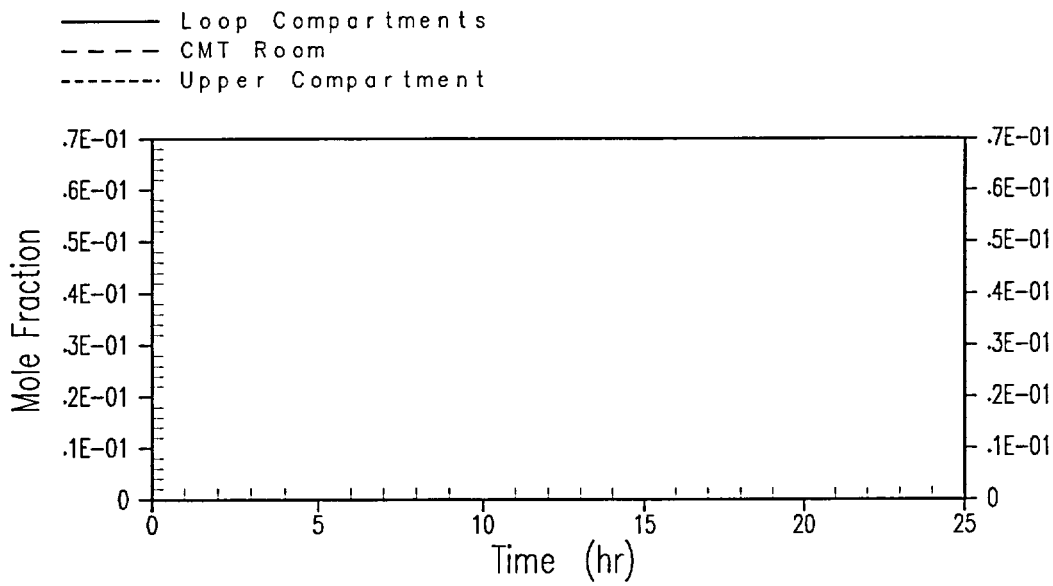

Figure 41A-93

Case 3BE-8: Well-Mixed Compartment Hydrogen Concentration SGTR

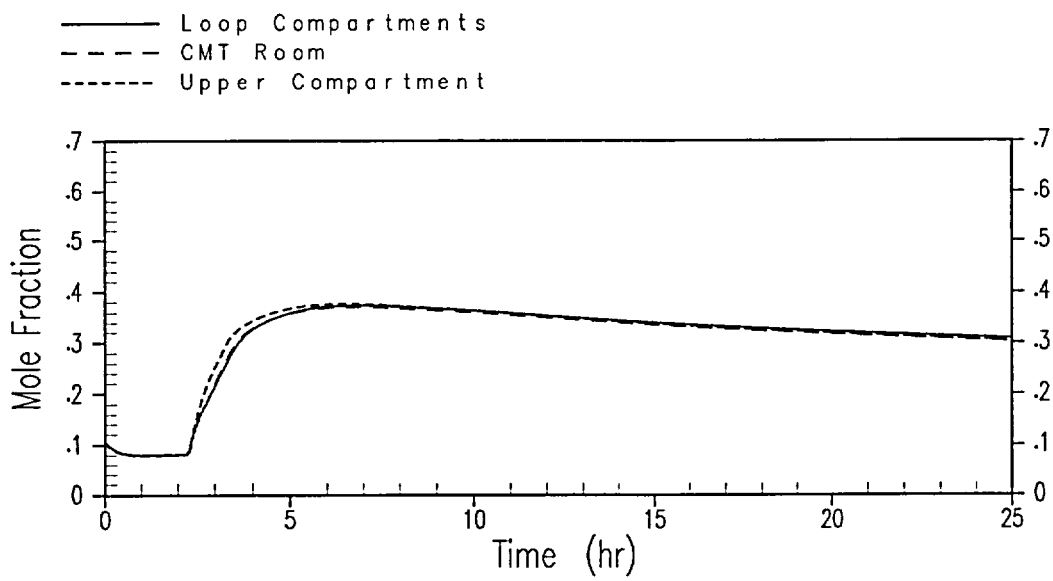

Figure 41A-94

Case 3BE-8: Well-Mixed Compartment Steam Concentration SGTR

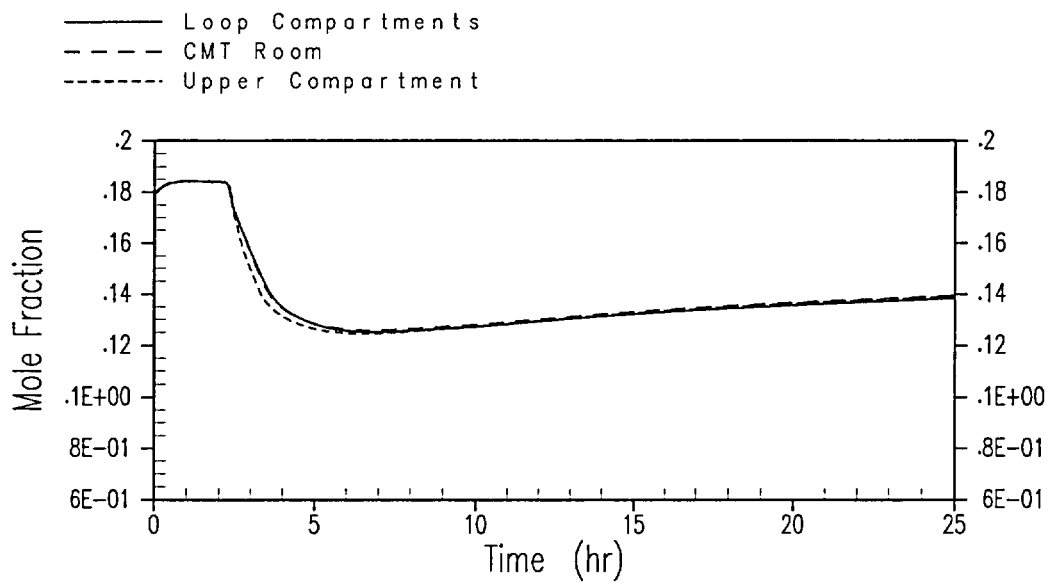

Figure 41A-95

Case 3BE-8: Well-Mixed Compartment Oxygen Concentration SGTR

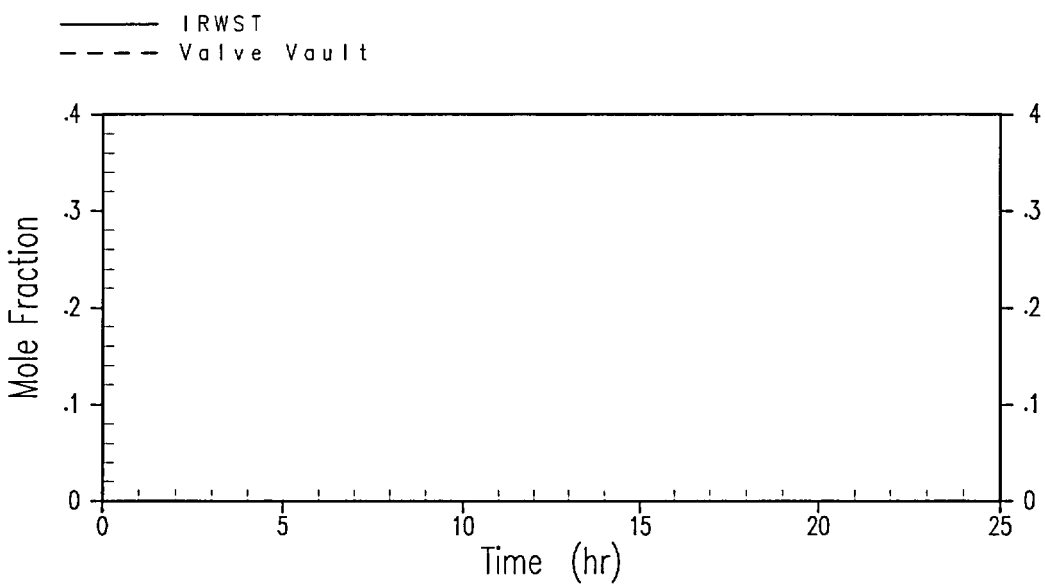

Figure 41A-96

Case 3BE-8: Confined Compartment Hydrogen Concentration SGTR

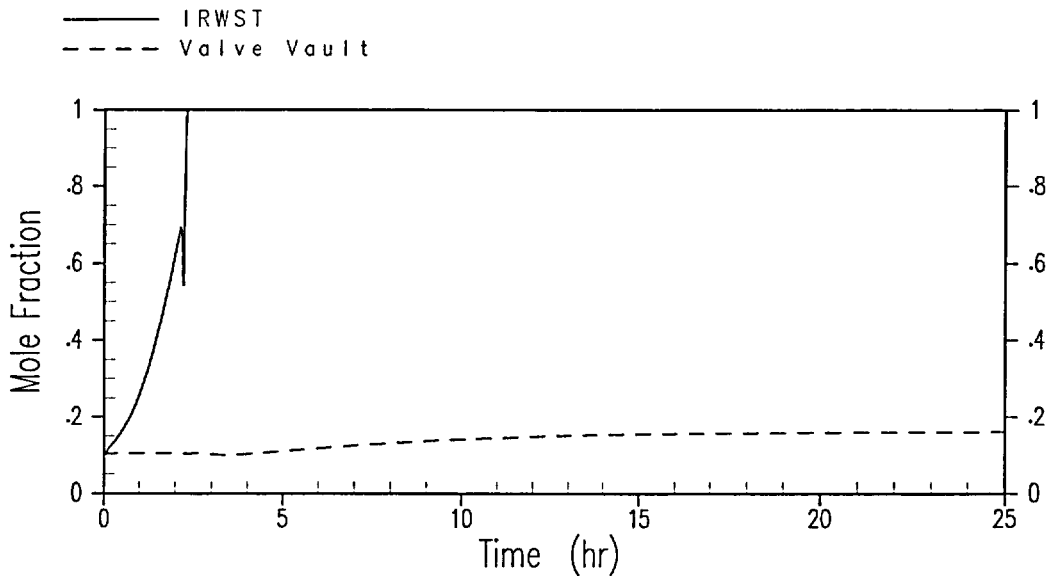

Figure 41A-97

Case 3BE-8: Confined Compartment Steam Concentration SGTR

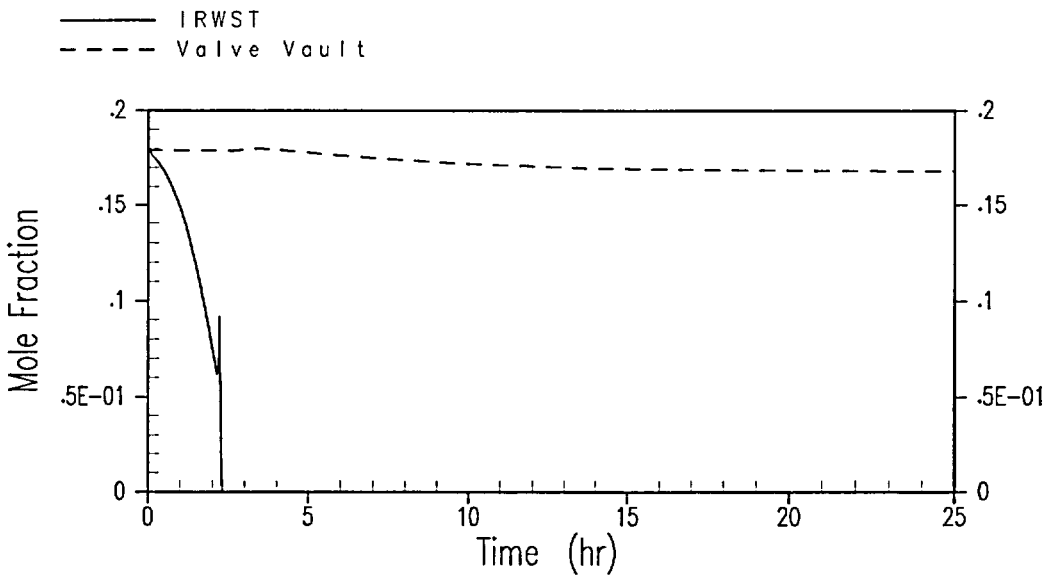

Figure 41A-98

Case 3BE-8: Confined Compartment Oxygen Concentration SGTR

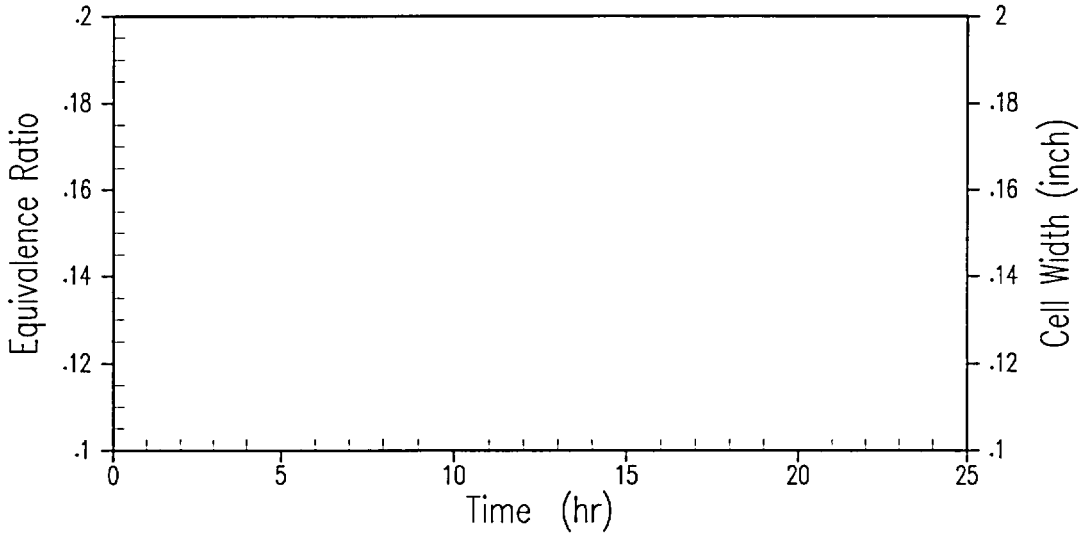

Figure 41A-99

Case 3BE-8: Equivalence Ratio in SG Room SGTR

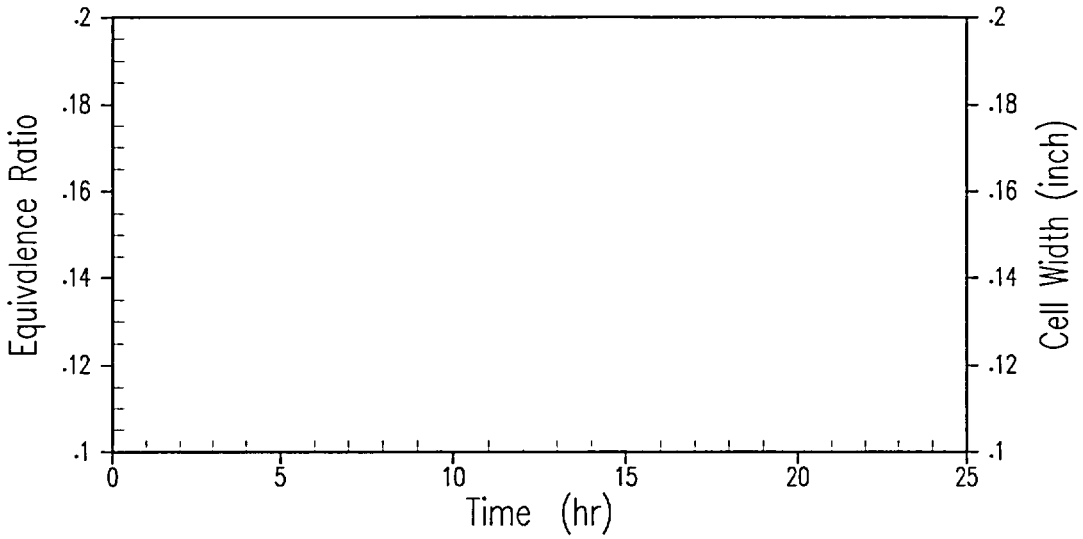

Figure 41A-100

Case 3BE-8: Equivalence Ratio in CMT Room SGTR

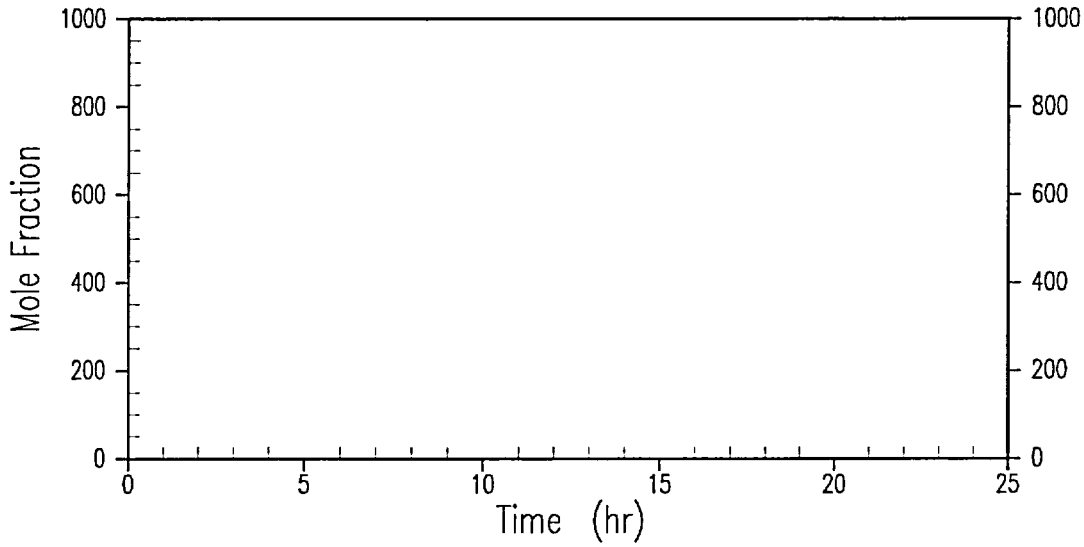

Figure 41A-101

Case 3BE-8: Equivalence Ratio in IRWST SGTR

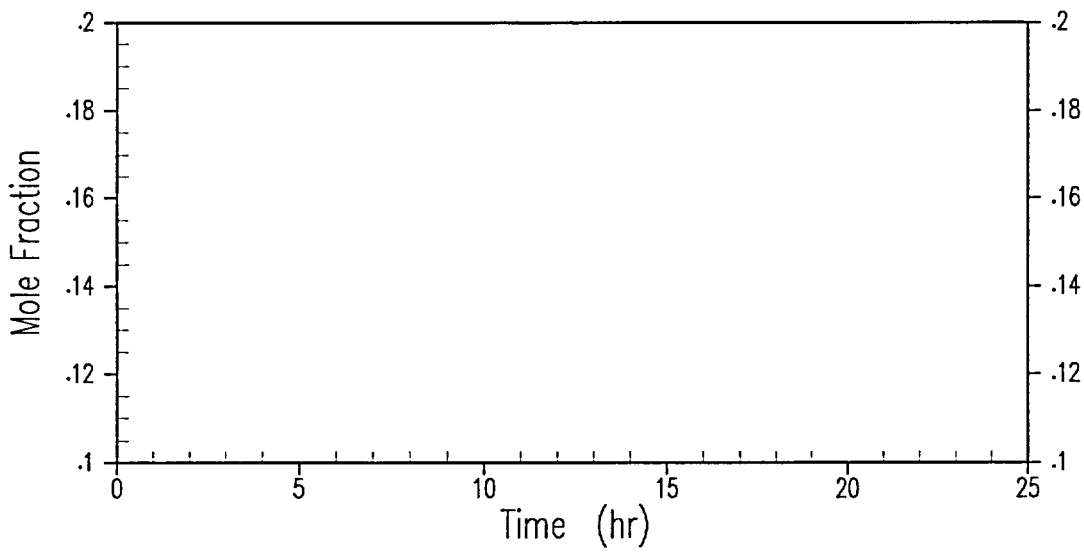

Figure 41A-102

Case 3BE-8: Equivalence Ratio in PXS SGTR

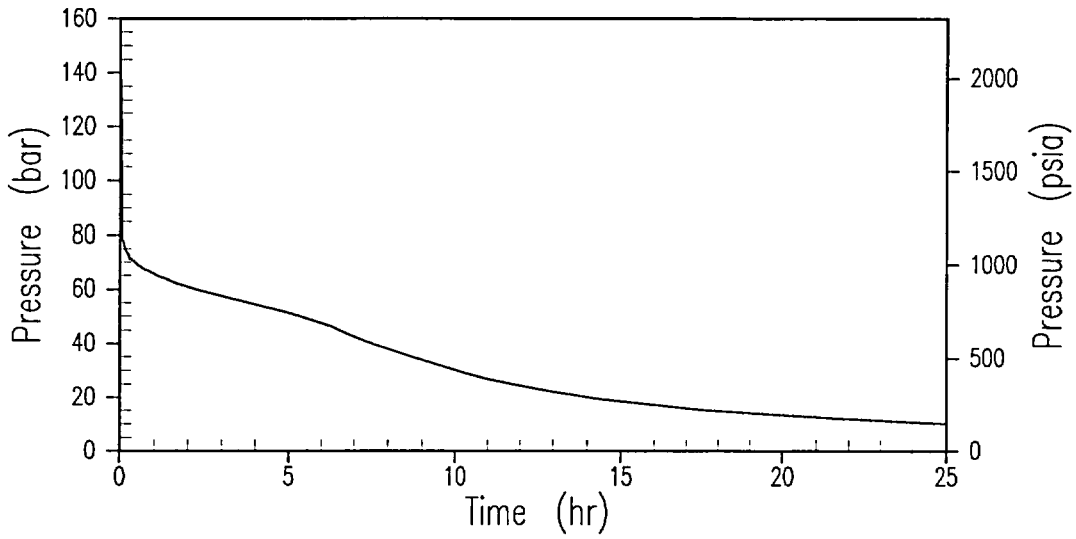

Figure 41A-103

Case 3BE-9: Reactor Coolant System Pressure SGTR

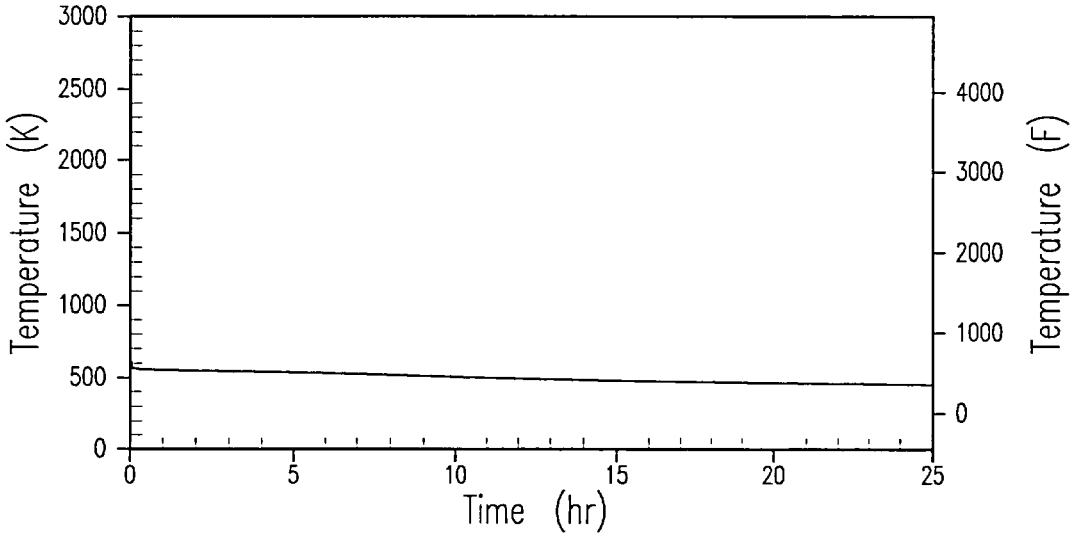

Figure 41A-104

Case 3BE-9: Core-Exit Gas Temperature SGTR

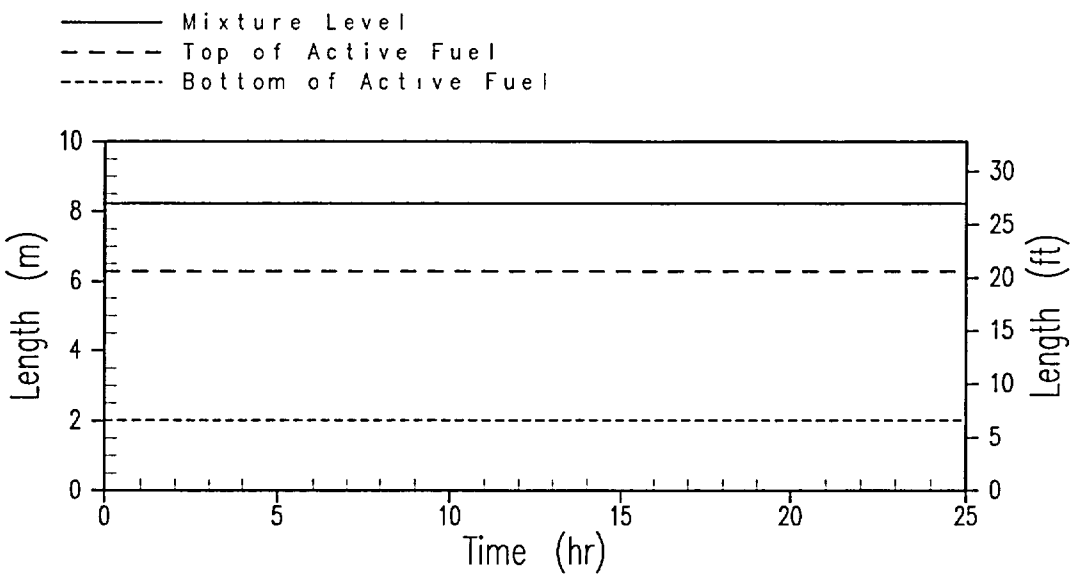

Figure 41A-105

Case 3BE-9: Reactor Vessel Mixture Level SGTR

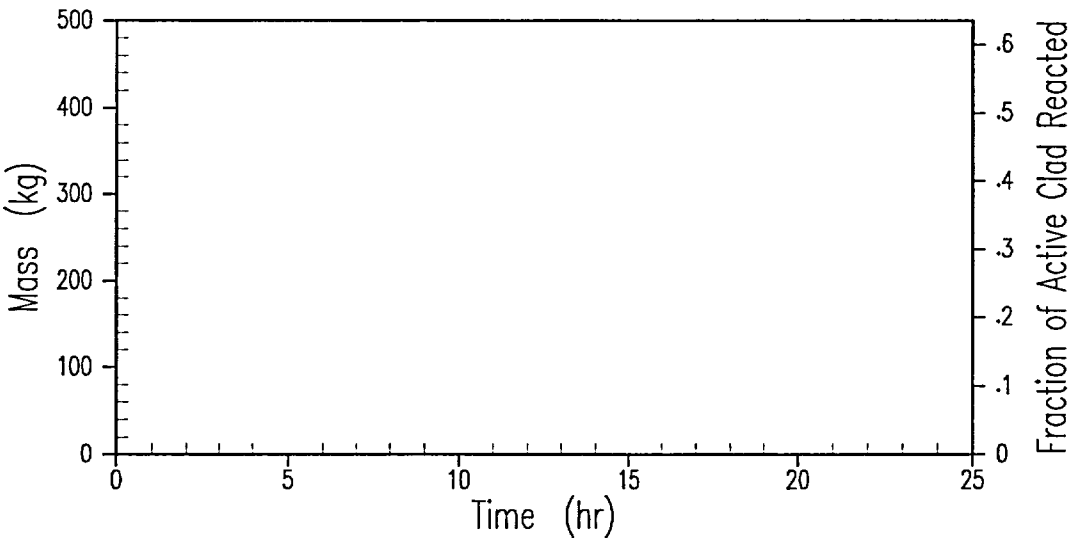

Figure 41A-106

Case 3BE-9: Hydrogen Generated In-Vessel SGTR

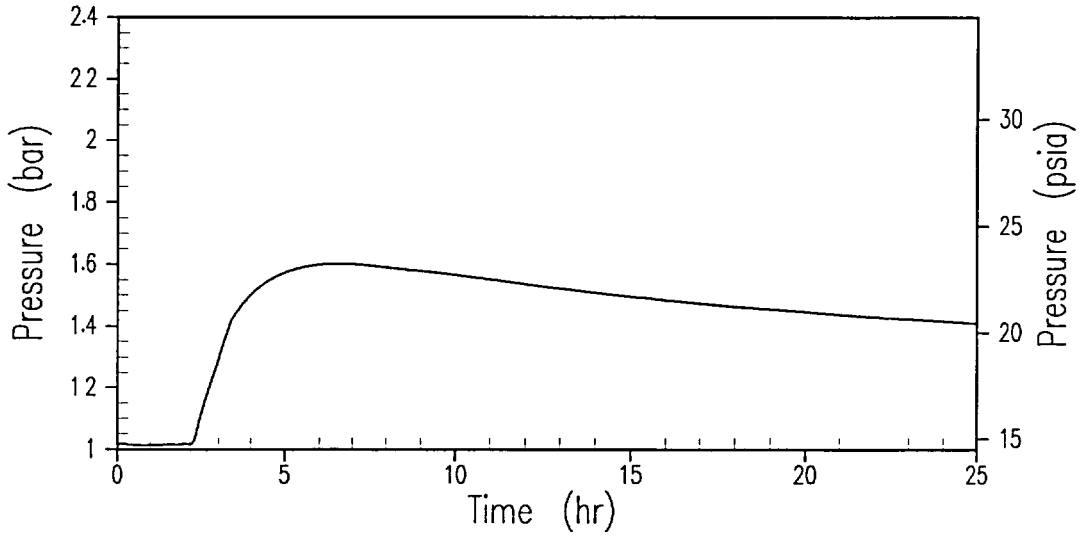

Figure 41A-107

Case 3BE-9: Containment Pressure SGTR

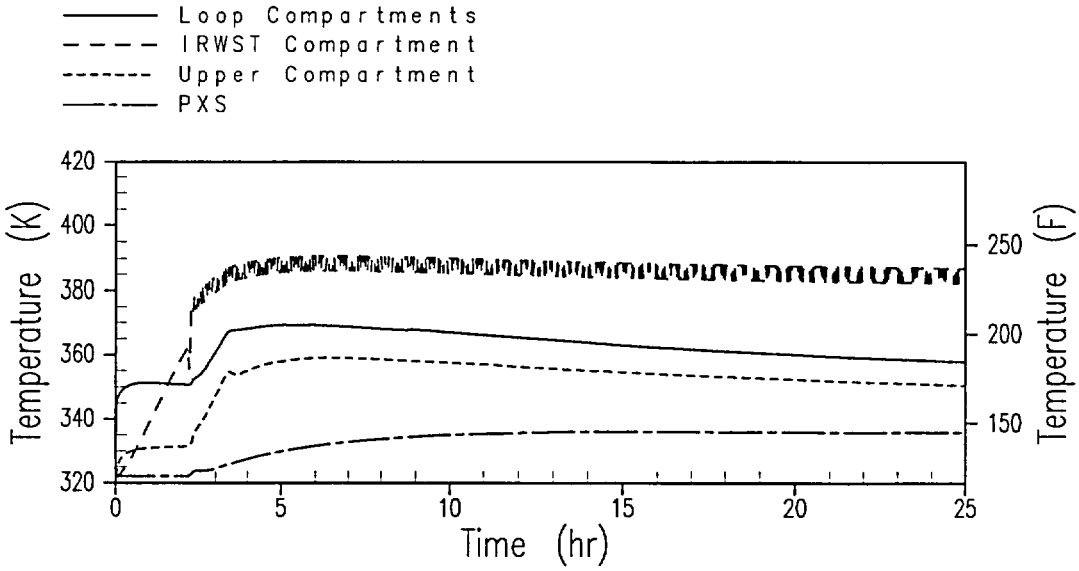

Figure 41A-108

Case 3BE-9: Containment Gas Temperature SGTR

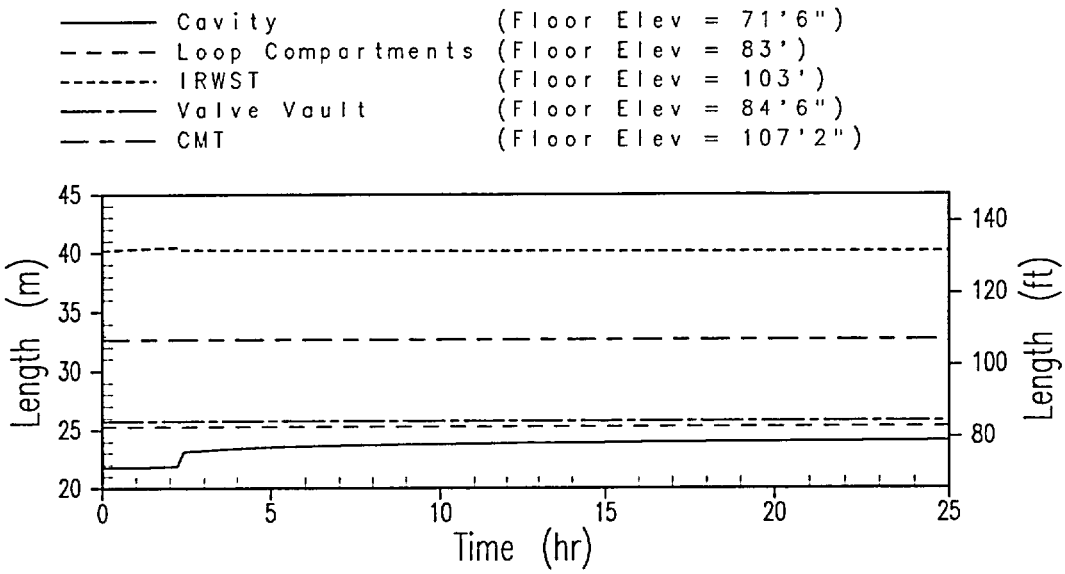

Figure 41A-109

Case 3BE-9: Containment Compartments Water Level SGTR

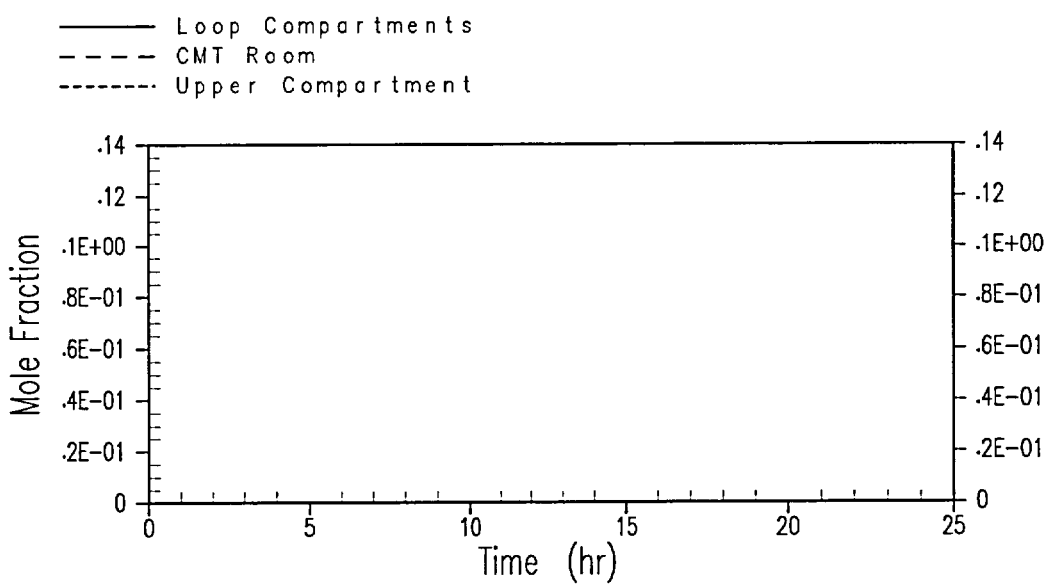

Figure 41A-110

Case 3BE-9: Well-Mixed Compartment Hydrogen Concentration SGTR

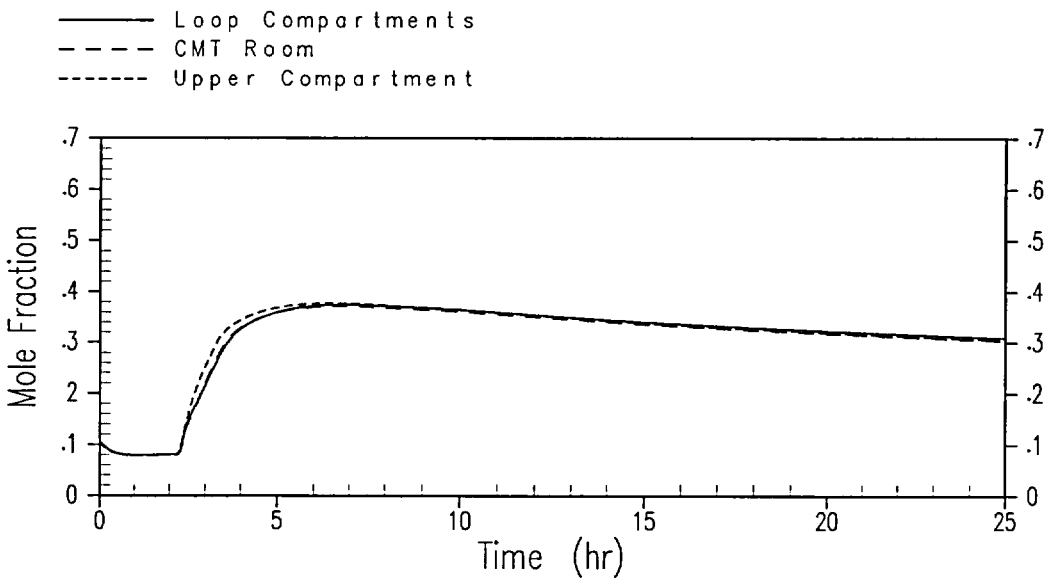

Figure 41A-111

Case 3BE-9: Well-Mixed Compartment Steam Concentration SGTR

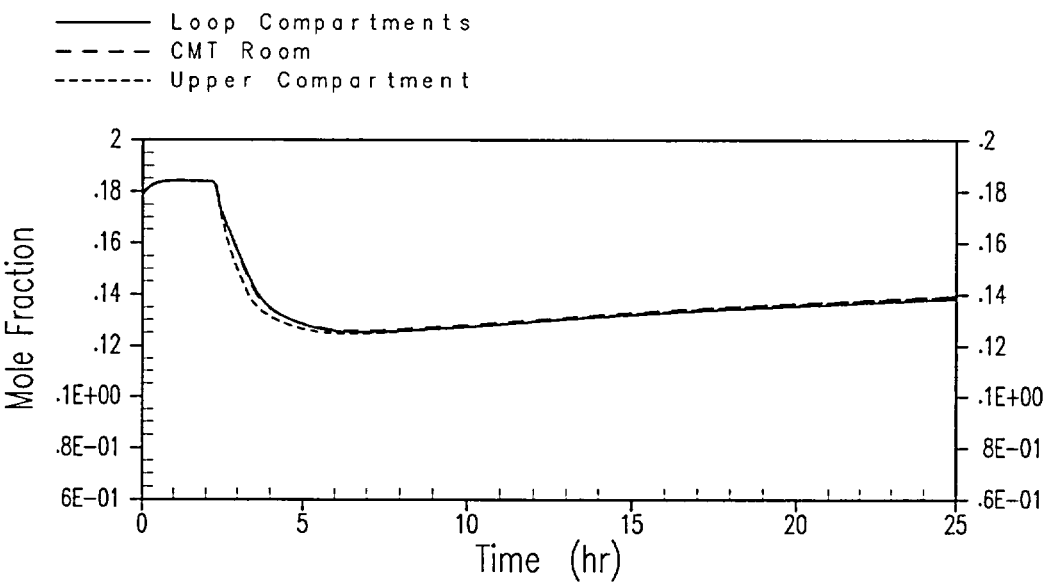

Figure 41A-112

Case 3BE-9: Well-Mixed Compartment Oxygen Concentration SGTR

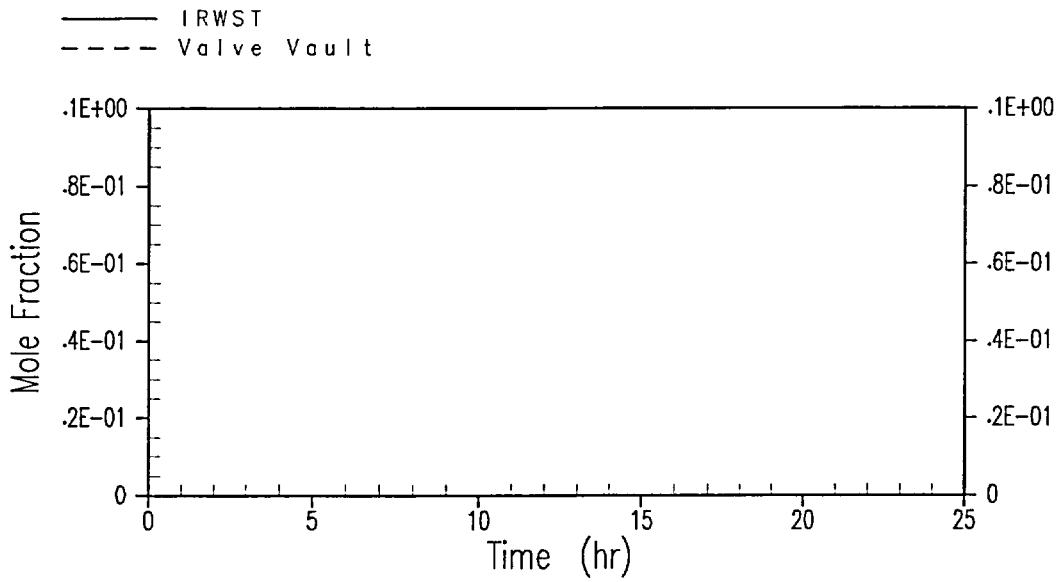

Figure 41A-113

Case 3BE-9: Confined Compartment Hydrogen Concentration SGTR

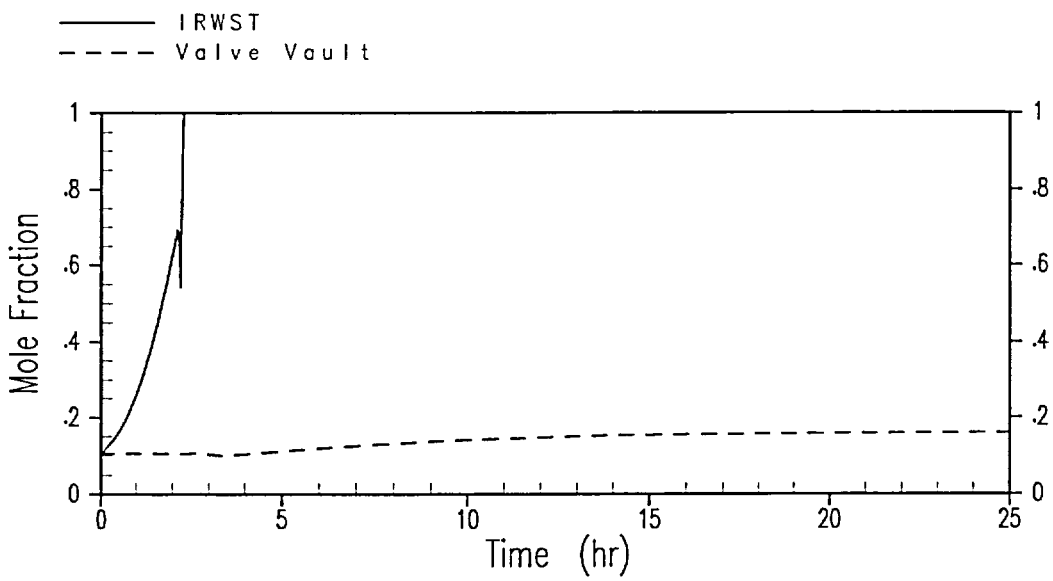

Figure 41A-114

Case 3BE-9: Confined Compartment Steam Concentration SGTR

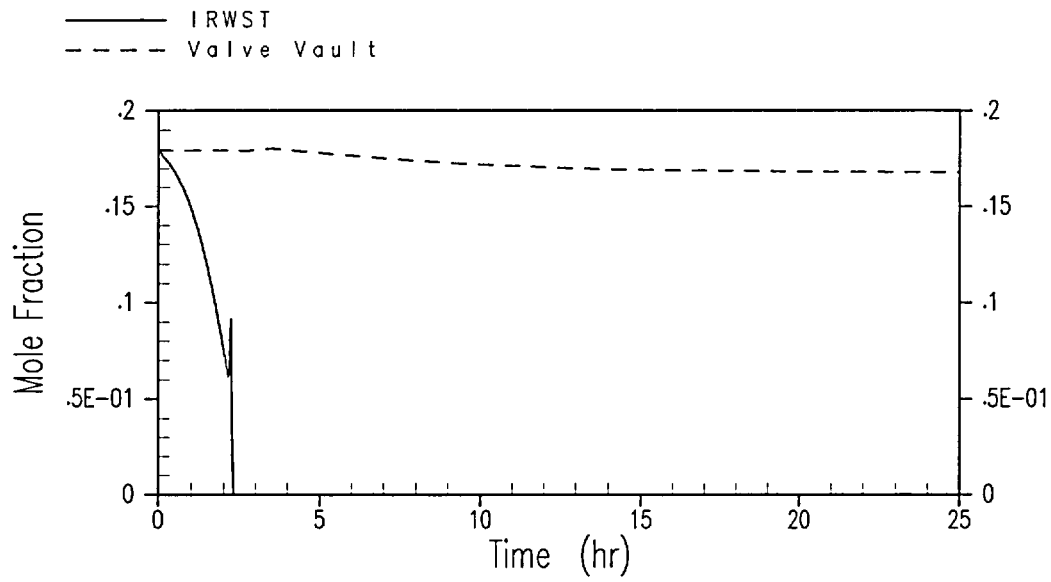

Figure 41A-115

Case 3BE-9: Confined Compartment Oxygen Concentration SGTR

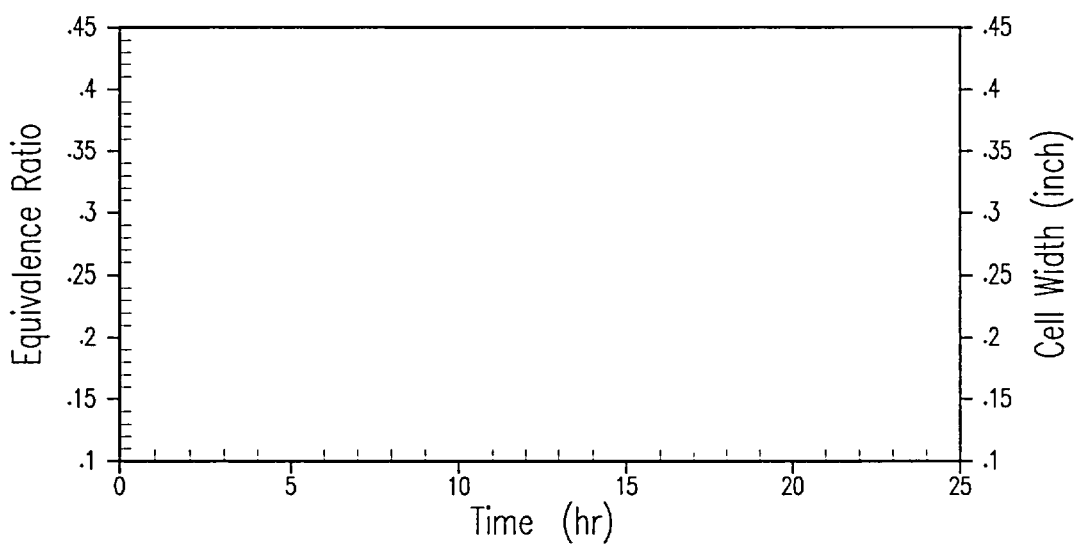

Figure 41A-116

Case 3BE-9: Equivalence Ratio in SG Room SGTR

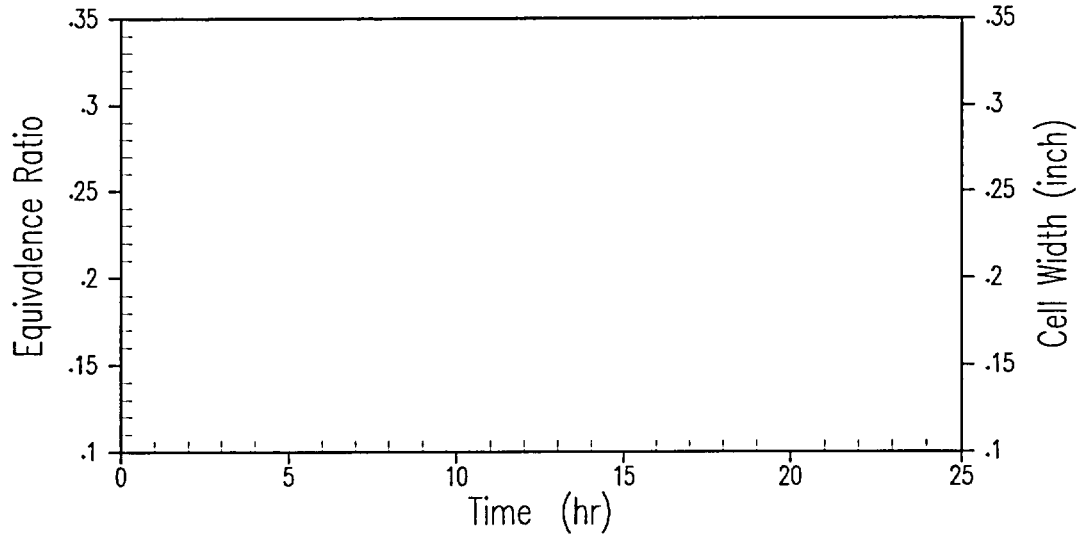

Figure 41A-117

Case 3BE-9: Equivalence Ratio in CMT Room SGTR

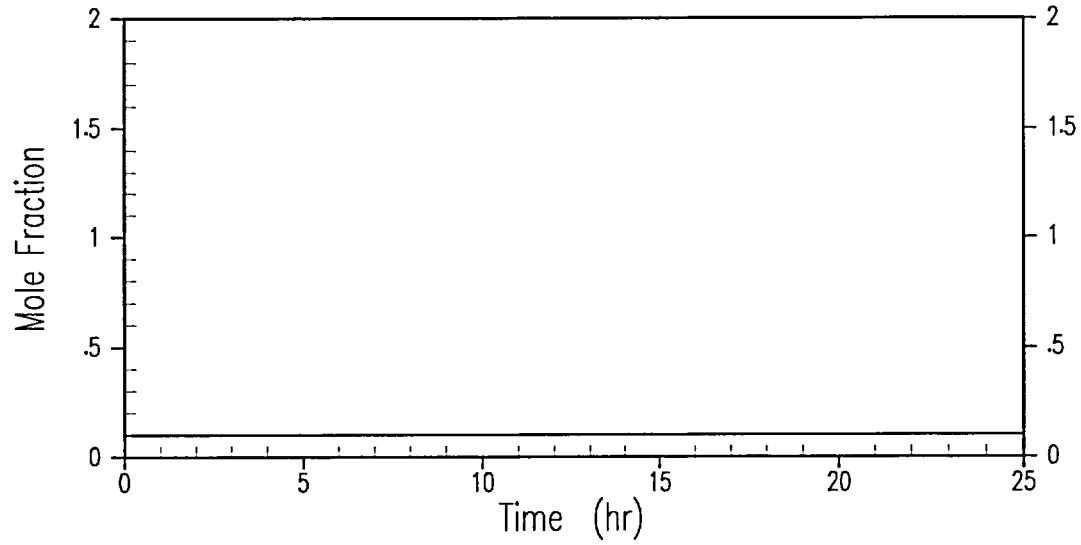

Figure 41A-118

Case 3BE-9: Equivalence Ratio in IRWST SGTR

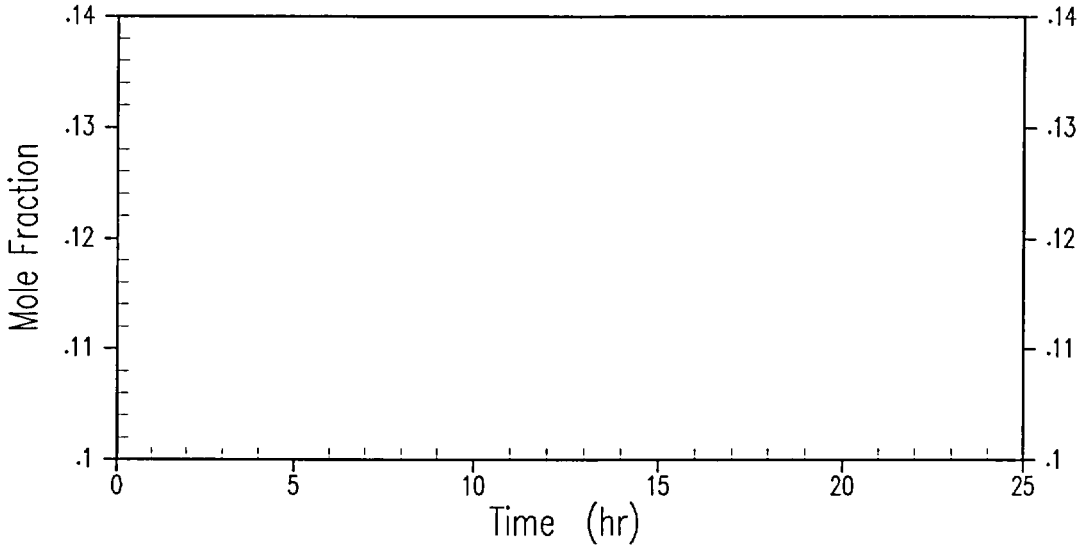

Figure 41A-119

Case 3BE-9: Equivalence Ratio in PXS SGTR

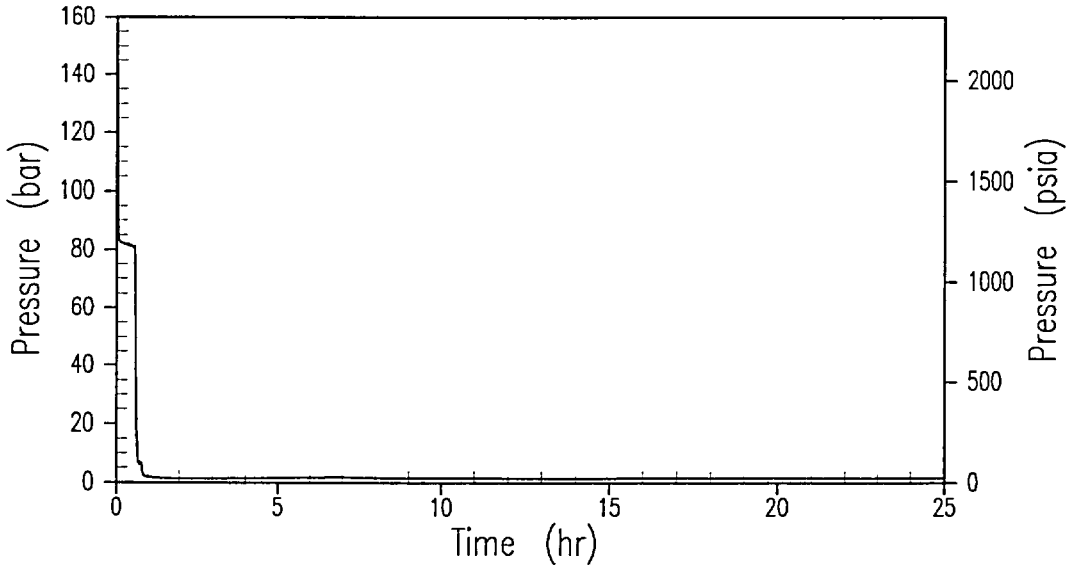

Figure 41A-120

Case 3BL-1: Reactor Coolant System Pressure SBLOCA with Failed Gravity Recirculation

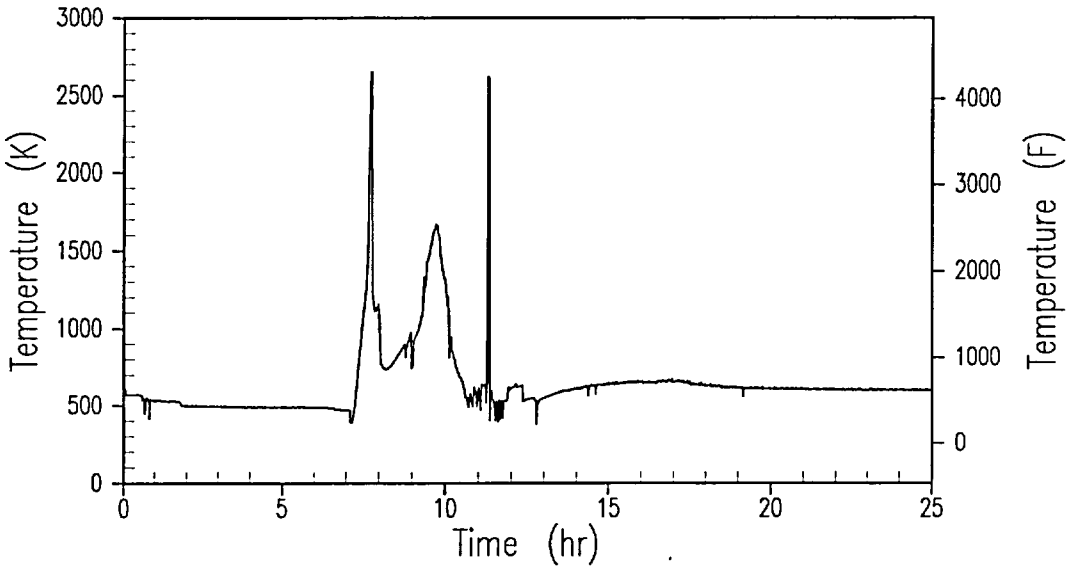

Figure 41A-121

Case 3BL-1: Core-Exit Gas Temperature SBLOCA with Failed Gravity Recirculation

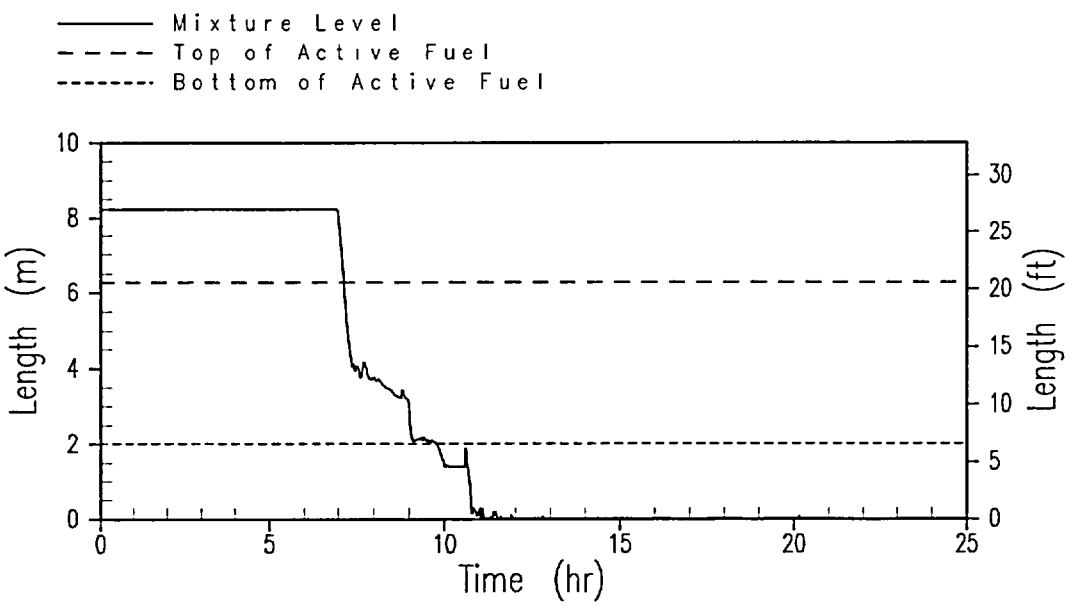

Figure 41A-122

Case 3BL-1: Reactor Vessel Mixture Level SBLOCA with Failed Gravity Recirculation

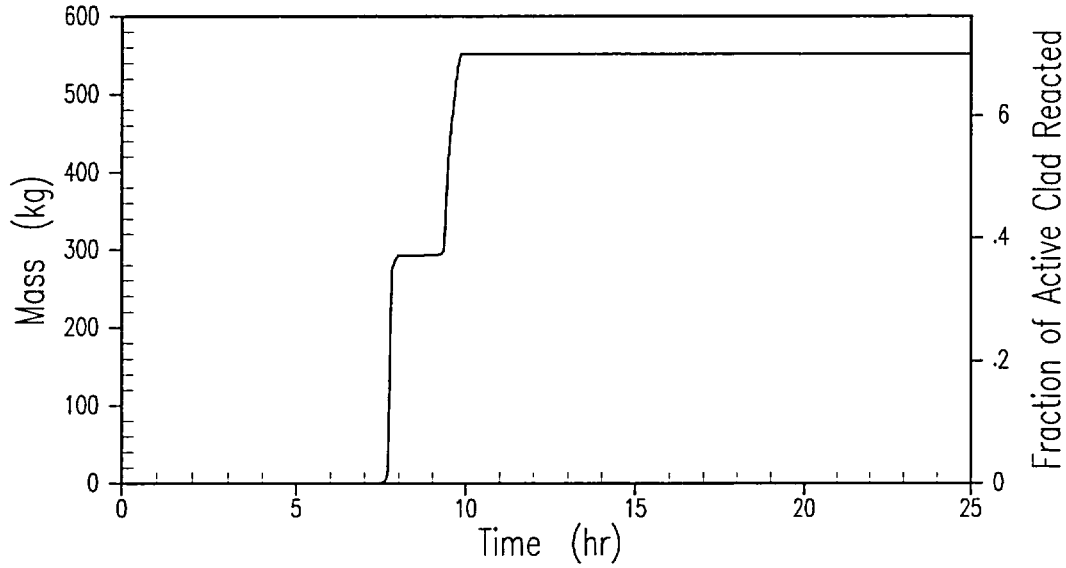

Figure 41A-123

Case 3BL-1: Hydrogen Generated In-Vessel SBLOCA with Failed Gravity Recirculation

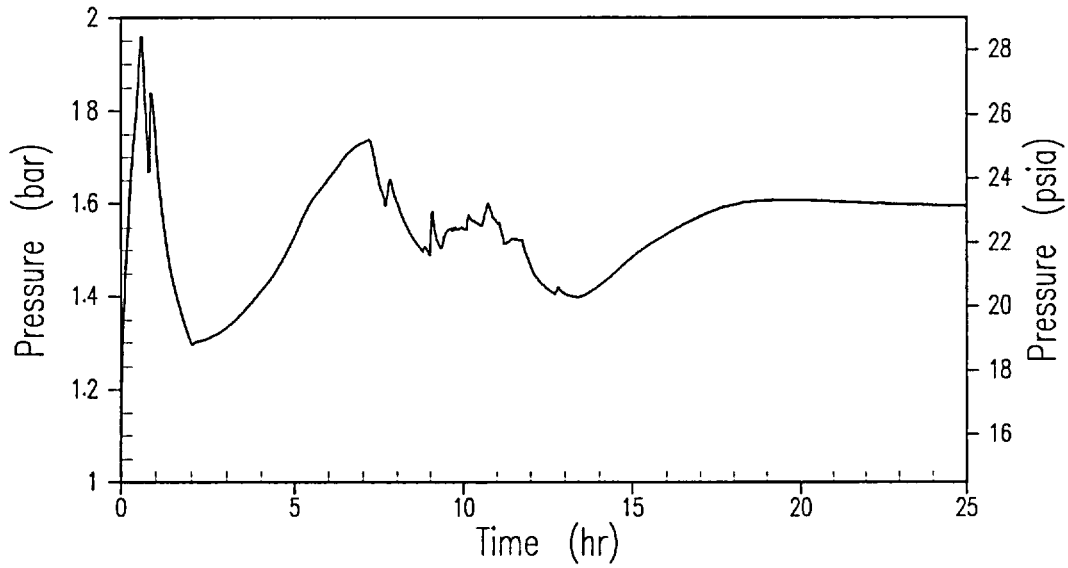

Figure 41A-124

Case 3BL-1: Containment Pressure SBLOCA with Failed Gravity Recirculation

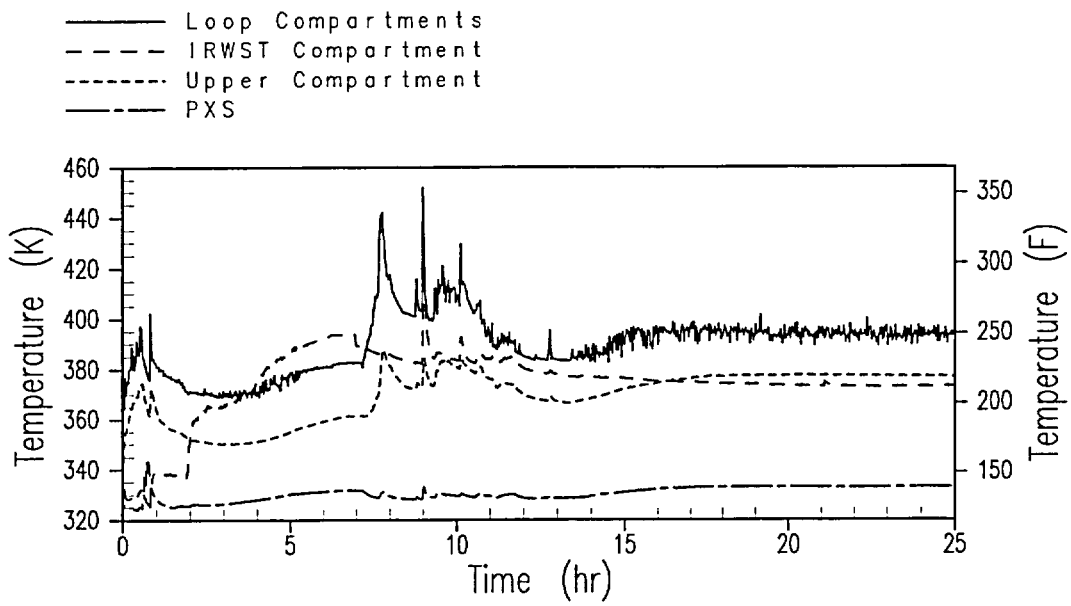

Figure 41A-125

Case 3BL-1: Containment Gas Temperature SBLOCA with Failed Gravity Recirculation

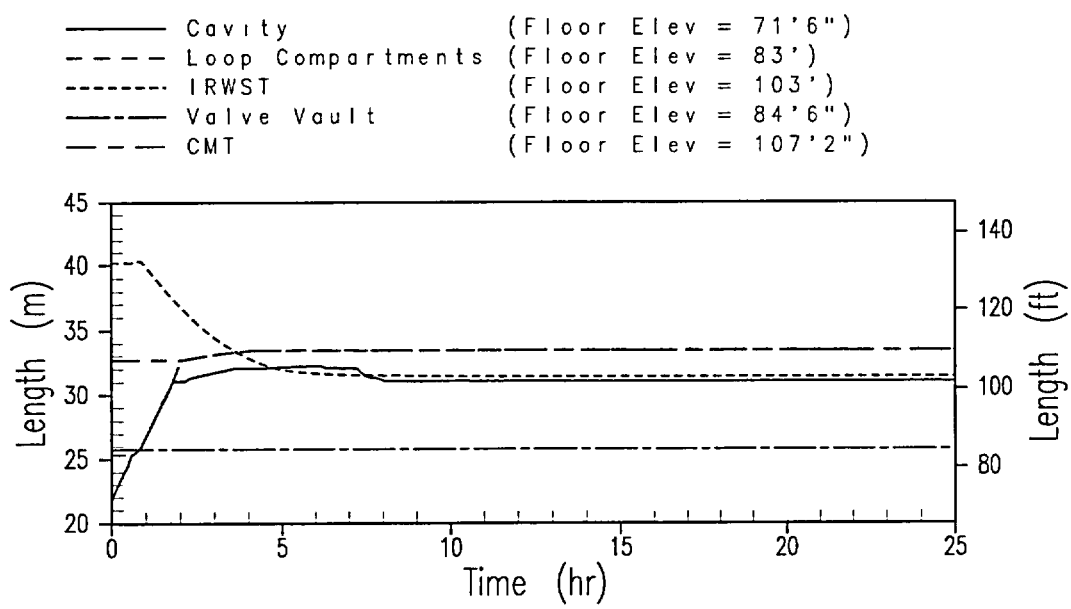

Figure 41A-126

Case 3BL-1: Containment Compartments Water Level SBLOCA with Failed Gravity Recirculation

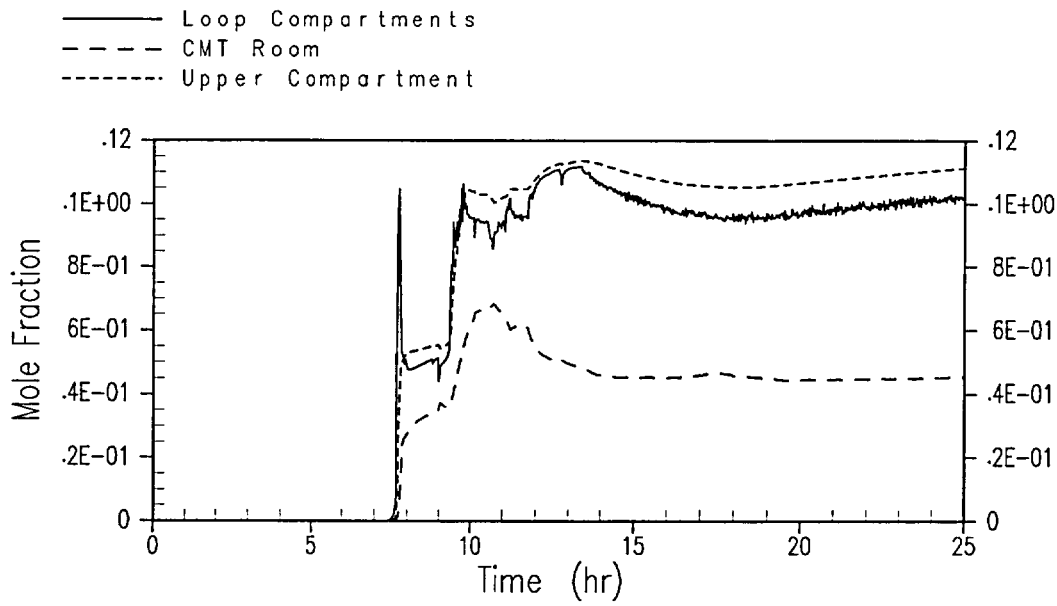

Figure 41A-127

Case 3BL-1: Well-Mixed Compartment Hydrogen Concentration SBLOCA with Failed Gravity Recirculation

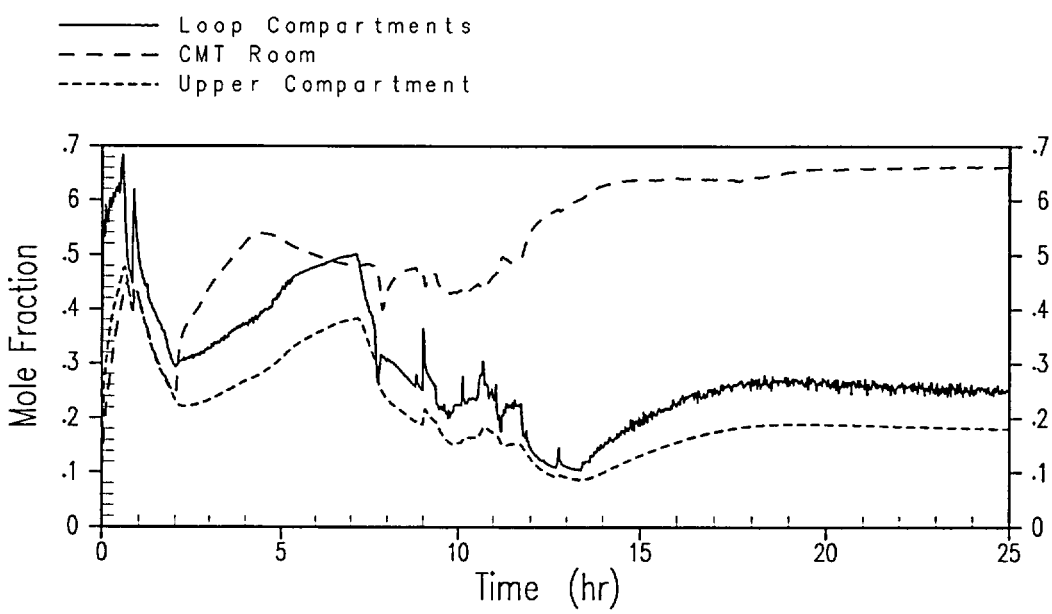

Figure 41A-128

Case 3BL-1: Well-Mixed Compartment Steam Concentration SBLOCA with Failed Gravity Recirculation

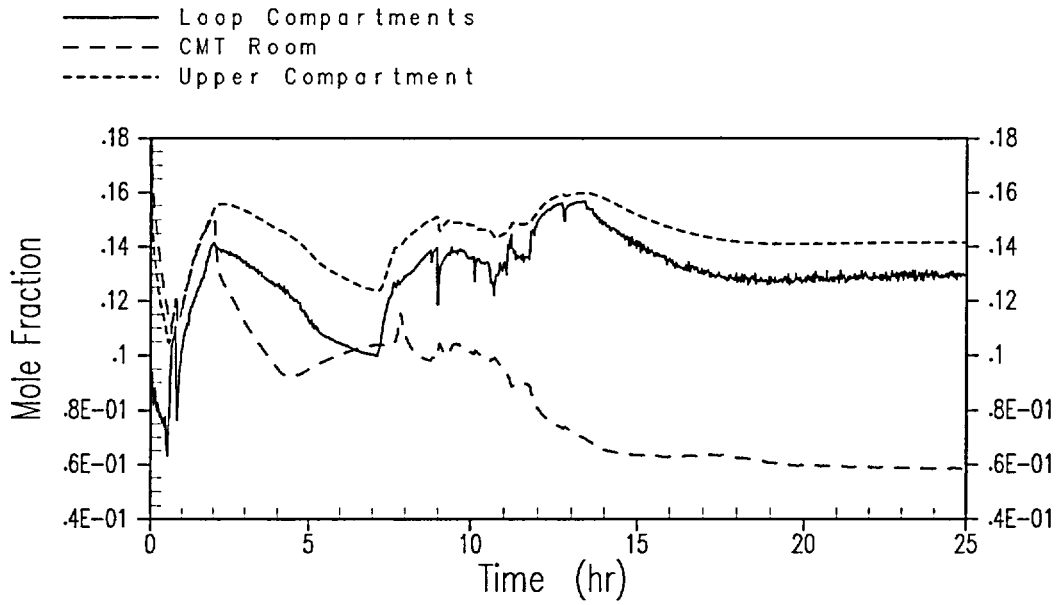

Figure 41A-129

Case 3BL-1: Well-Mixed Compartment Oxygen Concentration SBLOCA with Failed Gravity Recirculation

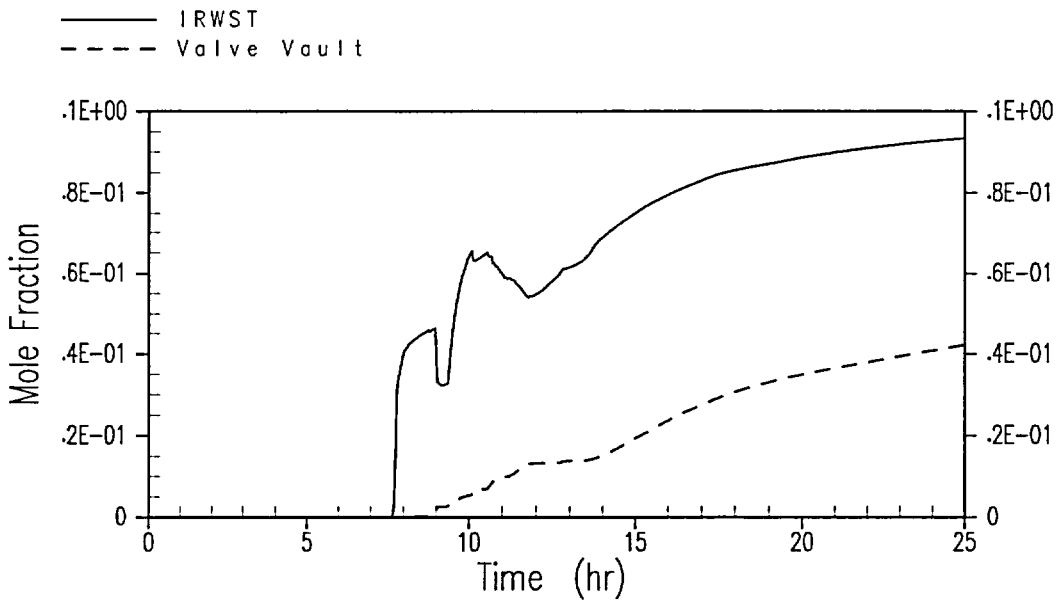

Figure 41A-130

Case 3BL-1: Confined Compartment Hydrogen Concentration SBLOCA with Failed Gravity Recirculation

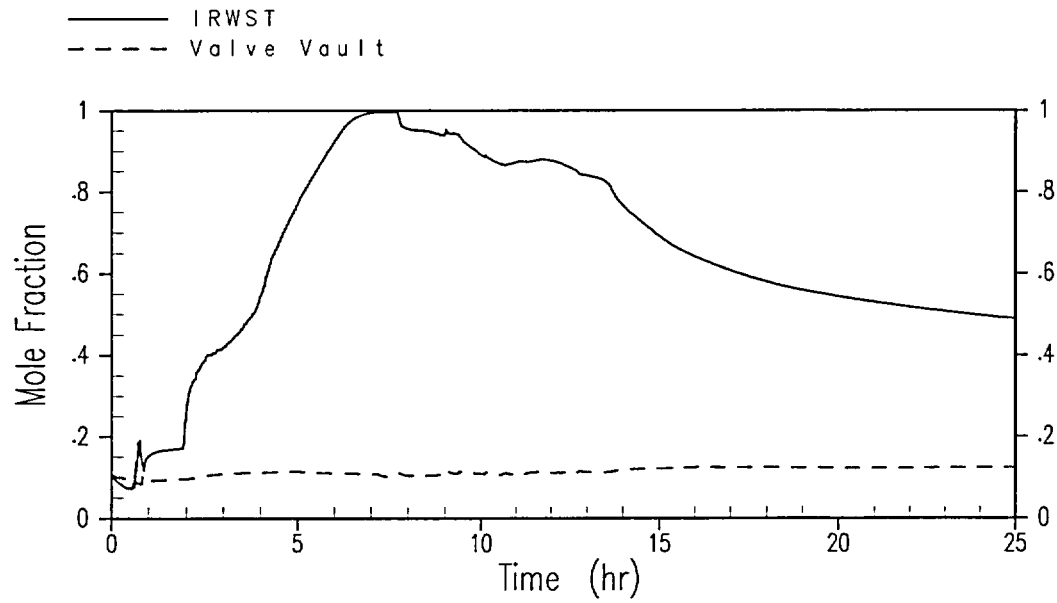

Figure 41A-131

Case 3BL-1: Confined Compartment Steam Concentration SBLOCA with Failed Gravity Recirculation

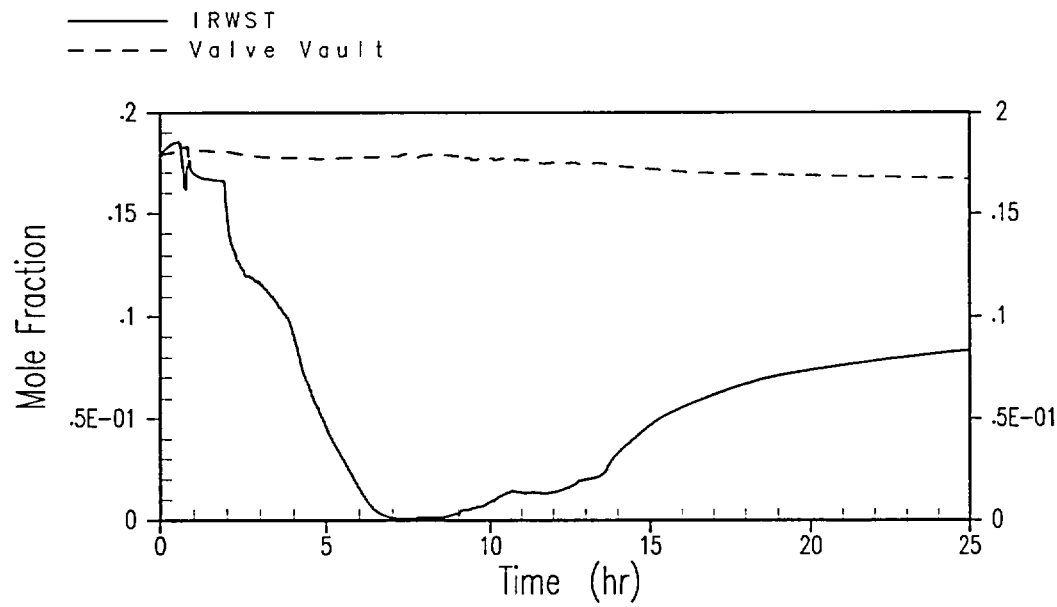

Figure 41A-132

Case 3BL-1: Confined Compartment Oxygen Concentration SBLOCA with Failed Gravity Recirculation

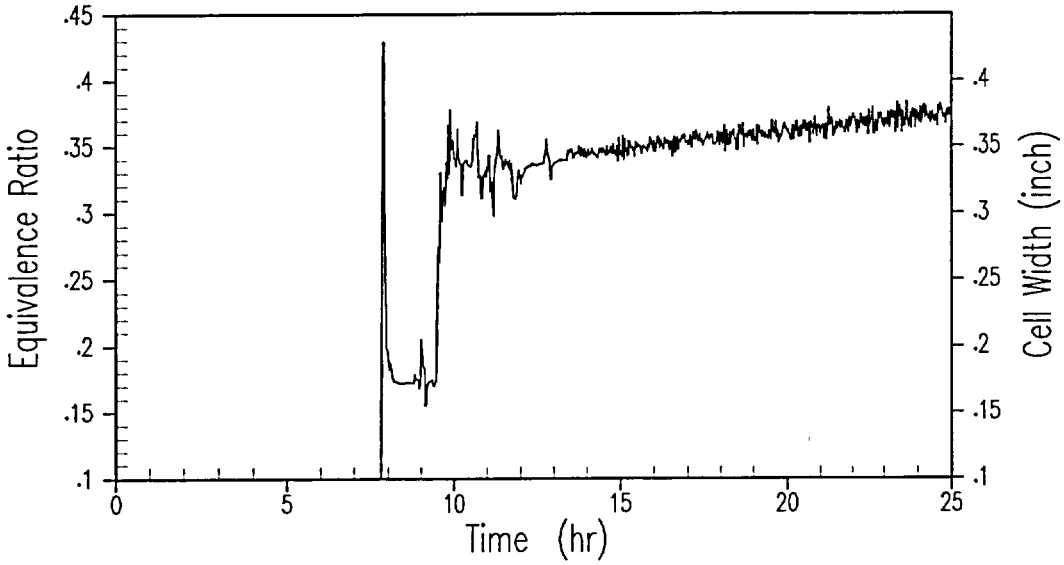

Figure 41A-133

Case 3BL-1: Equivalence Ratio in SG Room SBLOCA with Failed Gravity Recirculation

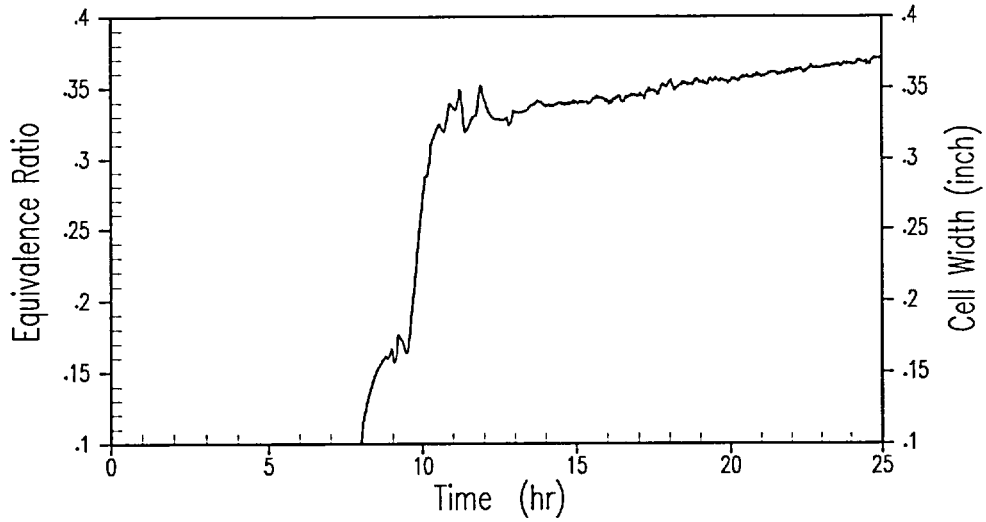

Figure 41A-134

Case 3BL-1: Equivalence Ratio in CMT Room SBLOCA with Failed Gravity Recirculation

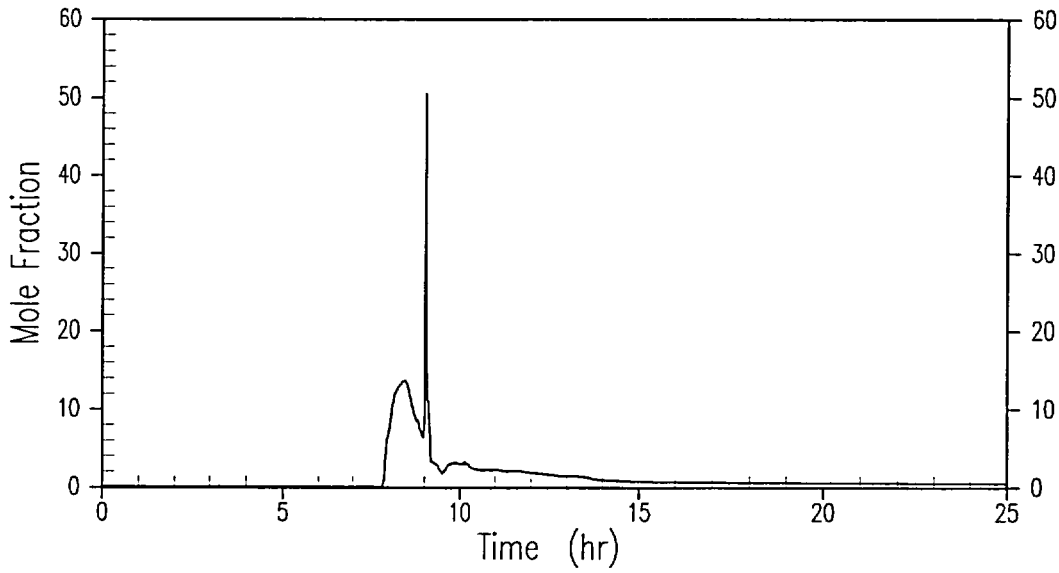

Figure 41A-135

Case 3BL-1: Equivalence Ratio in IRWST SBLOCA with Failed Gravity Recirculation

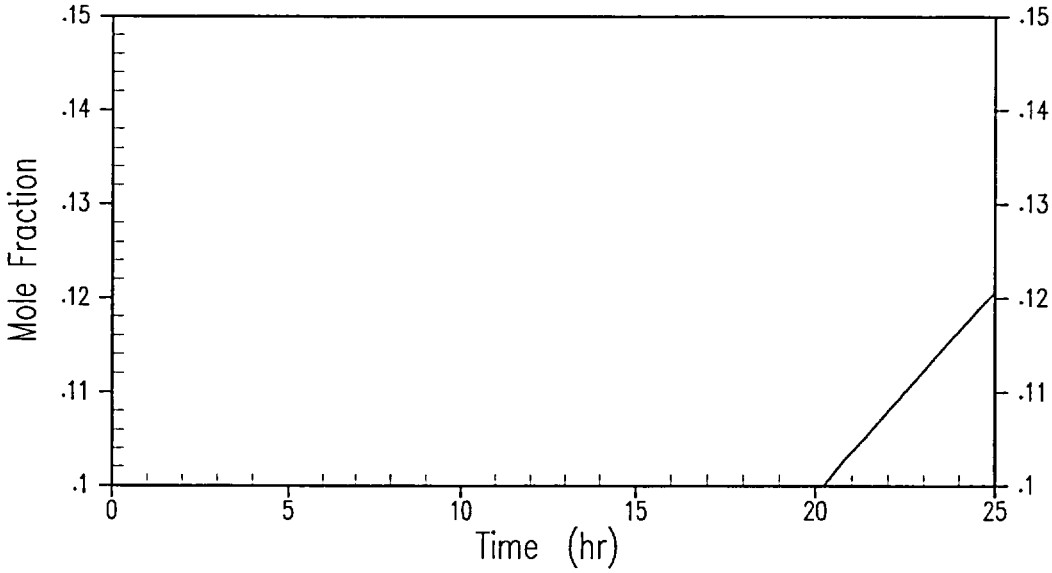

Figure 41A-136

Case 3BL-1: Equivalence Ratio in PXS SBLOCA with Failed Gravity Recirculation

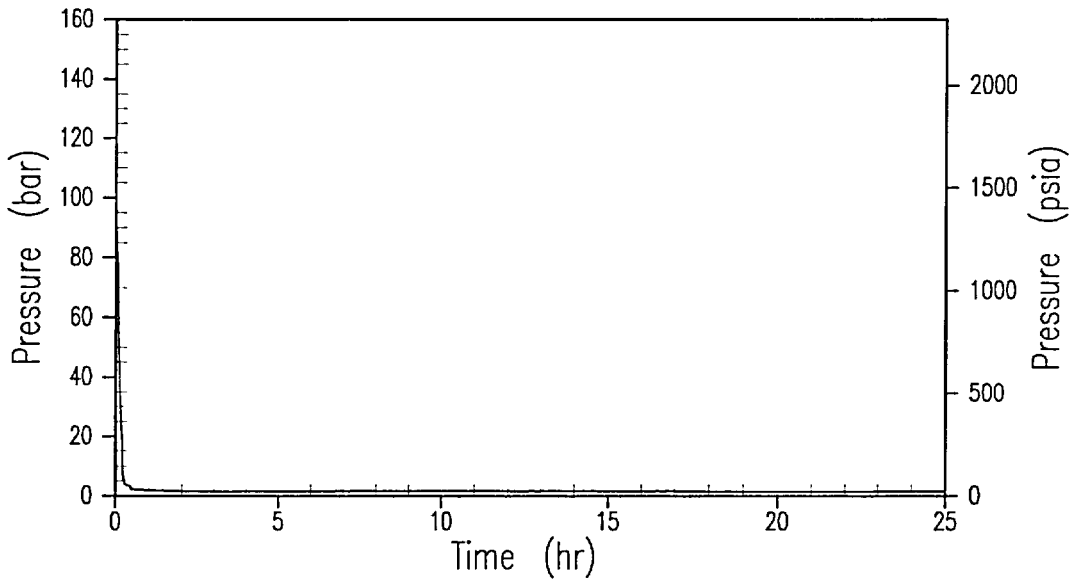

Figure 41A-137

Case 3BL-2: Reactor Coolant System Pressure
DVI Line Break with Failed Gravity Recirculation

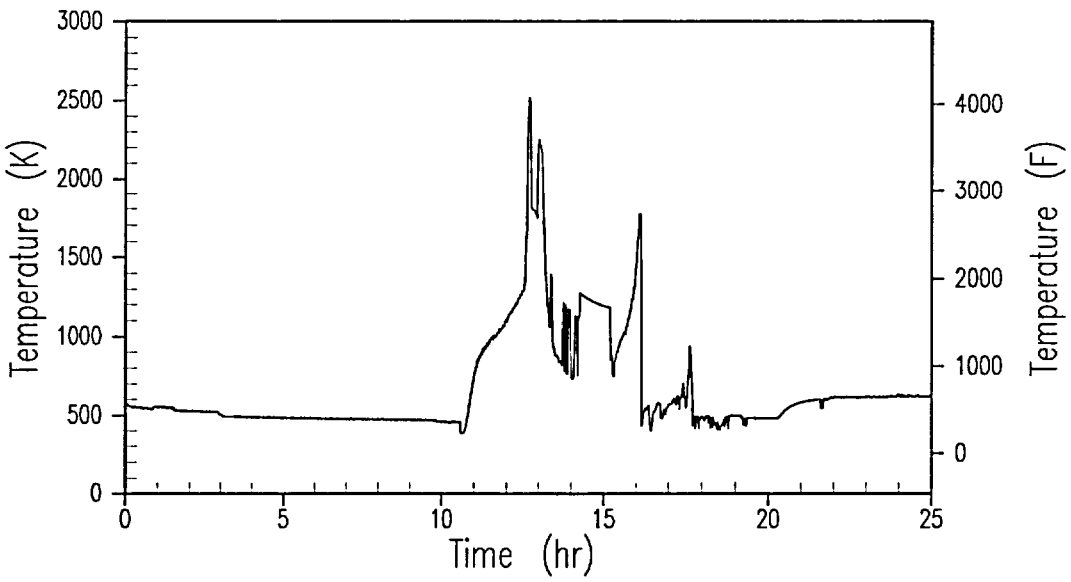

Figure 41A-138

Case 3BL-2: Core-Exit Gas Temperature
DVI Line Break with Failed Gravity Recirculation

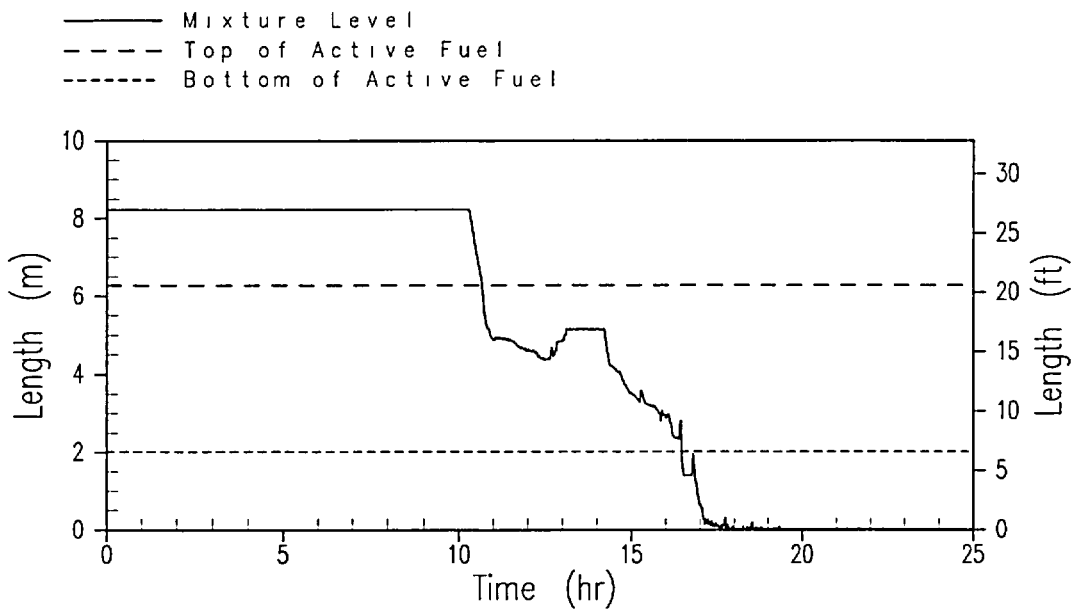

Figure 41A-139

Case 3BL-2: Reactor Vessel Mixture Level
DVI Line Break with Failed Gravity Recirculation

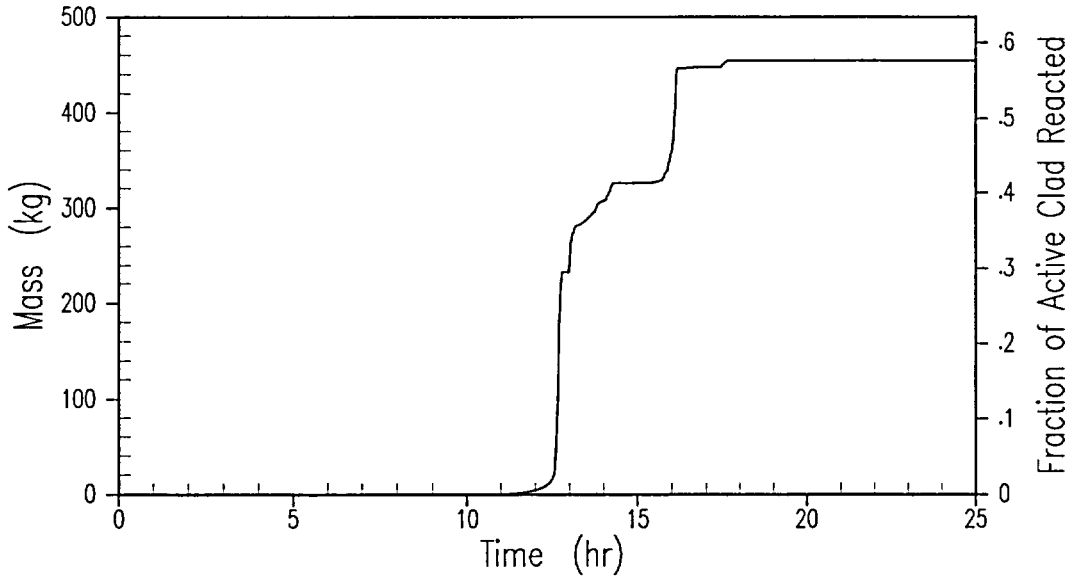

Figure 41A-140

Case 3BL-2: Hydrogen Generated In-Vessel
DVI Line Break with Failed Gravity Recirculation

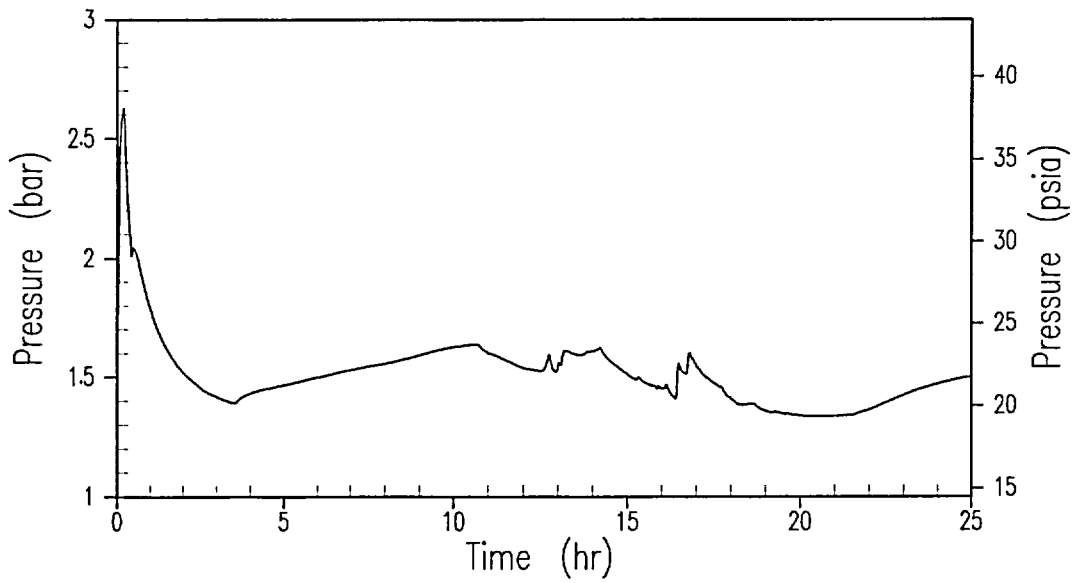

Figure 41A-141

Case 3BL-2: Containment Pressure
DVI Line Break with Failed Gravity Recirculation

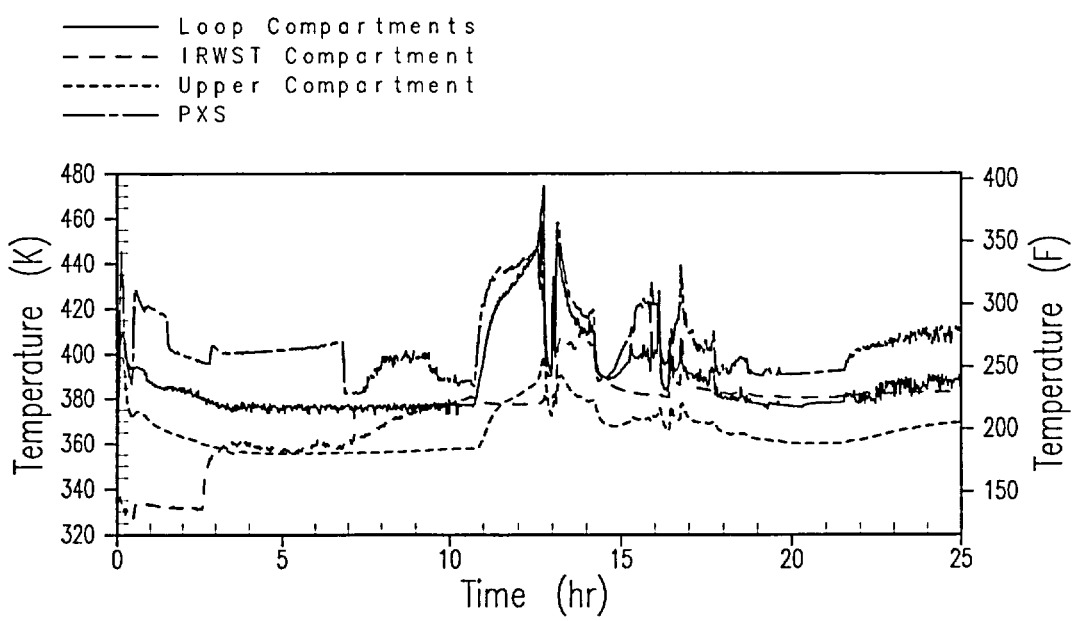

Figure 41A-142

Case 3BL-2: Containment Gas Temperature
DVI Line Break with Failed Gravity Recirculation

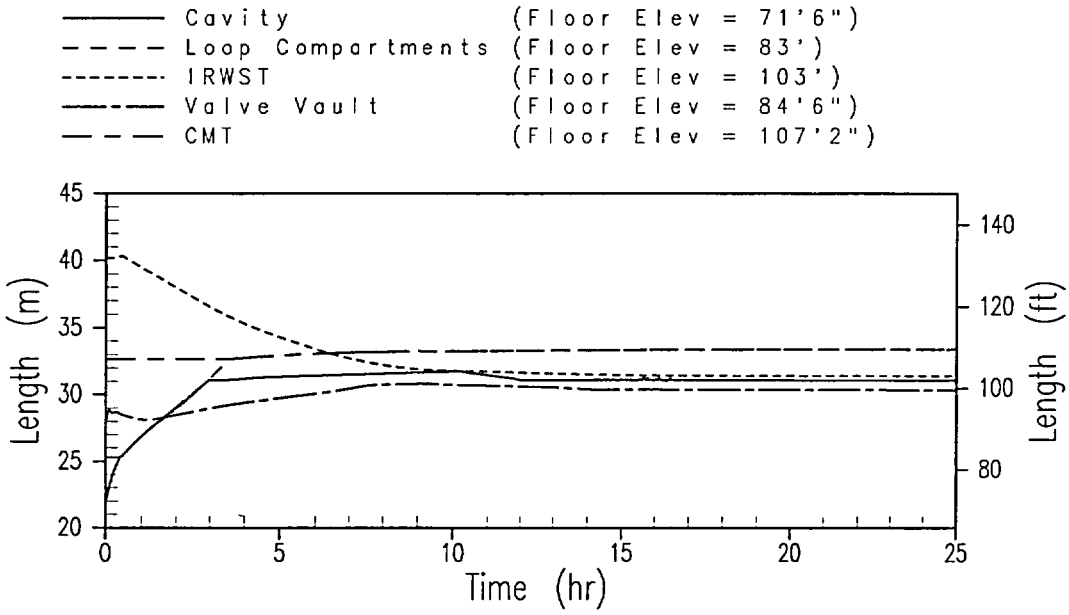

Figure 41A-143

Case 3BL-2: Containment Compartments Water Level
DVI Line Break with Failed Gravity Recirculation

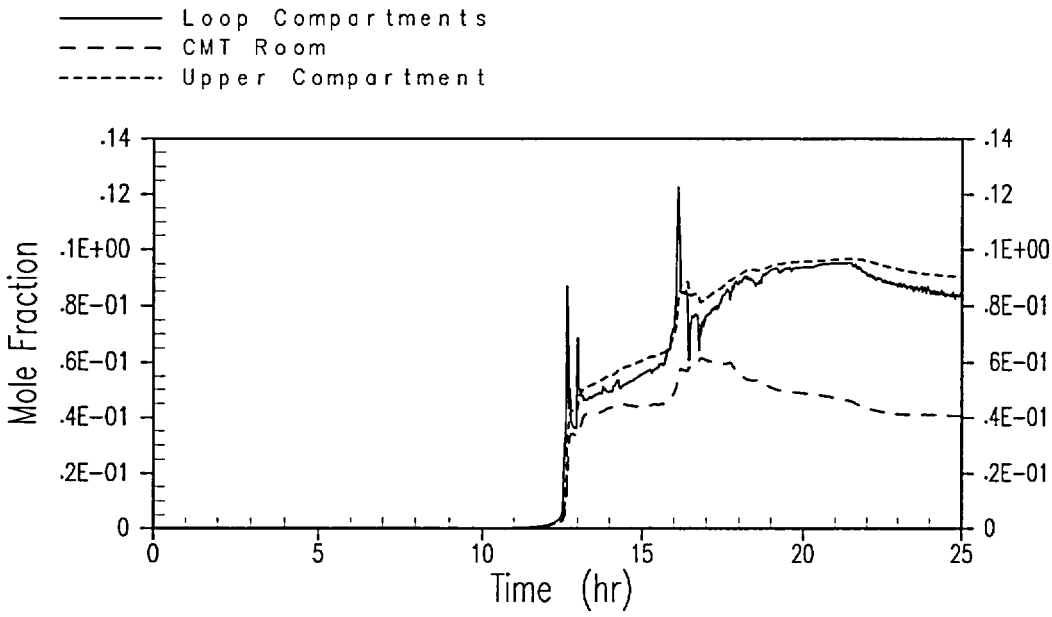

Figure 41A-144

Case 3BL-2: Well-Mixed Compartment Hydrogen Concentration
DVI Line Break with Failed Gravity Recirculation

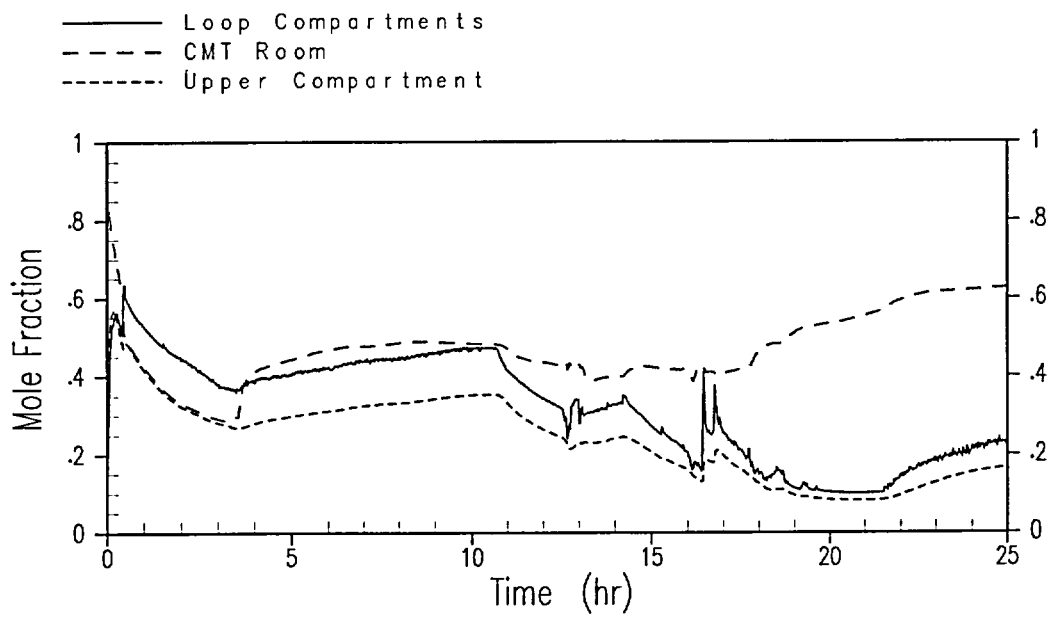

Figure 41A-145

Case 3BL-2: Well-Mixed Compartment Steam Concentration DVI Line Break with Failed Gravity Recirculation

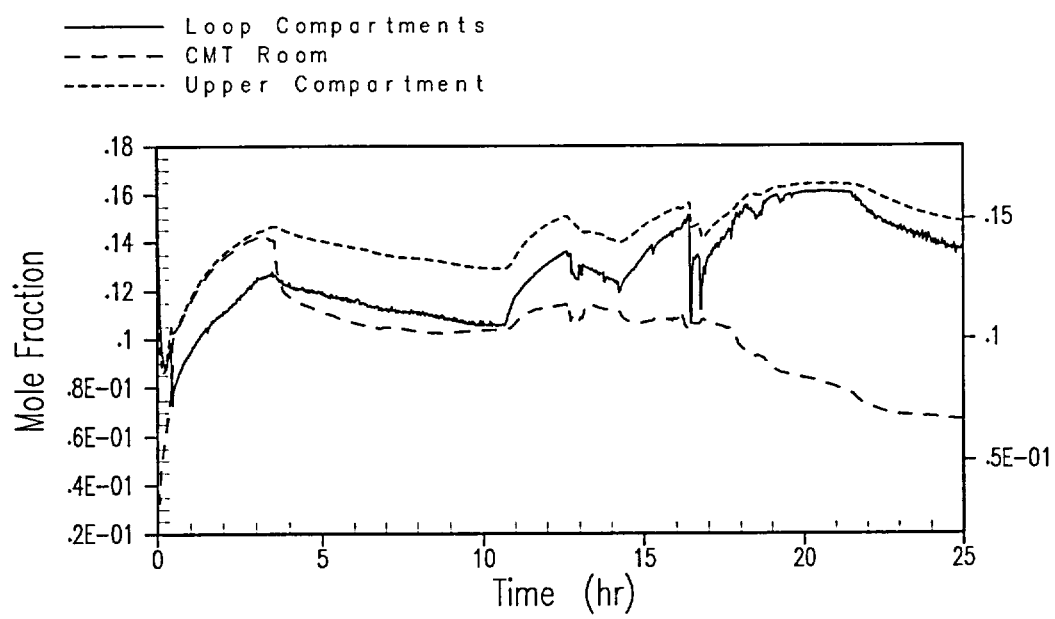

Figure 41A-146

Case 3BL-2: Well-Mixed Compartment Oxygen Concentration DVI Line Break with Failed Gravity Recirculation

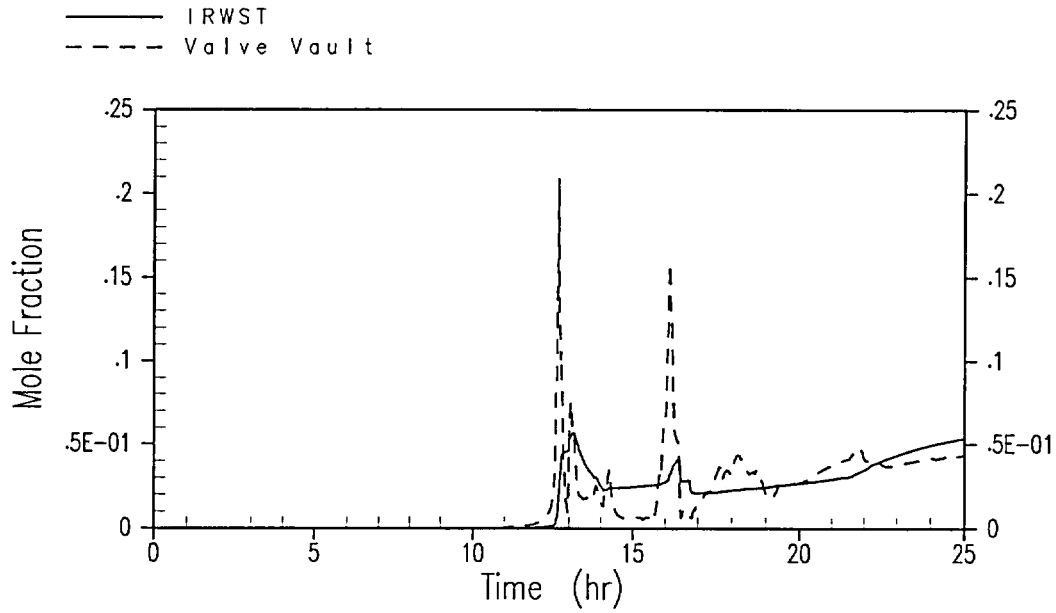

Figure 41A-147

Case 3BL-2: Confined Compartment Hydrogen Concentration DVI Line Break with Failed Gravity Recirculation

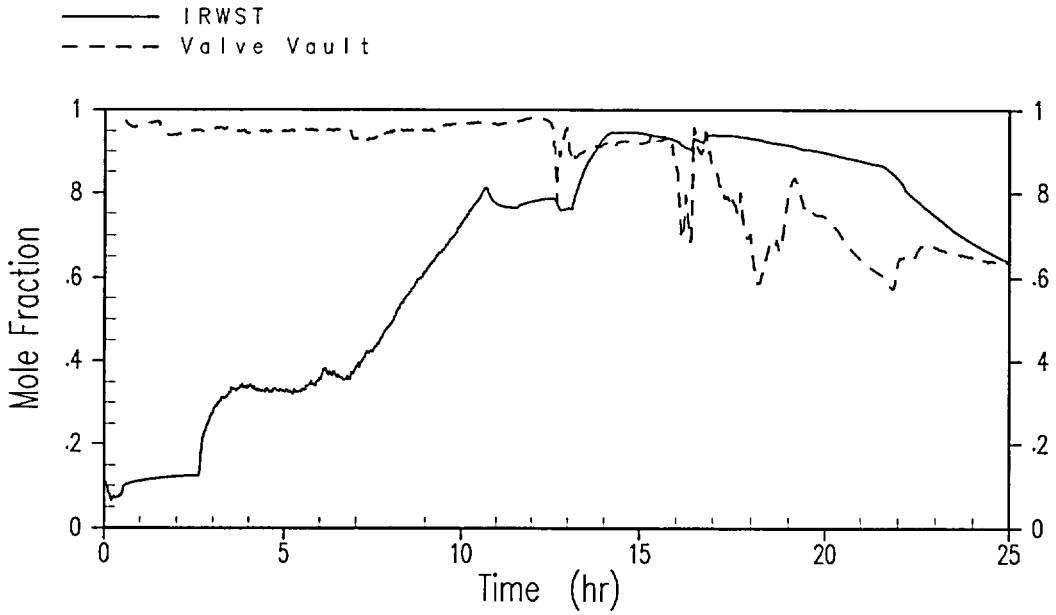

Figure 41A-148

Case 3BL-2: Confined Compartment Steam Concentration DVI Line Break with Failed Gravity Recirculation

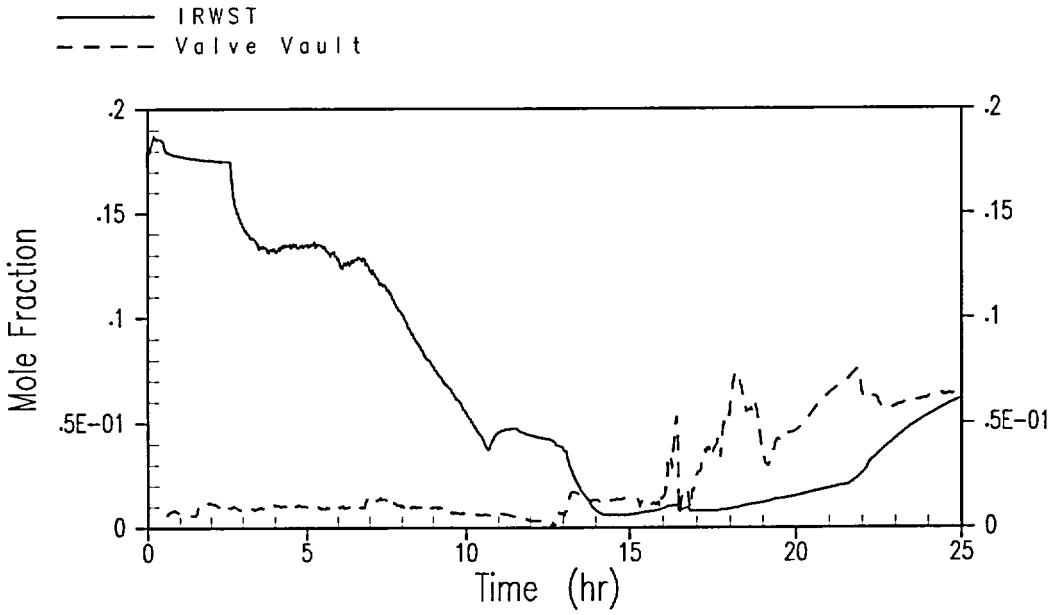

Figure 41A-149

Case 3BL-2: Confined Compartment Oxygen Concentration DVI Line Break with Failed Gravity Recirculation

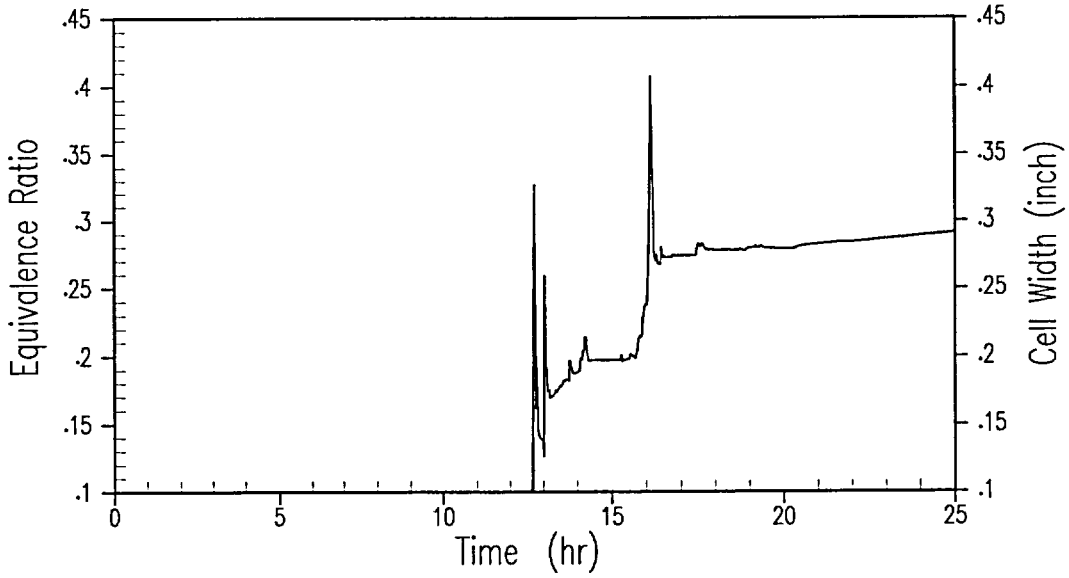

Figure 41A-150

Case 3BL-2: Equivalence Ratio in SG Room DVI Line Break with Failed Gravity Recirculation

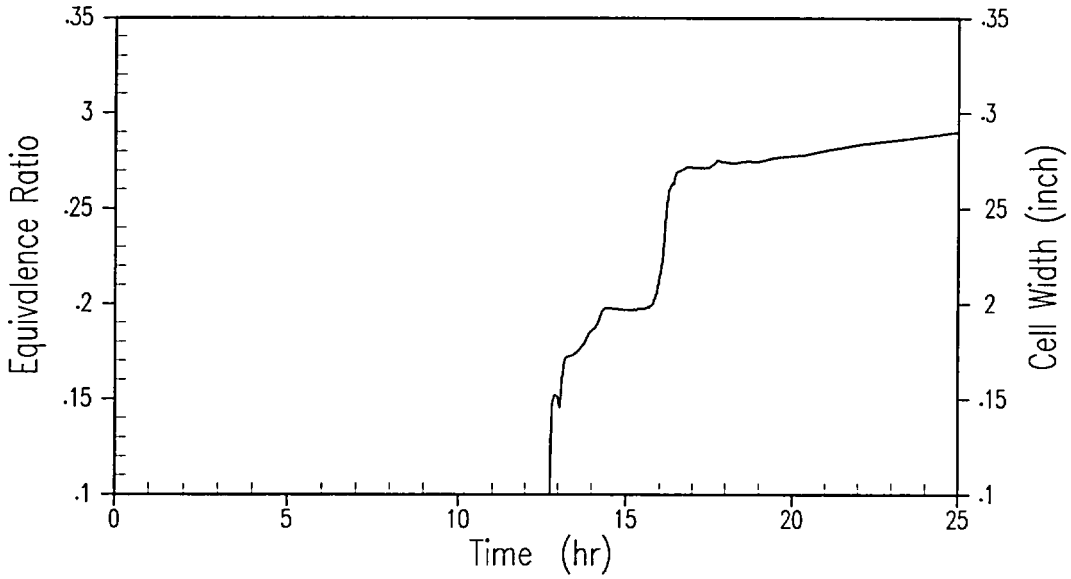

Figure 41A-151

Case 3BL-2: Equivalence Ratio in CMT Room
DVI Line Break with Failed Gravity Recirculation

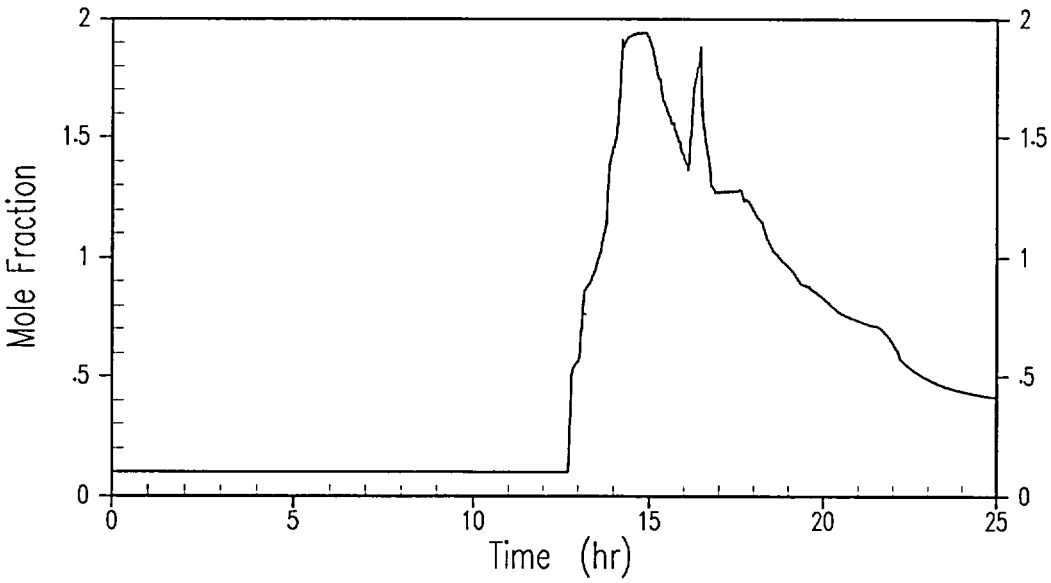

Figure 41A-152

Case 3BL-2: Equivalence Ratio in IRWST
DVI Line Break with Failed Gravity Recirculation

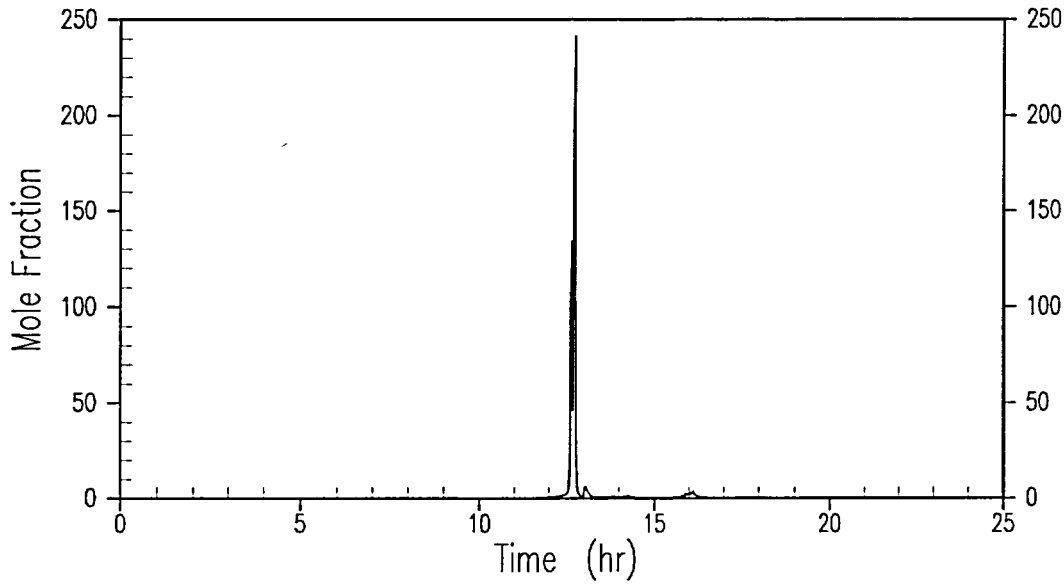

Figure 41A-153

Case 3BL-2: Equivalence Ratio in PXS DVI Line Break with Failed Gravity Recirculation

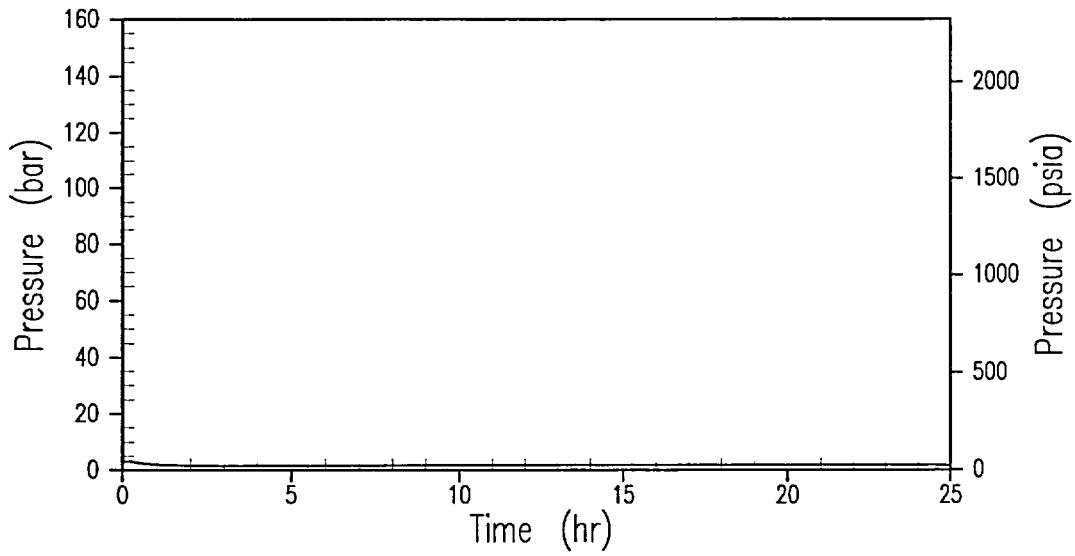

Figure 41A-154

Case 3BR-1: Reactor Coolant System Pressure CL LBLOCA with Accumulator Failure

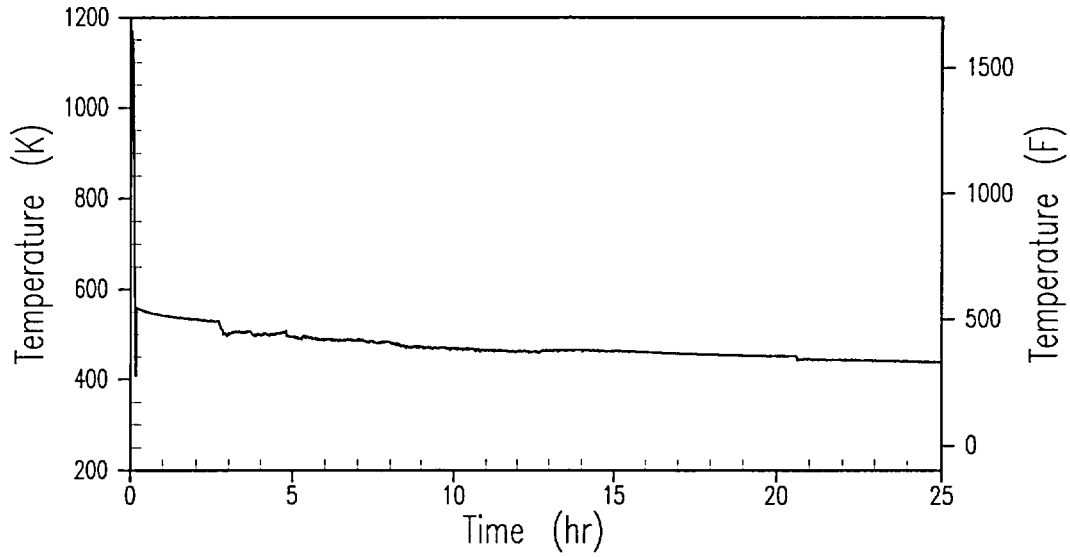

Figure 41A-155

Case 3BR-1: Core-Exit Gas Temperature
CL LBLOCA with Accumulator Failure

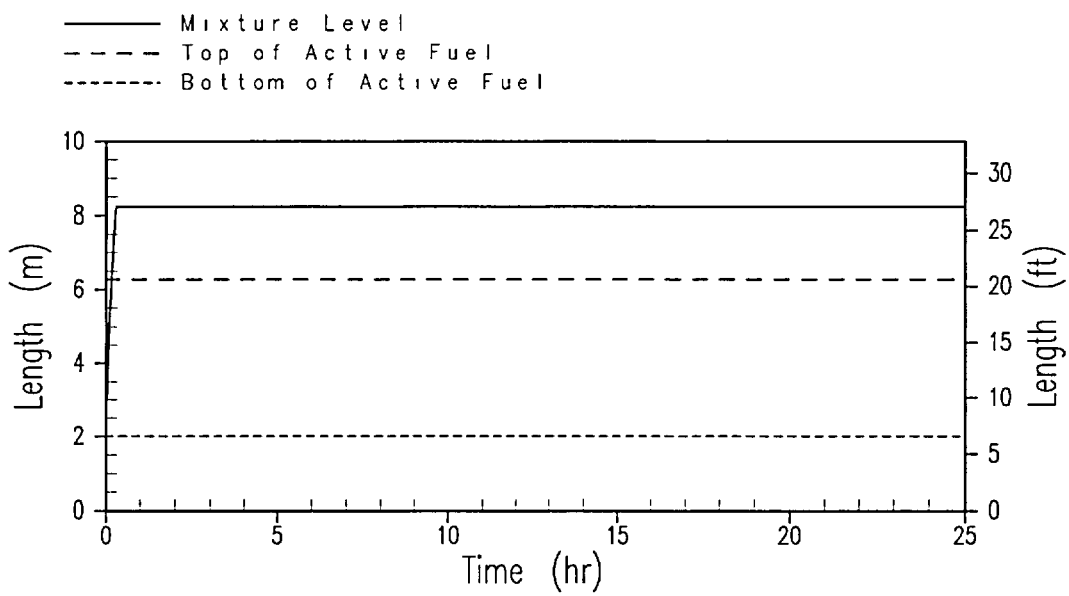

Figure 41A-156

Case 3BR-1: Reactor Vessel Mixture Level
CL LBLOCA with Accumulator Failure

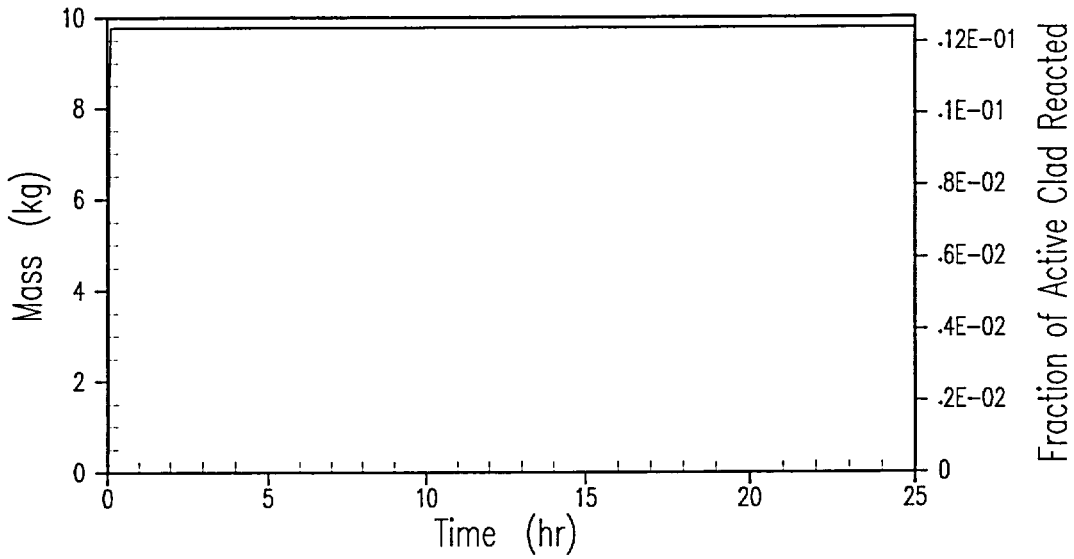

Figure 41A-157

Case 3BR-1: Hydrogen Generated In-Vessel CL LBLOCA with Accumulator Failure

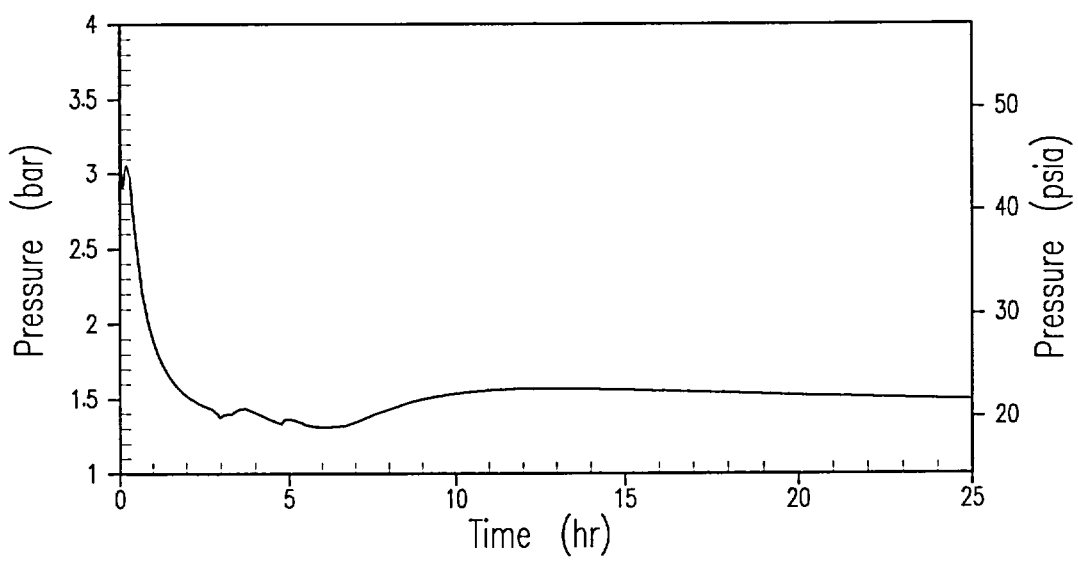

Figure 41A-158

Case 3BR-1: Containment Pressure CL LBLOCA with Accumulator Failure

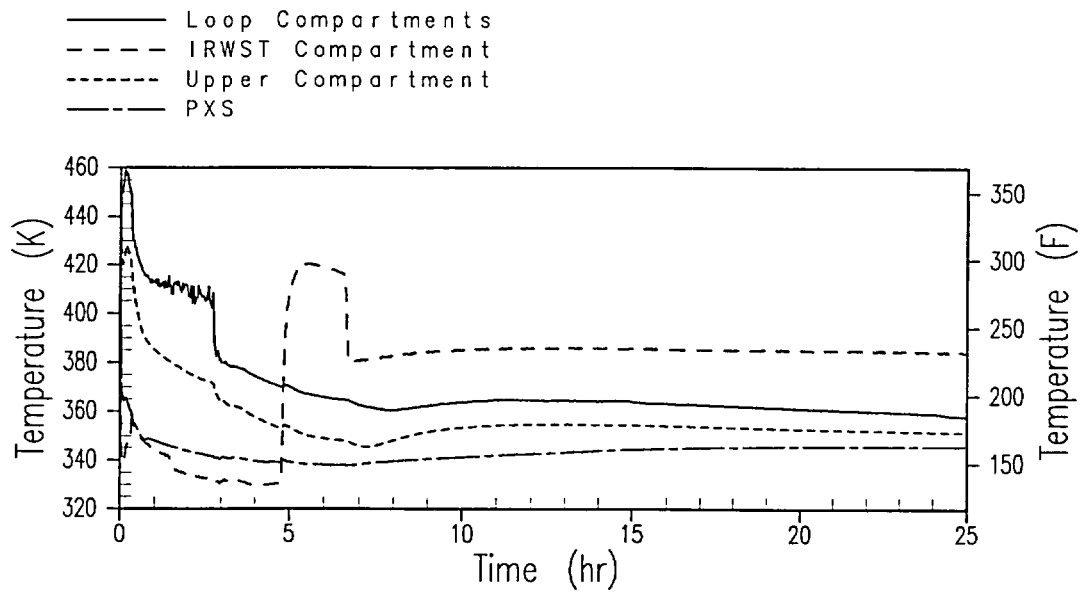

Figure 41A-159

Case 3BR-1: Containment Gas Temperature CL LBLOCA with Accumulator Failure

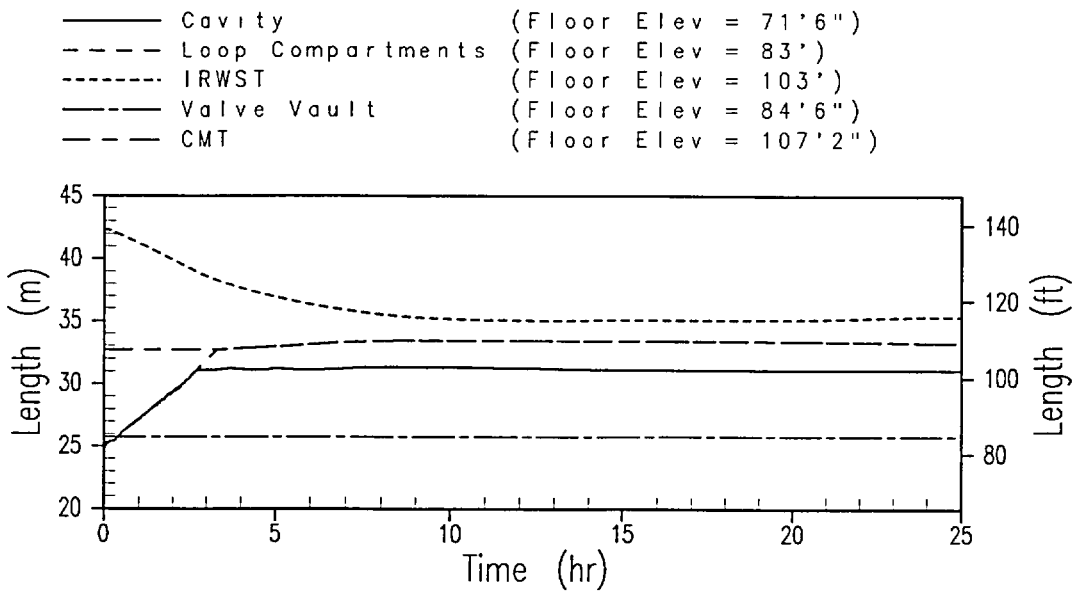

Figure 41A-160

Case 3BR-1: Containment Compartments Water Level CL LBLOCA with Accumulator Failure

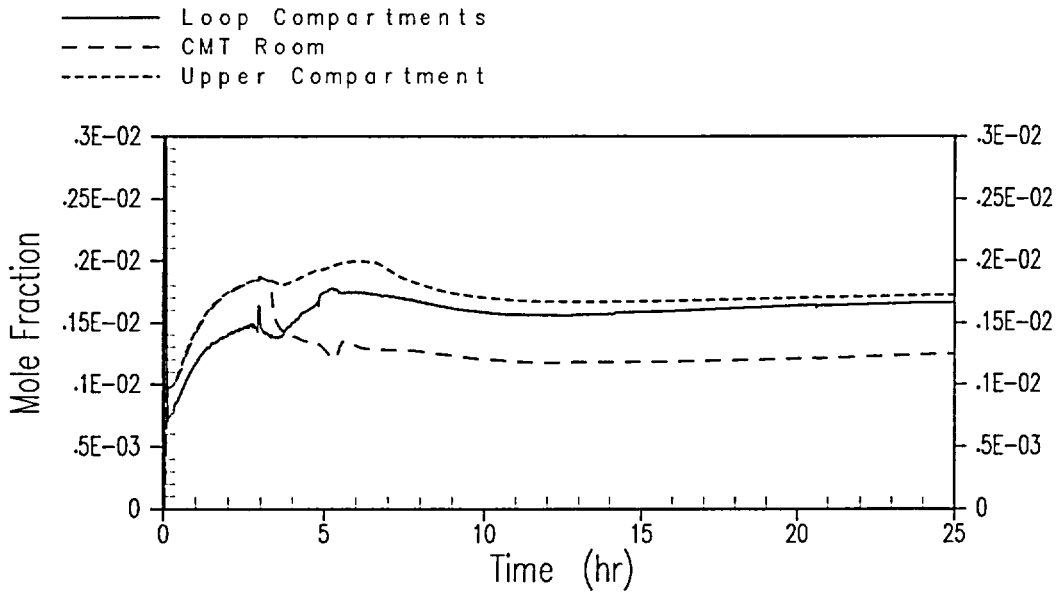

Figure 41A-161

Case 3BR-1: Well-Mixed Compartment Hydrogen Concentration CL LBLOCA with Accumulator Failure

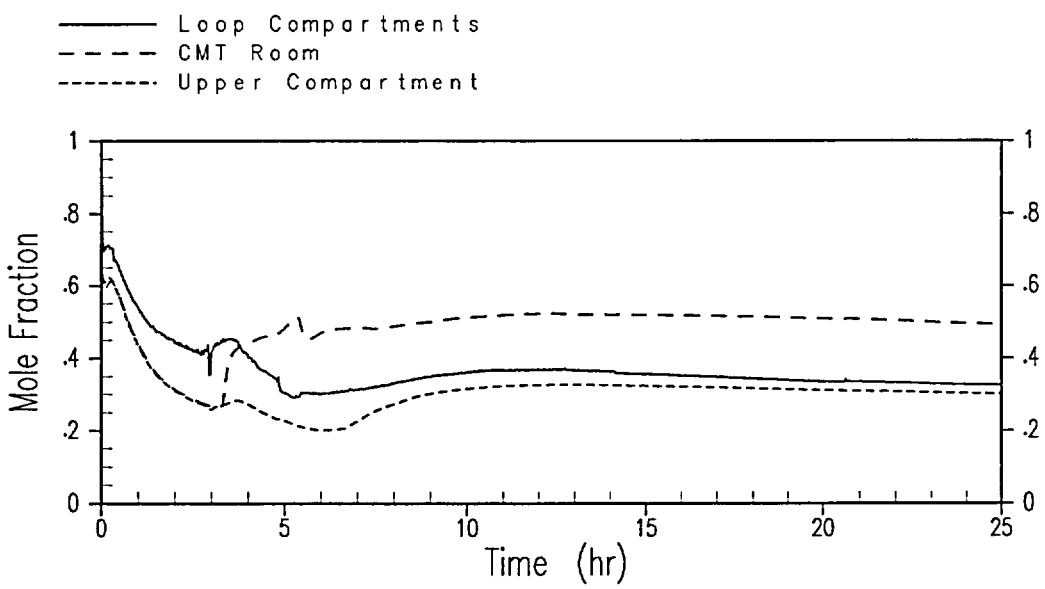

Figure 41A-162

Case 3BR-1: Well-Mixed Compartment Steam Concentration CL LBLOCA with Accumulator Failure

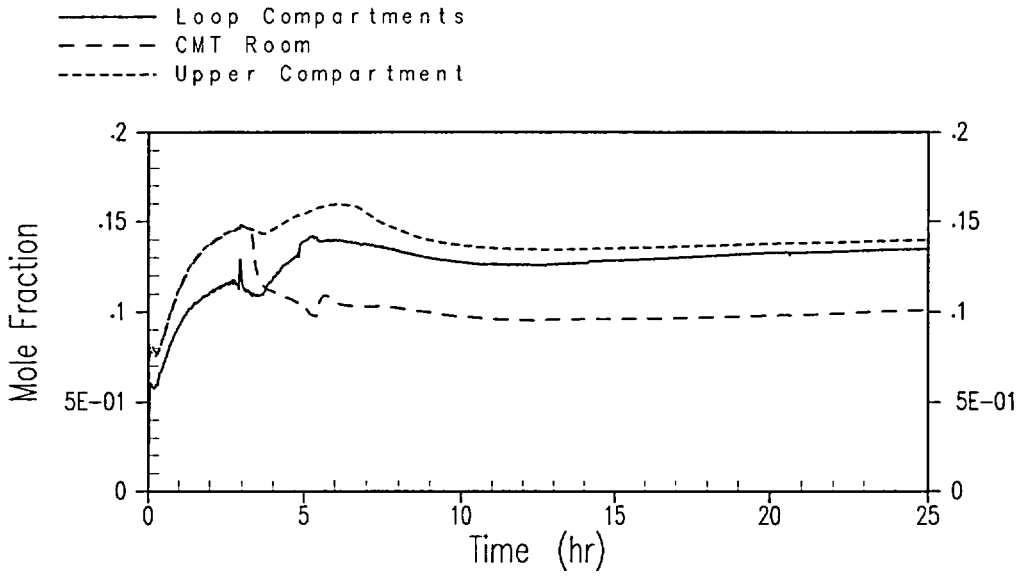

Figure 41A-163

Case 3BR-1: Well-Mixed Compartment Oxygen Concentration CL LBLOCA with Accumulator Failure

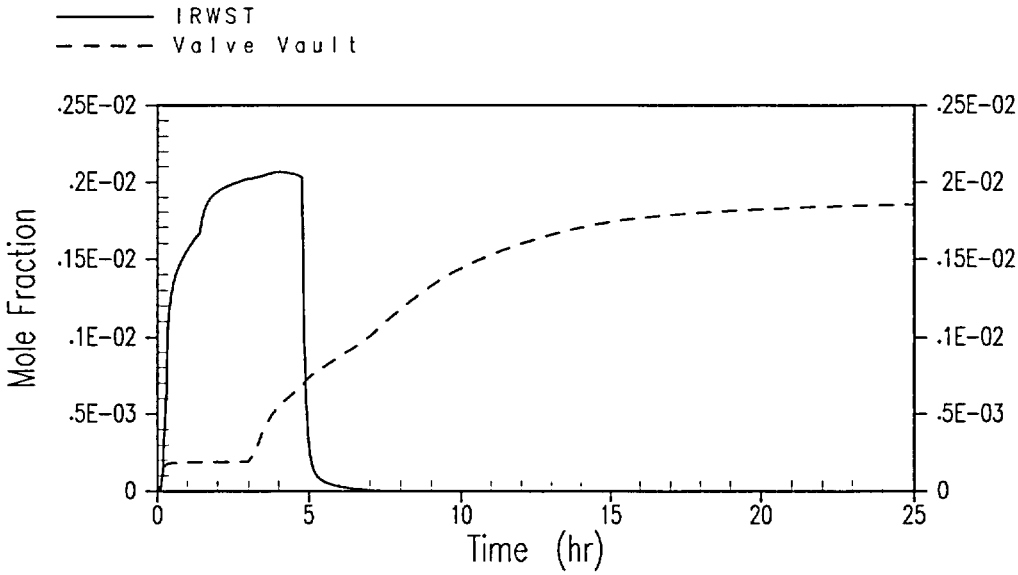

Figure 41A-164

Case 3BR-1: Confined Compartment Hydrogen Concentration CL LBLOCA with Accumulator Failure

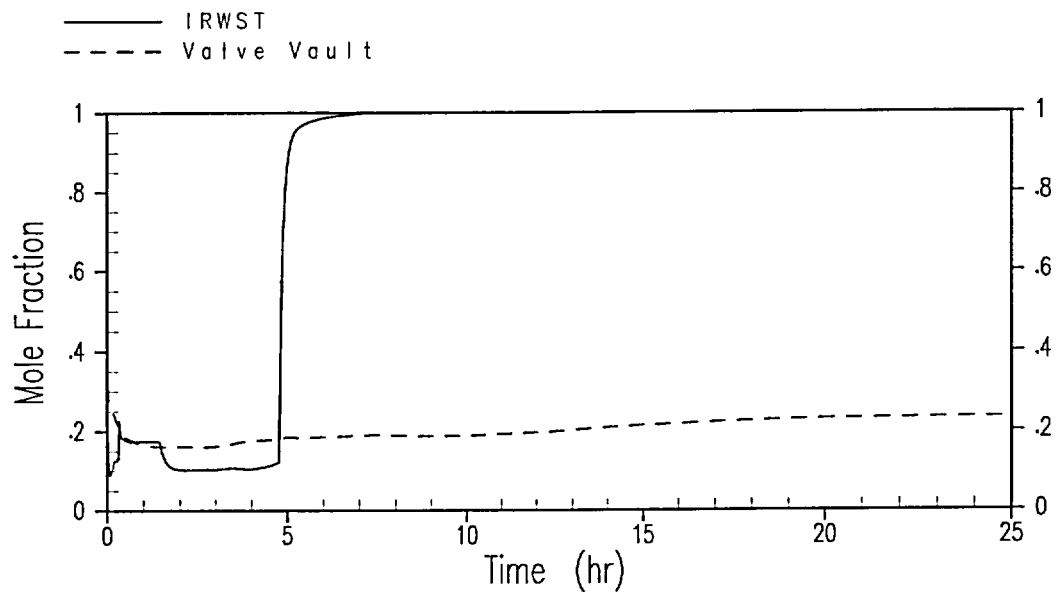

Figure 41A-165

Case 3BR-1: Confined Compartment Steam Concentration CL LBLOCA with Accumulator Failure

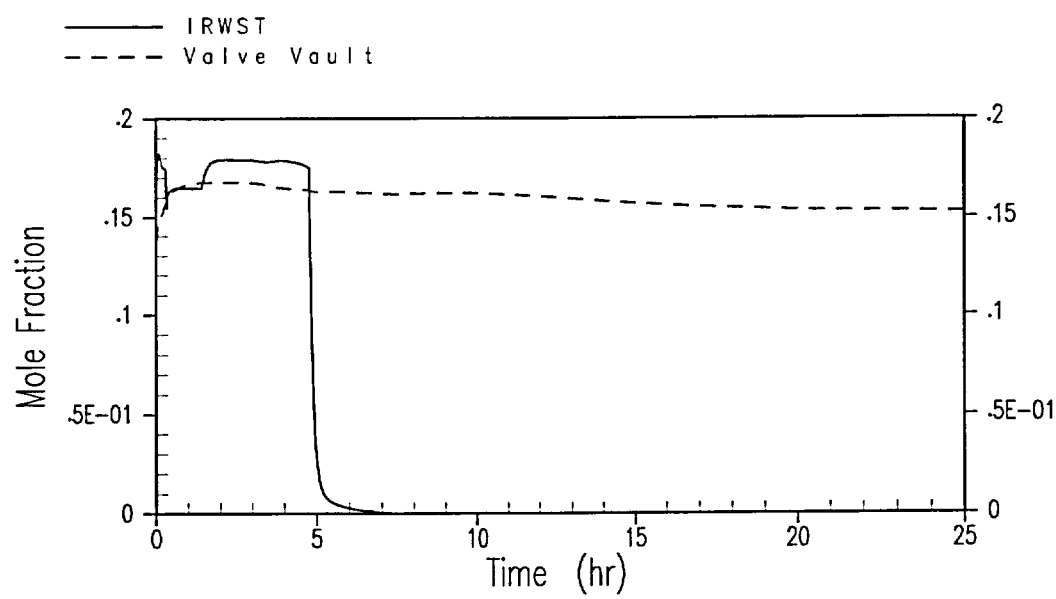

Figure 41A-166

Case 3BR-1: Confined Compartment Oxygen Concentration CL LBLOCA with Accumulator Failure

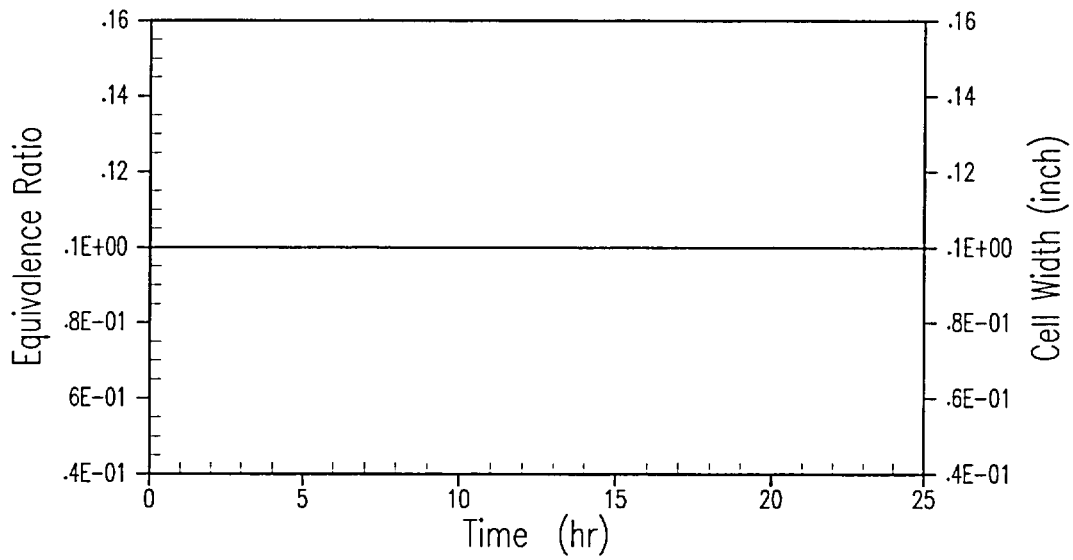

Figure 41A-167

Case 3BR-1: Equivalence Ratio in SG Room CL LBLOCA with Accumulator Failure

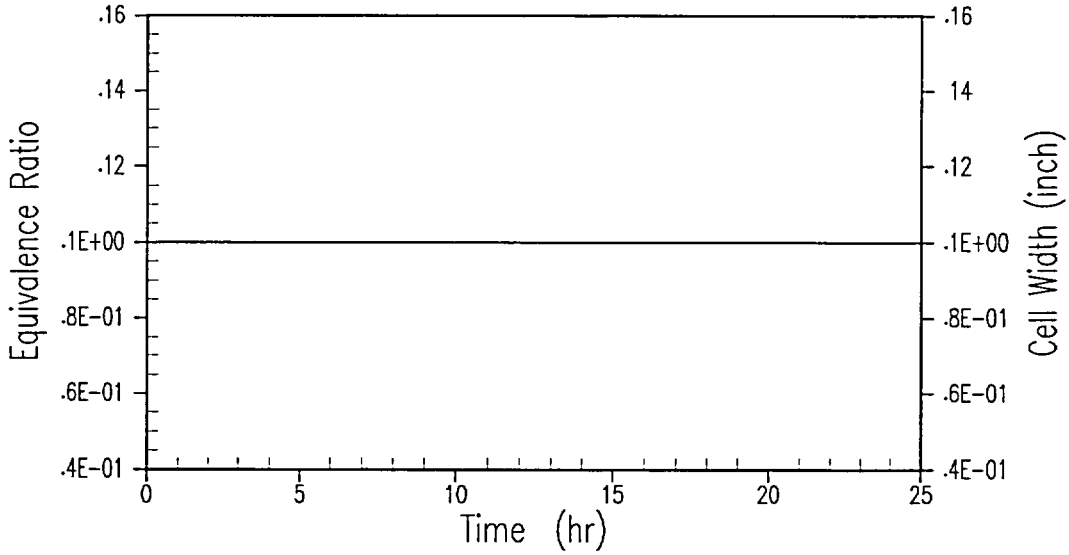

Figure 41A-168

Case 3BR-1: Equivalence Ratio in CMT Room CL LBLOCA with Accumulator Failure

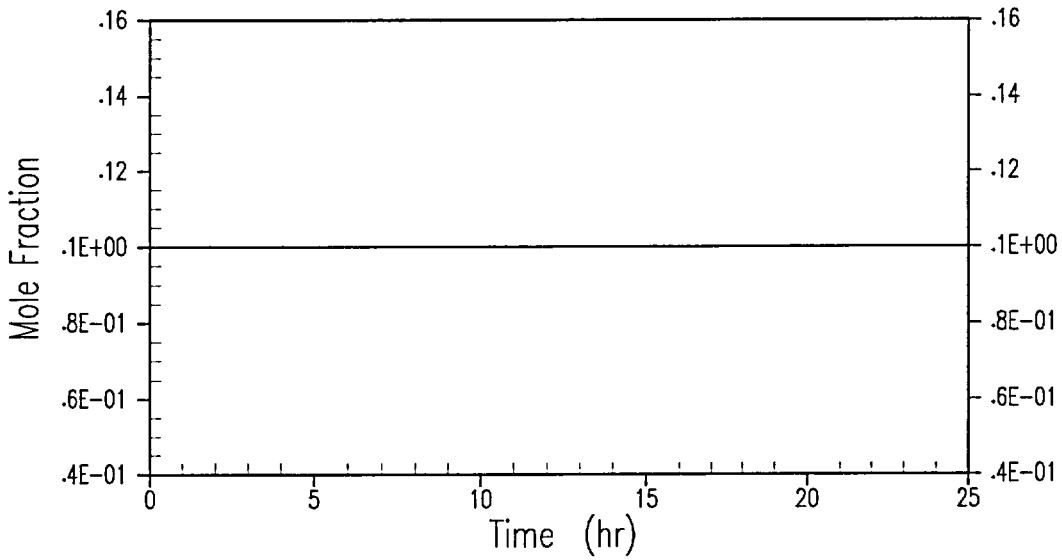

Figure 41A-169

Case 3BR-1: Equivalence Ratio in IRWST CL LBLOCA with Accumulator Failure

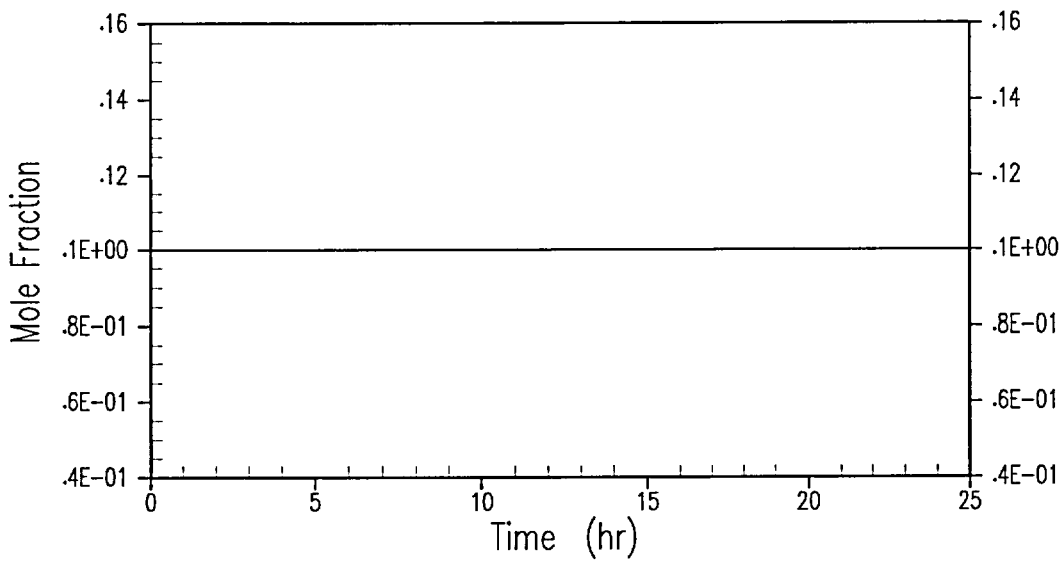

Figure 41A-170

Case 3BR-1: Equivalence Ratio in PXS CL LBLOCA with Accumulator Failure

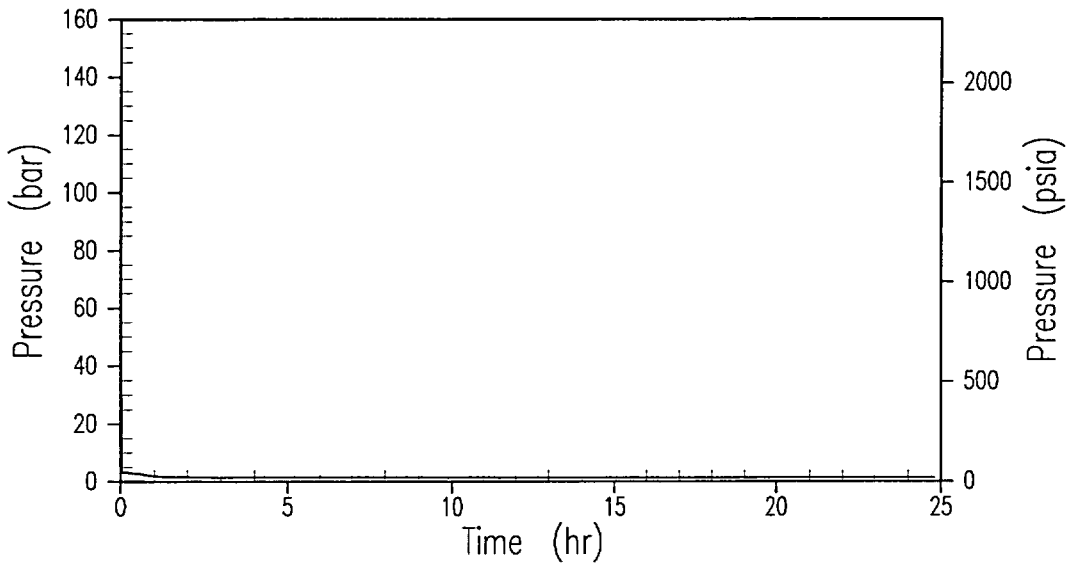

Figure 41A-171

Case 3BR-1a: Reactor Coolant System Pressure CL LBLOCA with Accumulator Failure

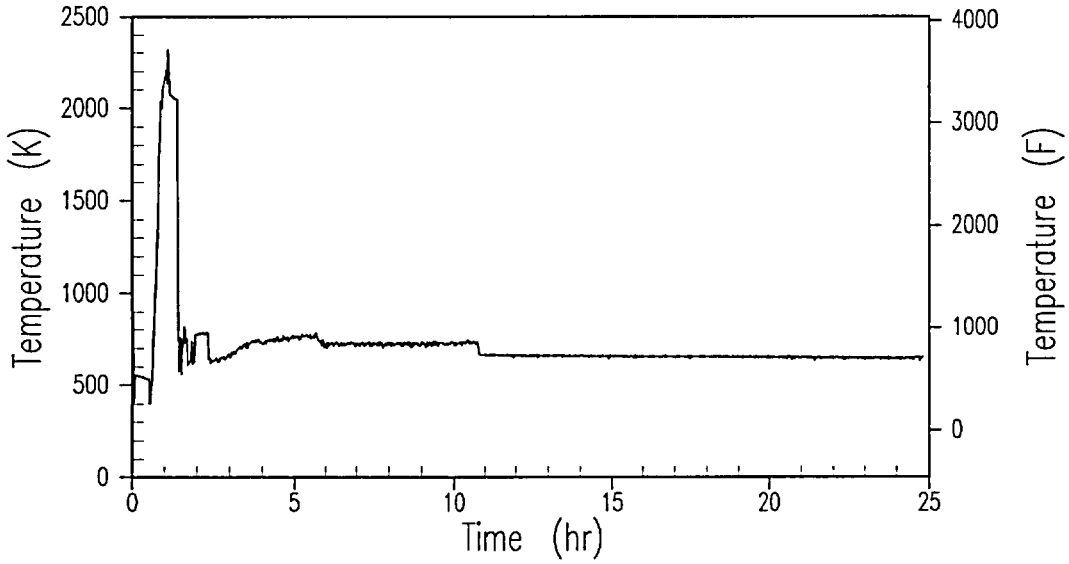

Figure 41A-172

Case 3BR-1a: Core-Exit Gas Temperature CL LBLOCA with Accumulator Failure

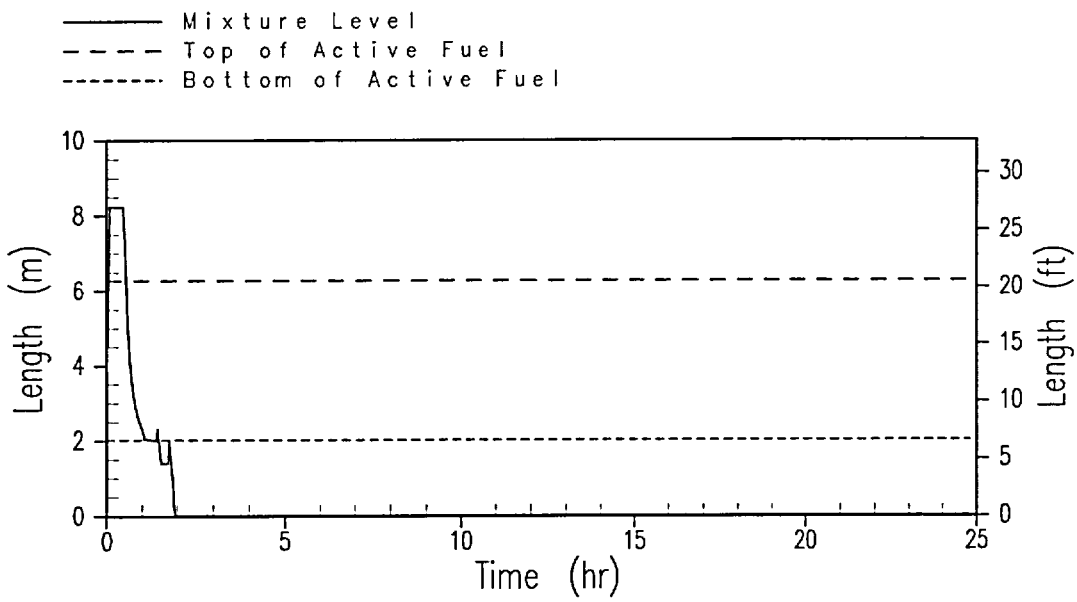

Figure 41A-173

Case 3BR-1a: Reactor Vessel Mixture Level
CL LBLOCA with Accumulator Failure

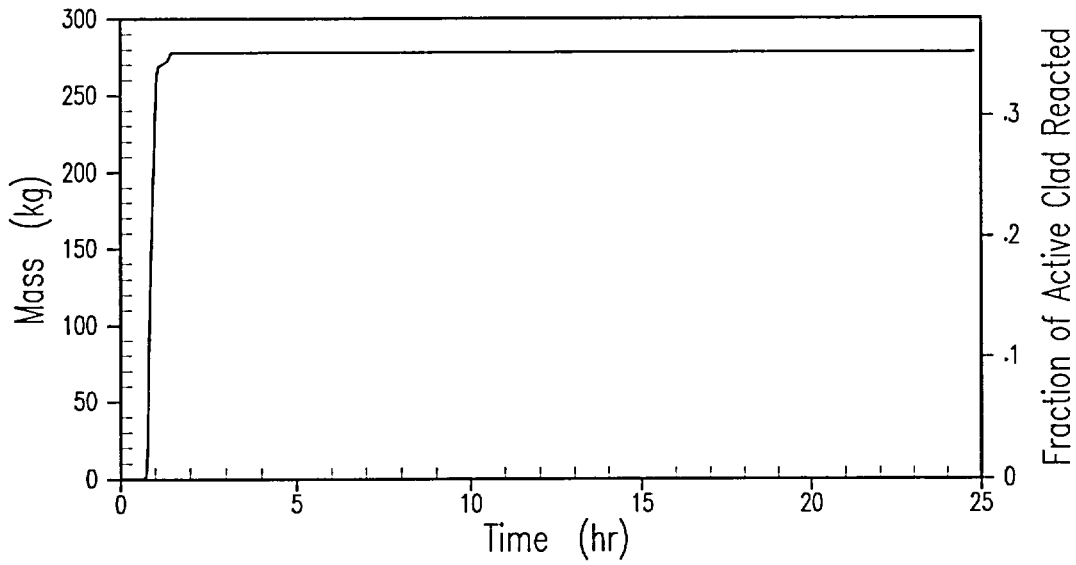

Figure 41A-174

Case 3BR-1a: Hydrogen Generated In-Vessel
CL LBLOCA with Accumulator Failure

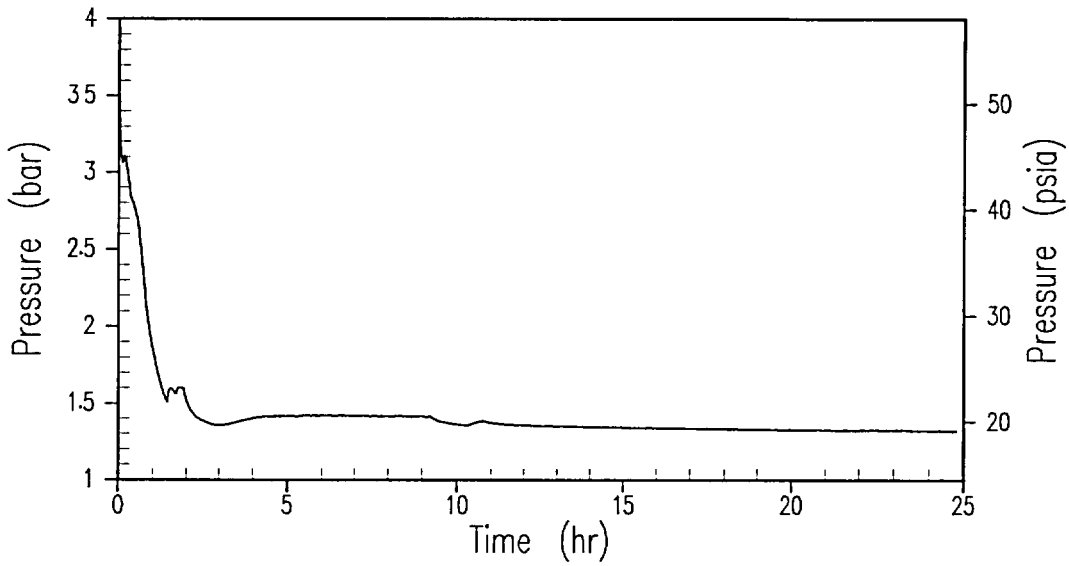

Figure 41A-175

Case 3BR-1a: Containment Pressure
CL LBLOCA with Accumulator Failure

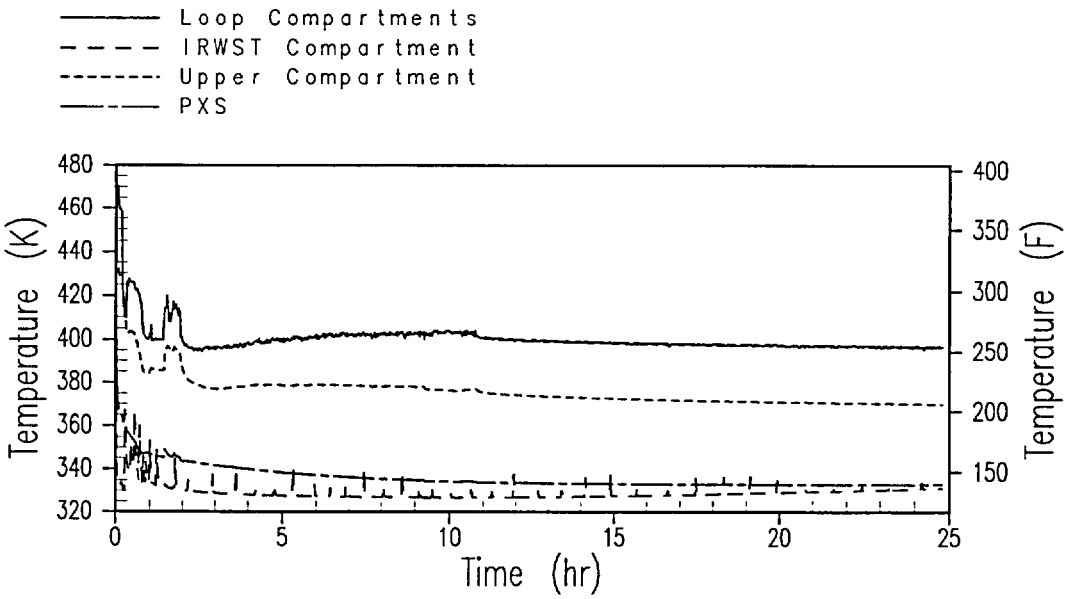

Figure 41A-176

Case 3BR-1a: Containment Gas Temperature
CL LBLOCA with Accumulator Failure

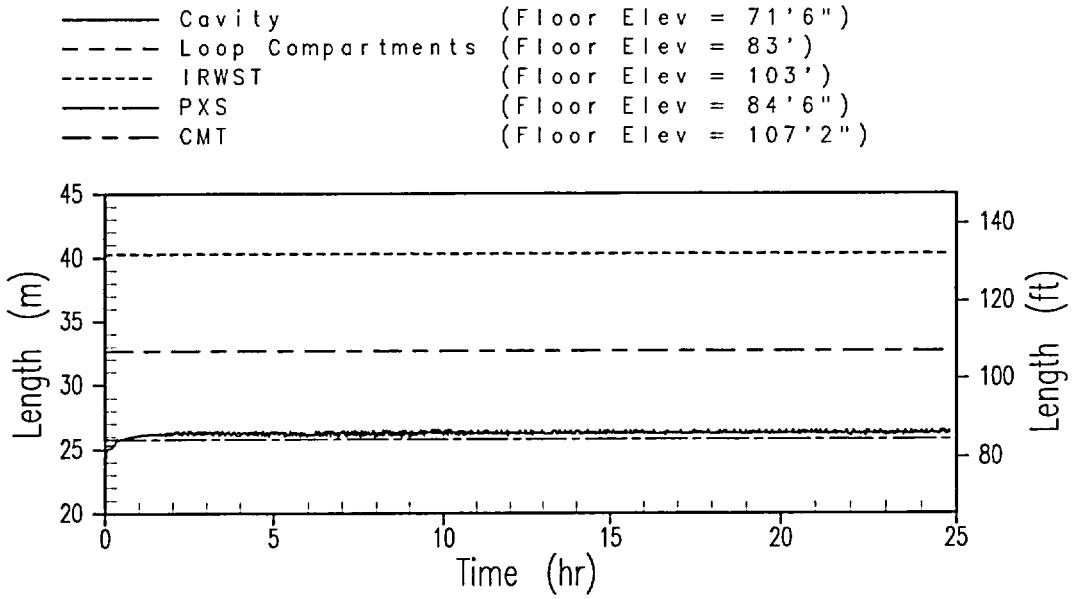

Figure 41A-177

Case 3BR-1a: Containment Compartments Water Level CL LBLOCA with Accumulator Failure

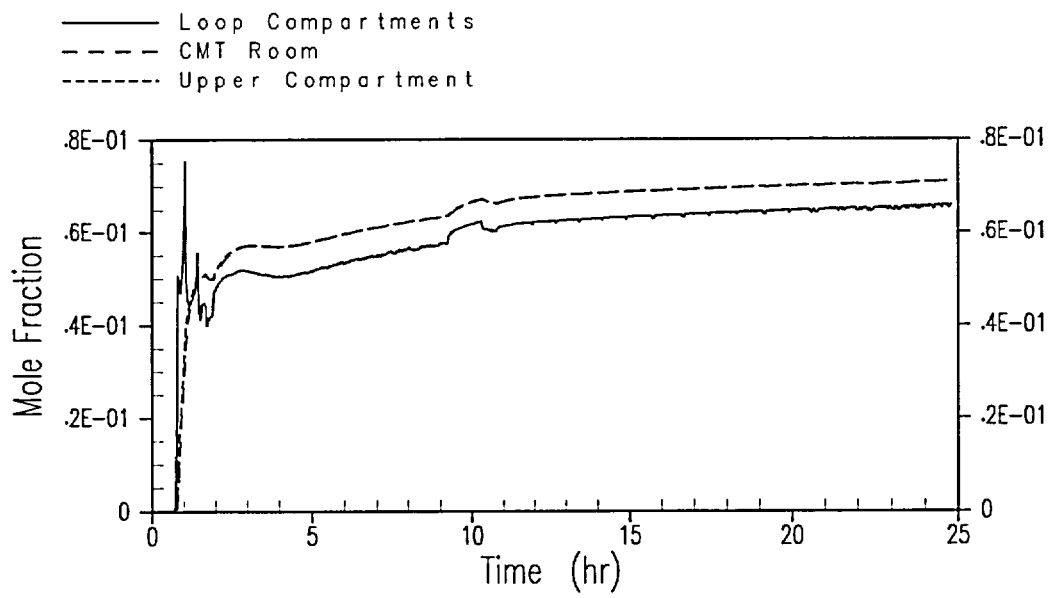

Figure 41A-178

Case 3BR-1a: Well-Mixed Compartment Hydrogen Concentration CL LBLOCA with Accumulator Failure

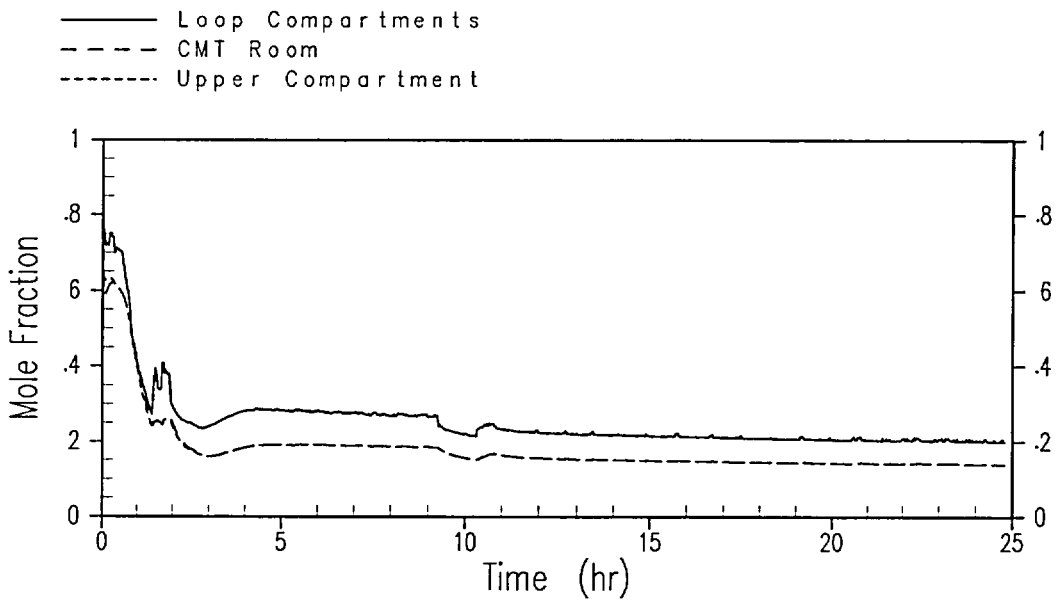

Figure 41A-179

Case 3BR-1a: Well-Mixed Compartment Steam Concentration CL LBLOCA with Accumulator Failure

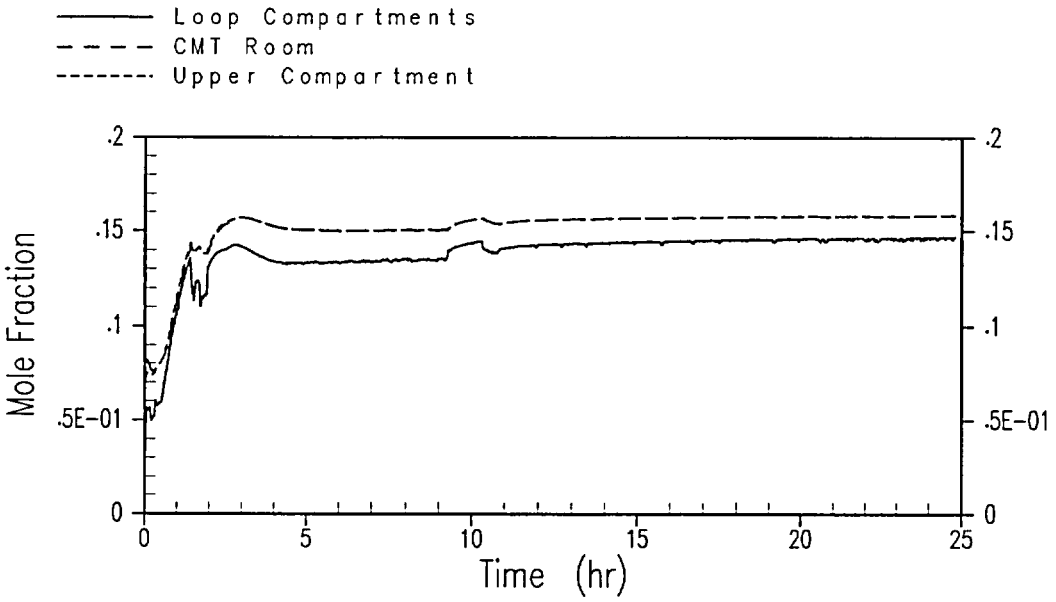

Figure 41A-180

Case 3BR-1a: Well-Mixed Compartment Oxygen Concentration CL LBLOCA with Accumulator Failure

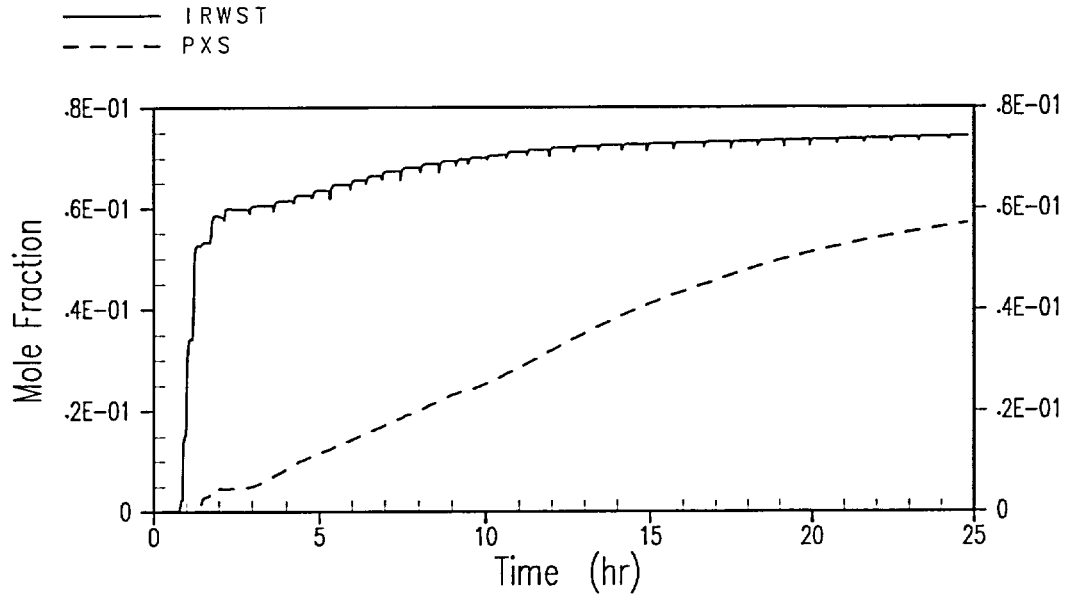

Figure 41A-181

Case 3BR-1a: Confined Compartment Hydrogen Concentration CL LBLOCA with Accumulator Failure

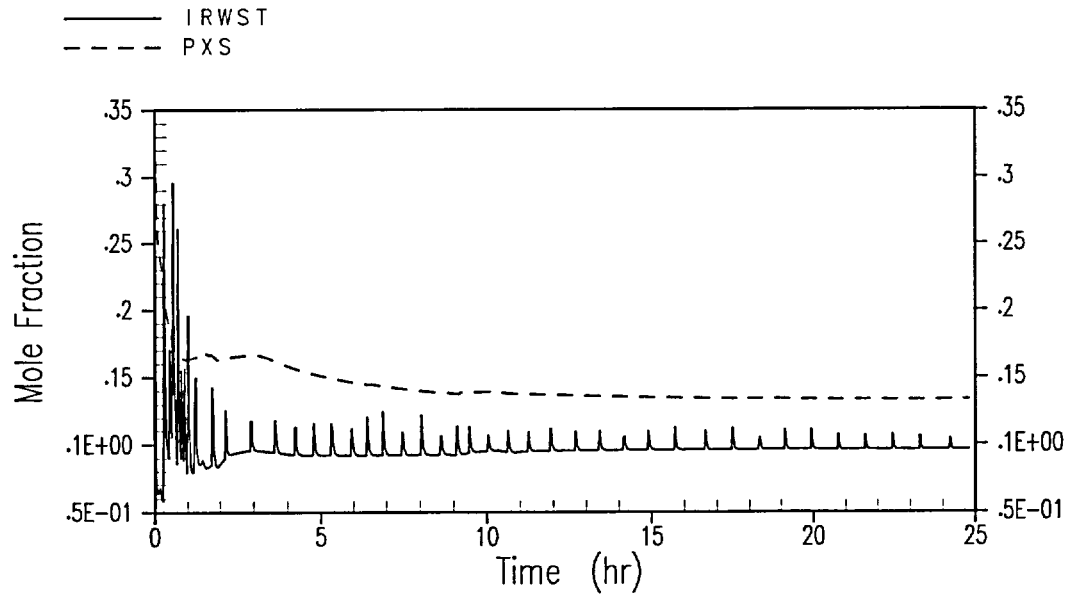

Figure 41A-182

Case 3BR-1a: Confined Compartment Steam Concentration CL LBLOCA with Accumulator Failure

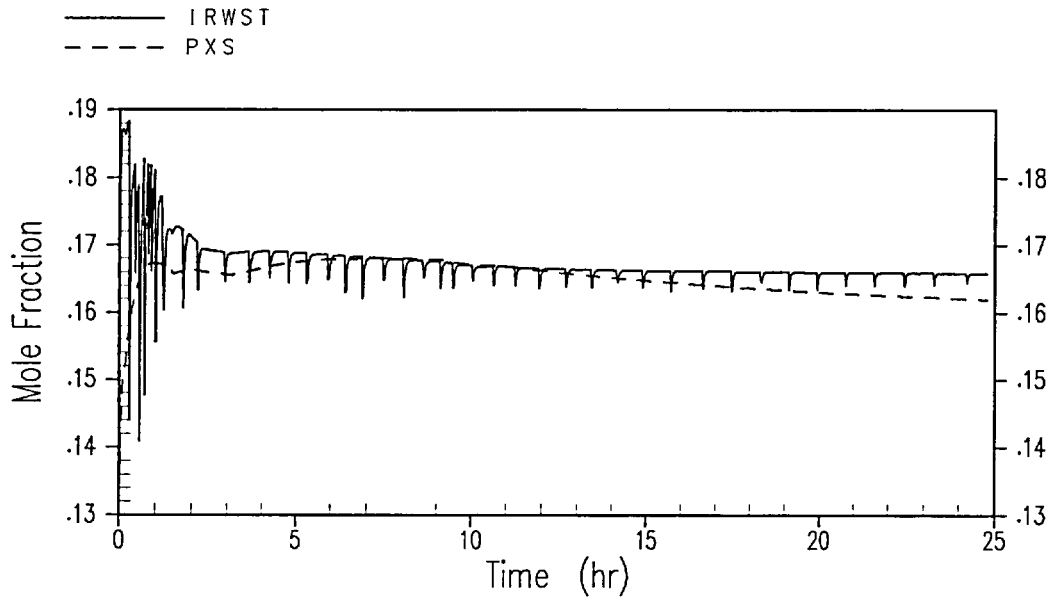

Figure 41A-183

Case 3BR-1a: Confined Compartment Oxygen Concentration CL LBLOCA with Accumulator Failure

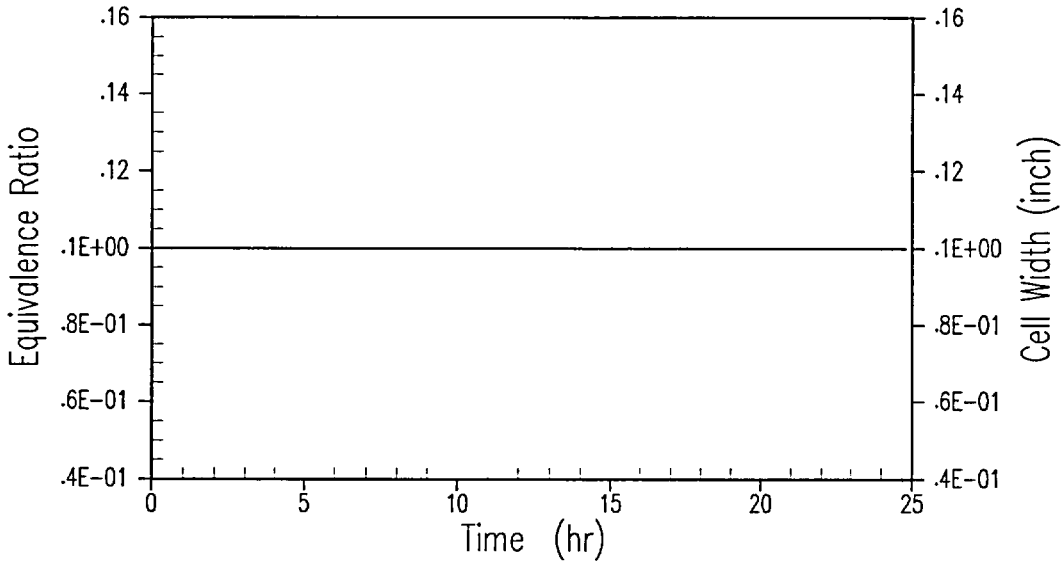

Figure 41A-184

Case 3BR-1a: Equivalence Ratio in SG Room CL LBLOCA with Accumulator Failure

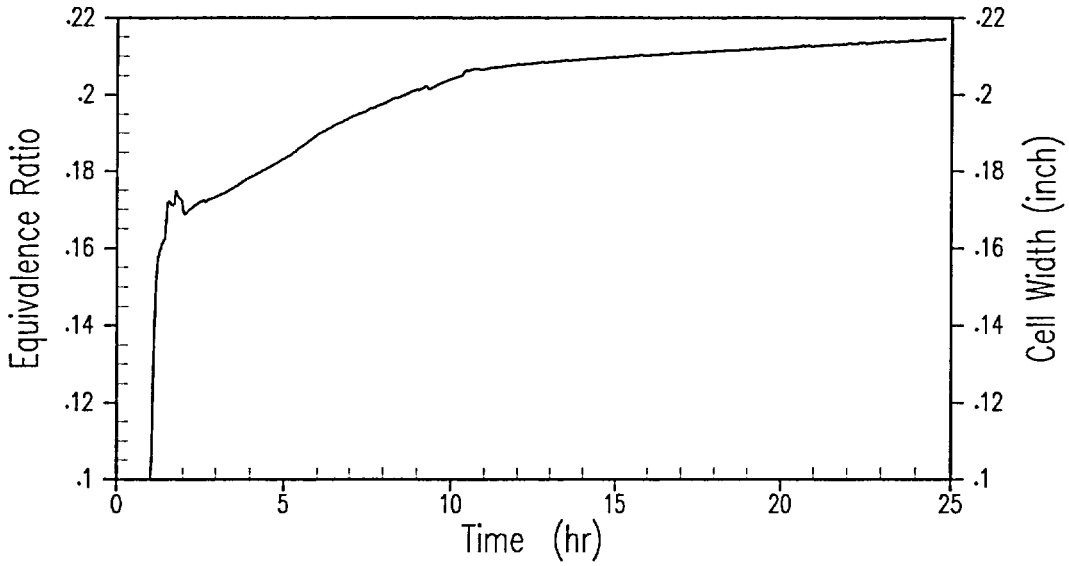

Figure 41A-185

Case 3BR-1a: Equivalence Ratio in CMT Room CL LBLOCA with Accumulator Failure

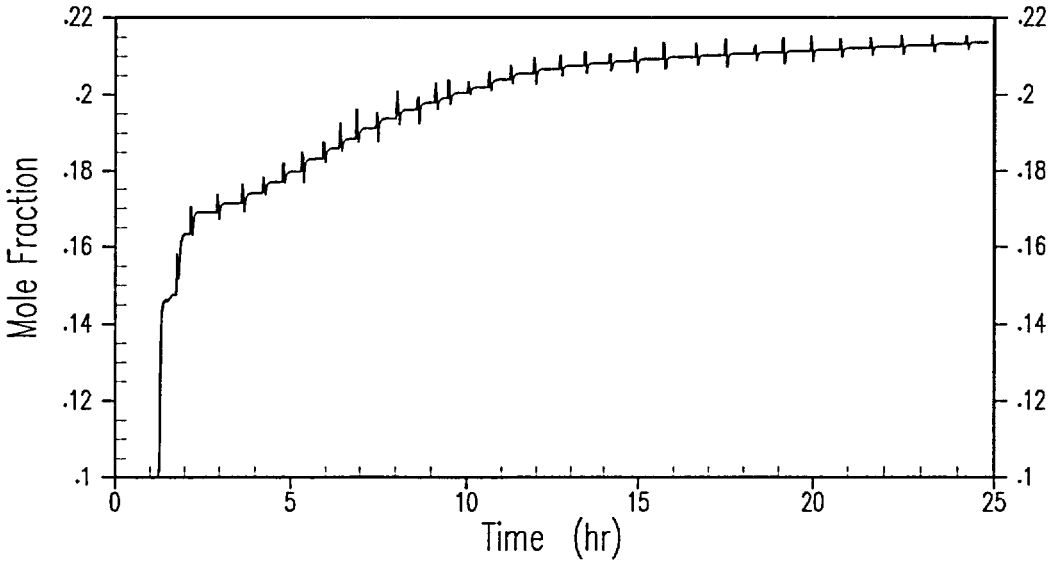

Figure 41A-186

Case 3BR-1a: Equivalence Ratio in IRWST CL LBLOCA with Accumulator Failure

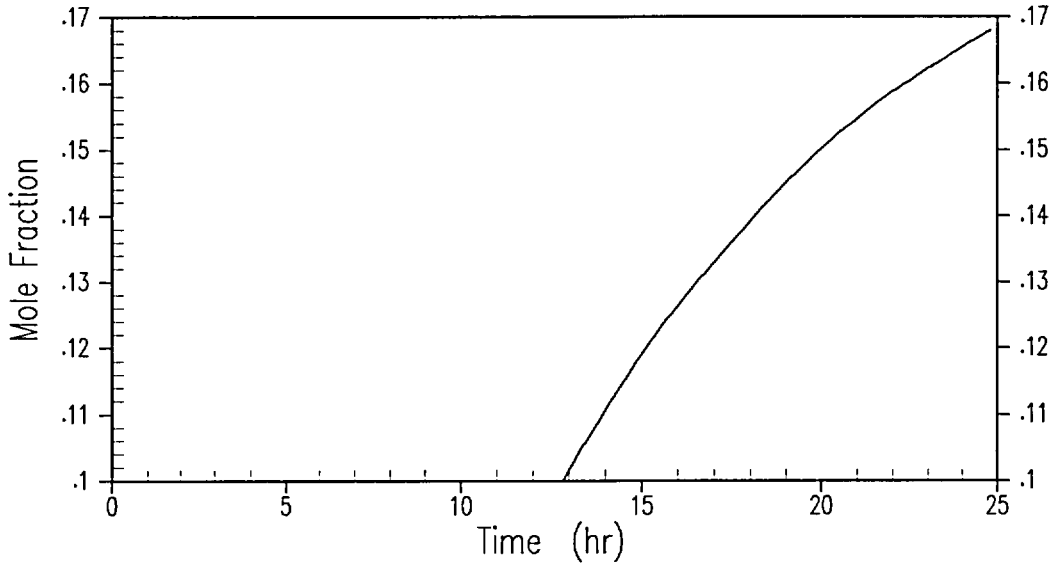

Figure 41A-187

Case 3BR-1a: Equivalence Ratio in PXS CL LBLOCA with Accumulator Failure

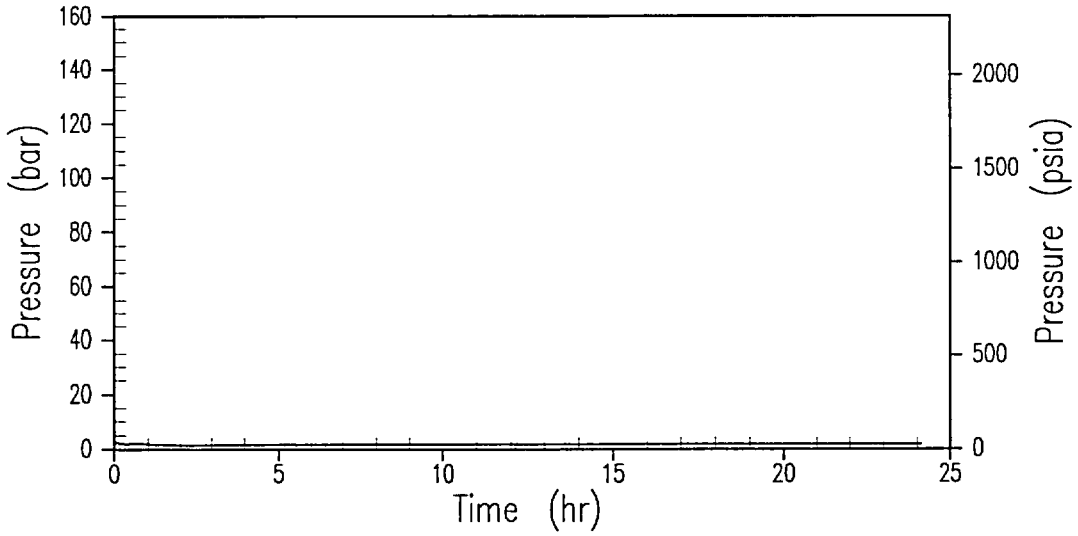

Figure 41A-188

Case 3C-1: Reactor Coolant System Pressure Vessel Rupture

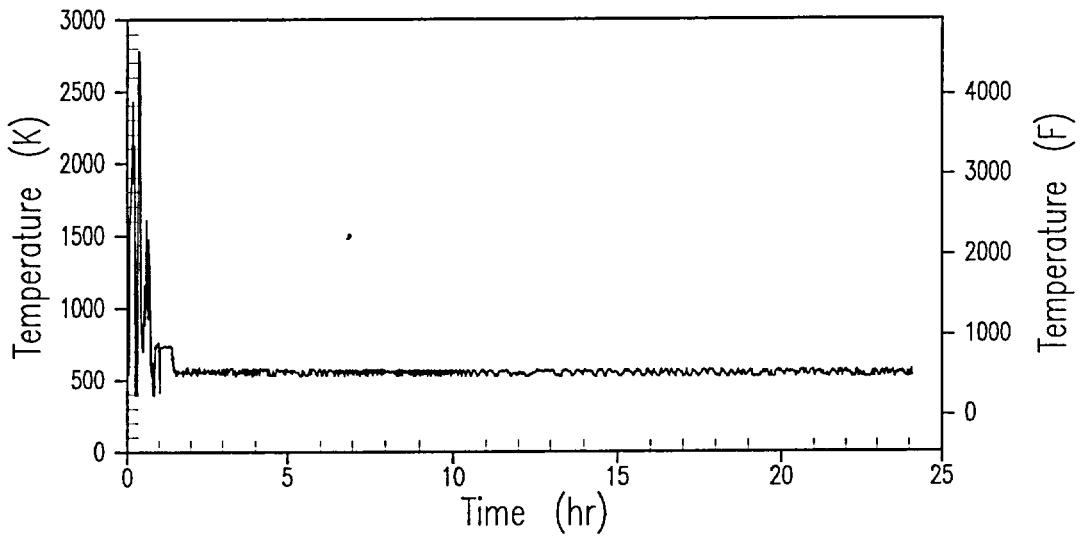

Figure 41A-189

Case 3C-1: Core-Exit Gas Temperature Vessel Rupture

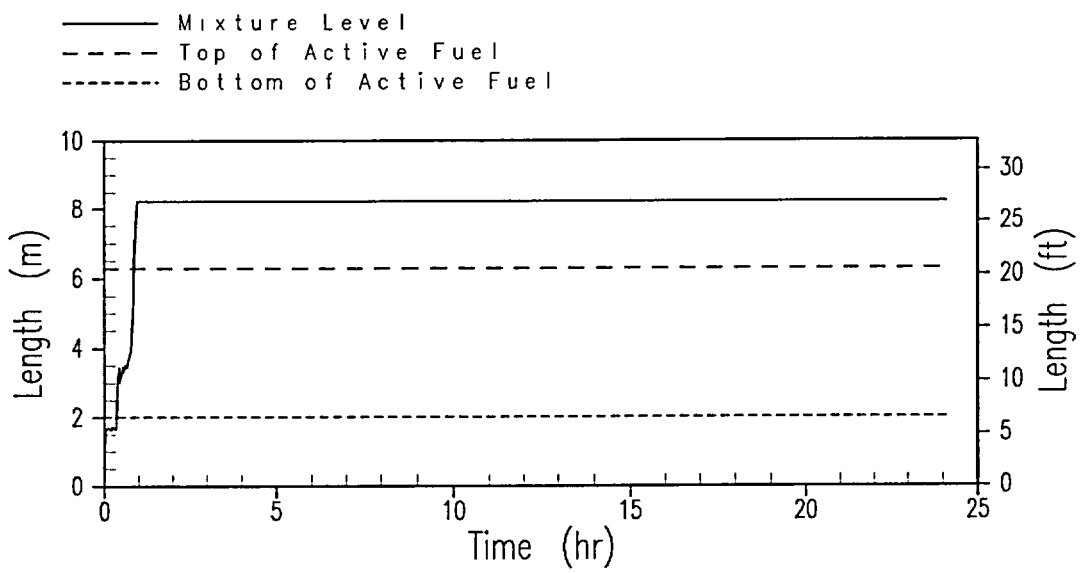

Figure 41A-190

Case 3C-1: Reactor Vessel Mixture Level Vessel Rupture

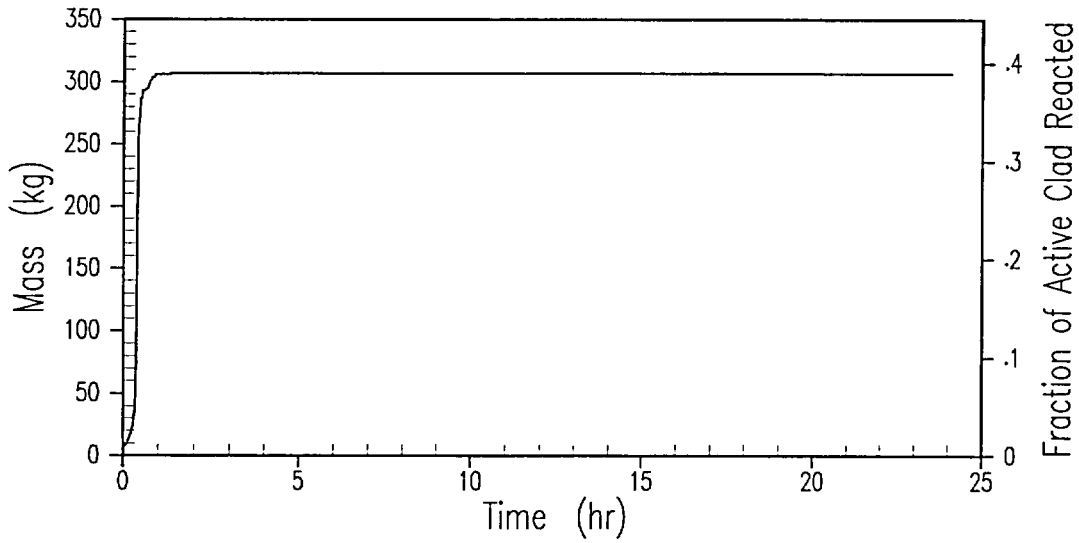

Figure 41A-191

Case 3C-1: Hydrogen Generated In-Vessel Vessel Rupture

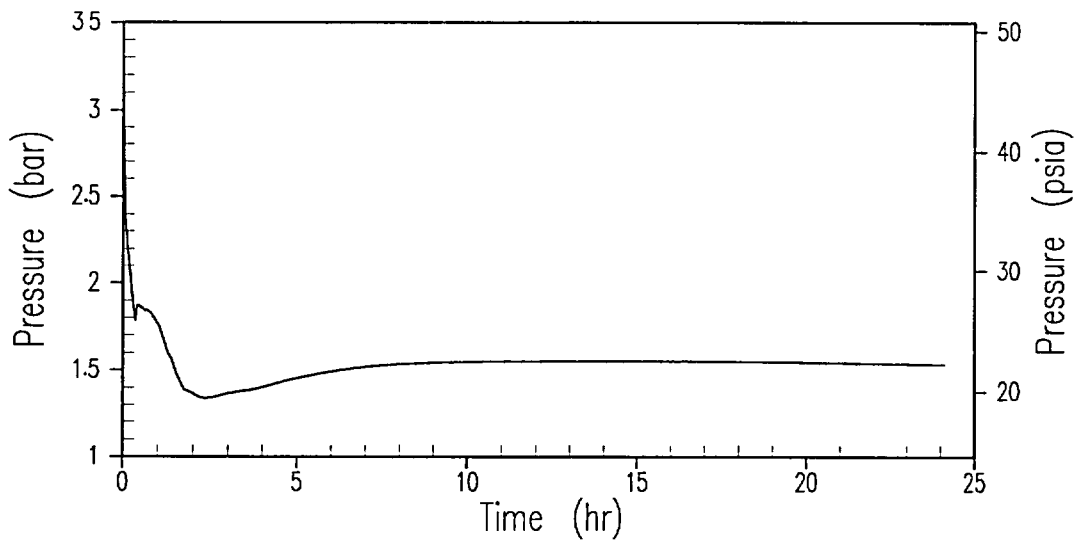

Figure 41A-192

Case 3C-1: Containment Pressure Vessel Rupture

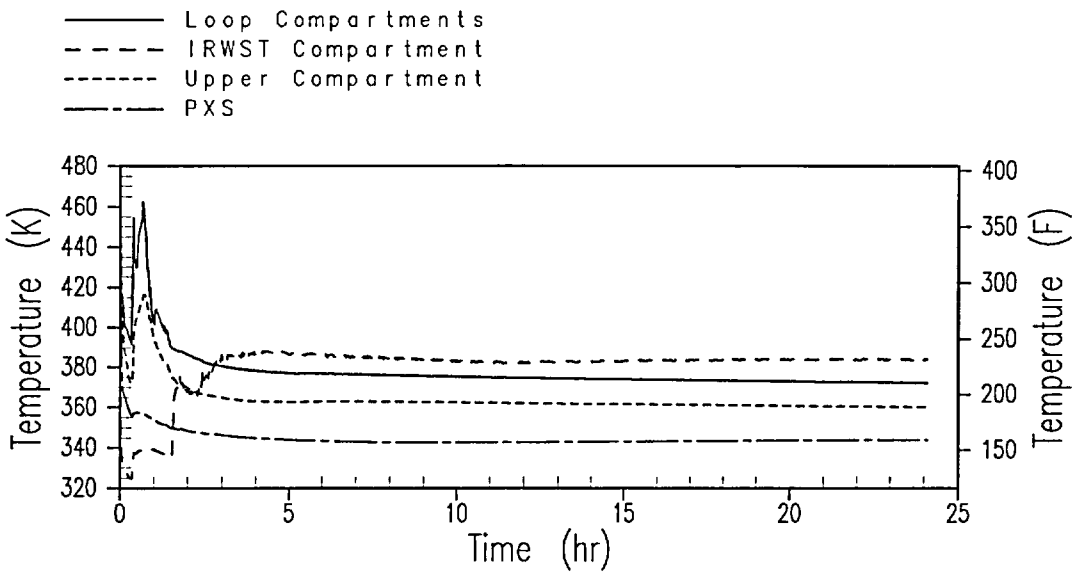

Figure 41A-193

Case 3C-1: Containment Gas Temperature Vessel Rupture

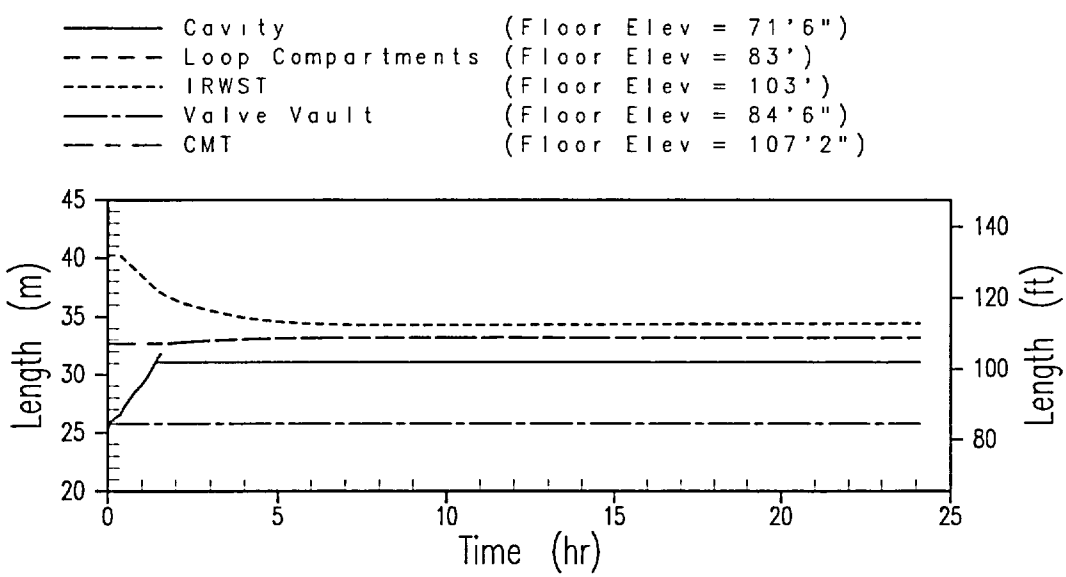

Figure 41A-194

Case 3C-1: Containment Compartments Water Level Vessel Rupture

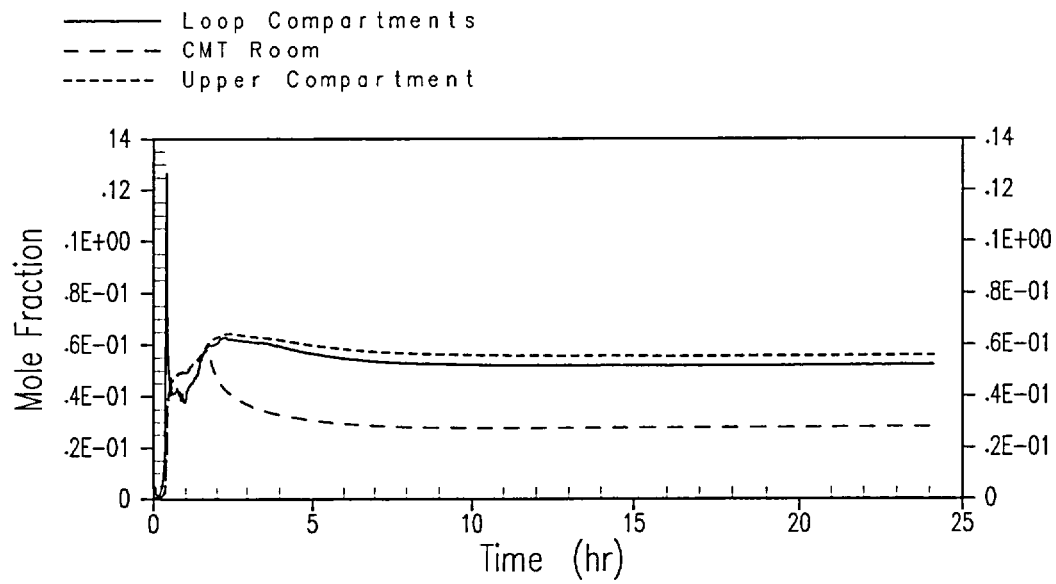

Figure 41A-195

Case 3C-1: Well-Mixed Compartment Hydrogen Concentration Vessel Rupture

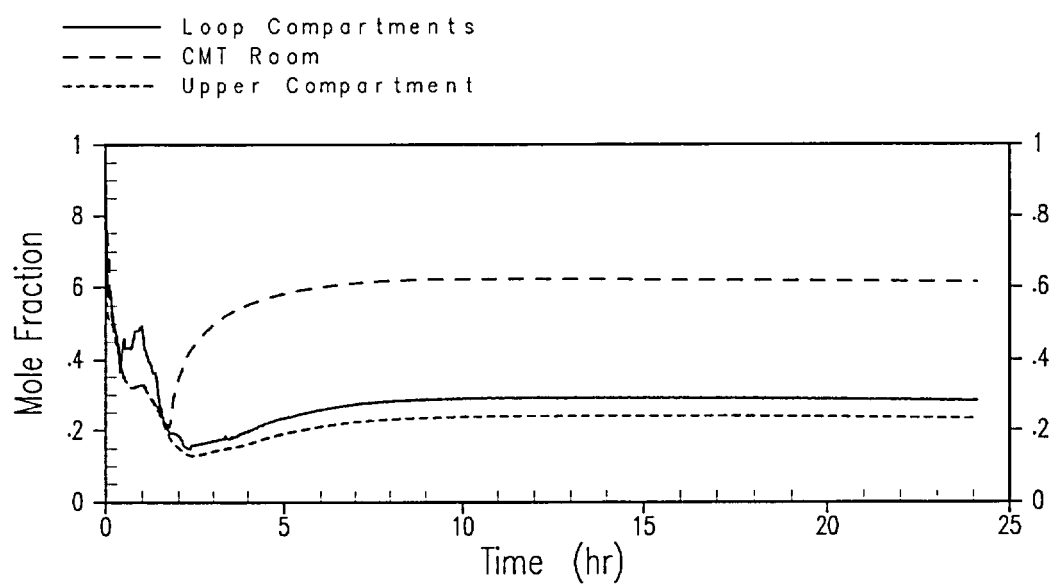

Figure 41A-196

Case 3C-1: Well-Mixed Compartment Steam Concentration Vessel Rupture

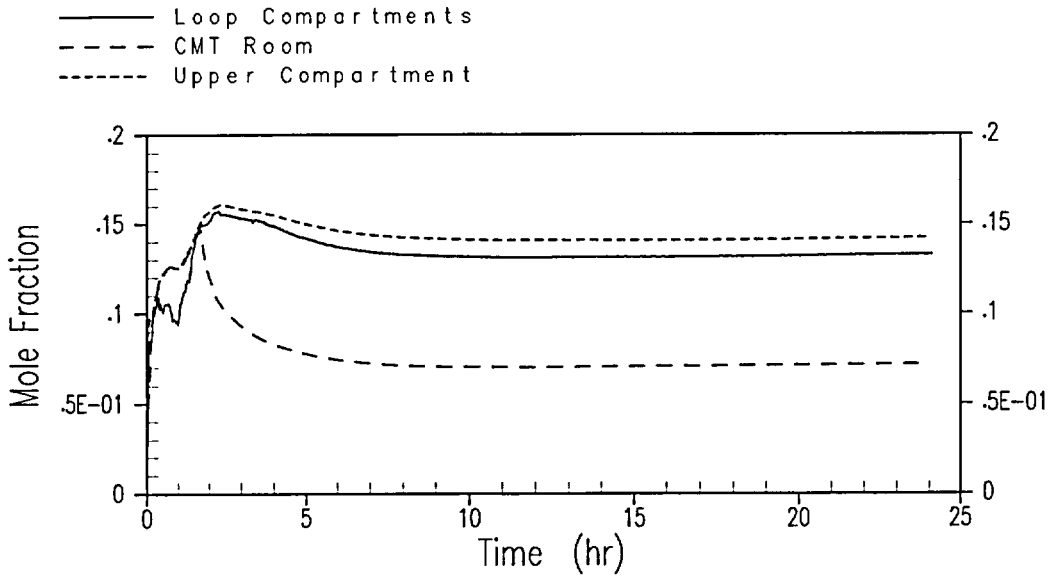

Figure 41A-197

Case 3C-1: Well-Mixed Compartment Oxygen Concentration Vessel Rupture

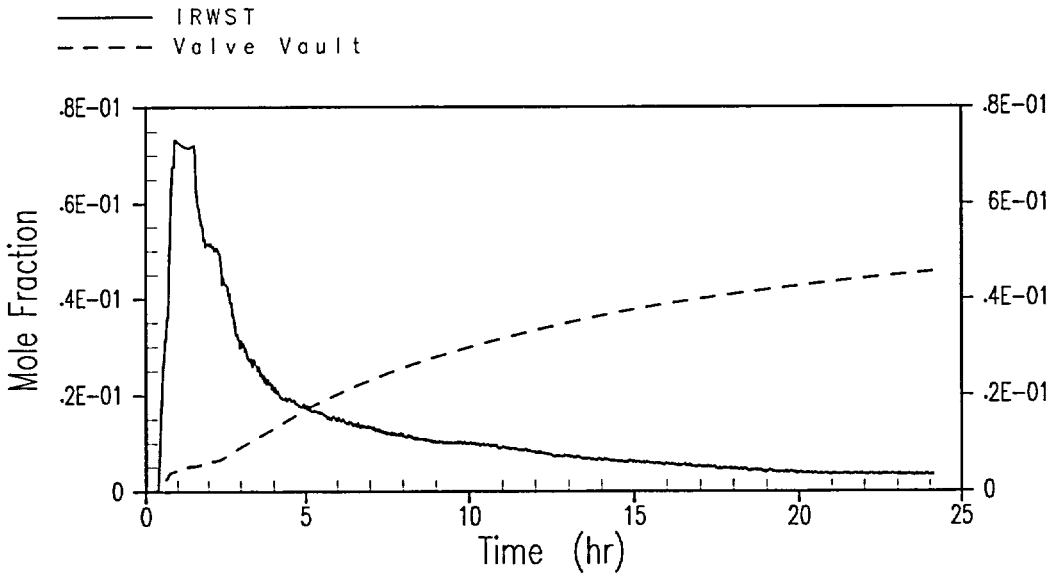

Figure 41A-198

Case 3C-1: Confined Compartment Hydrogen Concentration Vessel Rupture

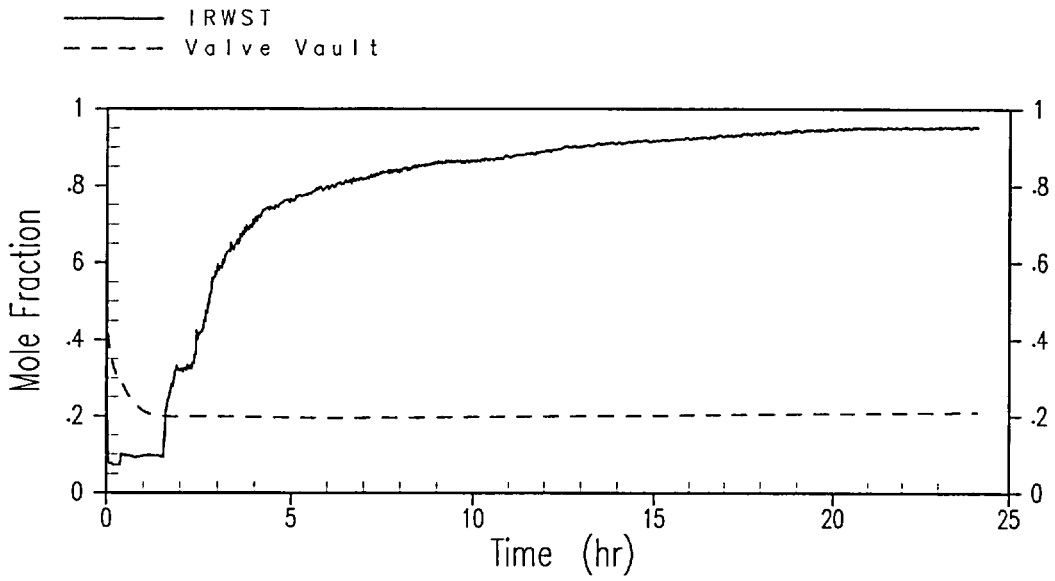

Figure 41A-199

Case 3C-1: Confined Compartment Steam Concentration Vessel Rupture

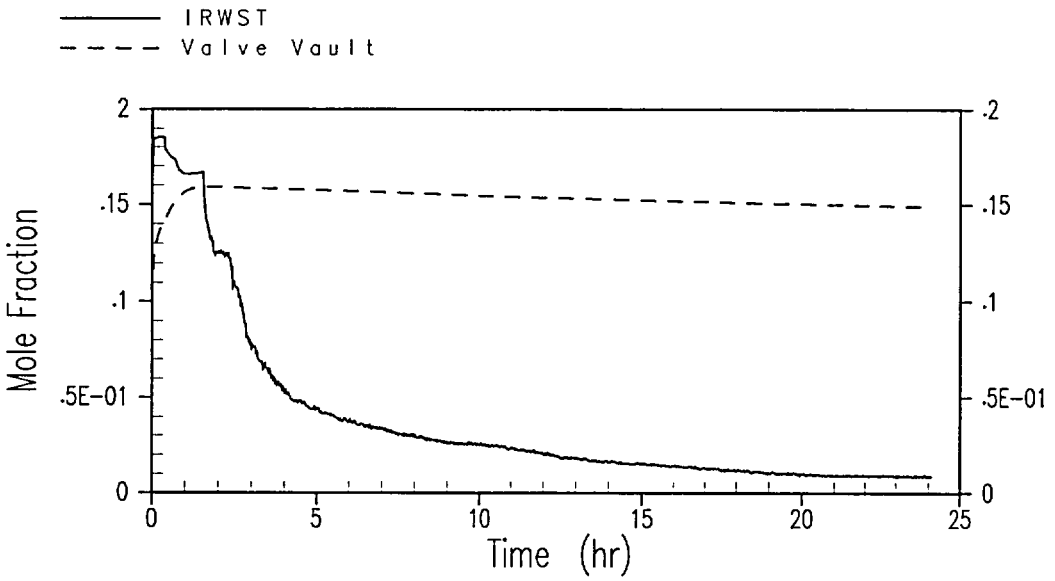

Figure 41A-200

Case 3C-1: Confined Compartment Oxygen Concentration Vessel Rupture

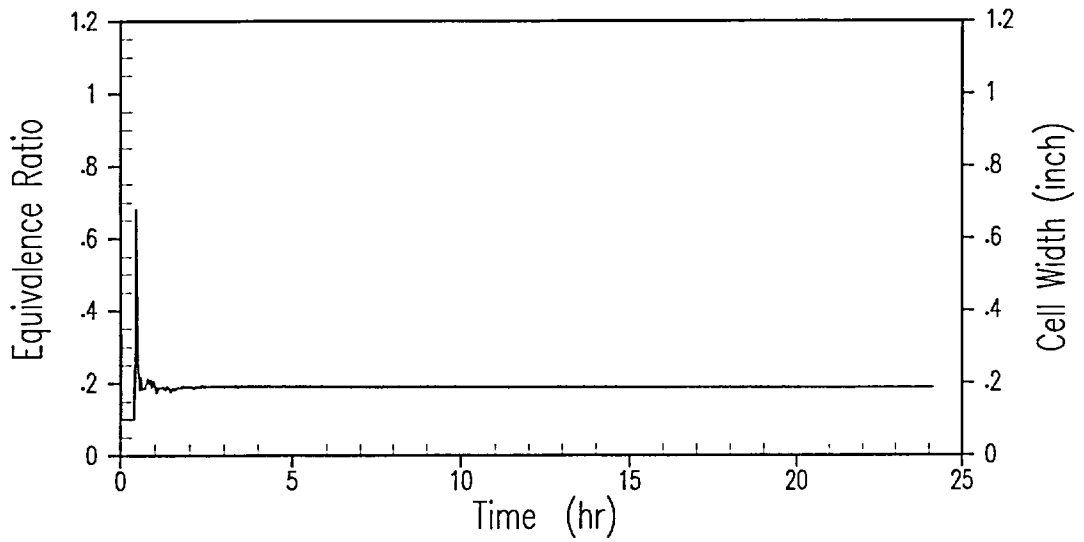

Figure 41A-201

Case 3C-1: Equivalence Ratio in SG Room Vessel Rupture

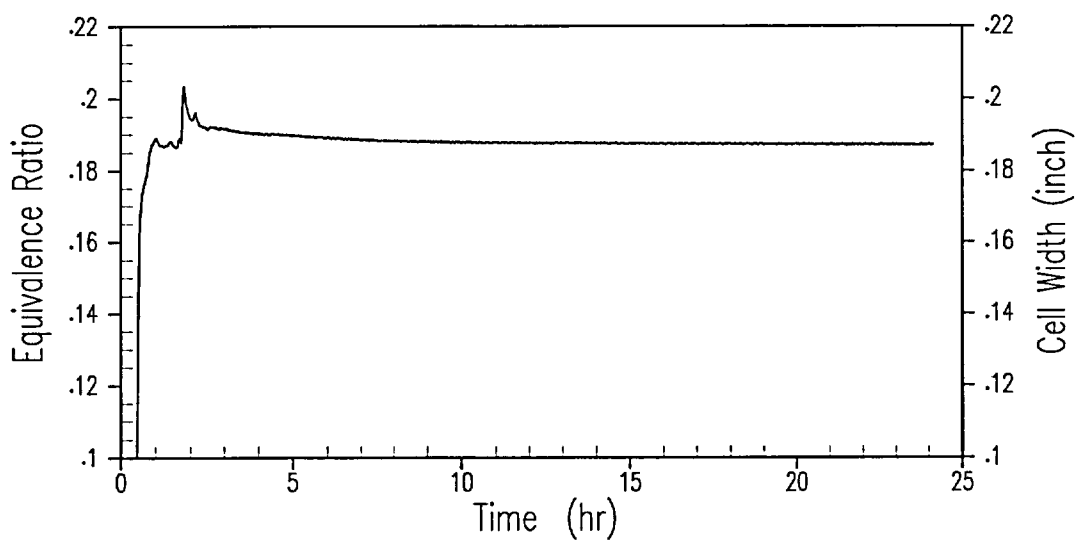

Figure 41A-202

Case 3C-1: Equivalence Ratio in CMT Room Vessel Rupture

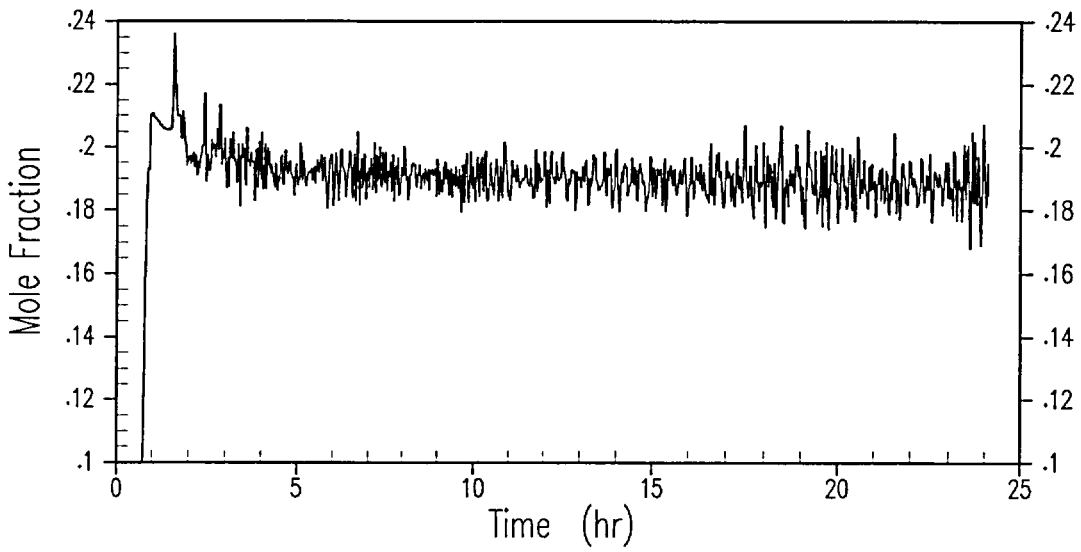

Figure 41A-203

Case 3C-1: Equivalence Ratio in IRWST Vessel Rupture

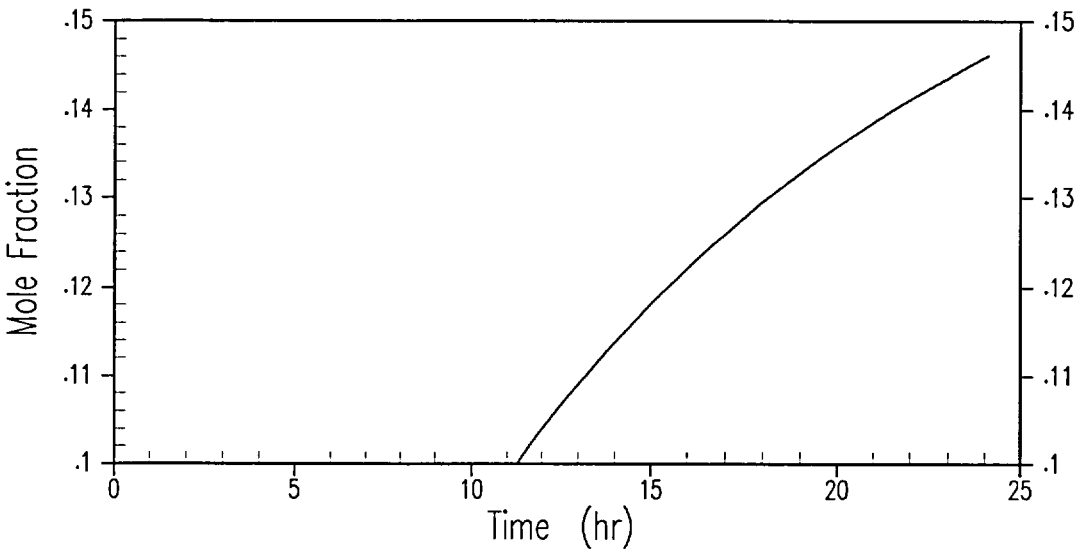

Figure 41A-204

Case 3C-1: Equivalence Ratio in PXS Vessel Rupture

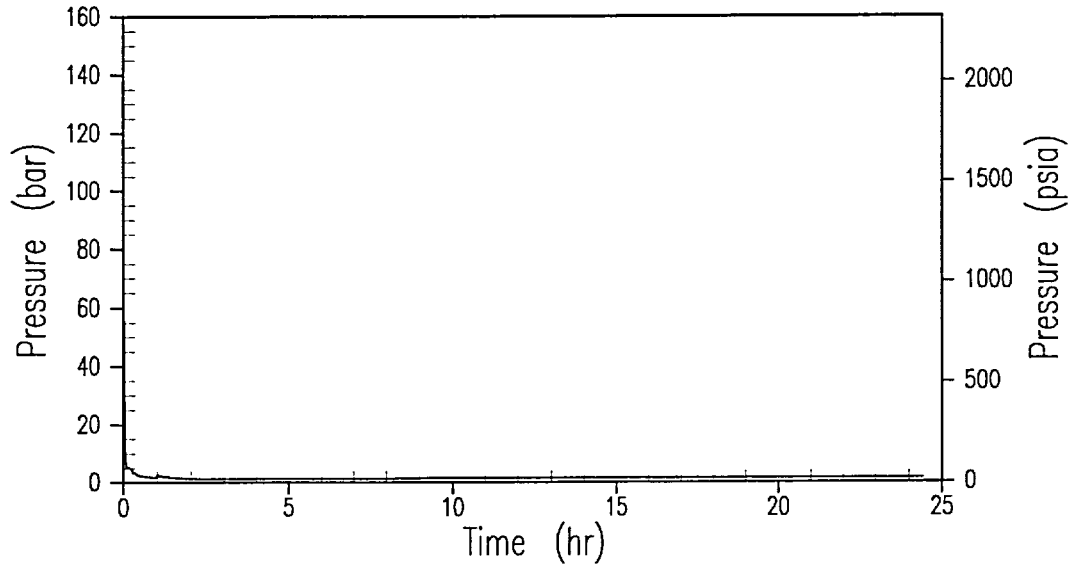

Figure 41A-205

Case 3D-1: Reactor Coolant System Pressure Spurious ADS-4 with Failed CMTs

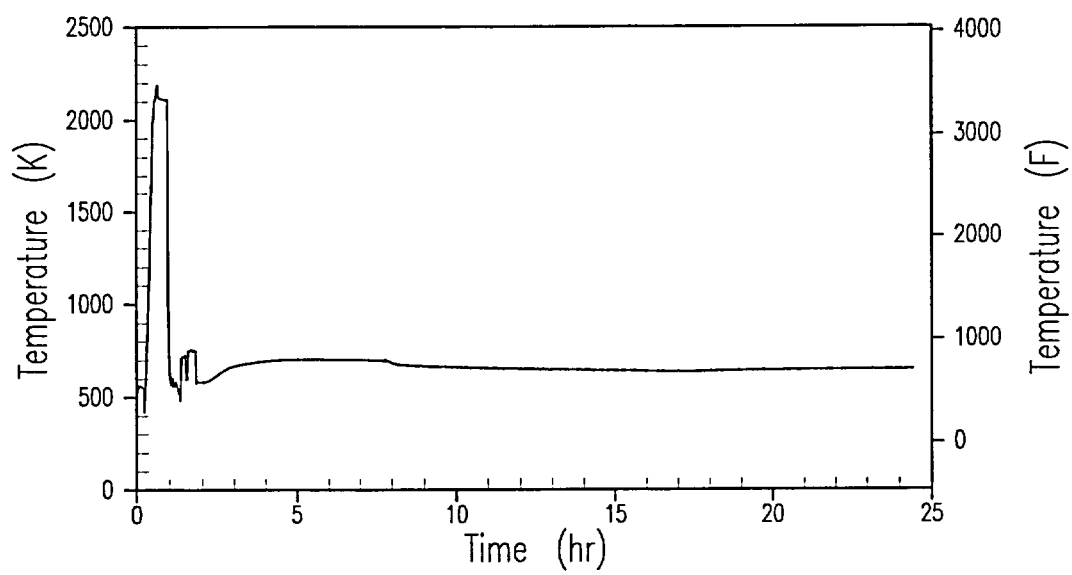

Figure 41A-206

Case 3D-1: Core-Exit Gas Temperature Spurious ADS-4 with Failed CMTs

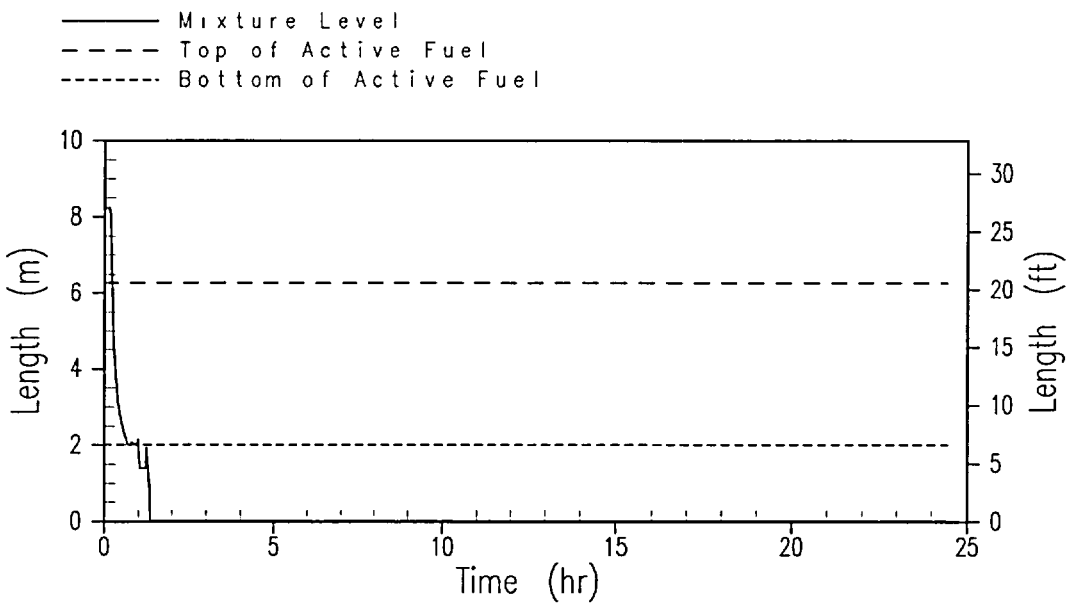

Figure 41A-207

Case 3D-1: Reactor Vessel Mixture Level Spurious ADS-4 with Failed CMTs

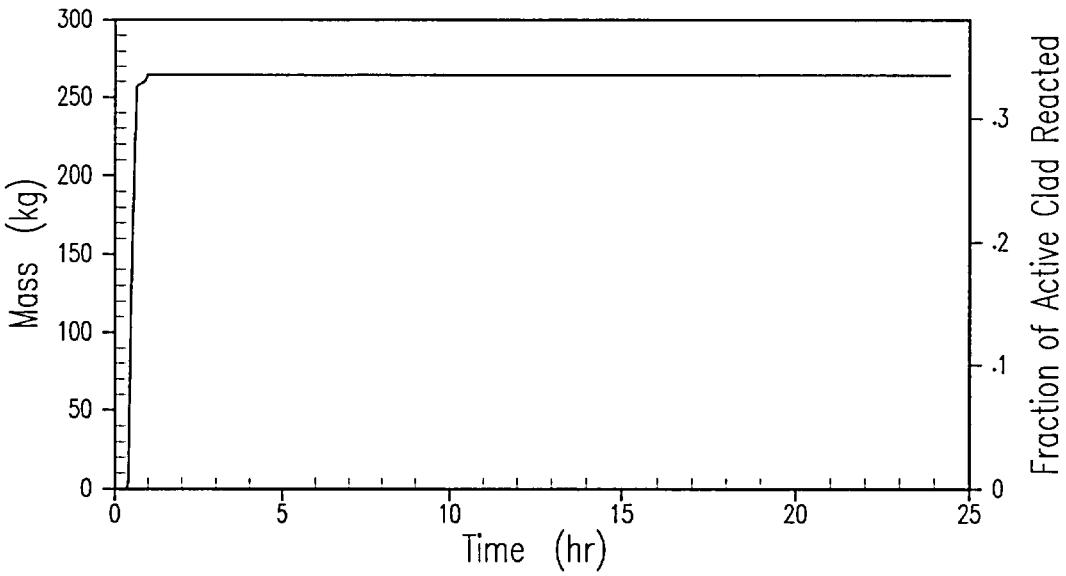

Figure 41A-208

Case 3D-1: Hydrogen Generated In-Vessel Spurious ADS-4 with Failed CMTs

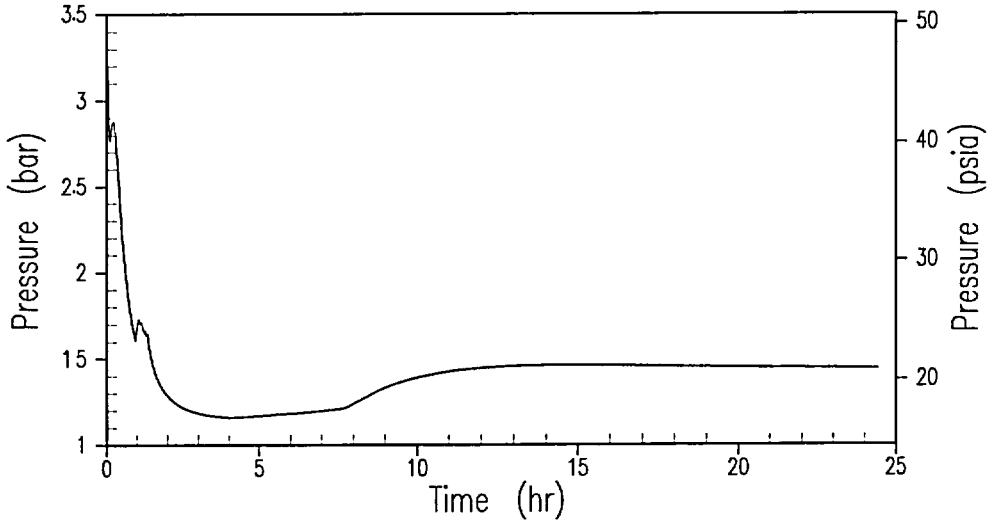

Figure 41A-209

Case 3D-1: Containment Pressure Spurious ADS-4 with Failed CMTs

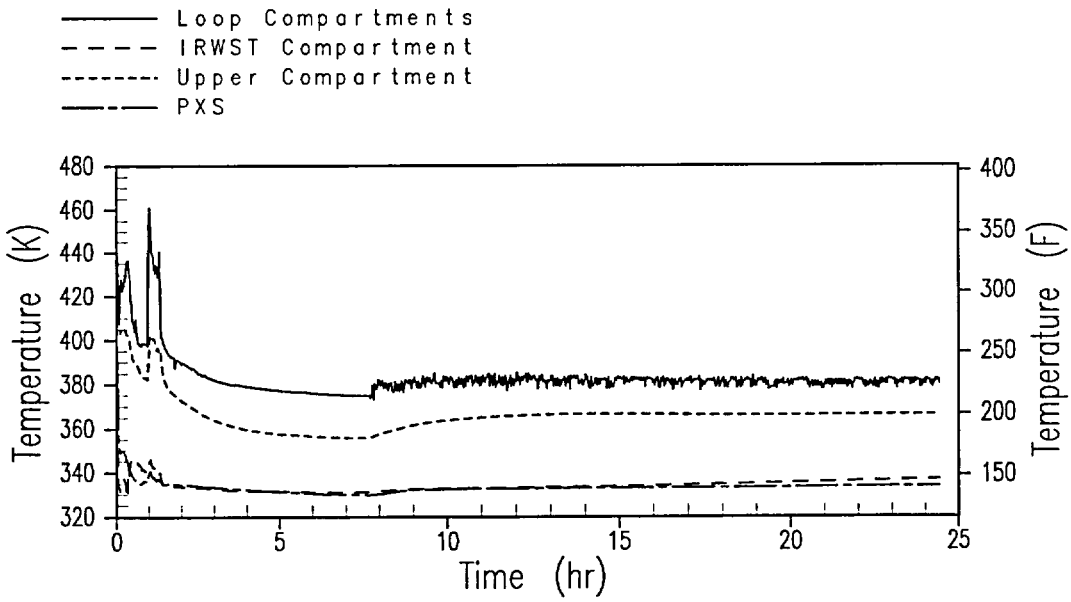

Figure 41A-210

Case 3D-1: Containment Gas Temperature Spurious ADS-4 with Failed CMTs

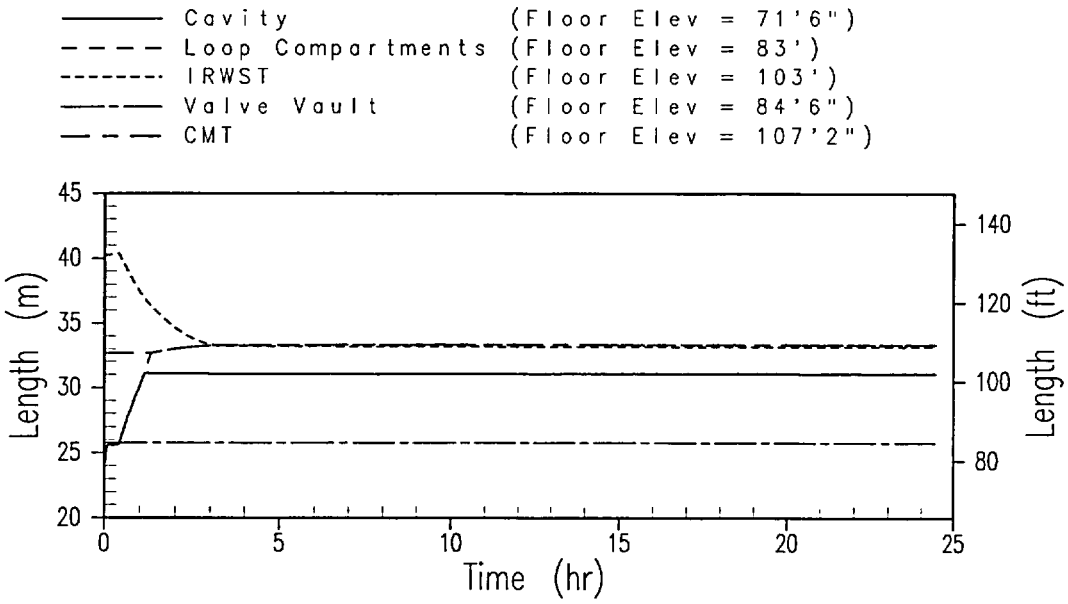

Figure 41A-211

Case 3D-1: Containment Compartments Water Level Spurious ADS-4 with Failed CMTs

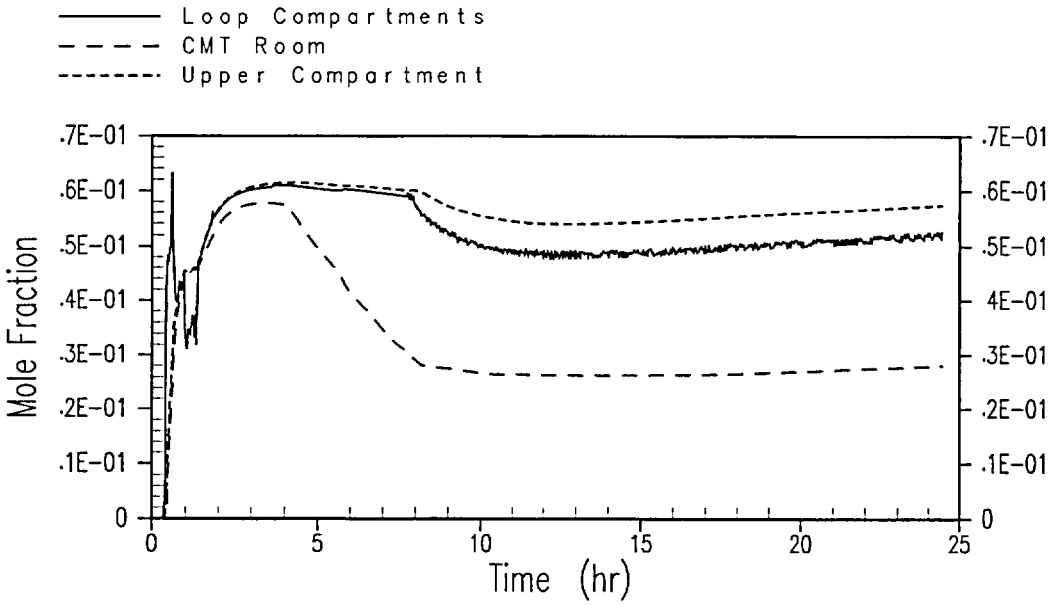

Figure 41A-212

Case 3D-1: Well-Mixed Compartment Hydrogen Concentration Spurious ADS-4 with Failed CMTs

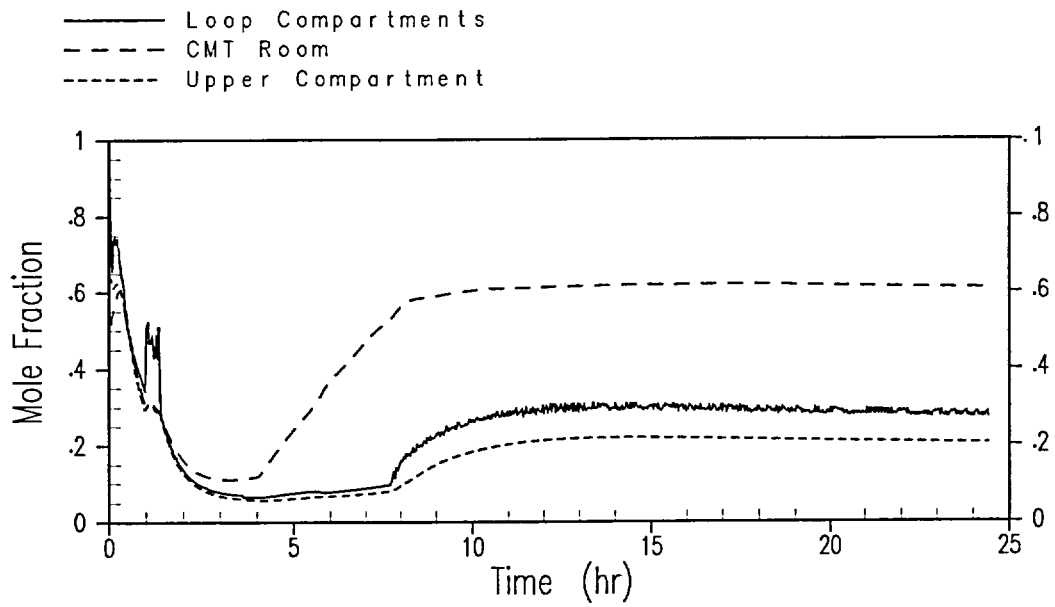

Figure 41A-213

Case 3D-1: Well-Mixed Compartment Steam Concentration Spurious ADS-4 with Failed CMTs

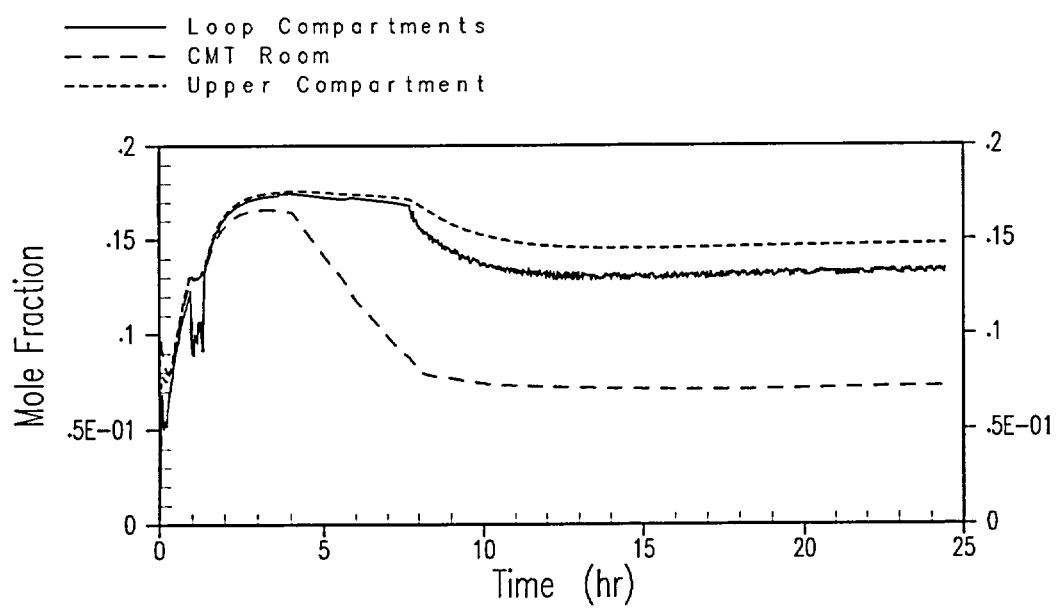

Figure 41A-214

Case 3D-1: Well-Mixed Compartment Oxygen Concentration Spurious ADS-4 with Failed CMTs

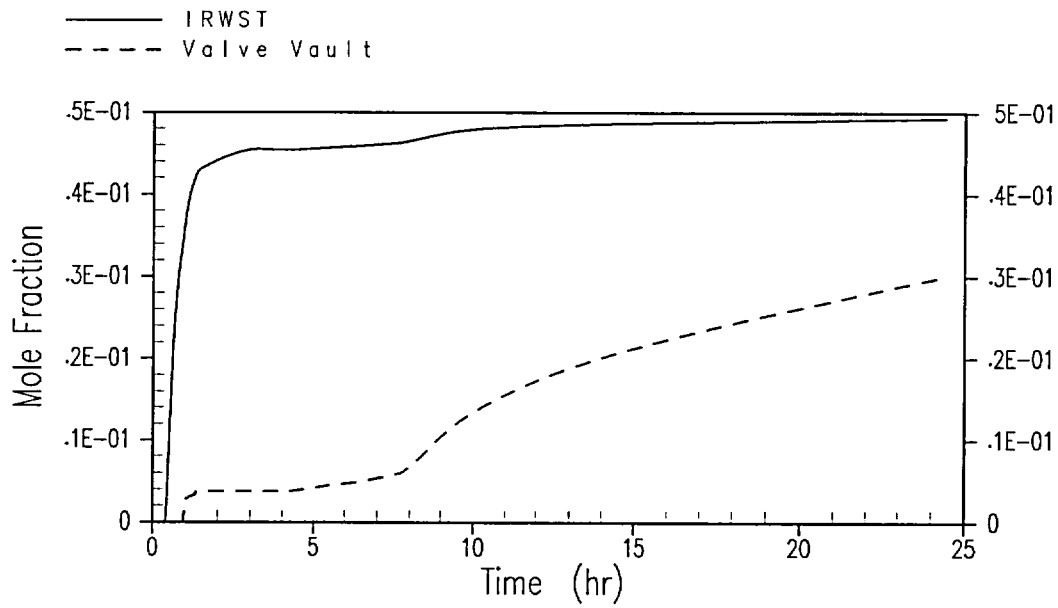

Figure 41A-215

Case 3D-1: Confined Compartment Hydrogen Concentration Spurious ADS-4 with Failed CMTs

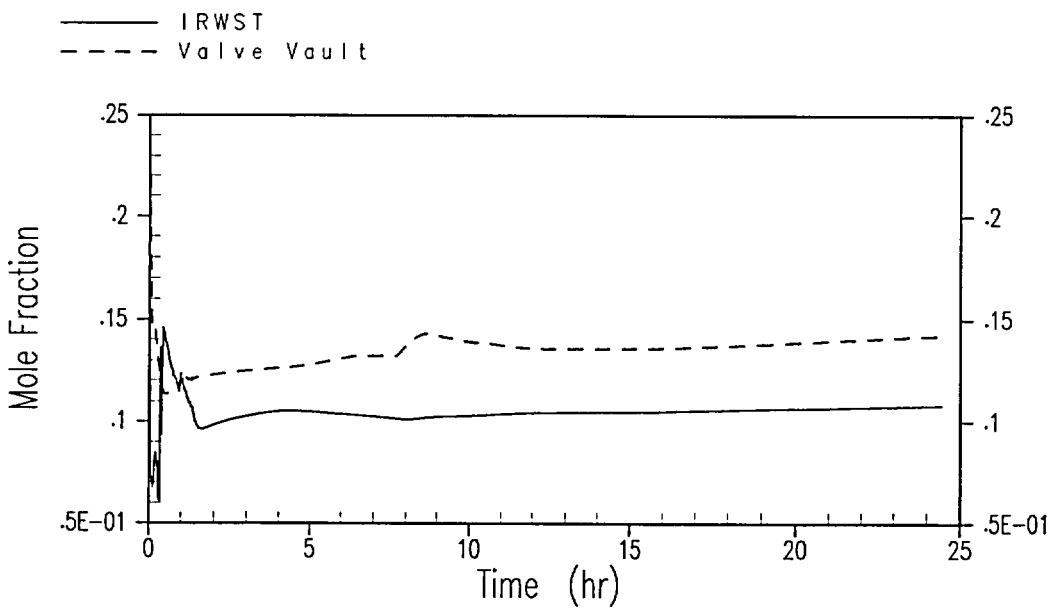

Figure 41A-216

Case 3D-1: Confined Compartment Steam Concentration Spurious ADS-4 with Failed CMTs

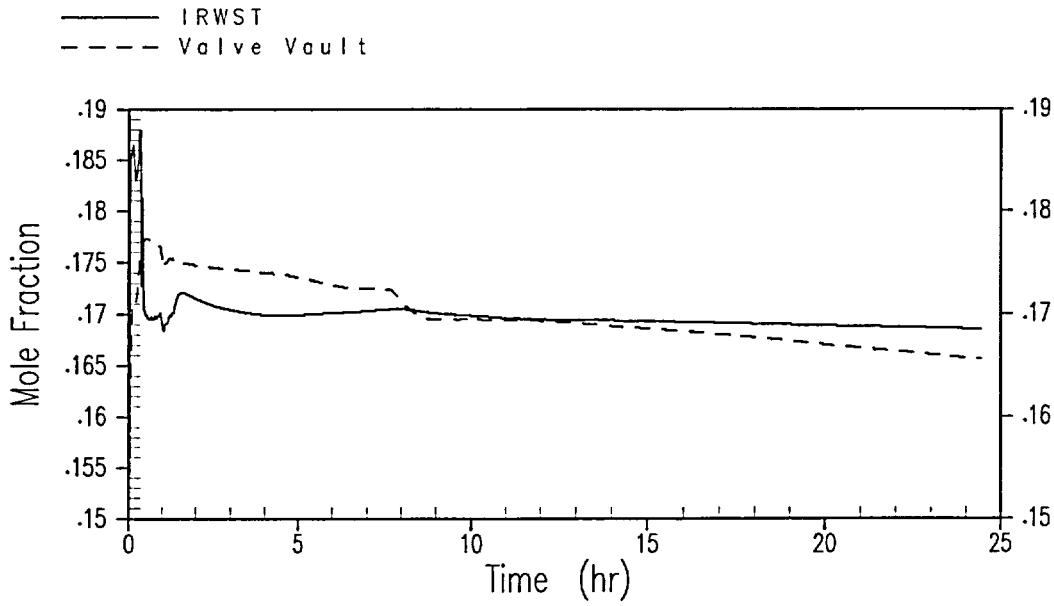

Figure 41A-217

Case 3D-1: Confined Compartment Oxygen Concentration Spurious ADS-4 with Failed CMTs

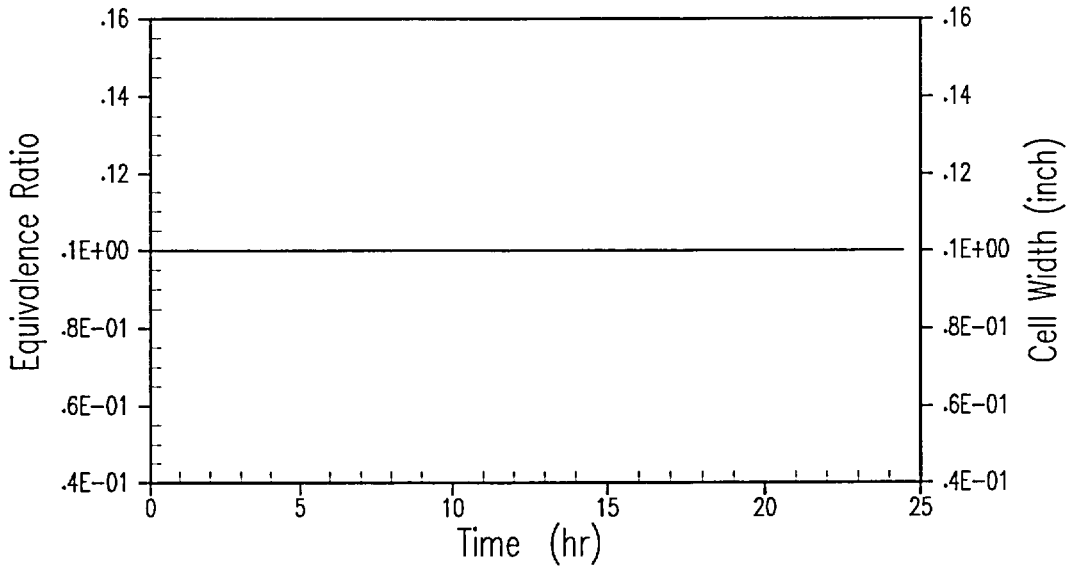

Figure 41A-218

Case 3D-1: Equivalence Ratio in SG Room Spurious ADS-4 with Failed CMTs

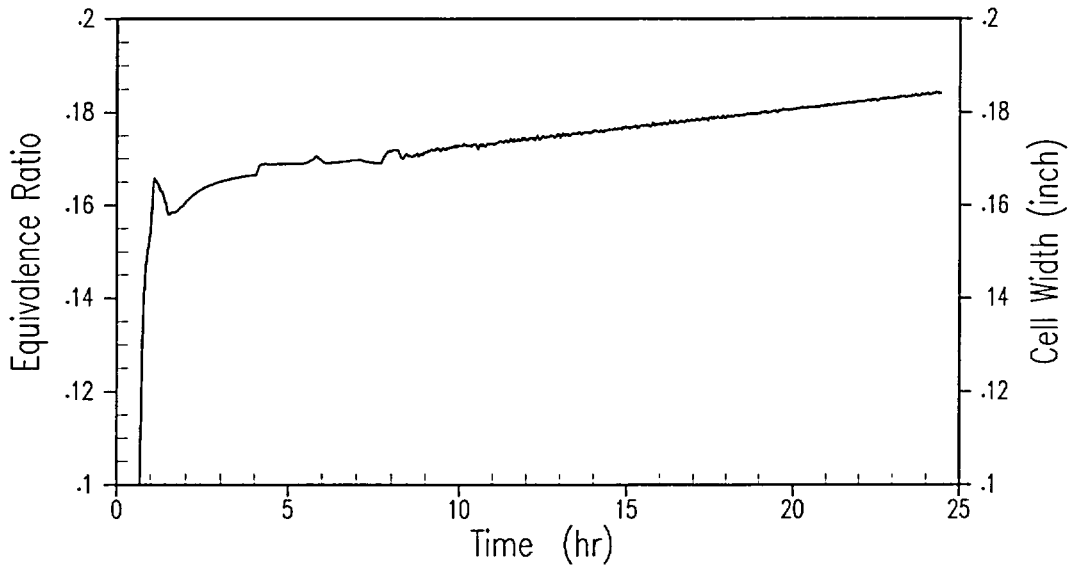

Figure 41A-219

Case 3D-1: Equivalence Ratio in CMT Room Spurious ADS-4 with Failed CMTs

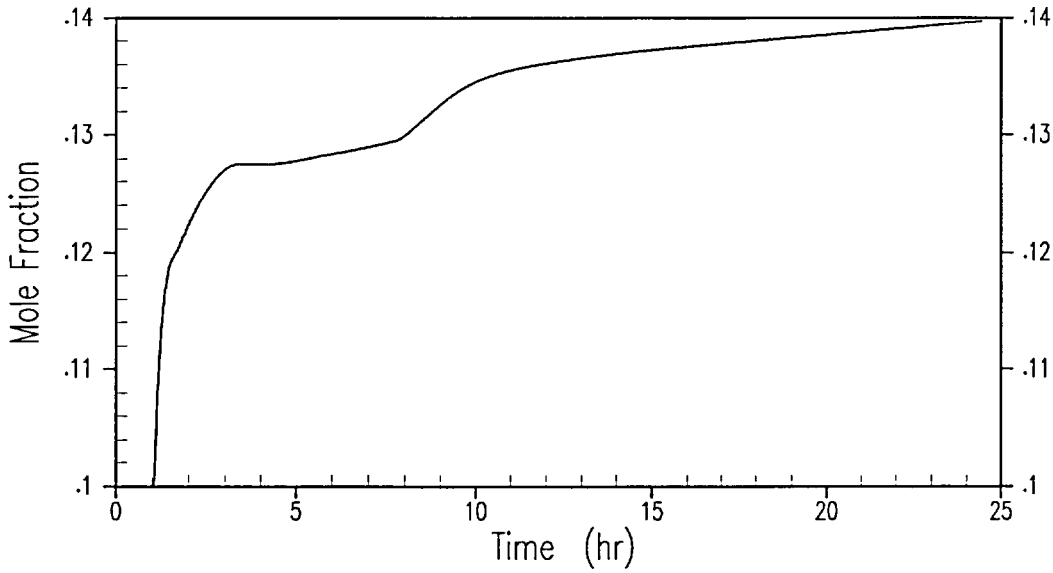

Figure 41A-220

Case 3D-1: Equivalence Ratio in IRWST Spurious ADS-4 with Failed CMTs

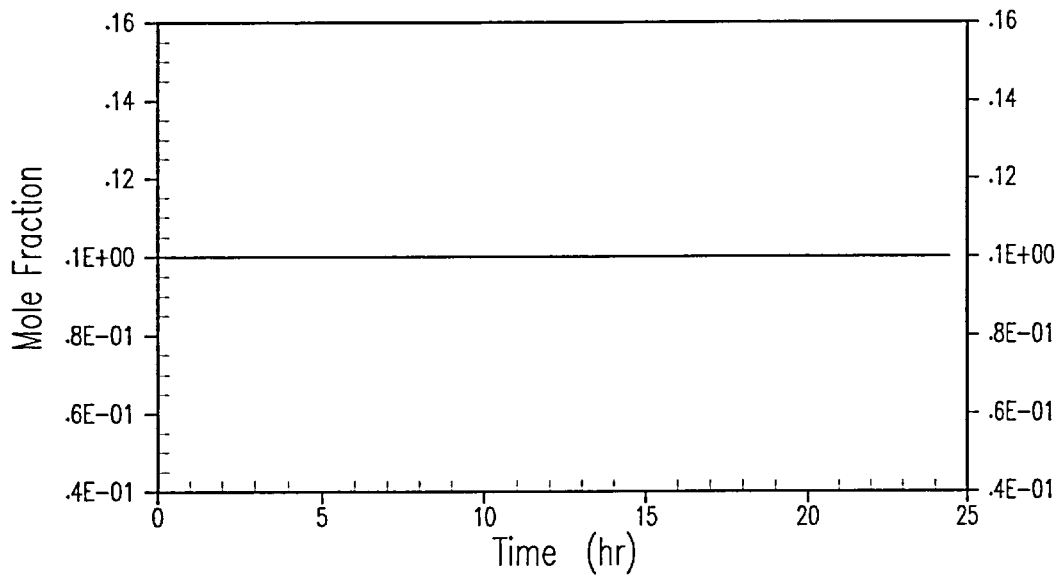

Figure 41A-221

Case 3D-1: Equivalence Ratio in PXS Spurious ADS-4 with Failed CMTs

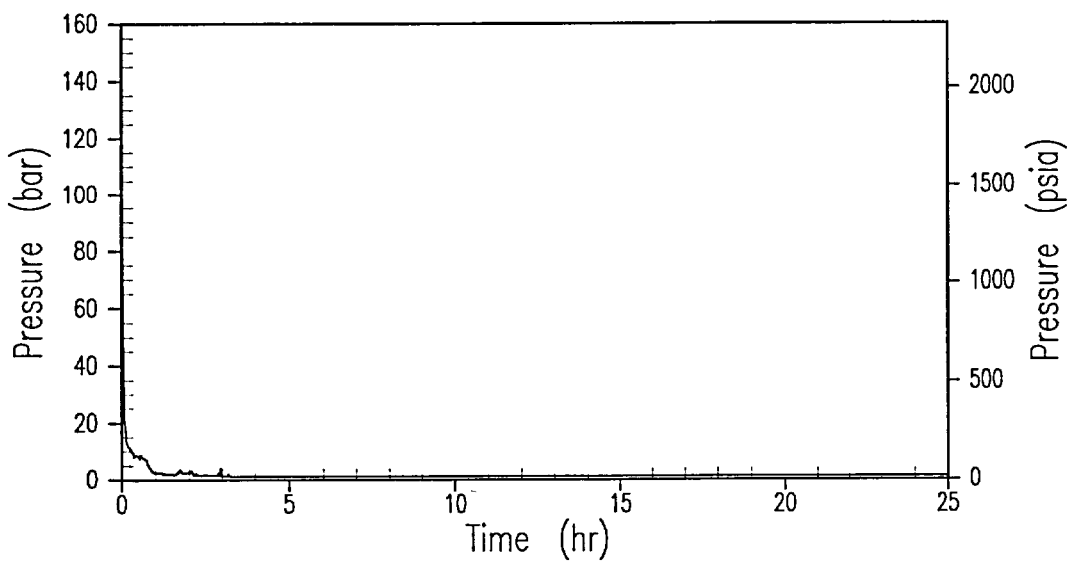

Figure 41A-222

Case 3D-2: Reactor Coolant System Pressure Spurious ADS-2, Failed CMTs

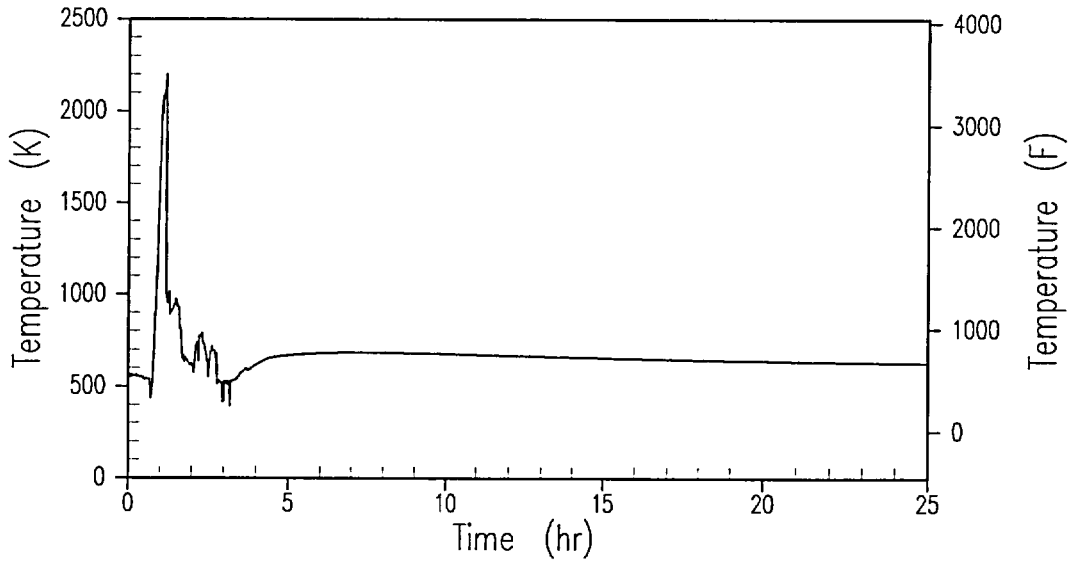

Figure 41A-223

Case 3D-2: Core-Exit Gas Temperature Spurious ADS-2, Failed CMTs

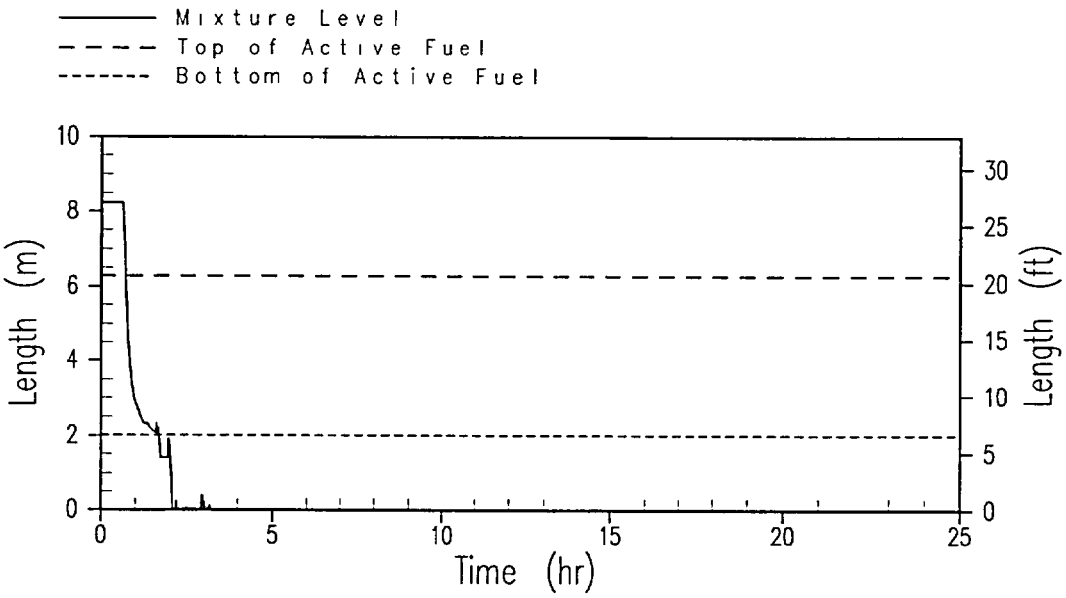

Figure 41A-224

Case 3D-2: Reactor Vessel Mixture Level Spurious ADS-2, Failed CMTs

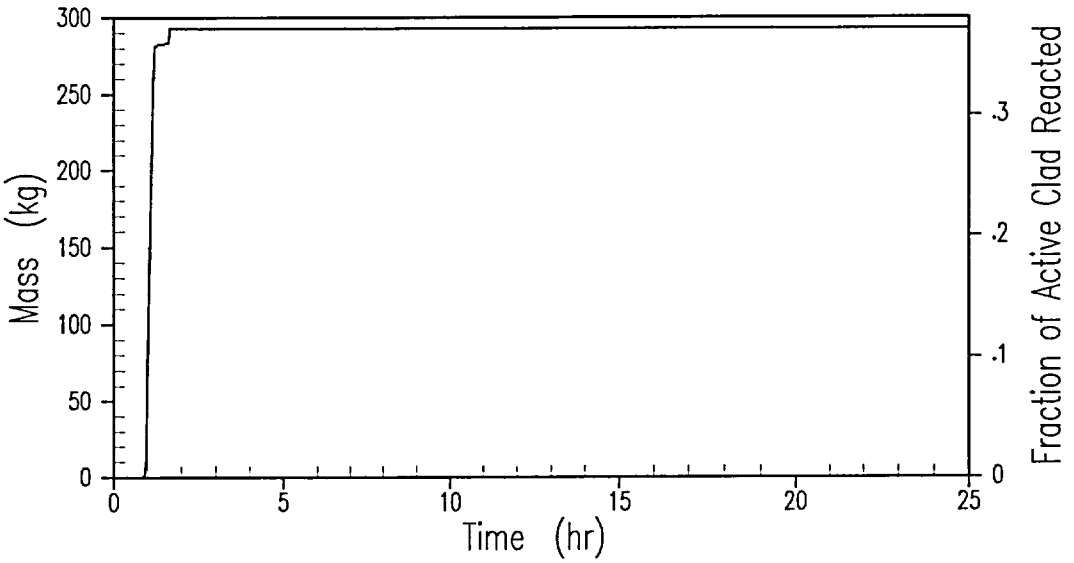

Figure 41A-225

Case 3D-2: Hydrogen Generated In-Vessel Spurious ADS-2, Failed CMTs

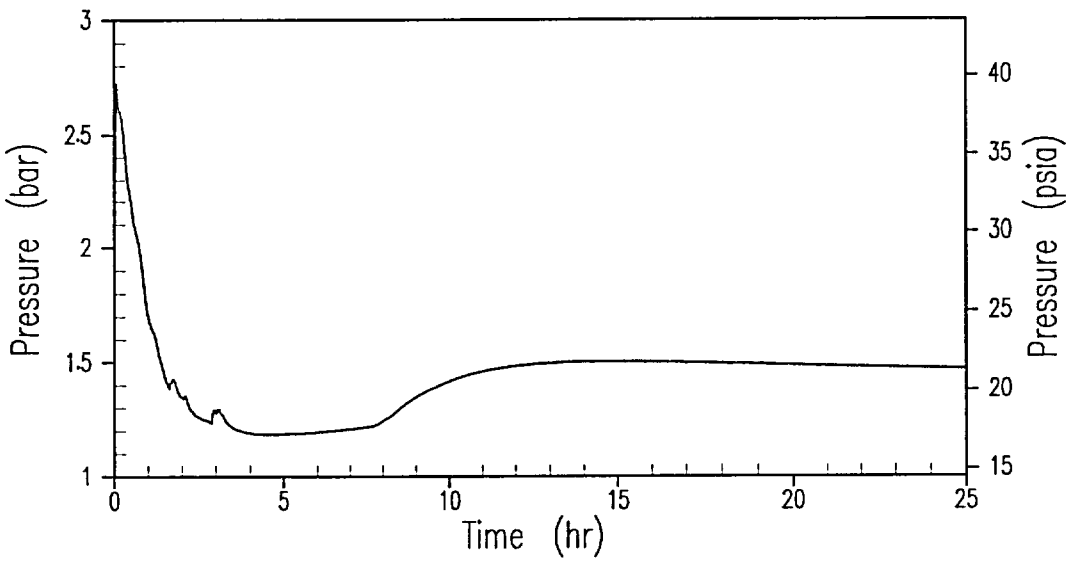

Figure 41A-226

Case 3D-2: Containment Pressure Spurious ADS-2, Failed CMTs

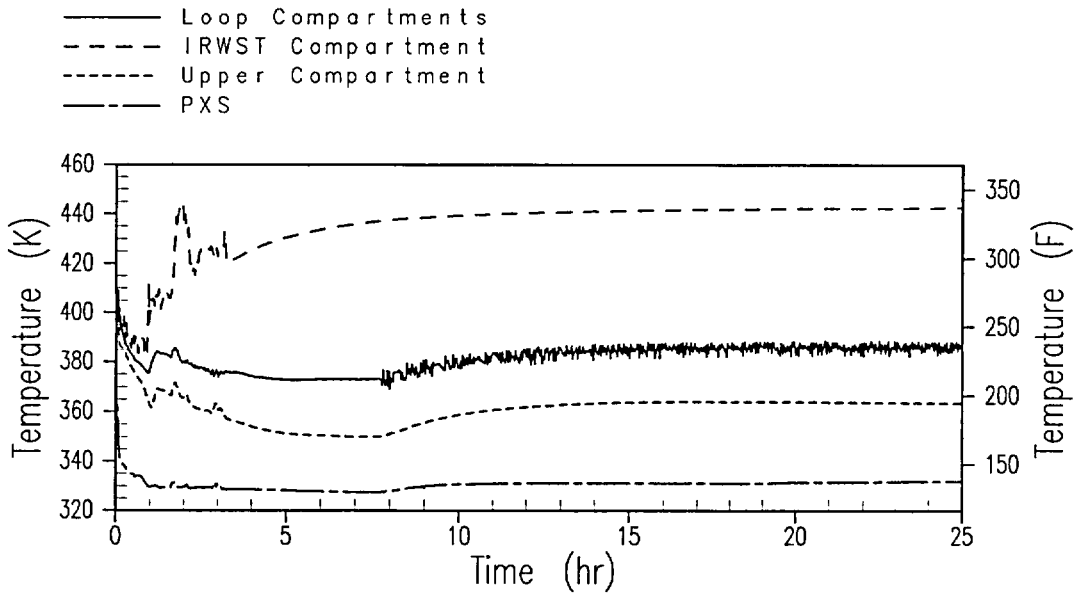

Figure 41A-227

Case 3D-2: Containment Gas Temperature Spurious ADS-2, Failed CMTs

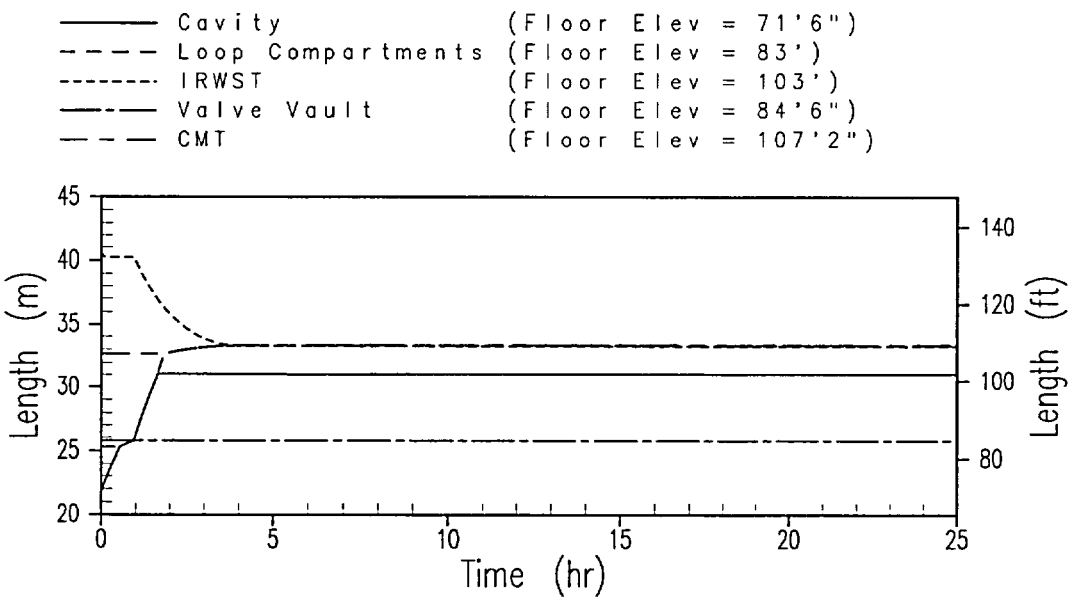

Figure 41A-228

Case 3D-2: Containment Compartments Water Level Spurious ADS-2, Failed CMTs

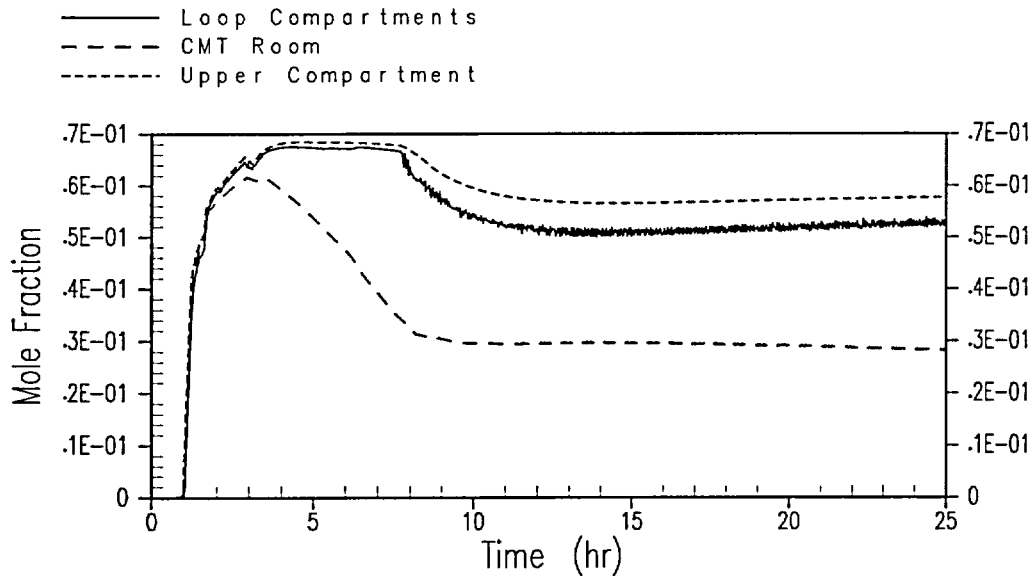

Figure 41A-229

Case 3D-2: Well-Mixed Compartment Hydrogen Concentration Spurious ADS-2, Failed CMTs

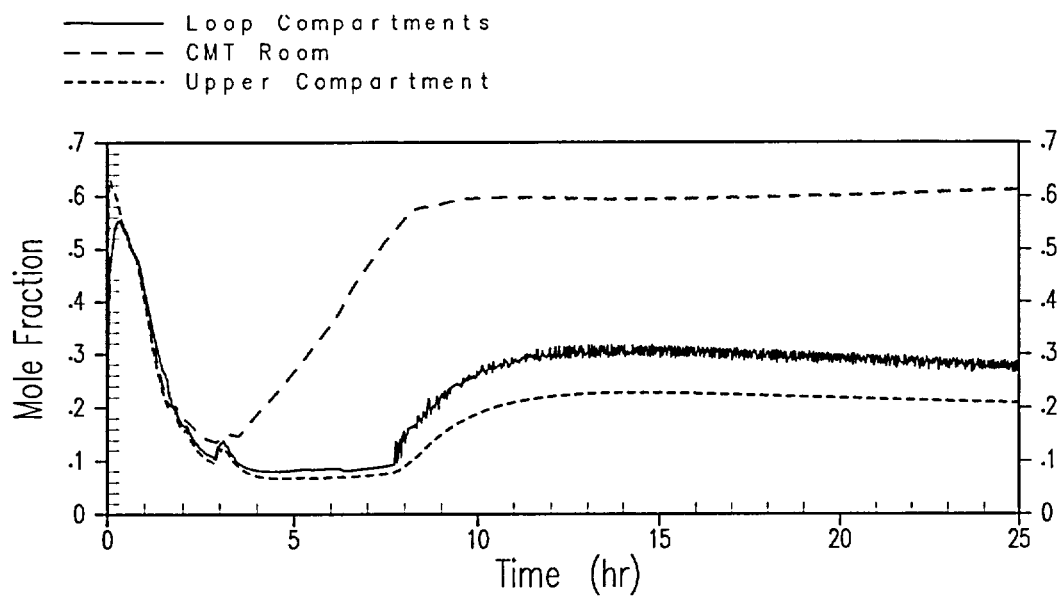

Figure 41A-230

Case 3D-2: Well-Mixed Compartment Steam Concentration Spurious ADS-2, Failed CMTs

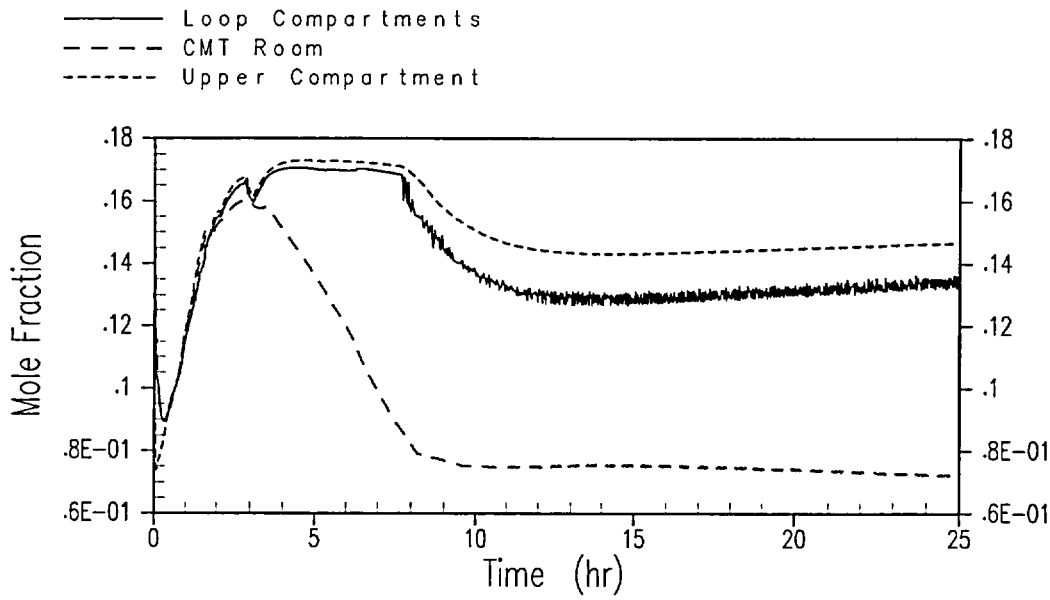

Figure 41A-231

Case 3D-2: Well-Mixed Compartment Oxygen Concentration Spurious ADS-2, Failed CMTs

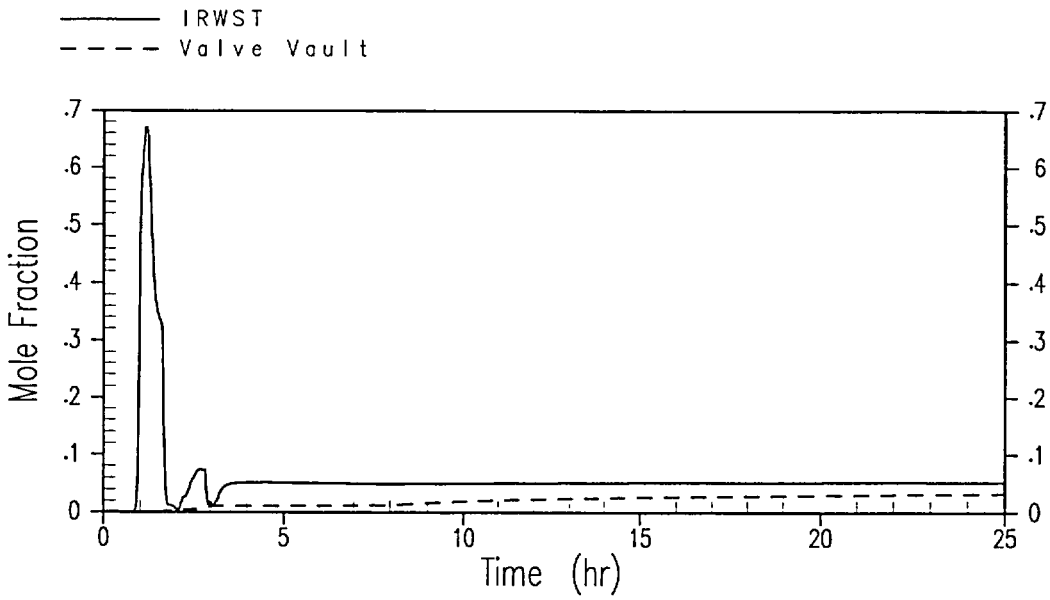

Figure 41A-232

Case 3D-2: Confined Compartment Hydrogen Concentration Spurious ADS-2, Failed CMTs

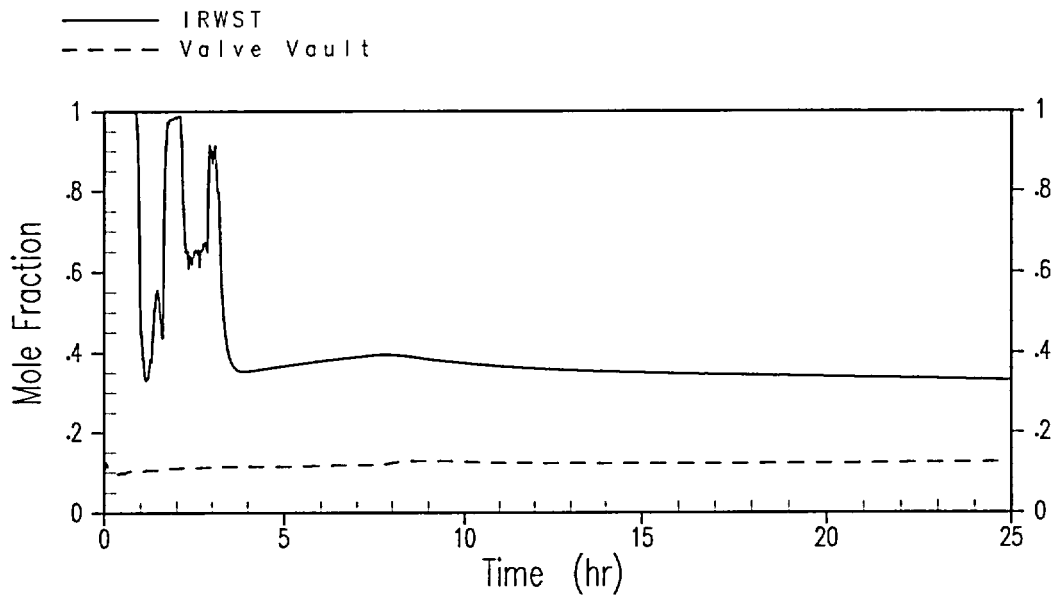

Figure 41A-233

Case 3D-2: Confined Compartment Steam Concentration Spurious ADS-2, Failed CMTs

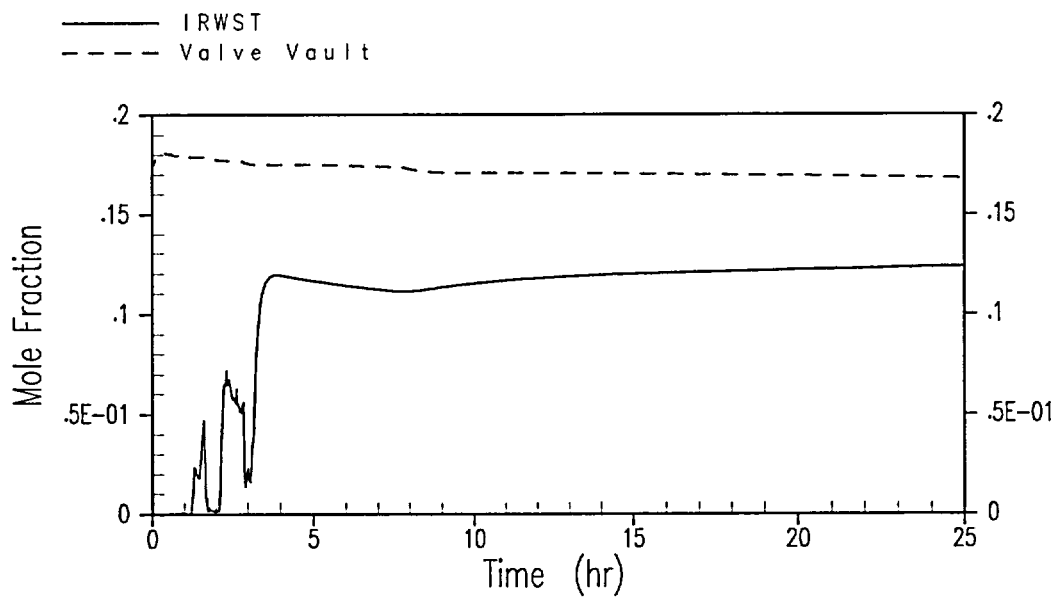

Figure 41A-234

Case 3D-2: Confined Compartment Oxygen Concentration Spurious ADS-2, Failed CMTs

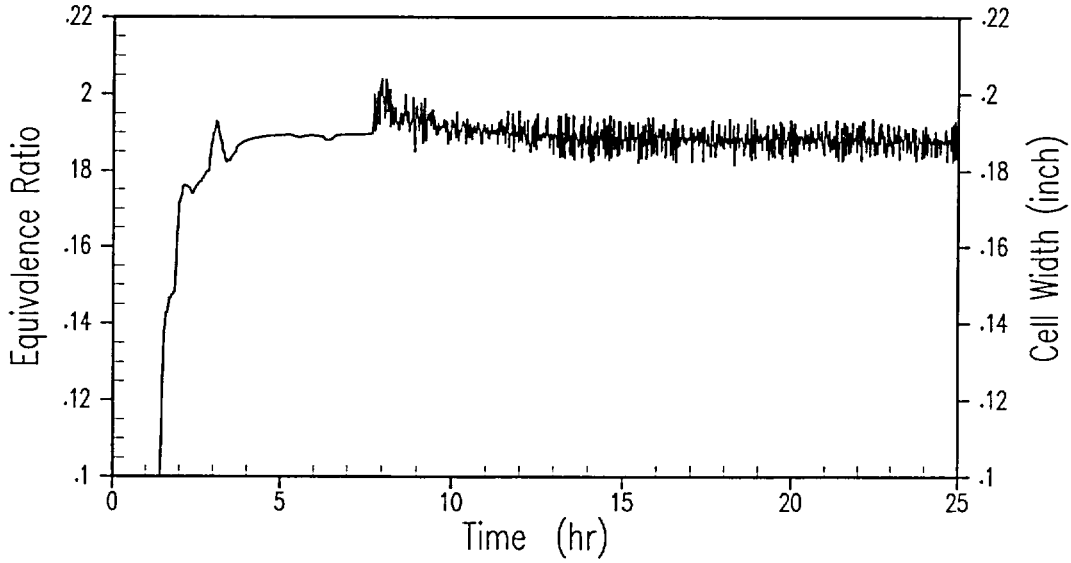

Figure 41A-235

Case 3D-2: Equivalence Ratio in SG Room Spurious ADS-2, Failed CMTs

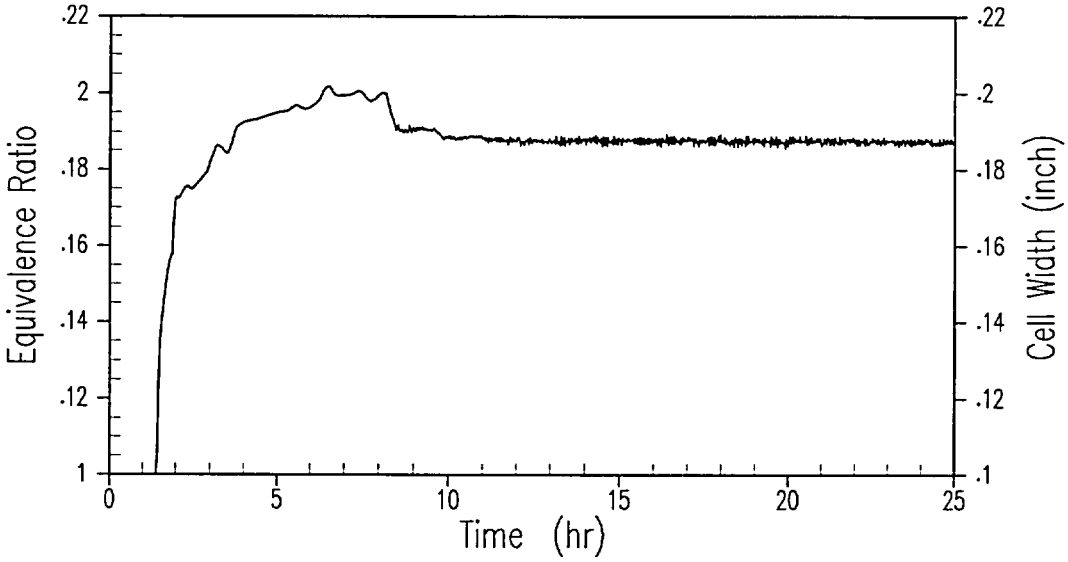

Figure 41A-236

Case 3D-2: Equivalence Ratio in CMT Room Spurious ADS-2, Failed CMTs

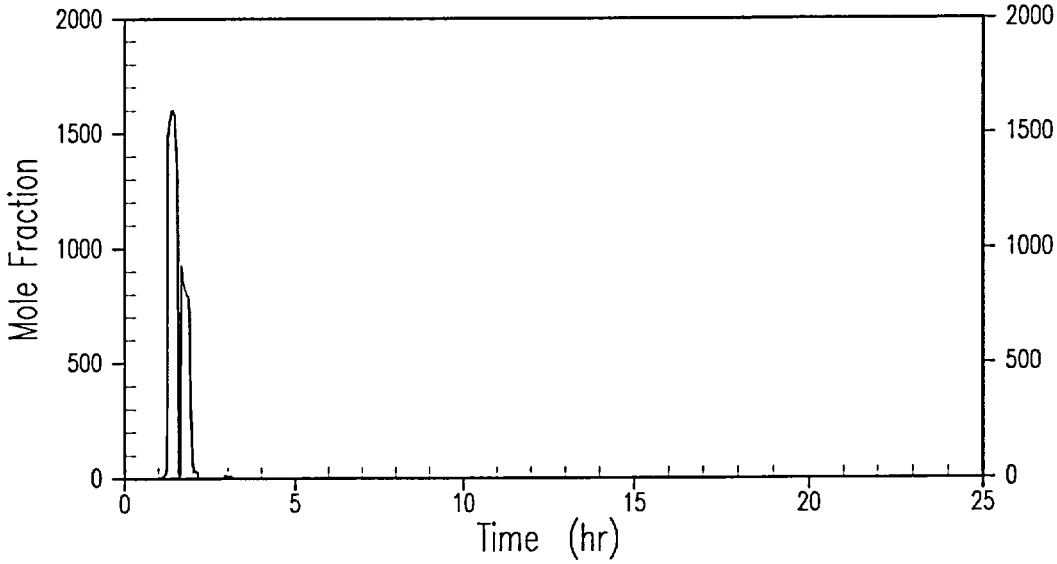

Figure 41A-237

Case 3D-2: Equivalence Ratio in IRWST Spurious ADS-2, Failed CMTs

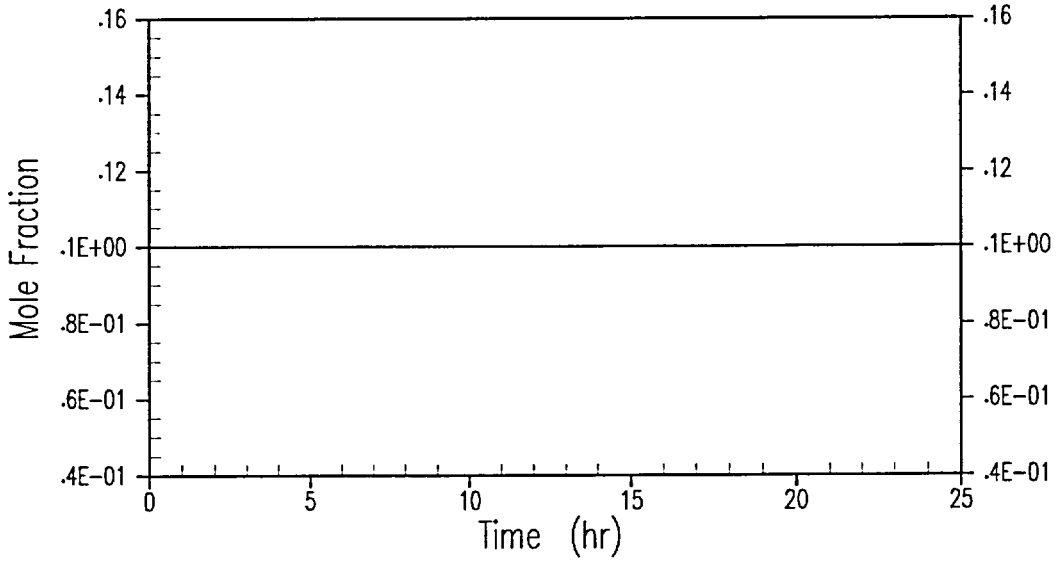

Figure 41A-238

Case 3D-2: Equivalence Ratio in PXS Spurious ADS-2, Failed CMTs

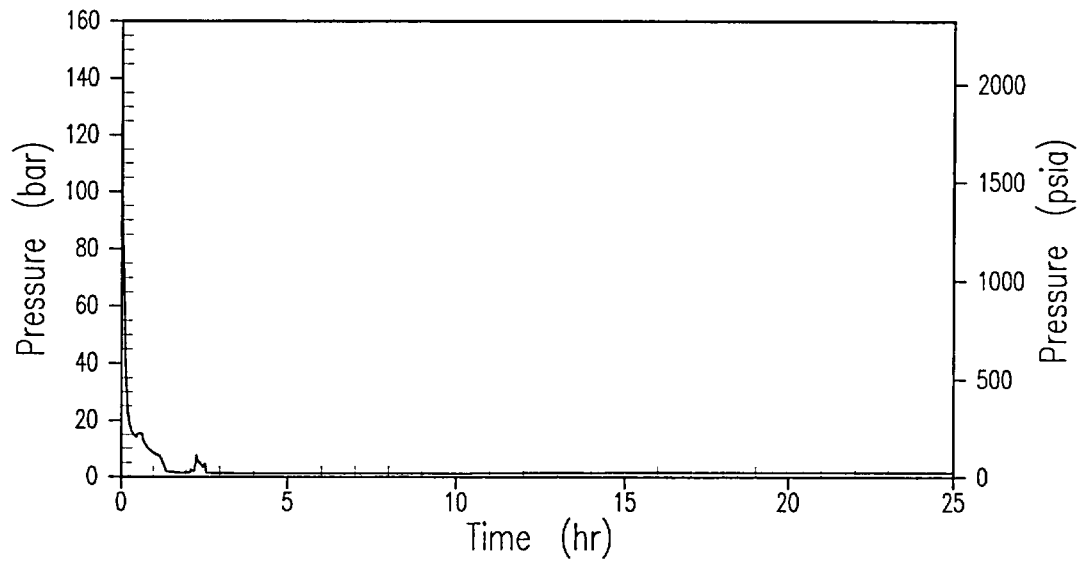

Figure 41A-239

Case 3D-3: Reactor Coolant System Pressure DVI Line Break with no ADS

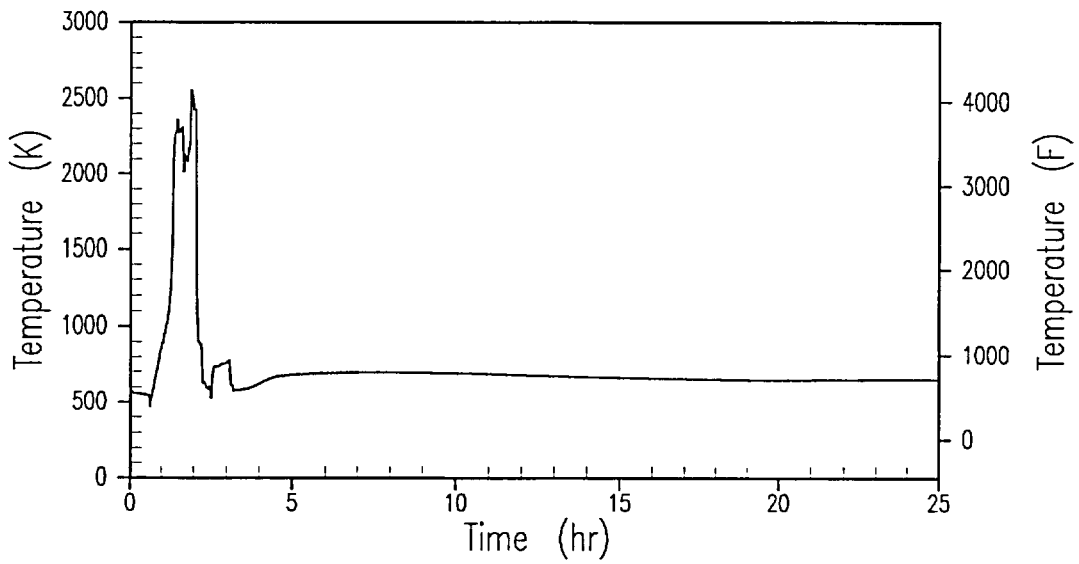

Figure 41A-240

Case 3D-3: Core-Exit Gas Temperature DVI Line Break with no ADS

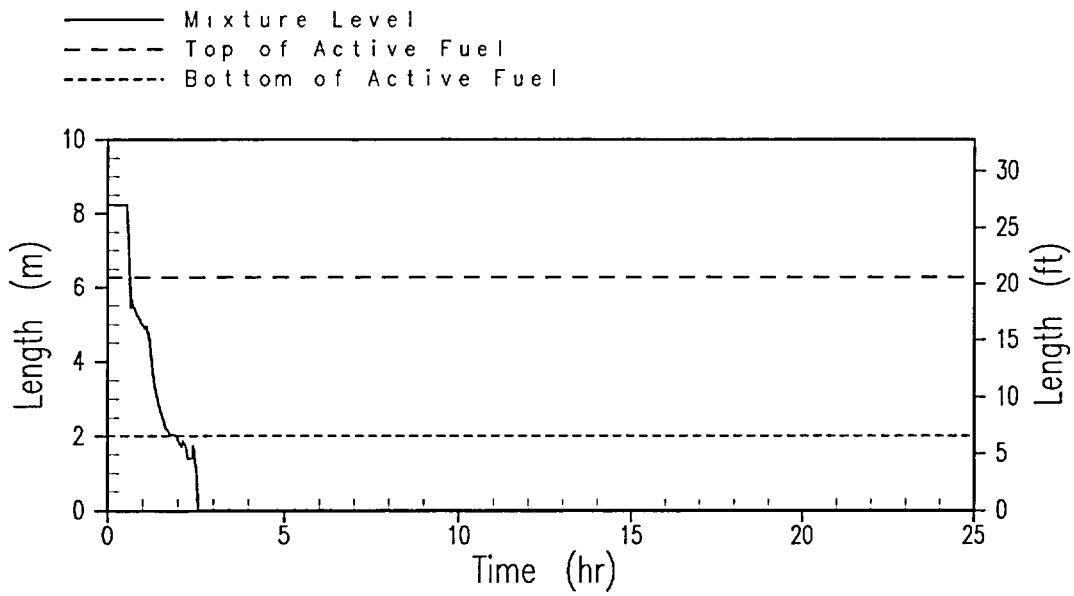

Figure 41A-241

Case 3D-3: Reactor Vessel Mixture Level DVI Line Break with no ADS

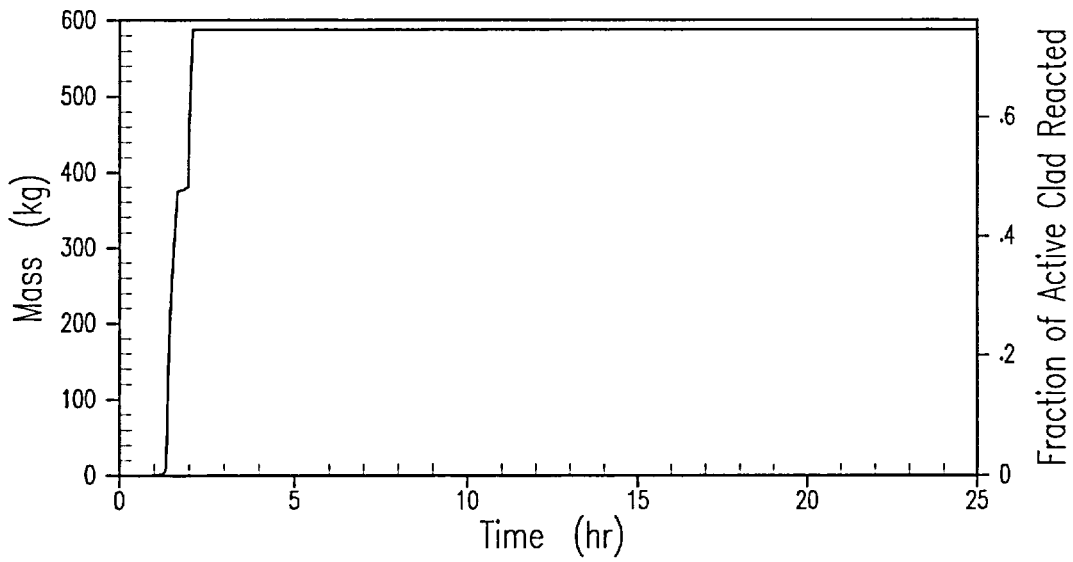

Figure 41A-242

Case 3D-3: Hydrogen Generated In-Vessel DVI Line Break with no ADS

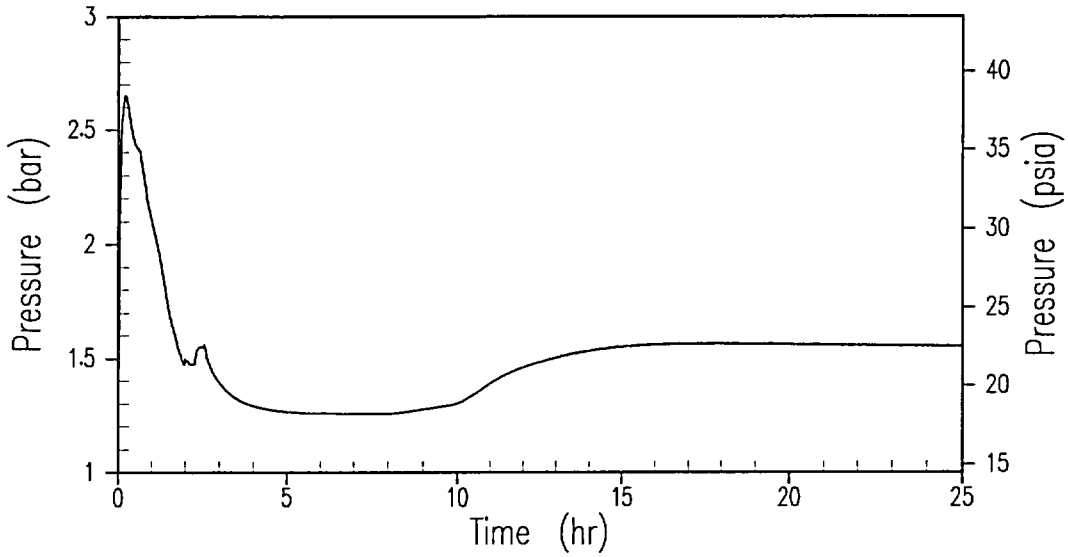

Figure 41A-243

Case 3D-3: Containment Pressure DVI Line Break with no ADS

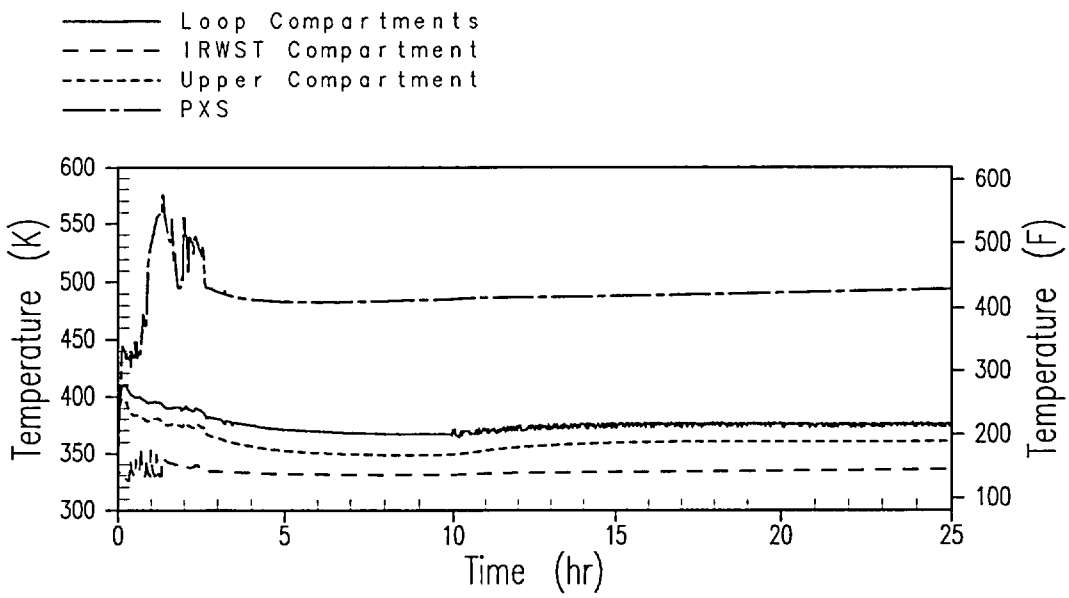

Figure 41A-244

Case 3D-3: Containment Gas Temperature DVI Line Break with no ADS

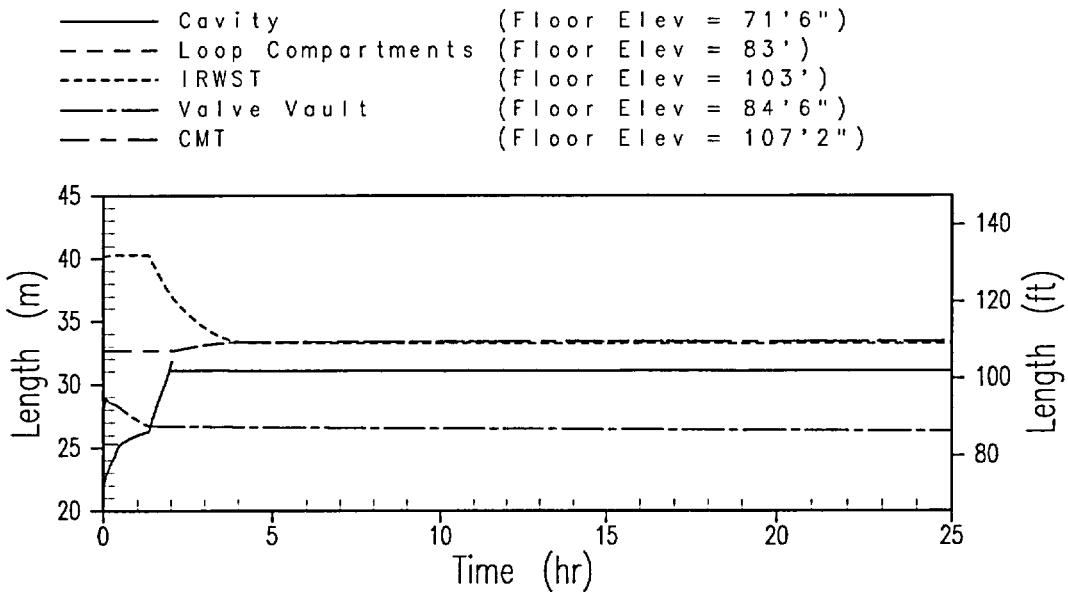

Figure 41A-245

Case 3D-3: Containment Compartments Water Level DVI Line Break with no ADS

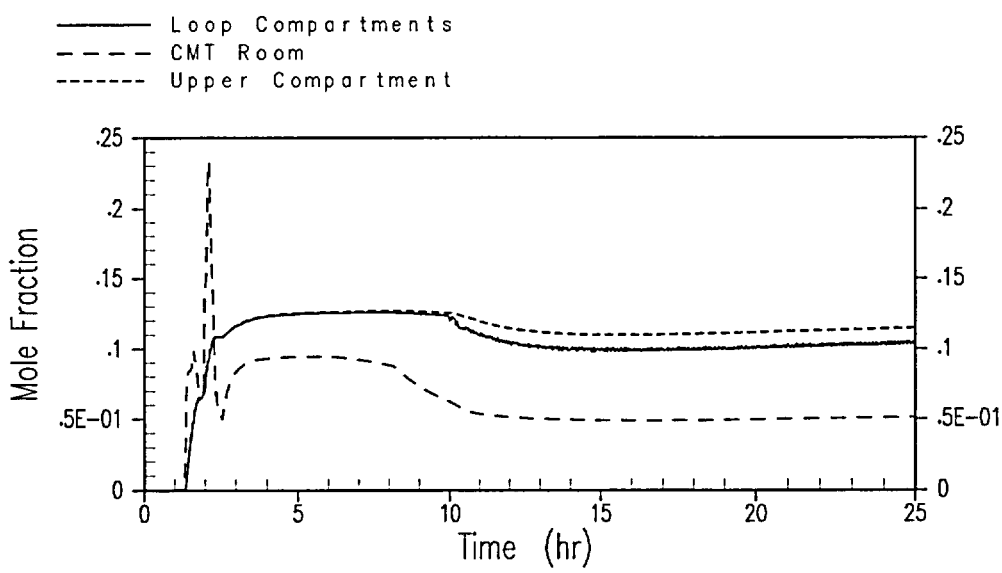

Figure 41A-246

Case 3D-3: Well-Mixed Compartment Hydrogen Concentration DVI Line Break with no ADS

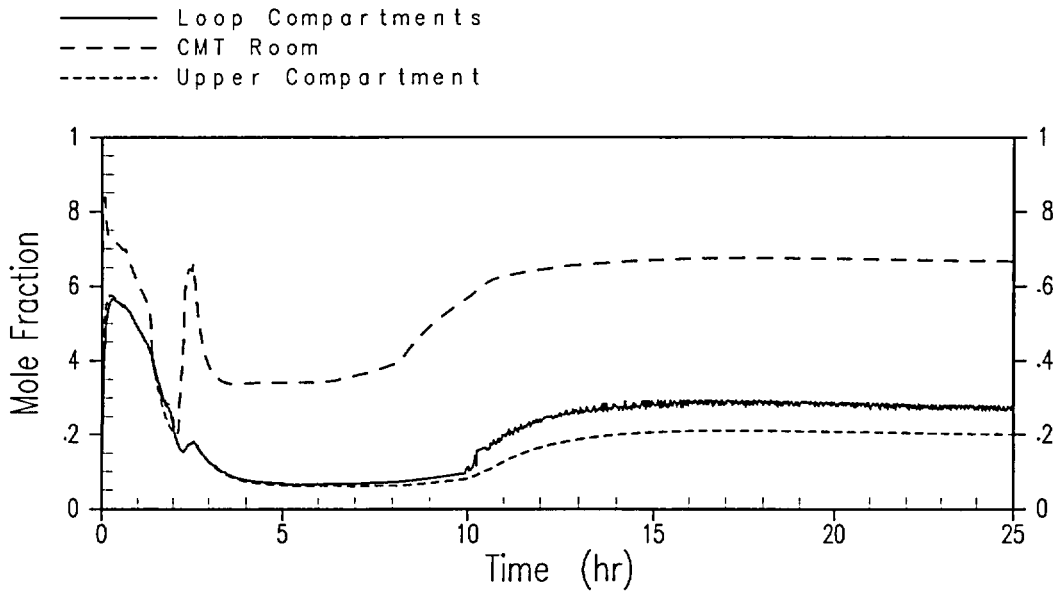

Figure 41A-247

Case 3D-3: Well-Mixed Compartment Steam Concentration DVI Line Break with no ADS

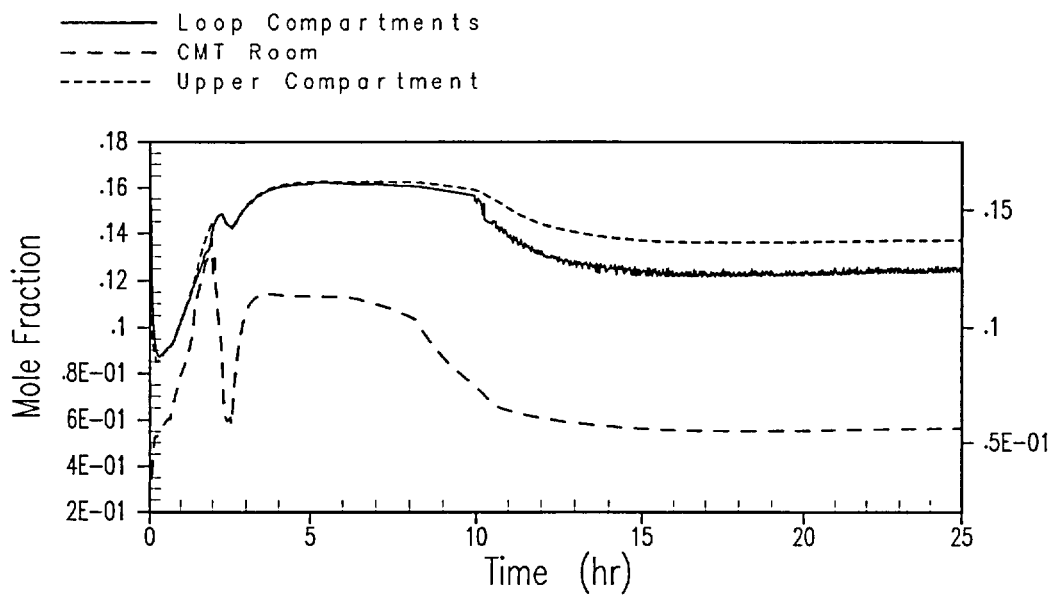

Figure 41A-248

Case 3D-3: Well-Mixed Compartment Oxygen Concentration DVI Line Break with no ADS

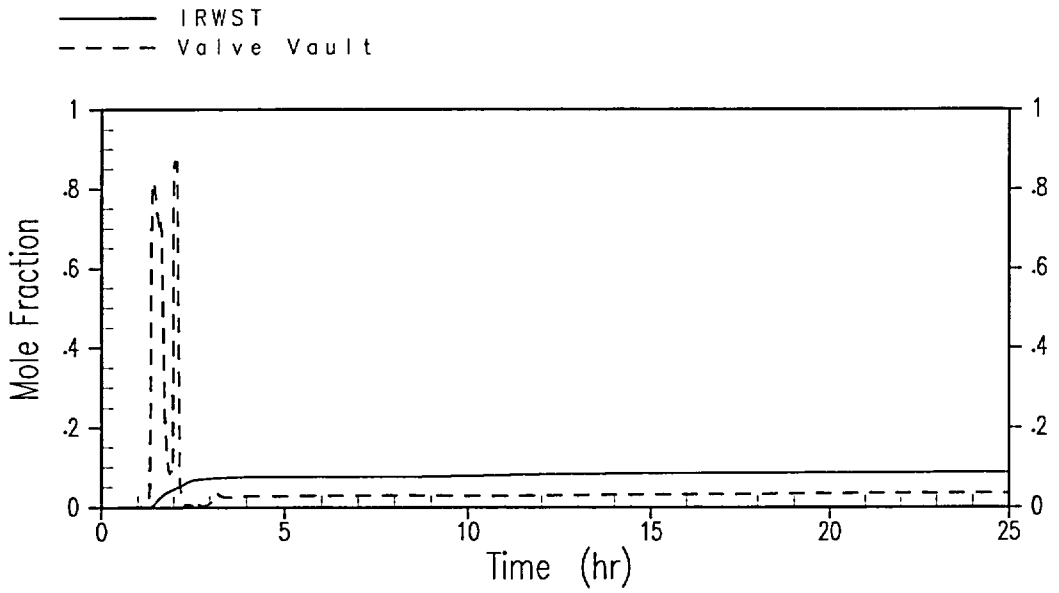

Figure 41A-249

Case 3D-3: Confined Compartment Hydrogen Concentration DVI Line Break with no ADS

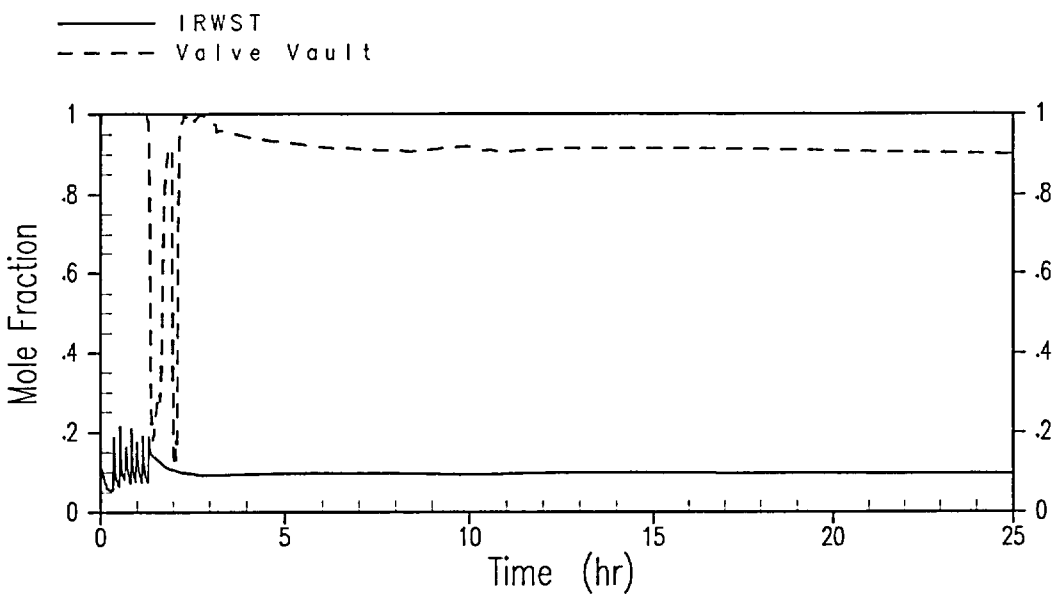

Figure 41A-250

Case 3D-3: Confined Compartment Steam Concentration DVI Line Break with no ADS

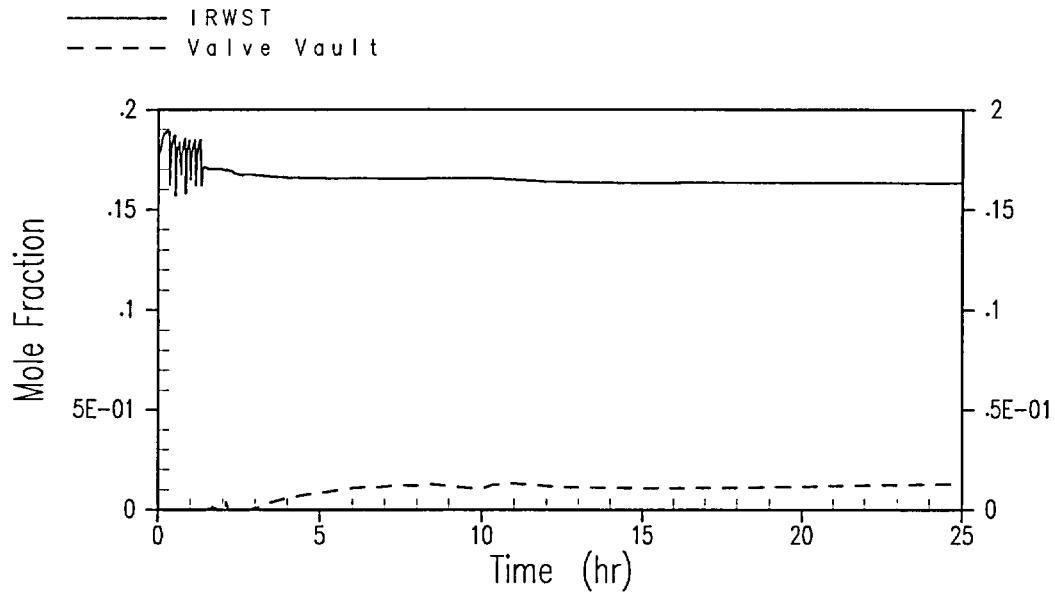

Figure 41A-251

Case 3D-3: Confined Compartment Oxygen Concentration DVI Line Break with no ADS

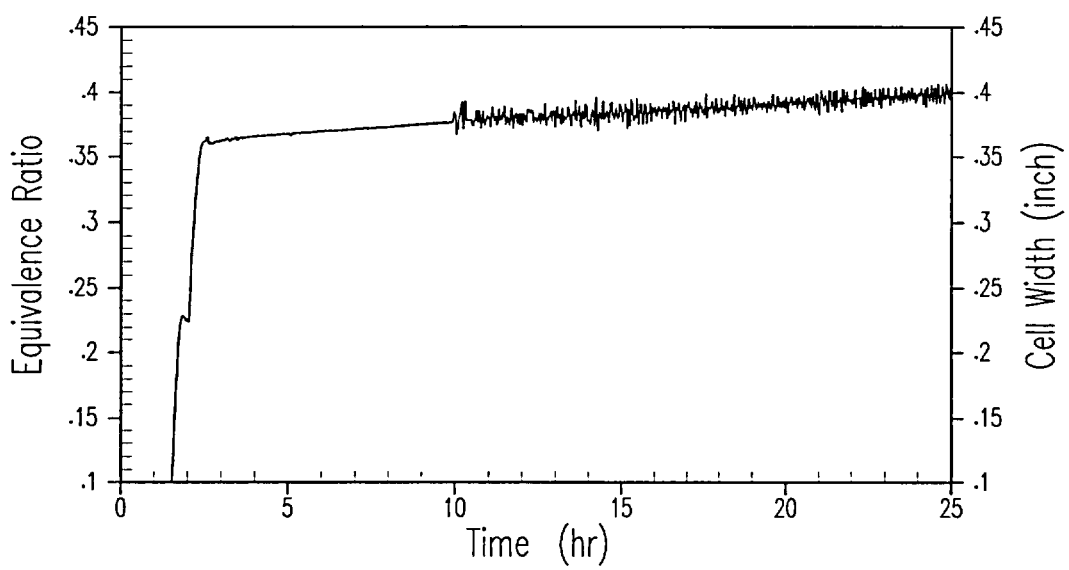

Figure 41A-252

Case 3D-3: Equivalence Ratio in SG Room DVI Line Break with no ADS

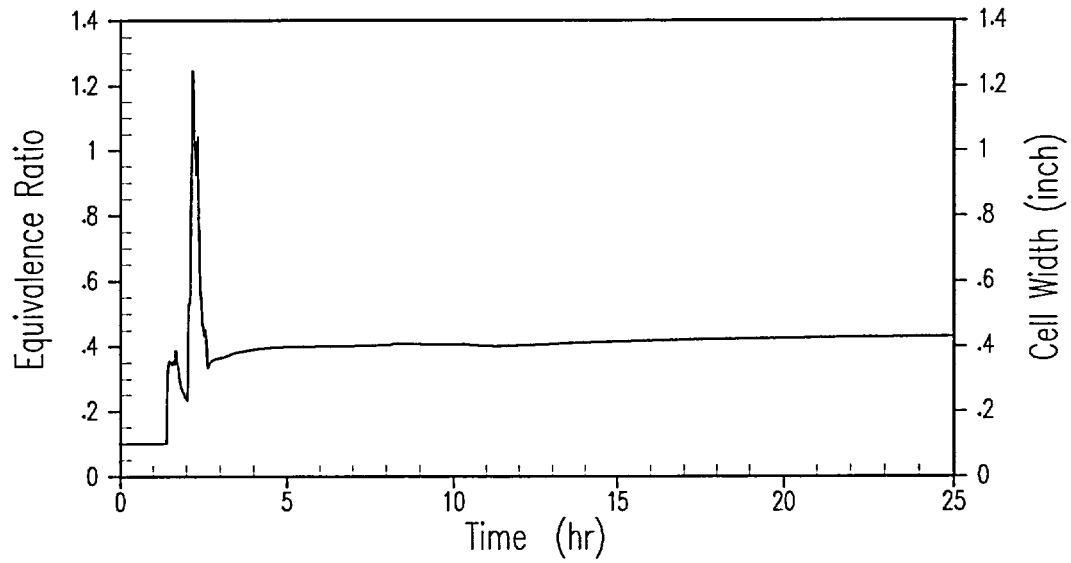

Figure 41A-253

Case 3D-3: Equivalence Ratio in CMT Room DVI Line Break with no ADS

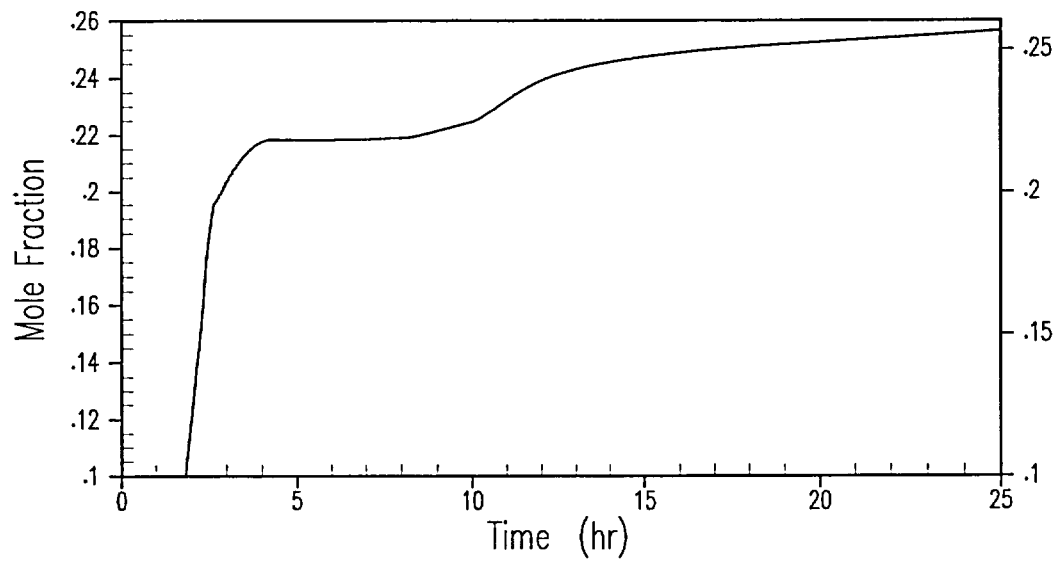

Figure 41A-254

Case 3D-3: Equivalence Ratio in IRWST DVI Line Break with no ADS

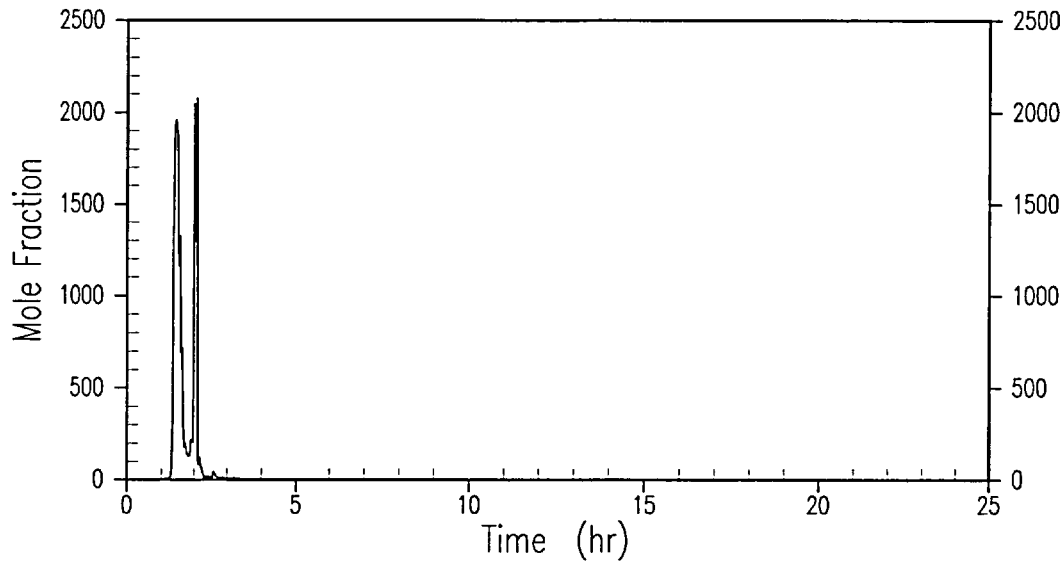

Figure 41A-255

Case 3D-3: Equivalence Ratio in PXS DVI Line Break with no ADS

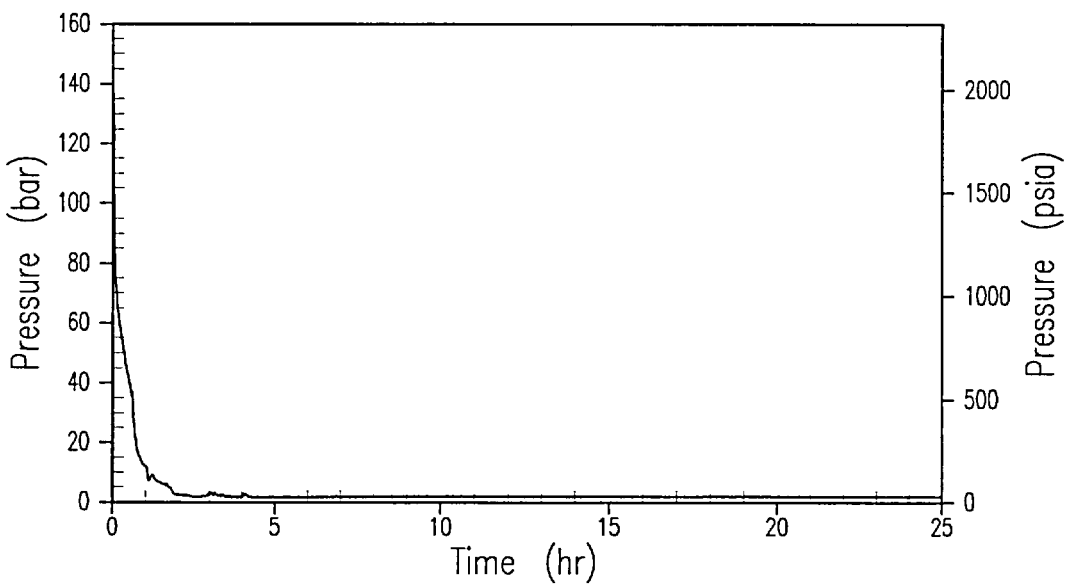

Figure 41A-256

Case 3D-5: Reactor Coolant System Pressure Spurious ADS-2, Failed CMTs, Diffusion Flame

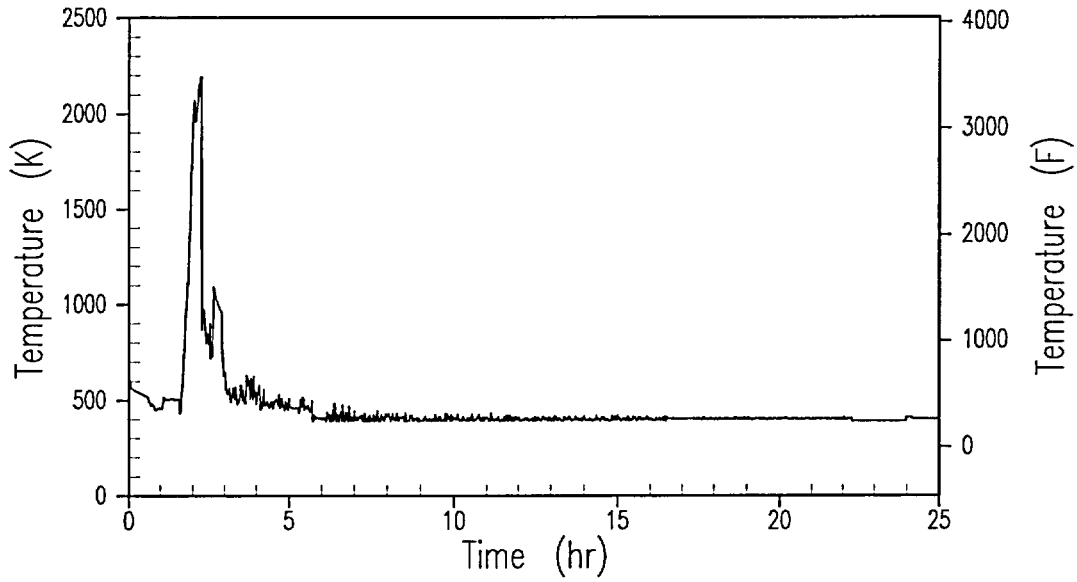

Figure 41A-257

Case 3D-5: Core-Exit Gas Temperature
Spurious ADS-2, Failed CMTs, Diffusion Flame

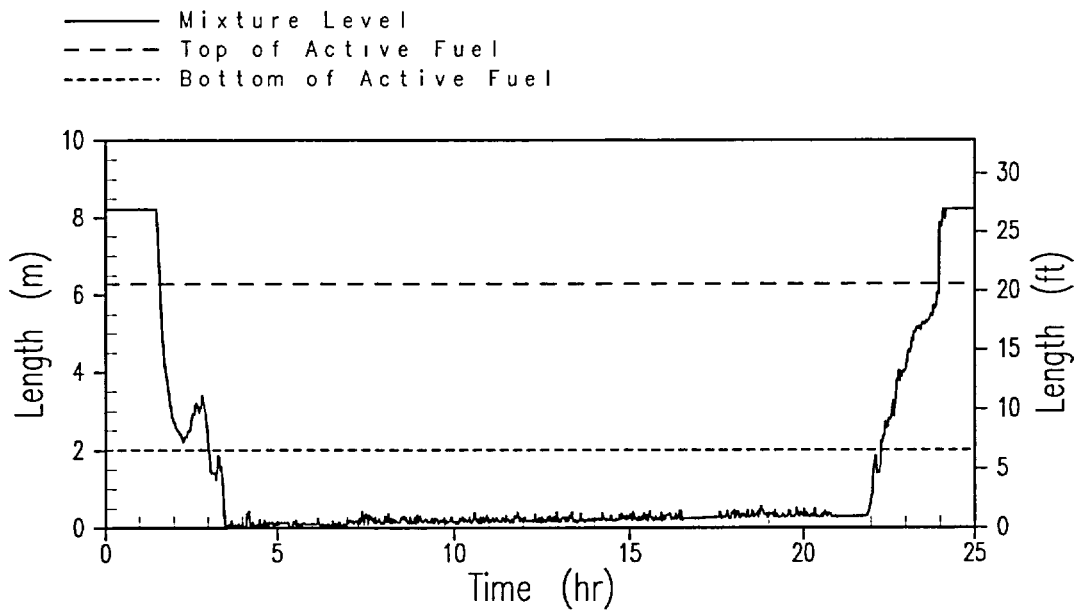

Figure 41A-258

Case 3D-5: Reactor Vessel Mixture Level
Spurious ADS-2, Failed CMTs, Diffusion Flame

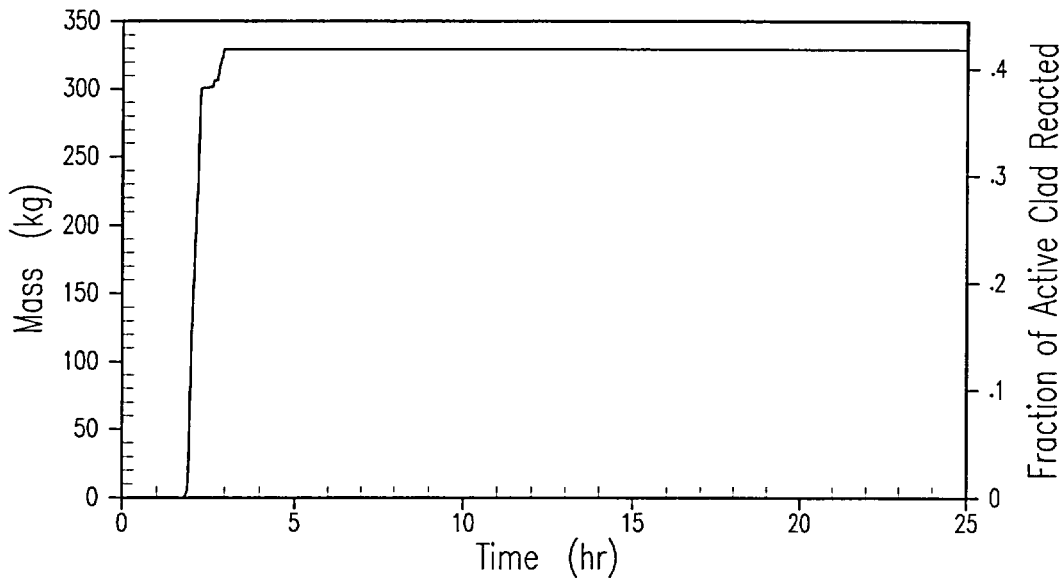

Figure 41A-259

Case 3D-5: Hydrogen Generated In-Vessel Spurious ADS-2, Failed CMTs, Diffusion Flame

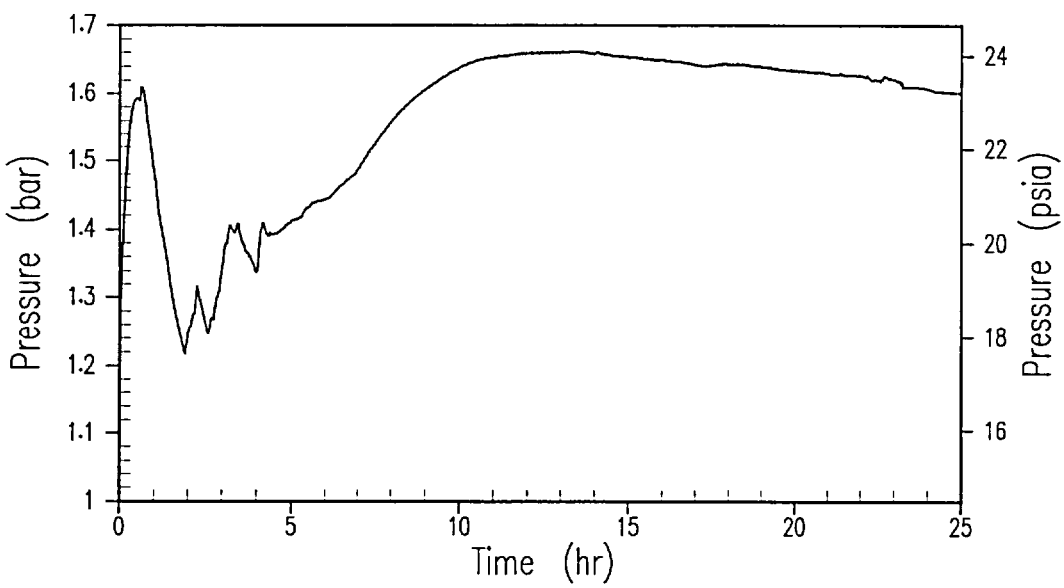

Figure 41A-260

Case 3D-5: Containment Pressure Spurious ADS-2, Failed CMTs, Diffusion Flame

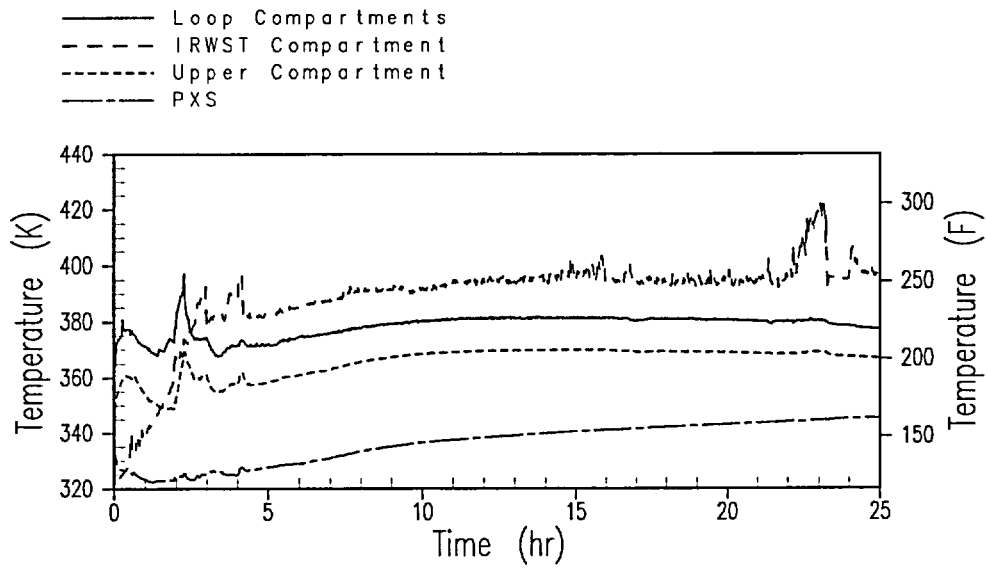

Figure 41A-261

Case 3D-5: Containment Gas Temperature Spurious ADS-2, Failed CMTs, Diffusion Flame

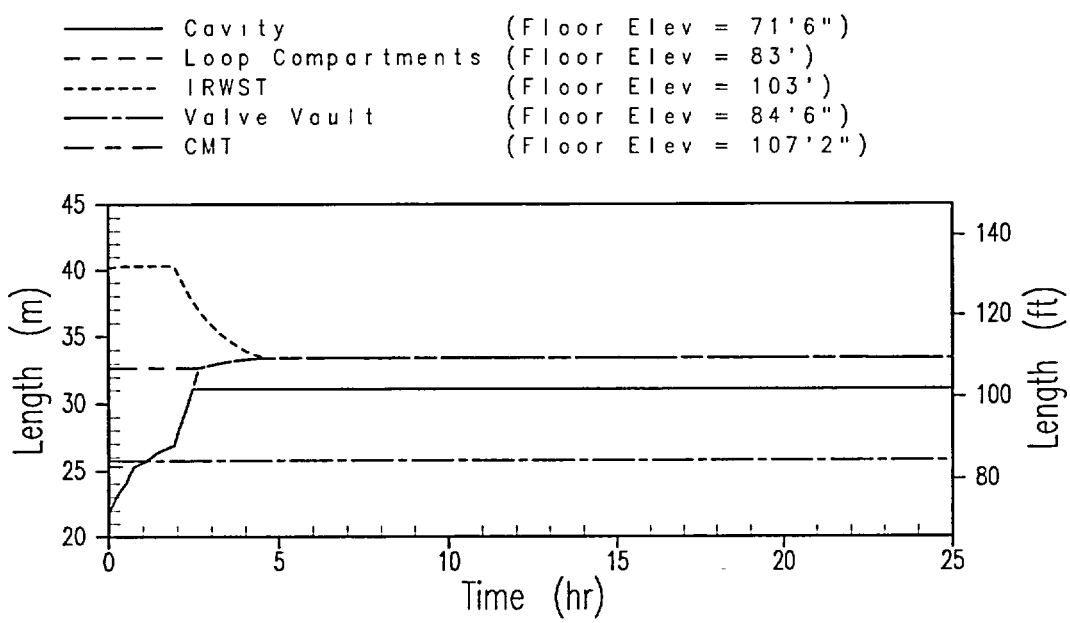

Figure 41A-262

Case 3D-5: Containment Compartments Water Level Spurious ADS-2, Failed CMTs, Diffusion Flame

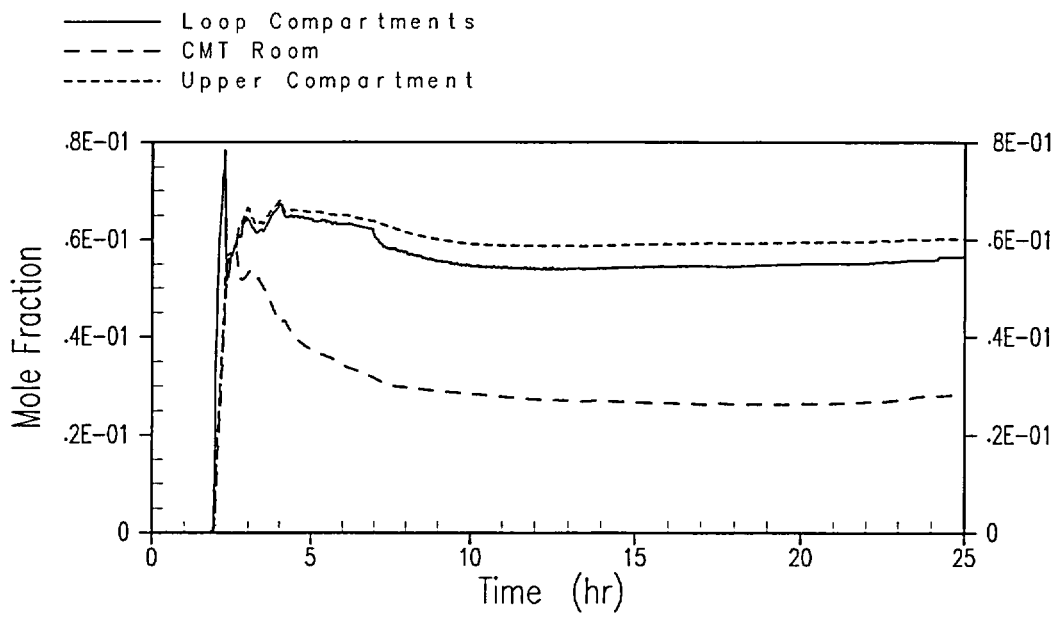

Figure 41A-263

Case 3D-5: Well-Mixed Compartment Hydrogen Concentration Spurious ADS-2, Failed CMTs, Diffusion Flame

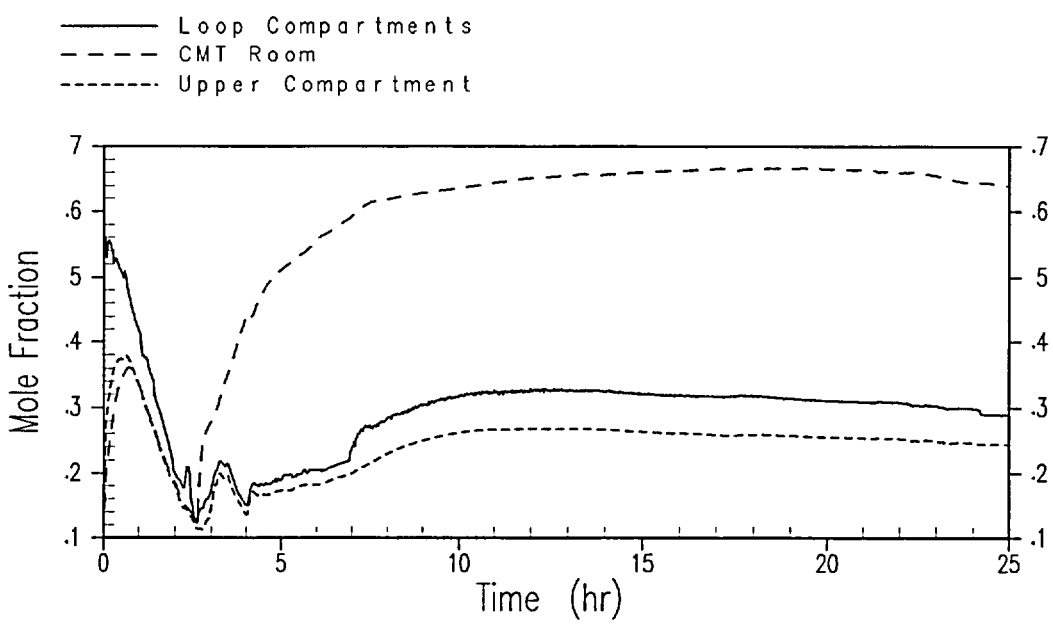

Figure 41A-264

Case 3D-5: Well-Mixed Compartment Steam Concentration Spurious ADS-2, Failed CMTs, Diffusion Flame

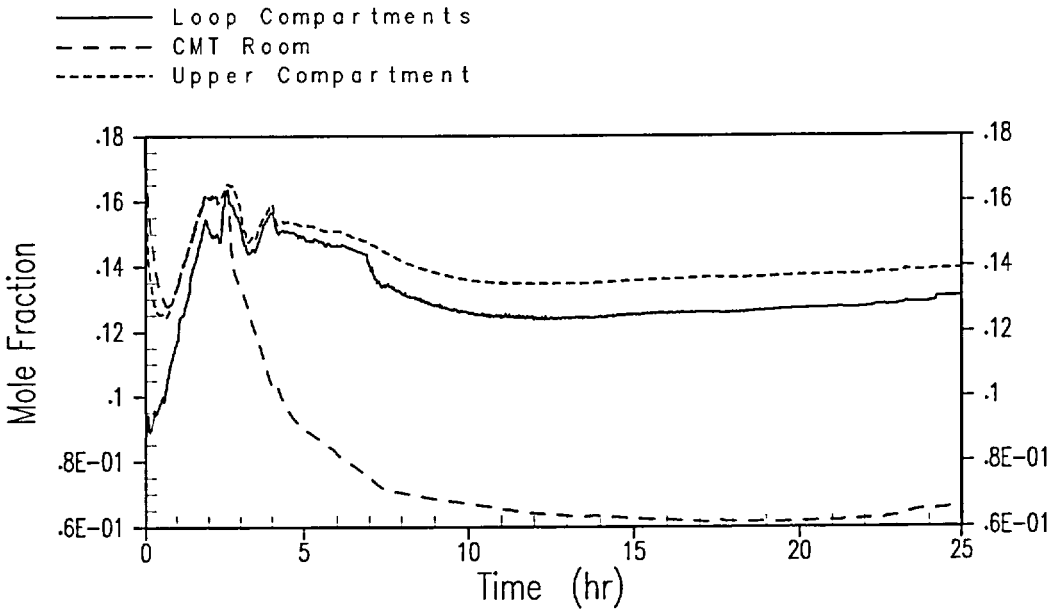

Figure 41A-265

Case 3D-5: Well-Mixed Compartment Oxygen Concentration Spurious ADS-2, Failed CMTs, Diffusion Flame

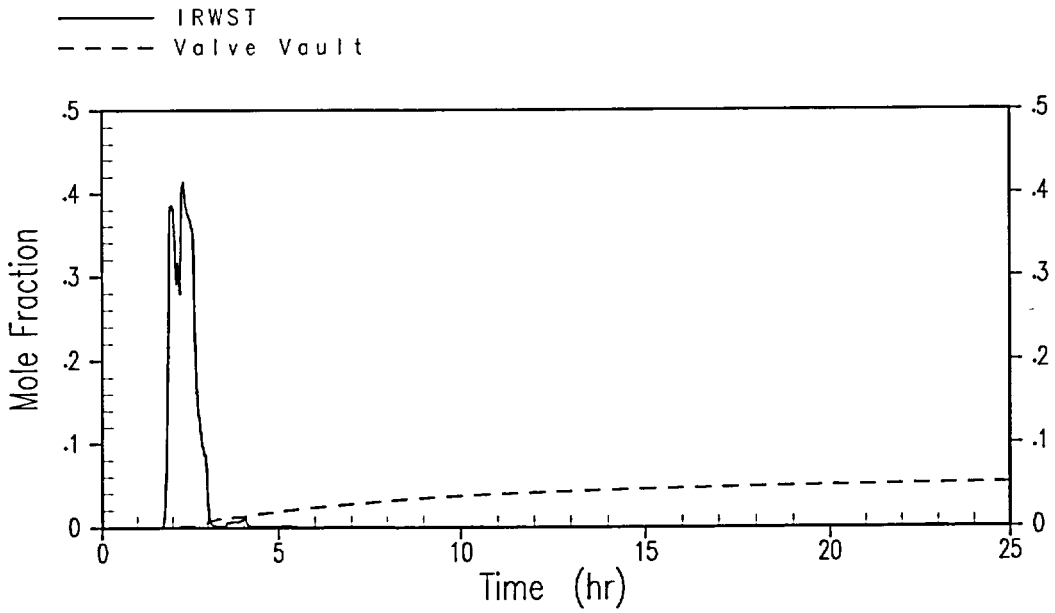

Figure 41A-266

Case 3D-5: Confined Compartment Hydrogen Concentration Spurious ADS-2, Failed CMTs, Diffusion Flame

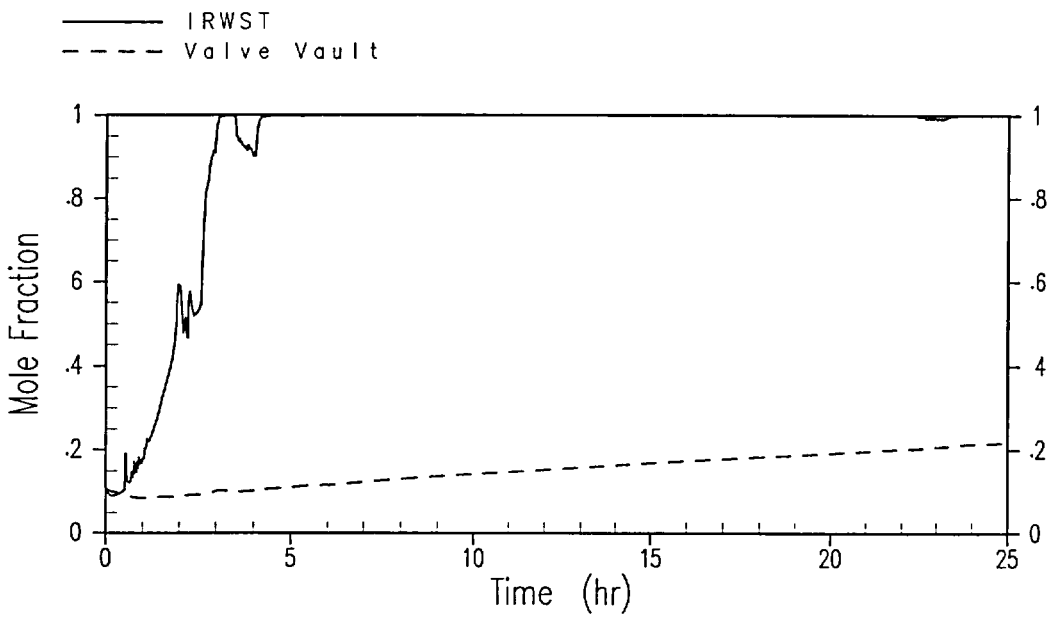

Figure 41A-267

Case 3D-5: Confined Compartment Steam Concentration Spurious ADS-2, Failed CMTs, Diffusion Flame

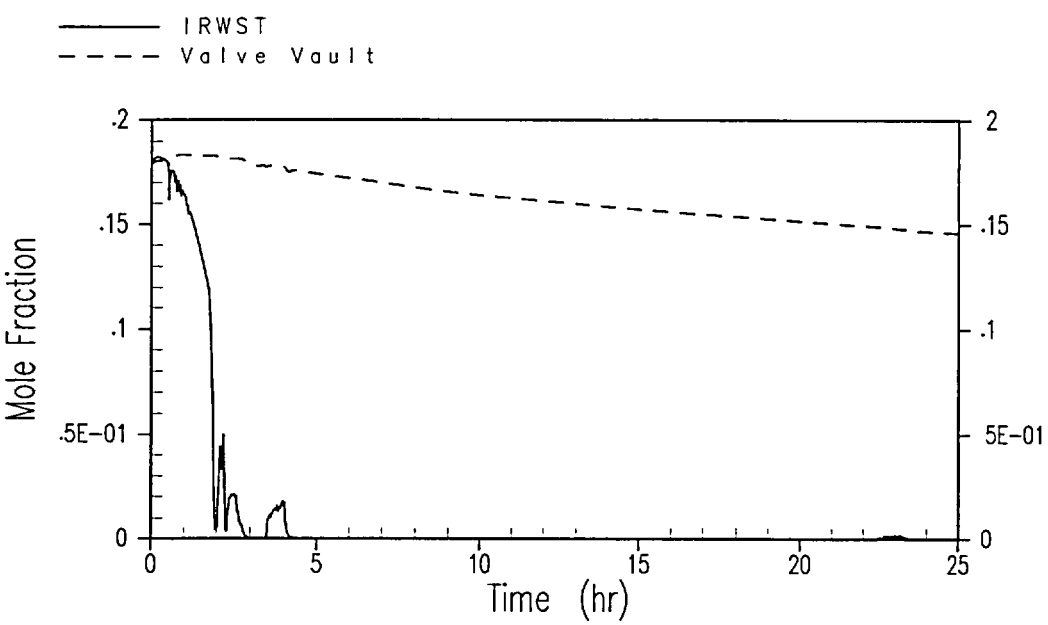

Figure 41A-268

Case 3D-5: Confined Compartment Oxygen Concentration Spurious ADS-2, Failed CMTs, Diffusion Flame

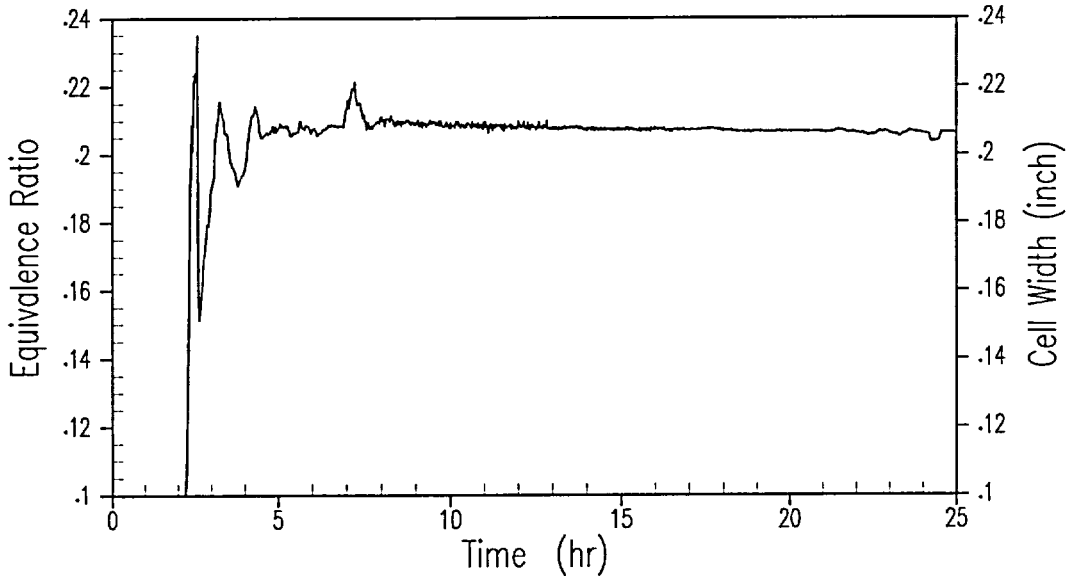

Figure 41A-269

Case 3D-5: Equivalence Ratio in SG Room Spurious ADS-2, Failed CMTs, Diffusion Flame

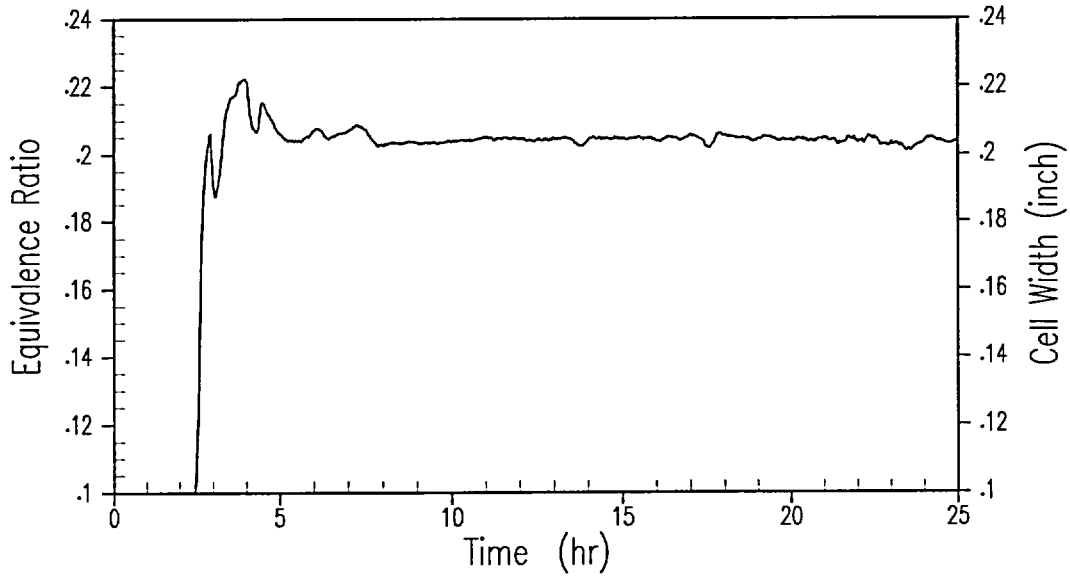

Figure 41A-270

Case 3D-5: Equivalence Ratio in CMT Room Spurious ADS-2, Failed CMTs, Diffusion Flame

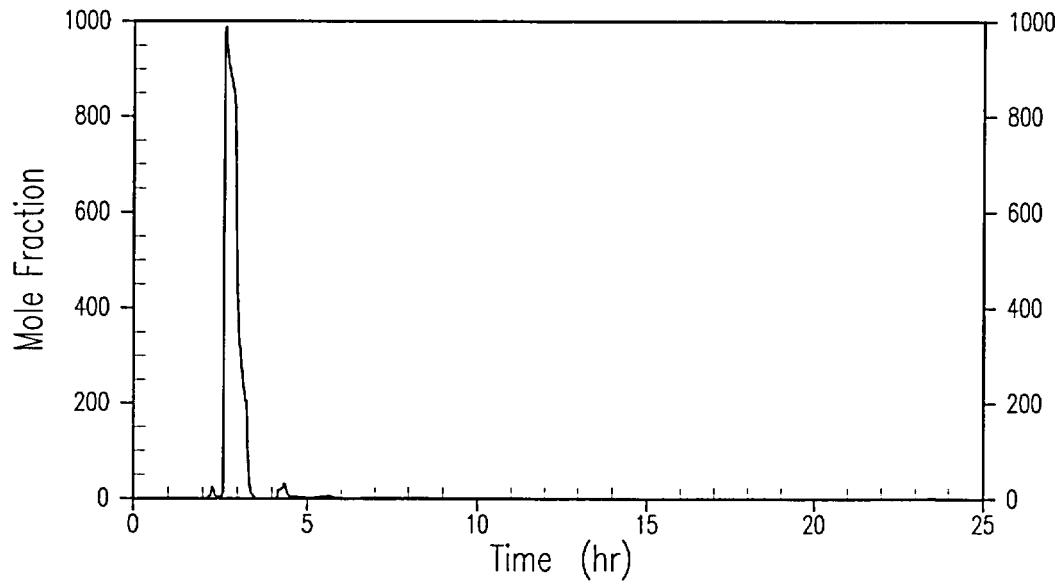

Figure 41A-271

Case 3D-5: Equivalence Ratio in IRWST
Spurious ADS-2, Failed CMTs, Diffusion Flame

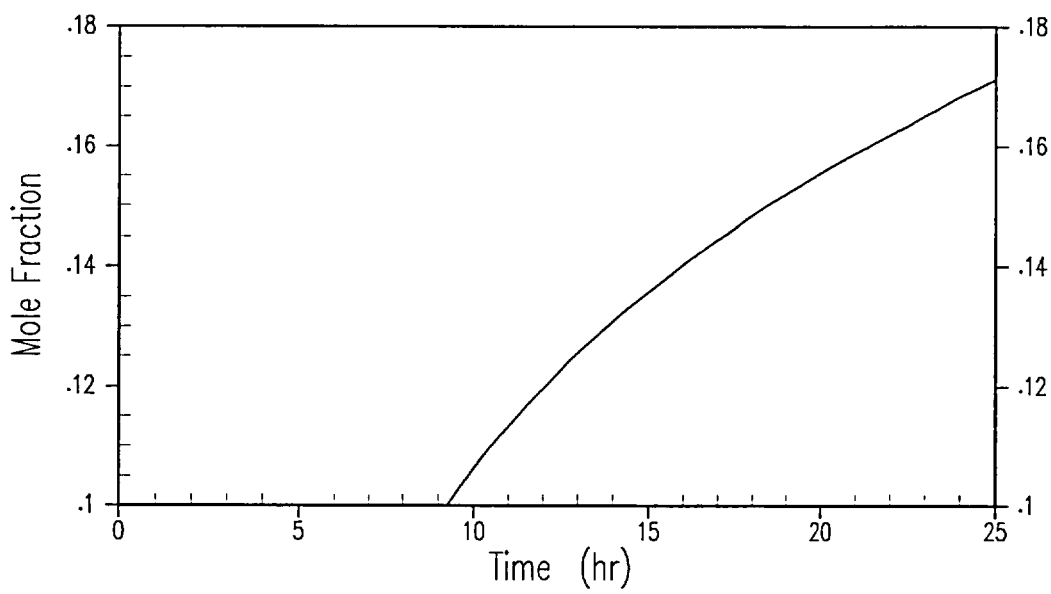

Figure 41A-272

Case 3D-5: Equivalence Ratio in PXS
Spurious ADS-2, Failed CMTs, Diffusion Flame

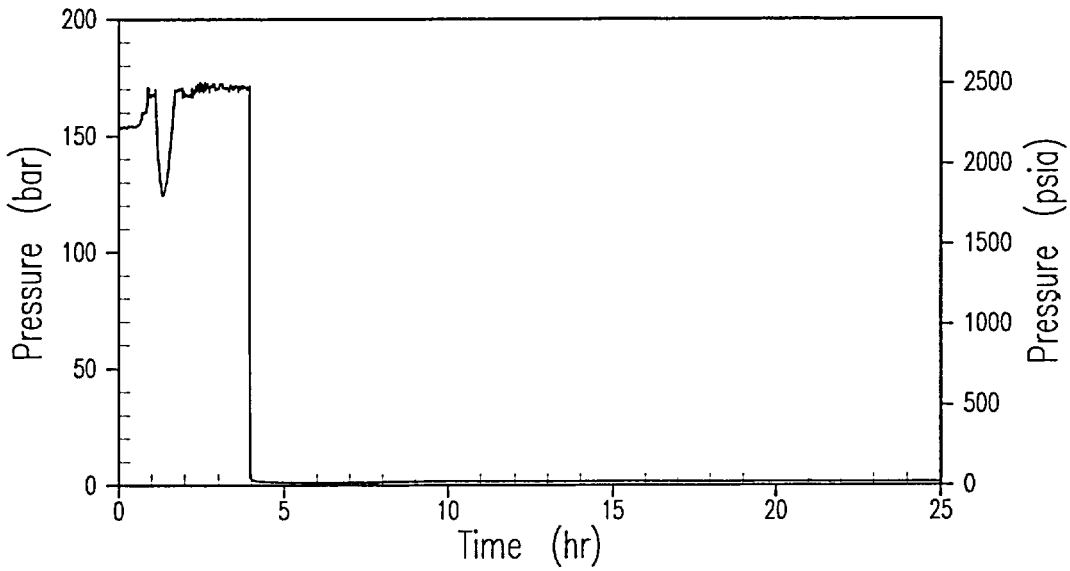

Figure 41A-273

Case 1A-3: Reactor Coolant System Pressure FW Failure with Creep of SG Tubes

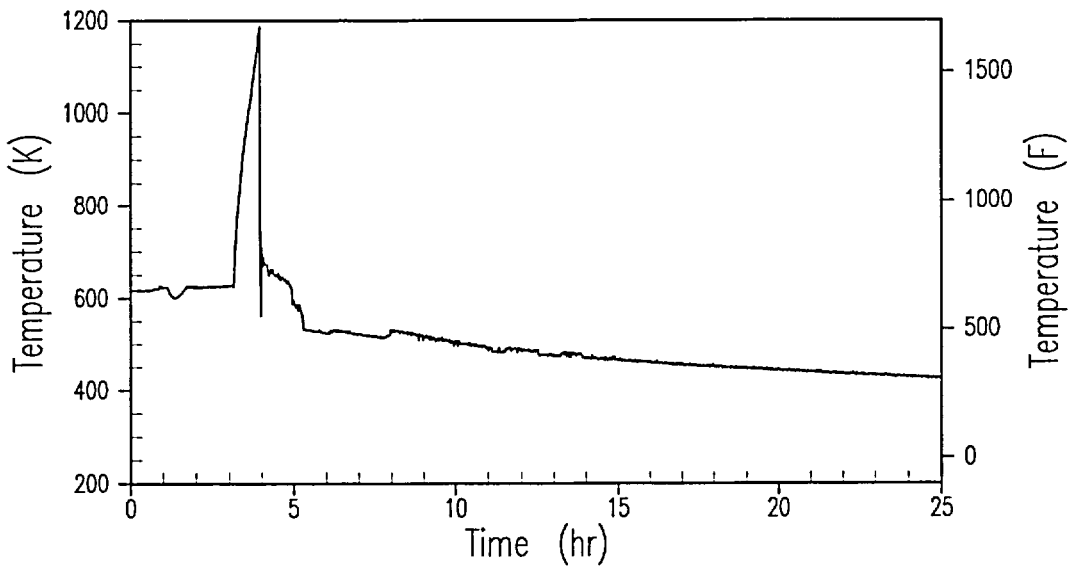

Figure 41A-274

Case 1A-3: Core-Exit Gas Temperature FW Failure with Creep of SG Tubes

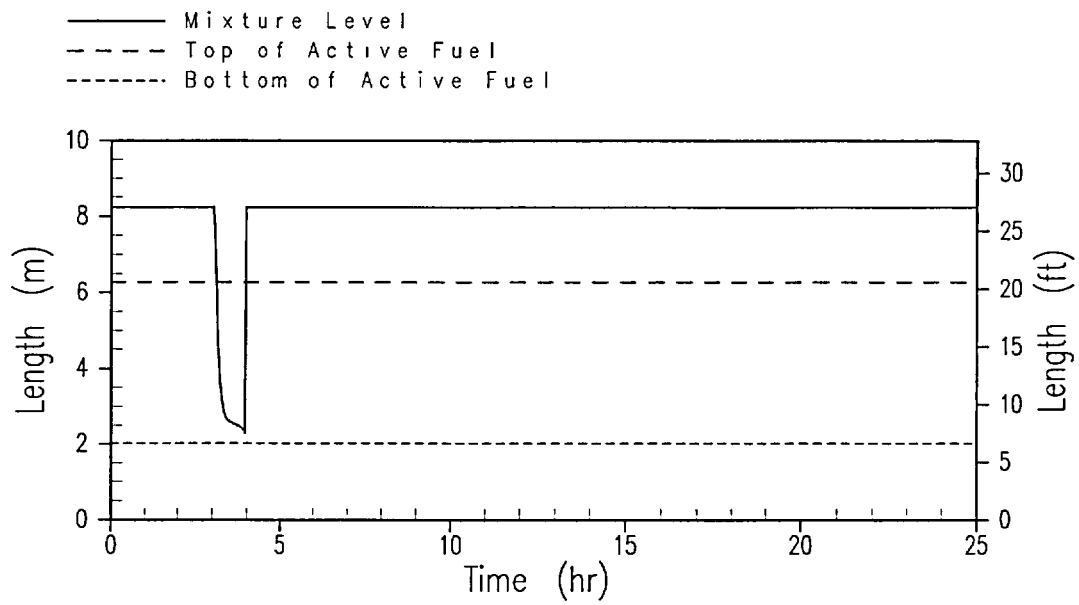

Figure 41A-275

Case 1A-3: Reactor Vessel Mixture Level FW Failure with Creep of SG Tubes

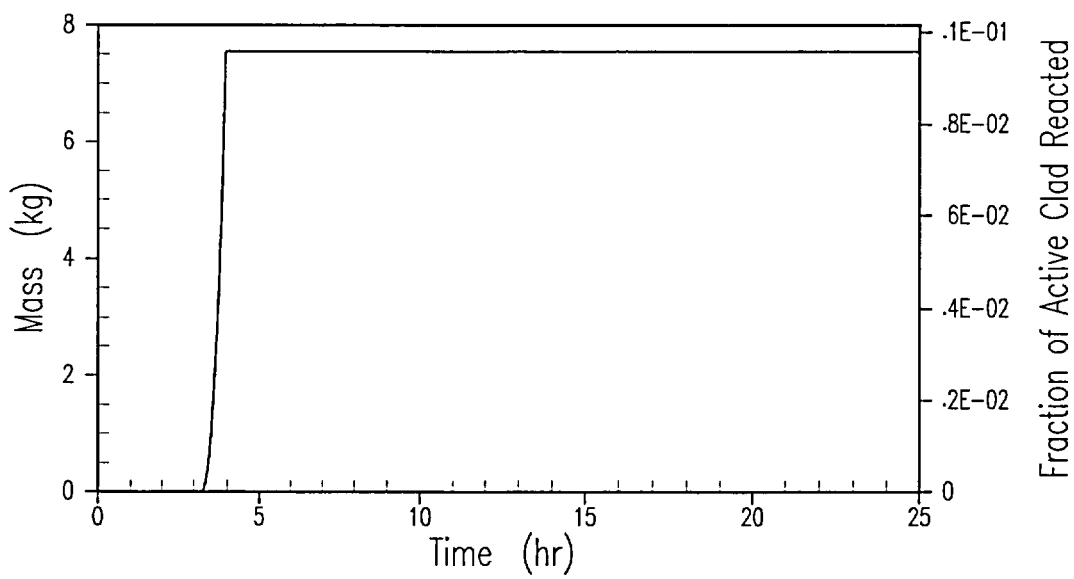

Figure 41A-276

Case 1A-3: Hydrogen Generated In-Vessel FW Failure with Creep of SG Tubes

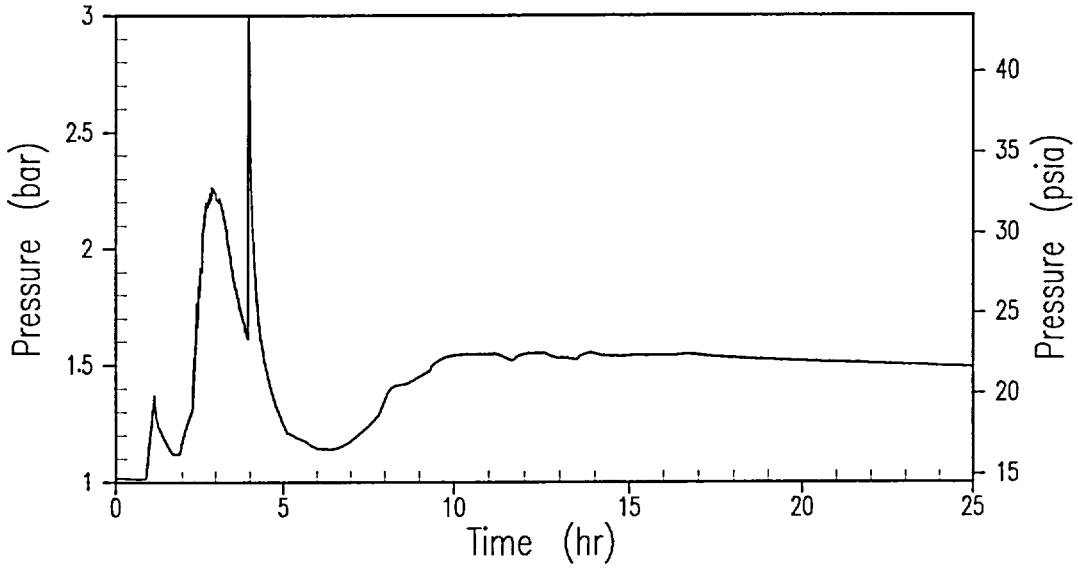

Figure 41A-277

Case 1A-3: Containment Pressure FW Failure with Creep of SG Tubes

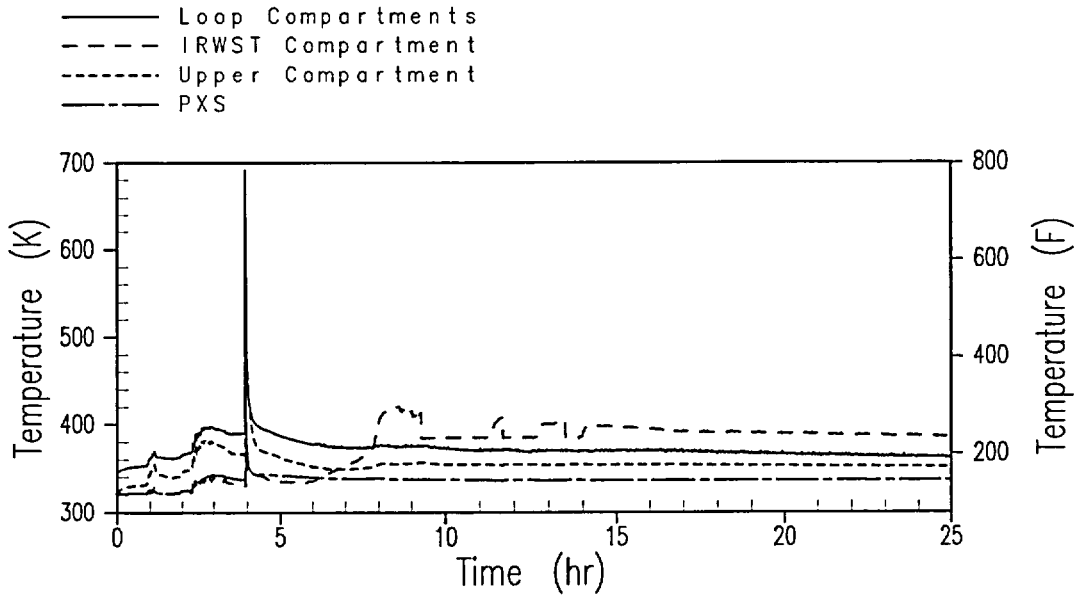

Figure 41A-278

Case 1A-3: Containment Gas Temperature FW Failure with Creep of SG Tubes

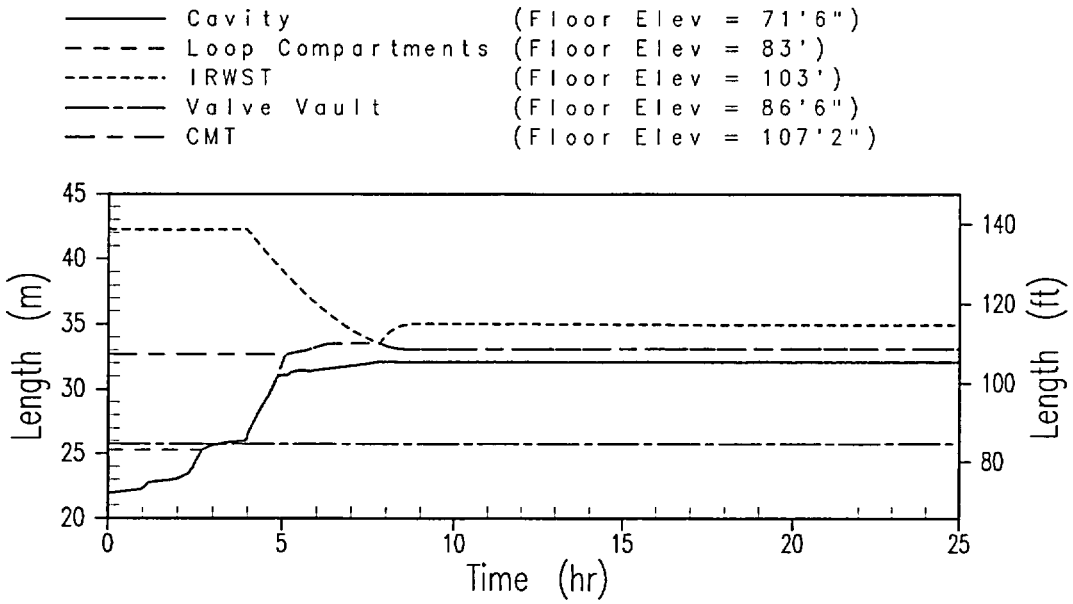

Figure 41A-279

Case 1A-3: Containment Compartments Water Level
FW Failure with Creep of SG Tubes

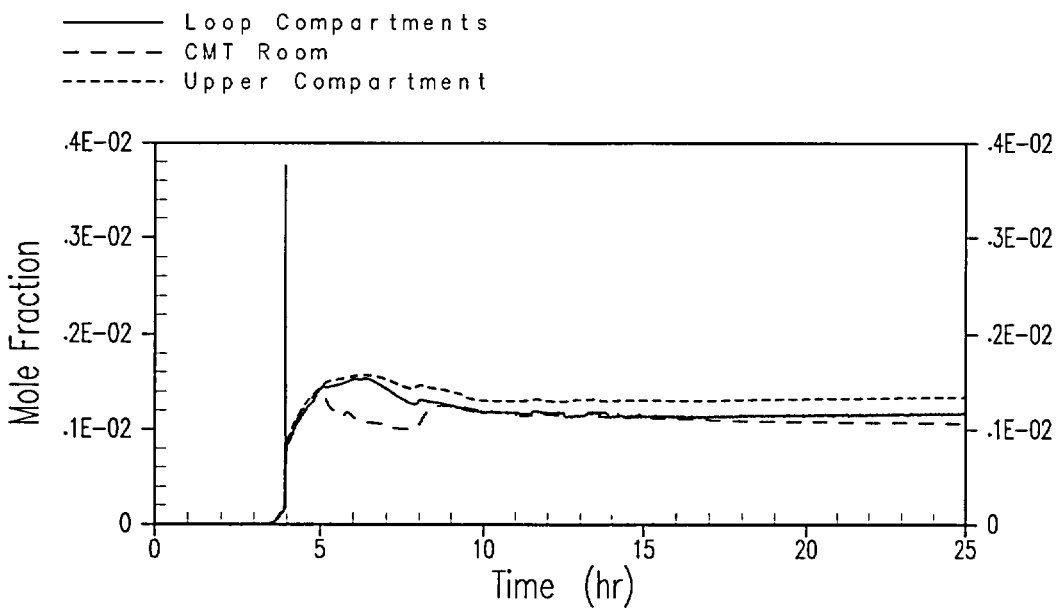

Figure 41A-280

Case 1A-3: Well-Mixed Compartment Hydrogen Concentration
FW Failure with Creep of SG Tubes

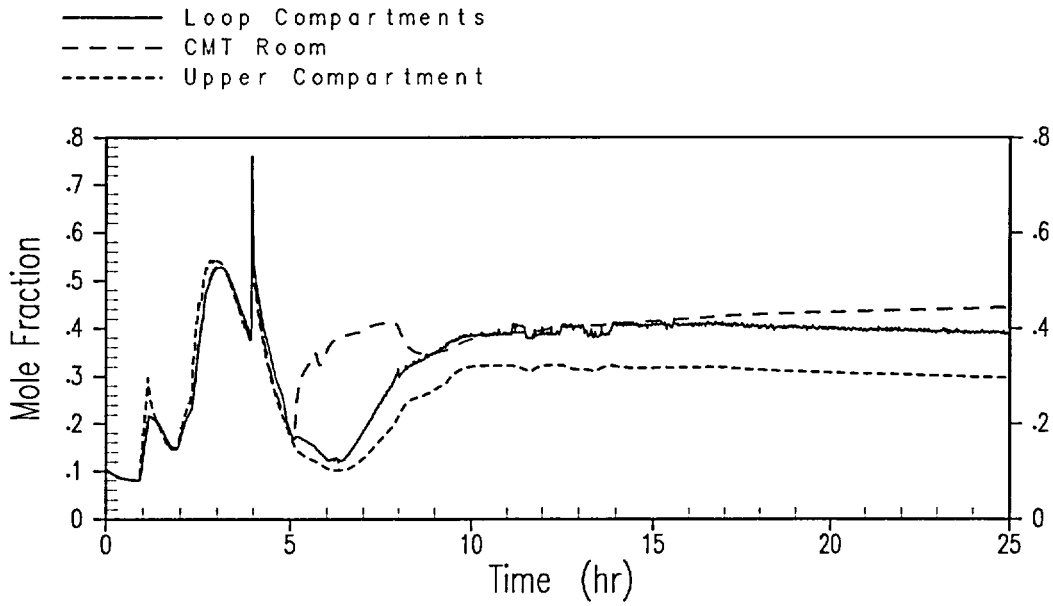

Figure 41A-281

Case 1A-3: Well-Mixed Compartment Steam Concentration FW Failure with Creep of SG Tubes

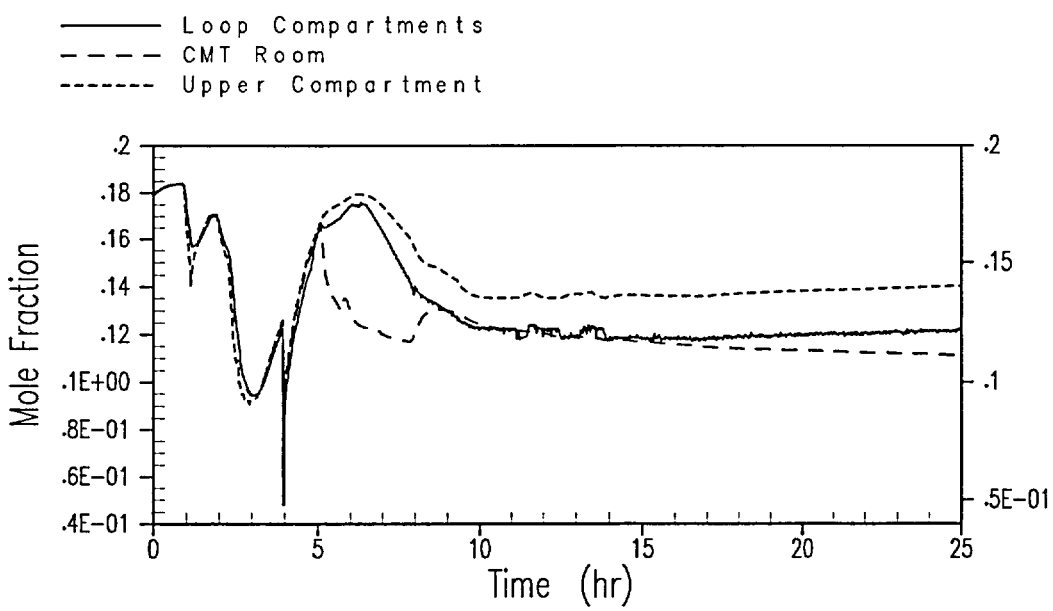

Figure 41A-282

Case 1A-3: Well-Mixed Compartment Oxygen Concentration FW Failure with Creep of SG Tubes

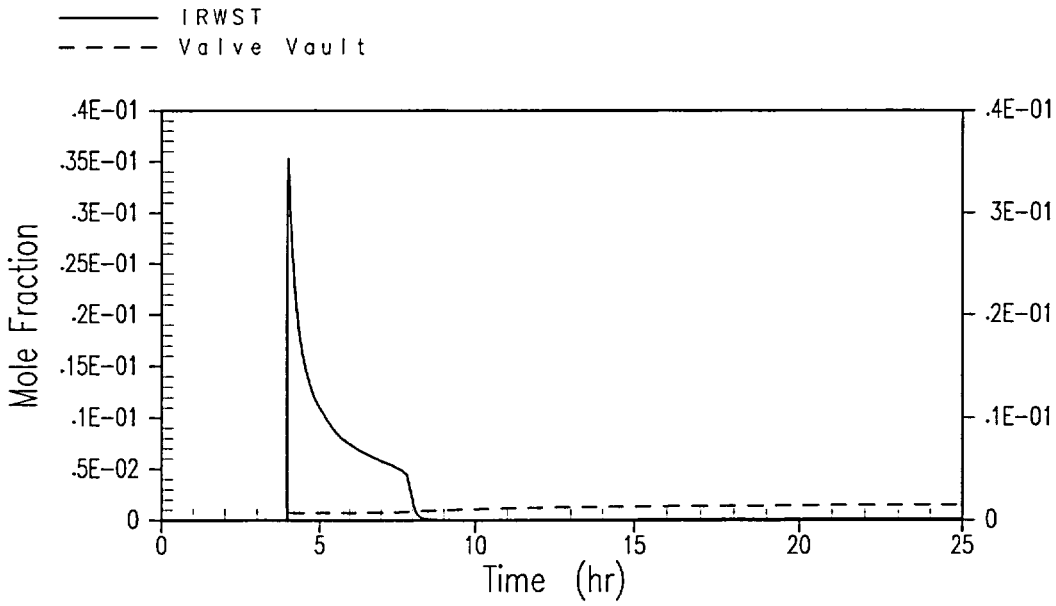

Figure 41A-283

Case 1A-3: Confined Compartment Hydrogen Concentration FW Failure with Creep of SG Tubes

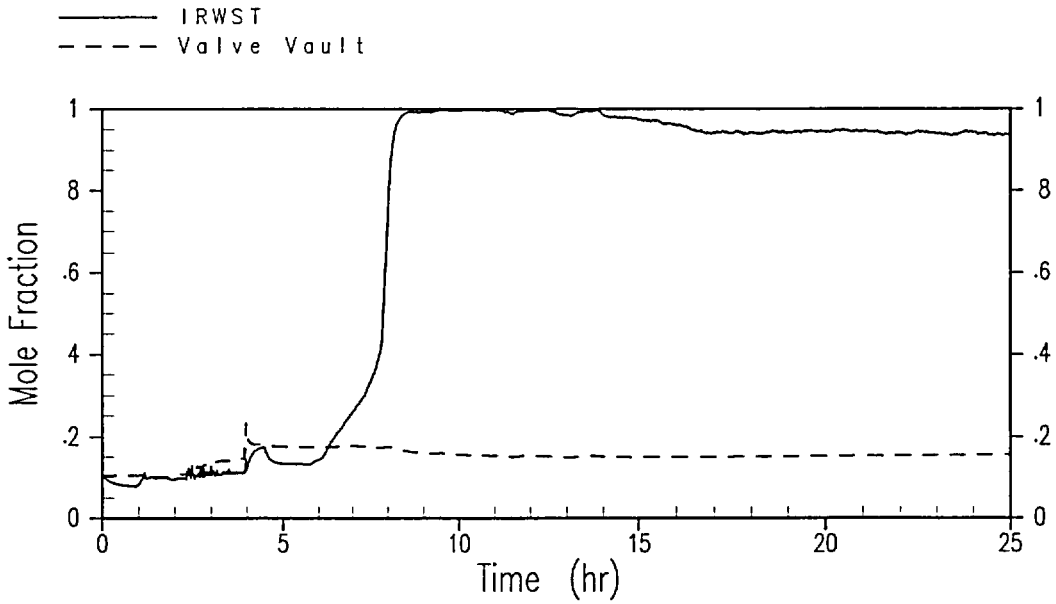

Figure 41A-284

Case 1A-3: Confined Compartment Steam Concentration FW Failure with Creep of SG Tubes

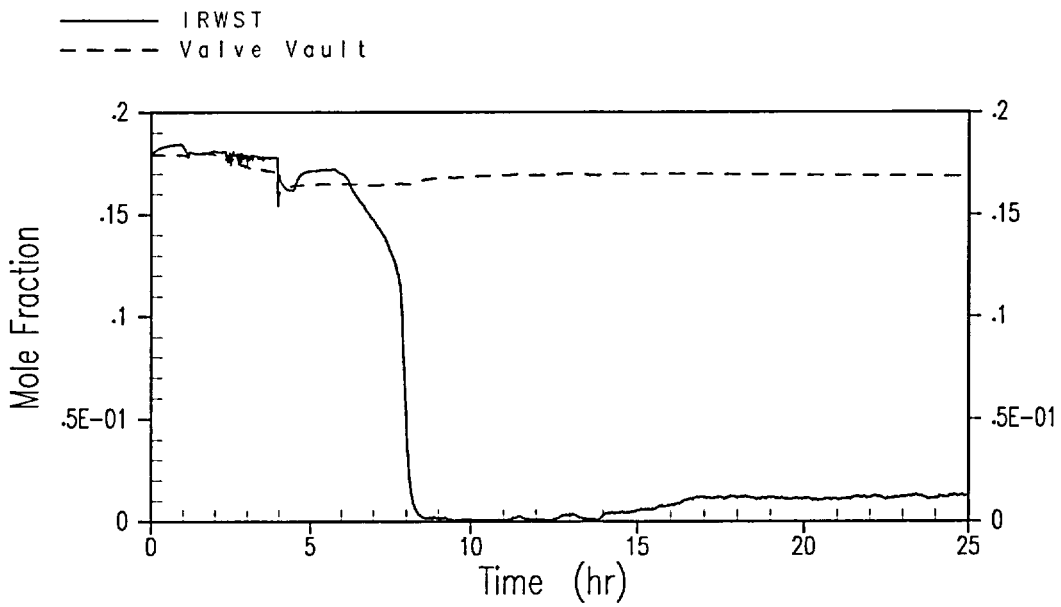

Figure 41A-285

Case 1A-3: Confined Compartment Oxygen Concentration FW Failure with Creep of SG Tubes

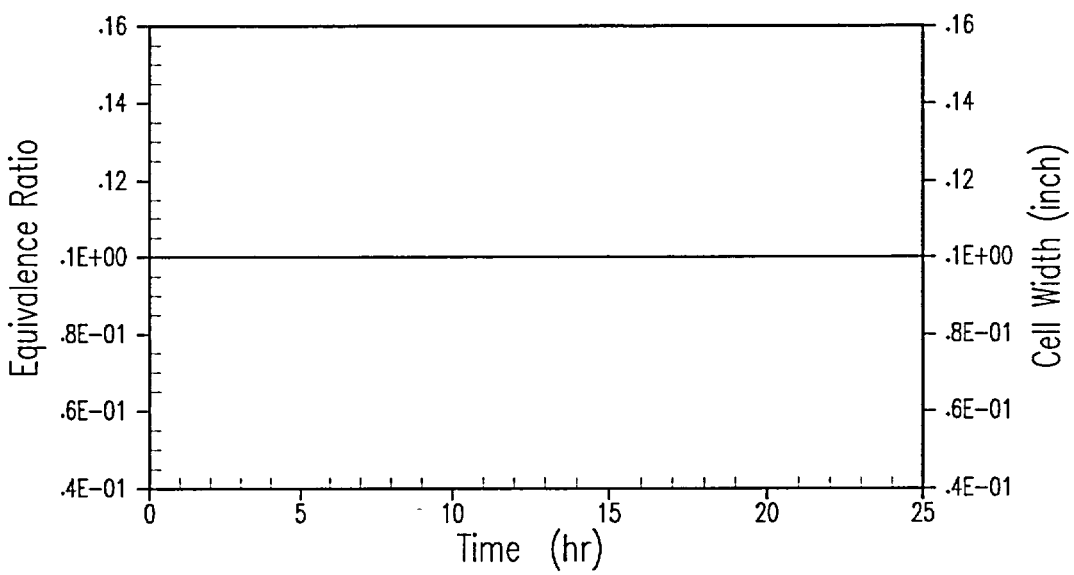

Figure 41A-286

Case 1A-3: Equivalence Ratio in SG Room FW Failure with Creep of SG Tubes

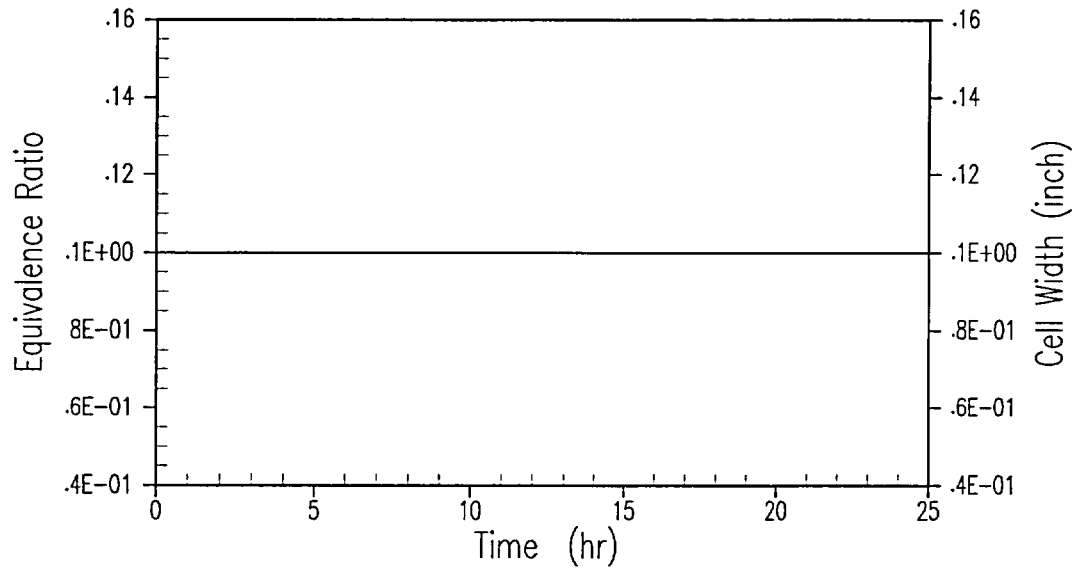

Figure 41A-287

Case 1A-3: Equivalence Ratio in CMT Room
FW Failure with Creep of SG Tubes

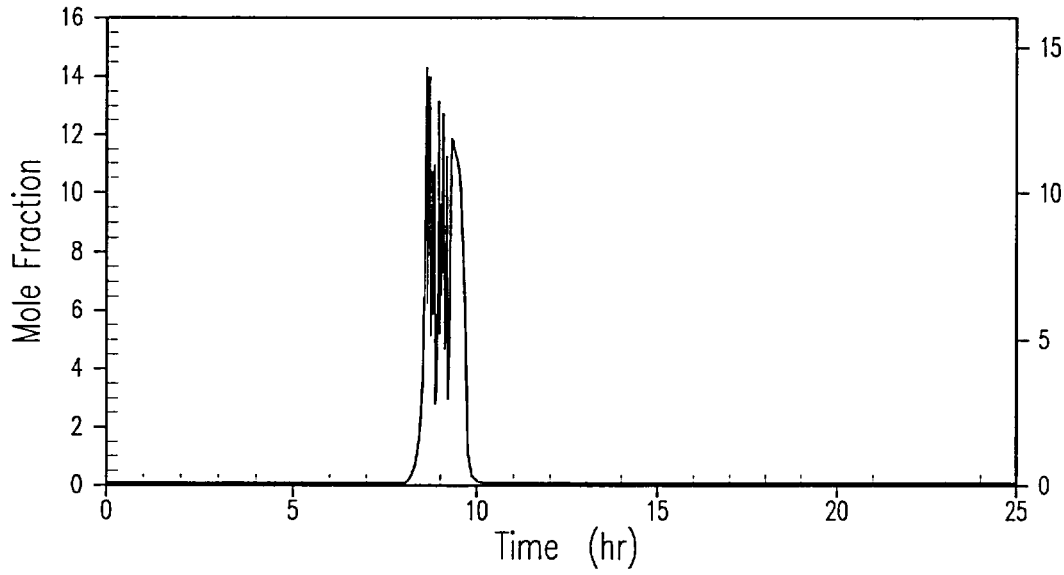

Figure 41A-288

Case 1A-3: Equivalence Ratio in IRWST
FW Failure with Creep of SG Tubes

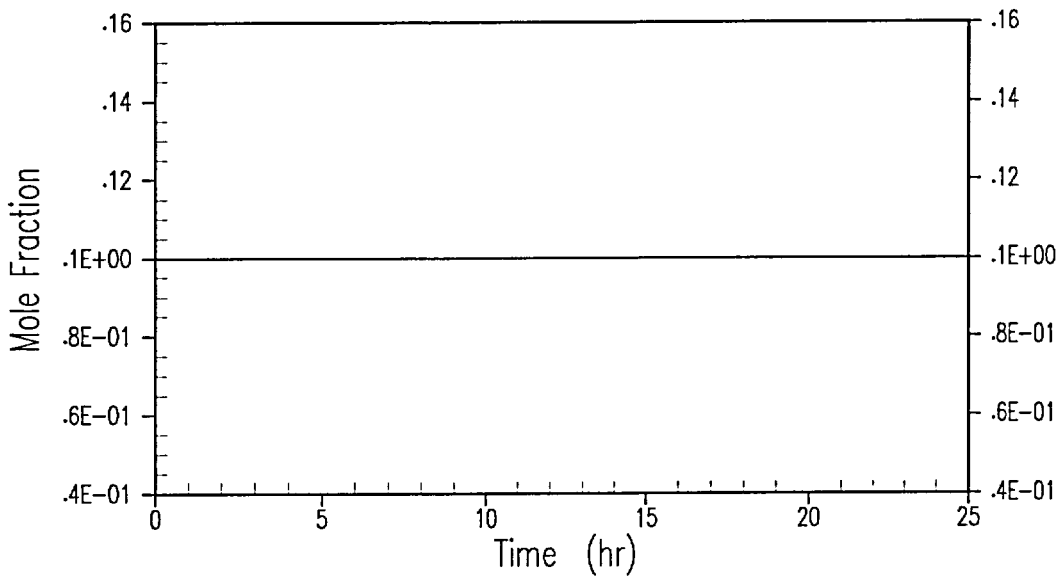

Figure 41A-289

Case 1A-3: Equivalence Ratio in PXS FW Failure with Creep of SG Tubes

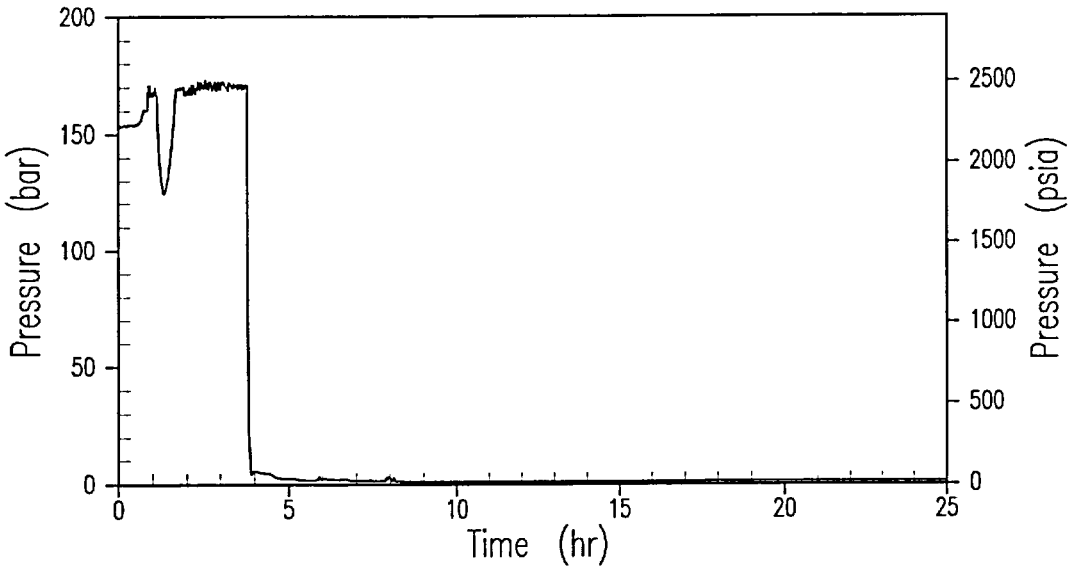

Figure 41A-290

Case 1A-3a: Reactor Coolant System Pressure Transient with Creep of SG Tubes

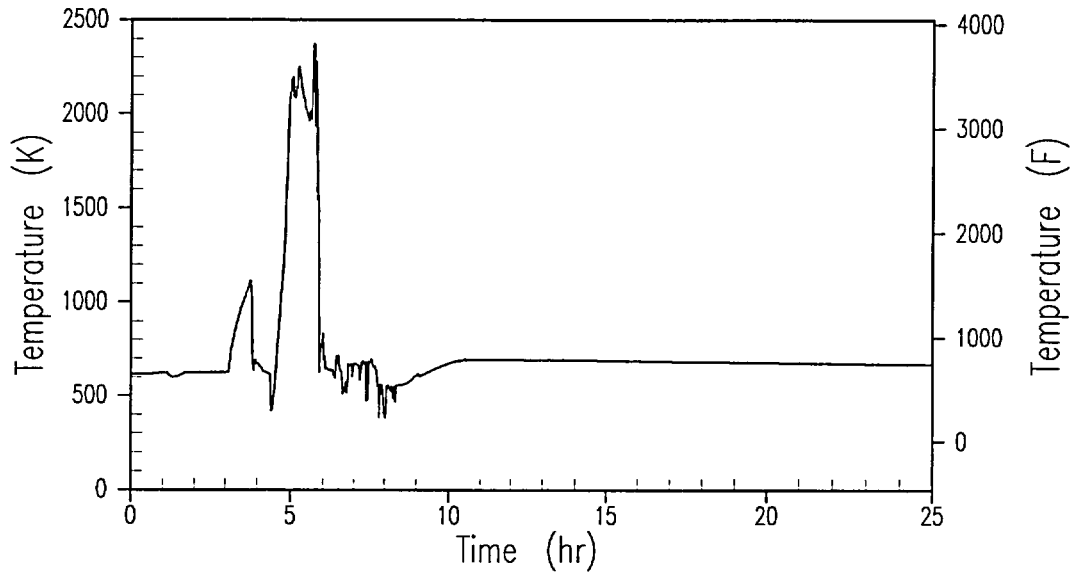

Figure 41A-291

Case 1A-3a: Core-Exit Gas Temperature Transient with Creep of SG Tubes

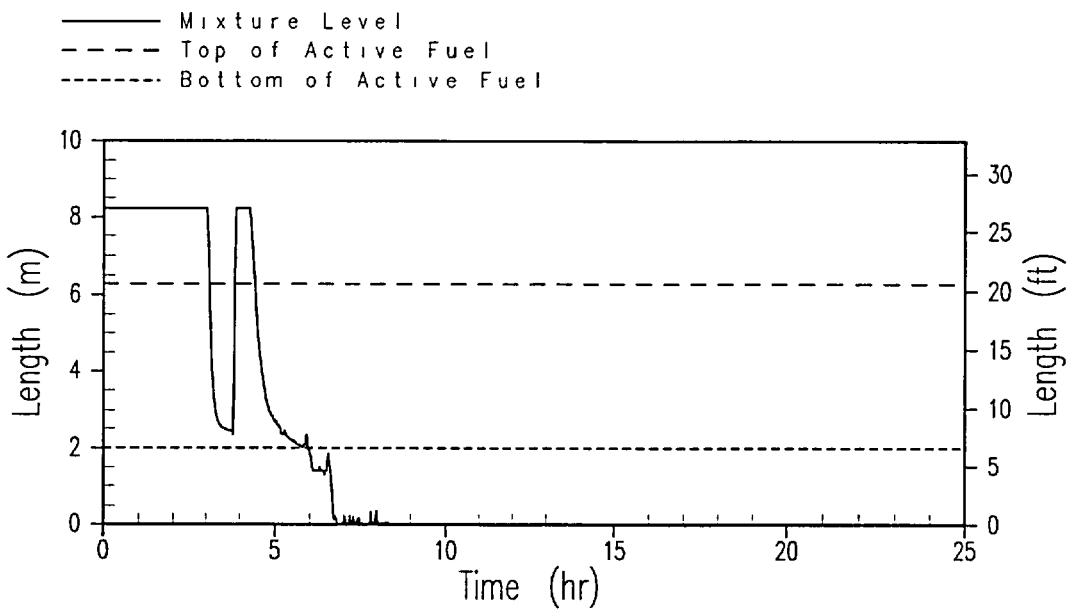

Figure 41A-292

Case 1A-3a: Reactor Vessel Mixture Level Transient with Creep of SG Tubes

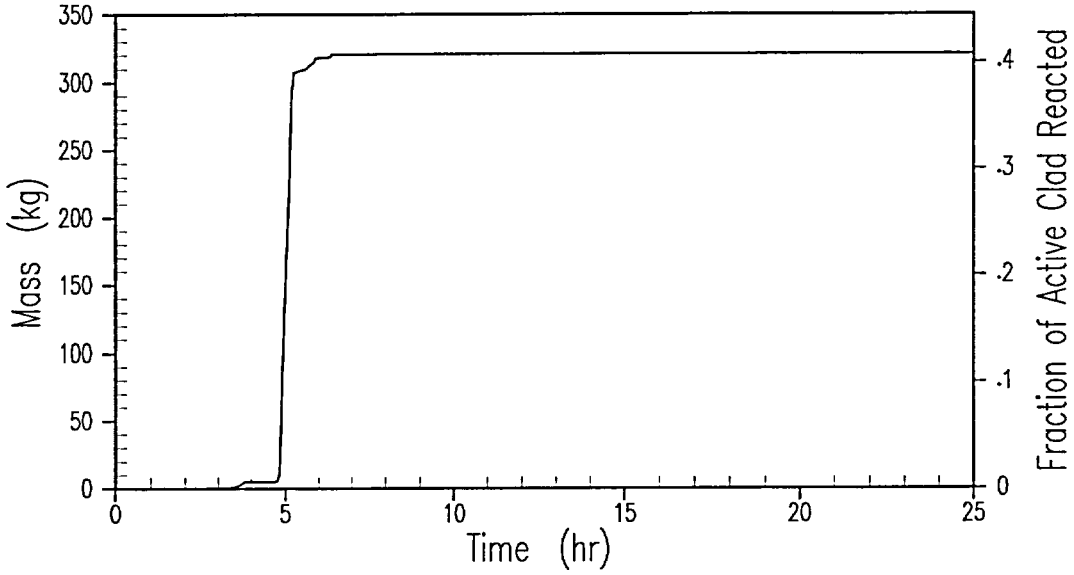

Figure 41A-293

Case 1A-3a: Hydrogen Generated In-Vessel Transient with Creep of SG Tubes

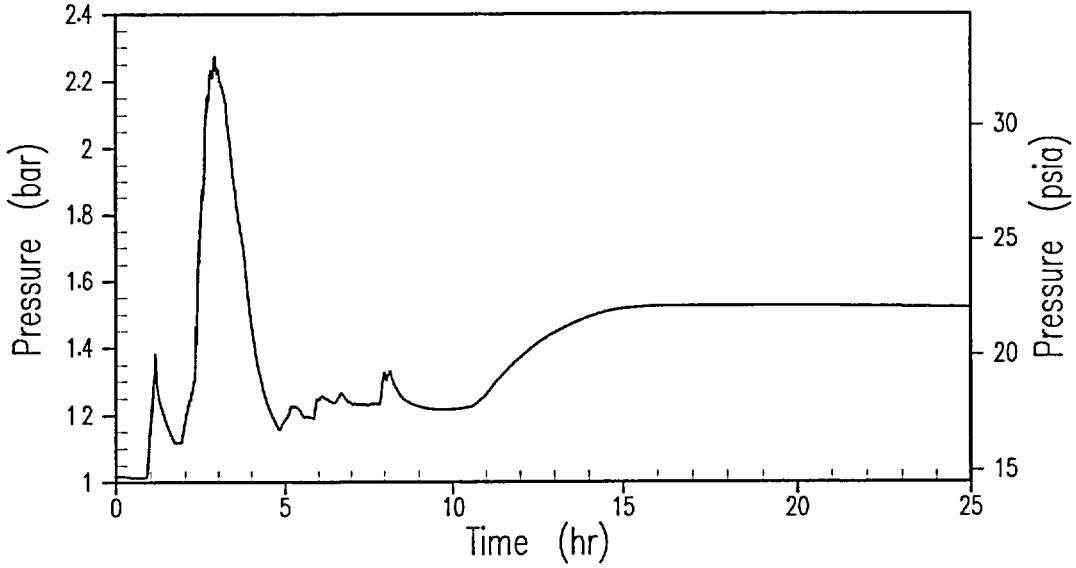

Figure 41A-294

Case 1A-3a: Containment Pressure Transient with Creep of SG Tubes

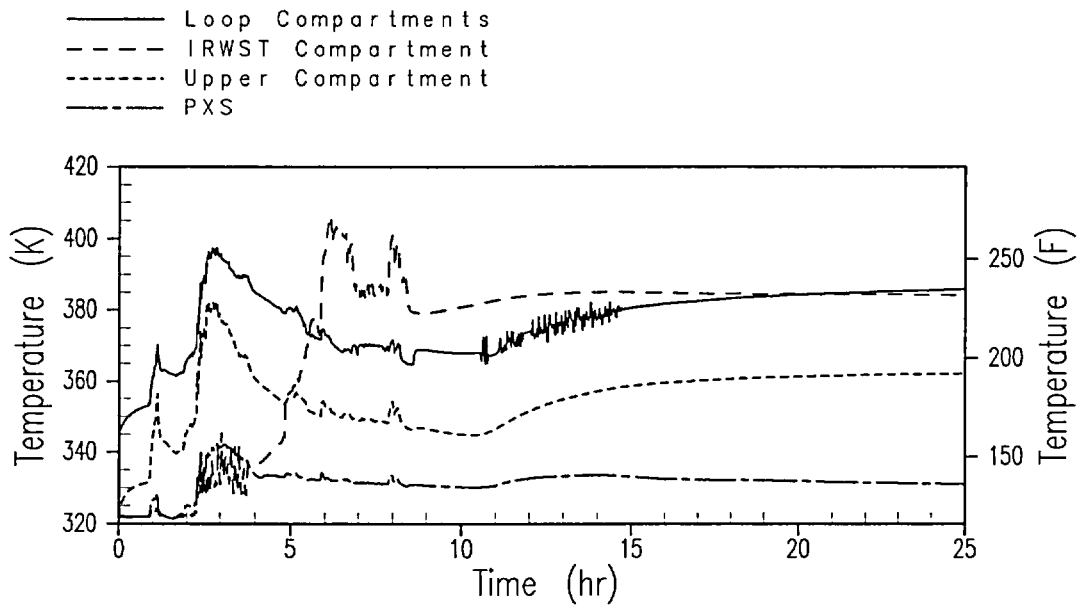

Figure 41A-295

Case 1A-3a: Containment Gas Temperature Transient with Creep of SG Tubes

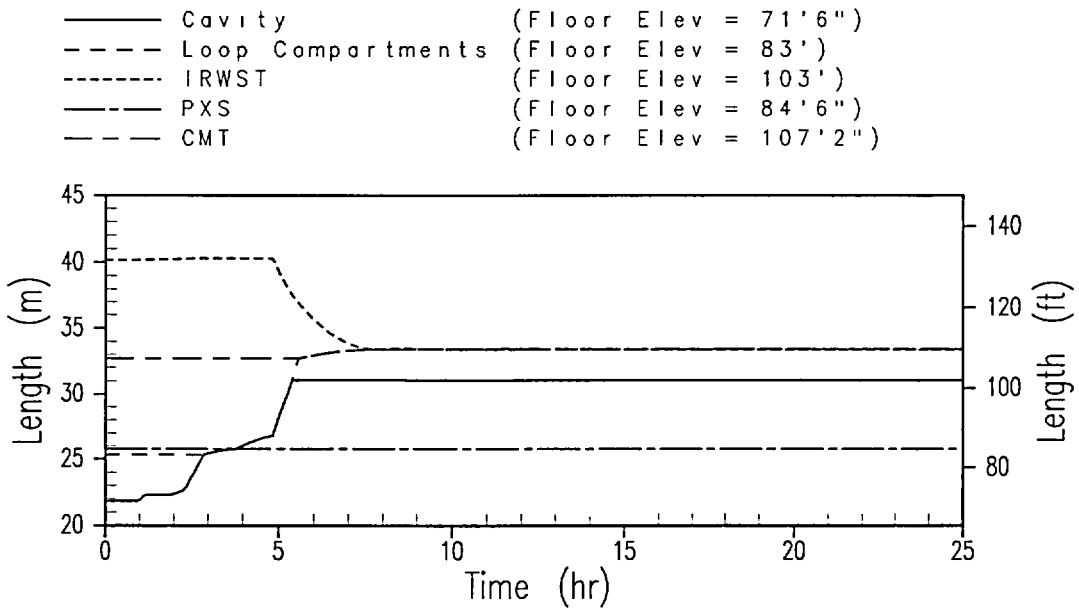

Figure 41A-296

Case 1A-3a: Containment Compartments Water Level Transient with Creep of SG Tubes

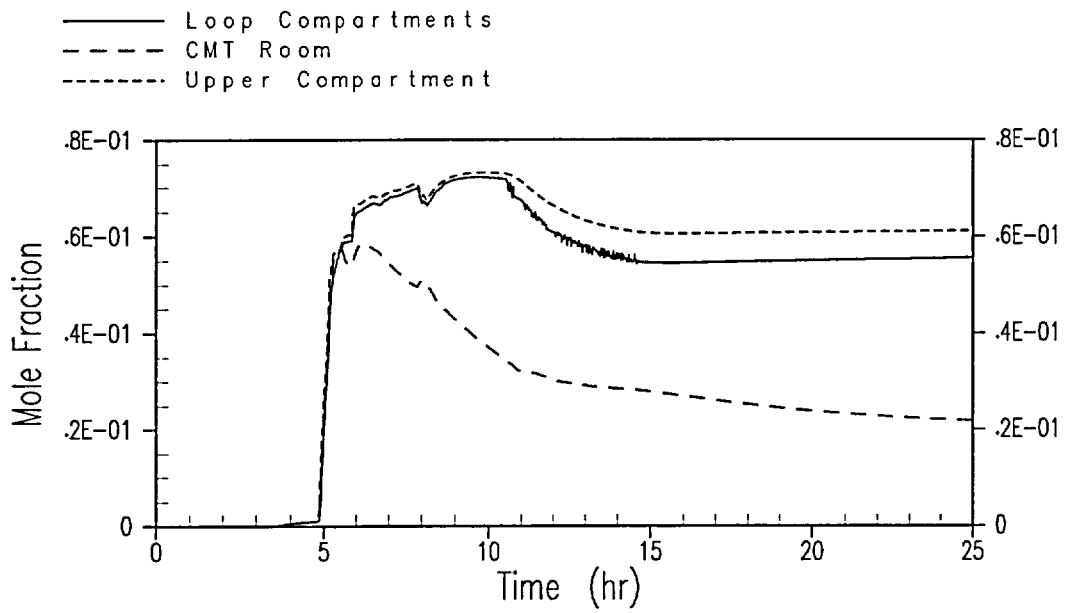

Figure 41A-297

Case 1A-3a: Well-Mixed Compartment Hydrogen Concentration Transient with Creep of SG Tubes

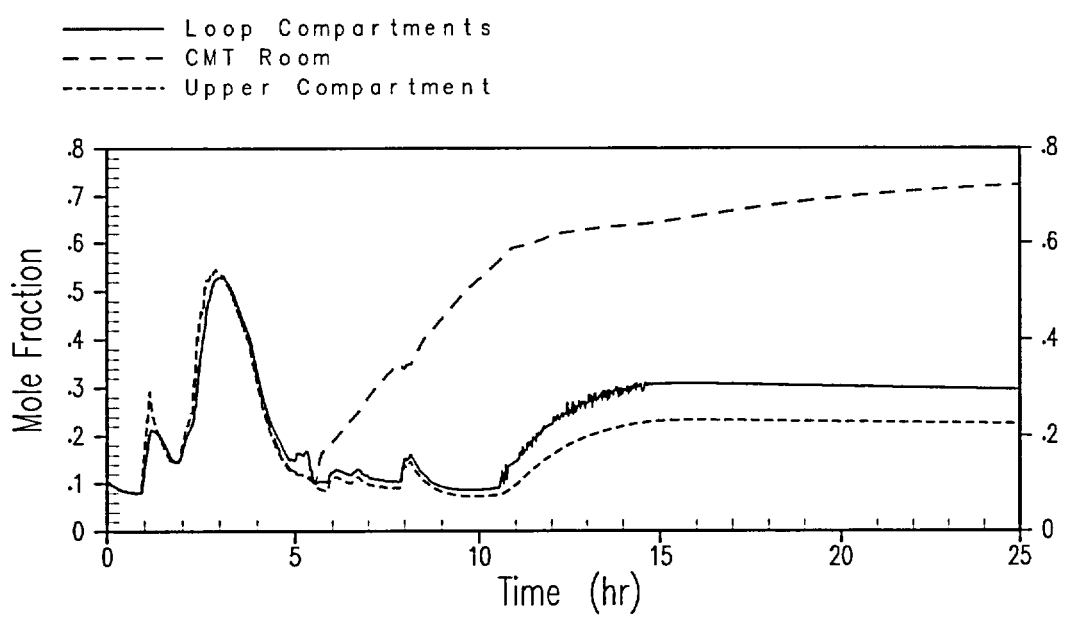

Figure 41A-298

Case 1A-3a: Well-Mixed Compartment Steam Concentration Transient with Creep of SG Tubes

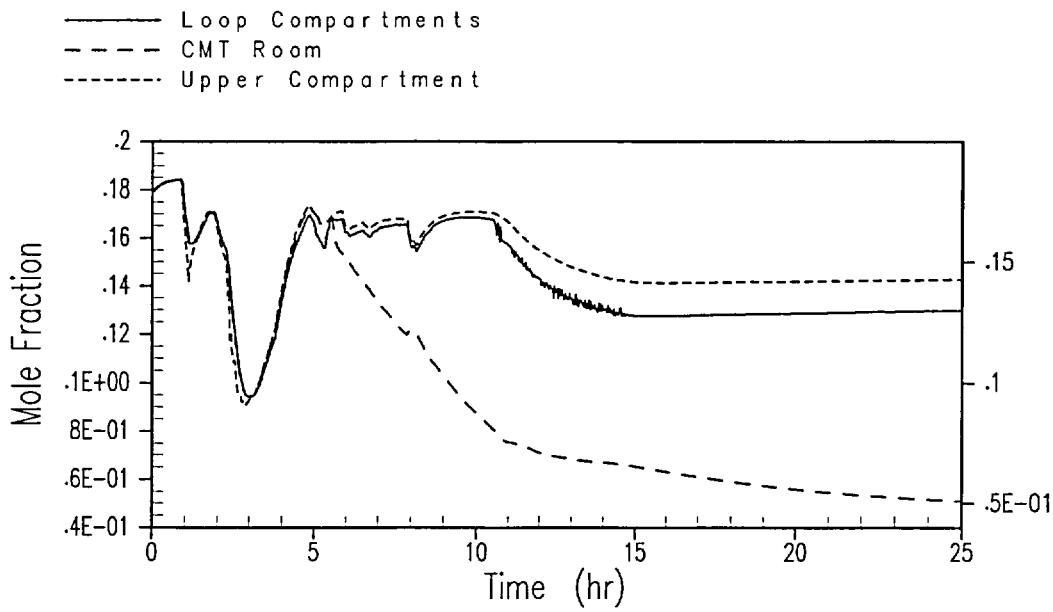

Figure 41A-299

Case 1A-3a: Well-Mixed Compartment Oxygen Concentration Transient with Creep of SG Tubes

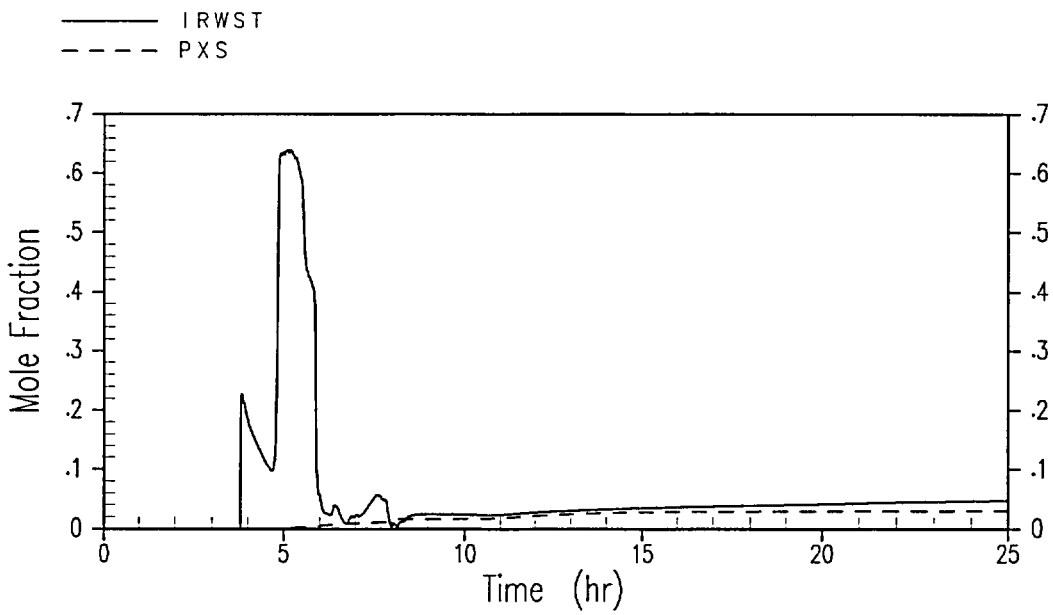

Figure 41A-300

Case 1A-3a: Confined Compartment Hydrogen Concentration Transient with Creep of SG Tubes

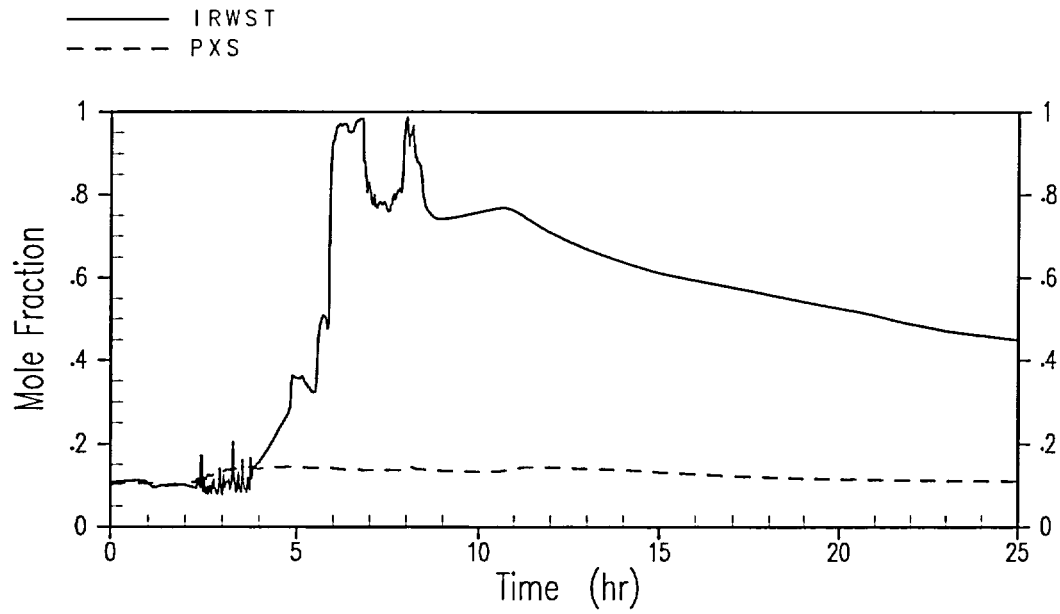

Figure 41A-301

Case 1A-3a: Confined Compartment Steam Concentration Transient with Creep of SG Tubes

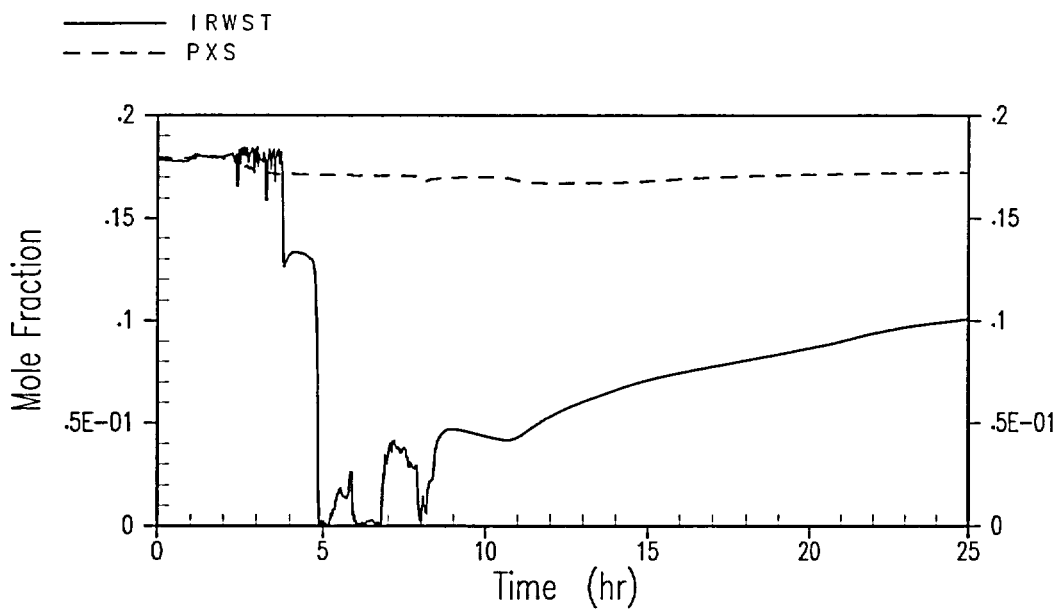

Figure 41A-302

Case 1A-3a: Confined Compartment Oxygen Concentration Transient with Creep of SG Tubes

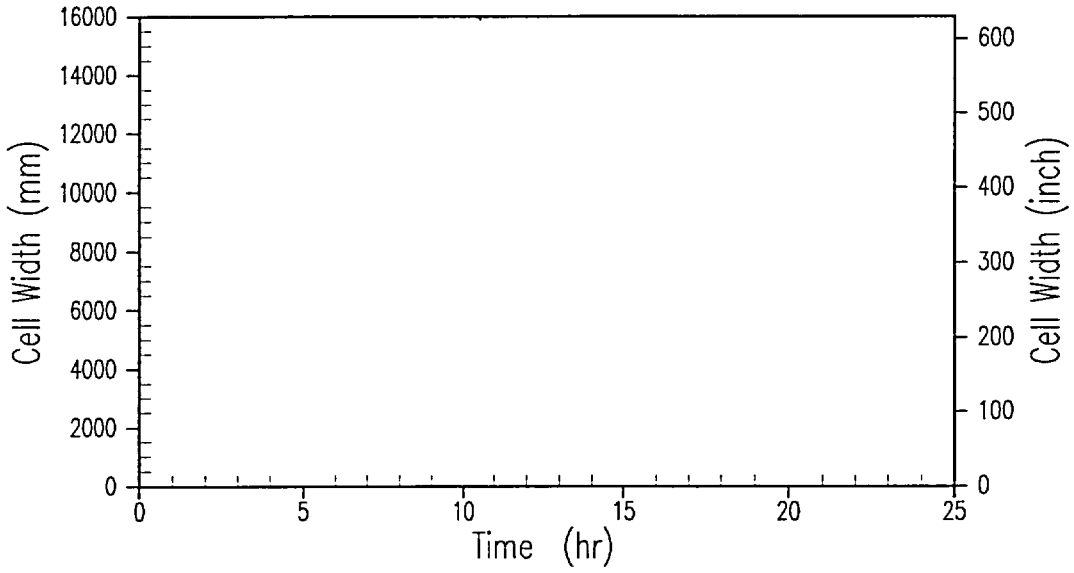

Figure 41A-303

Case 1A-3a: Approximate Detonation Cell Width in SG Room Transient with Creep of SG Tubes

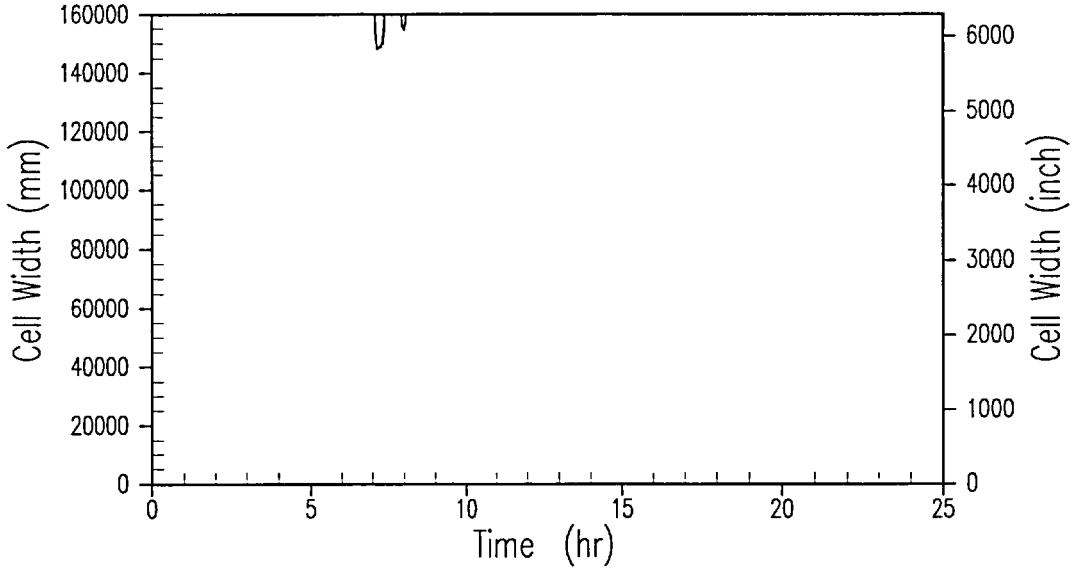

Figure 41A-304

Case 1A-3a: Approximate Detonation Cell Width in CMT Room Transient with Creep of SG Tubes

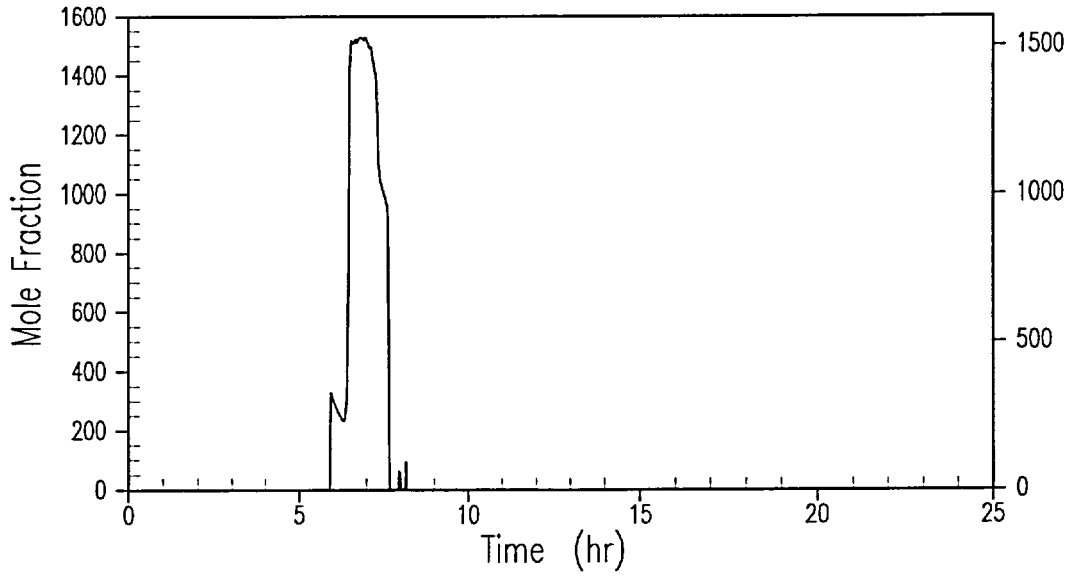

Figure 41A-305

Case 1A-3a: Equivalence Ratio in IRWST Transient with Creep of SG Tubes

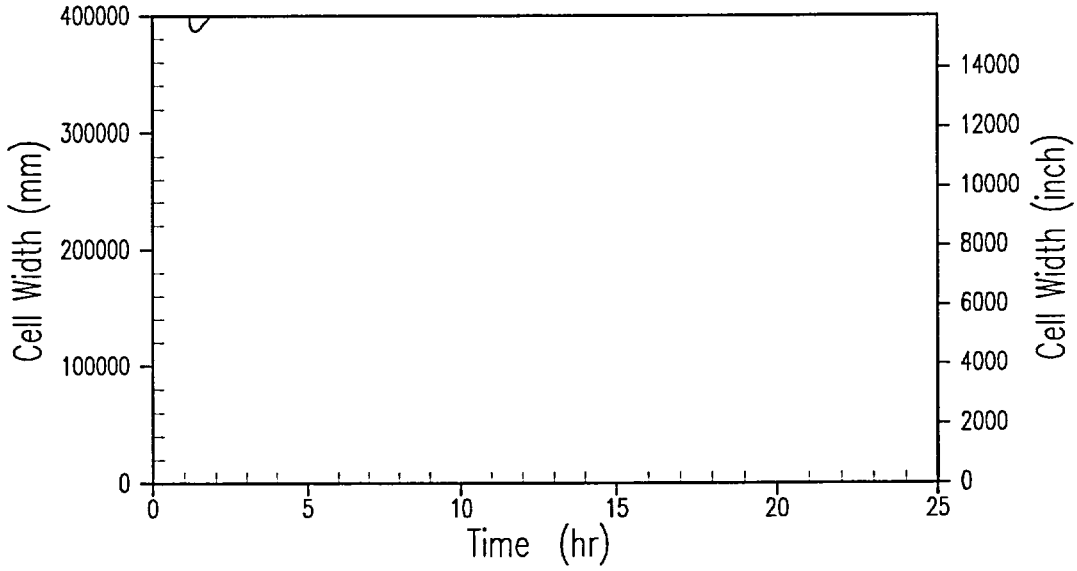

Figure 41A-306

Case 1A-3a: Approximate Detonation Cell Width in PXS Transient with Creep of SG Tubes

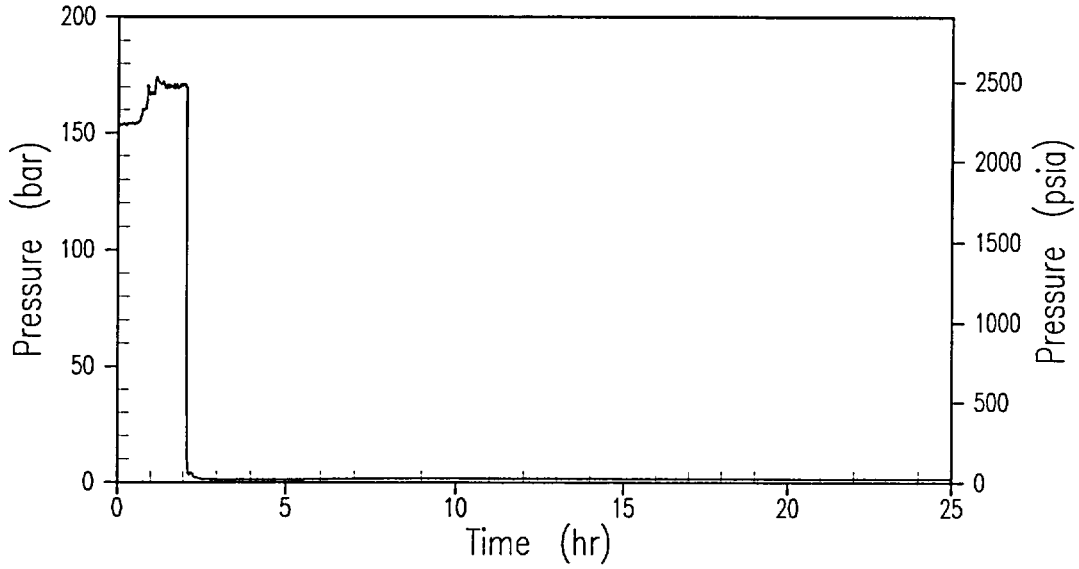

Figure 41A-307

Case 1A-4: Reactor Coolant System Pressure FW Failure with Creep of SG Tubes

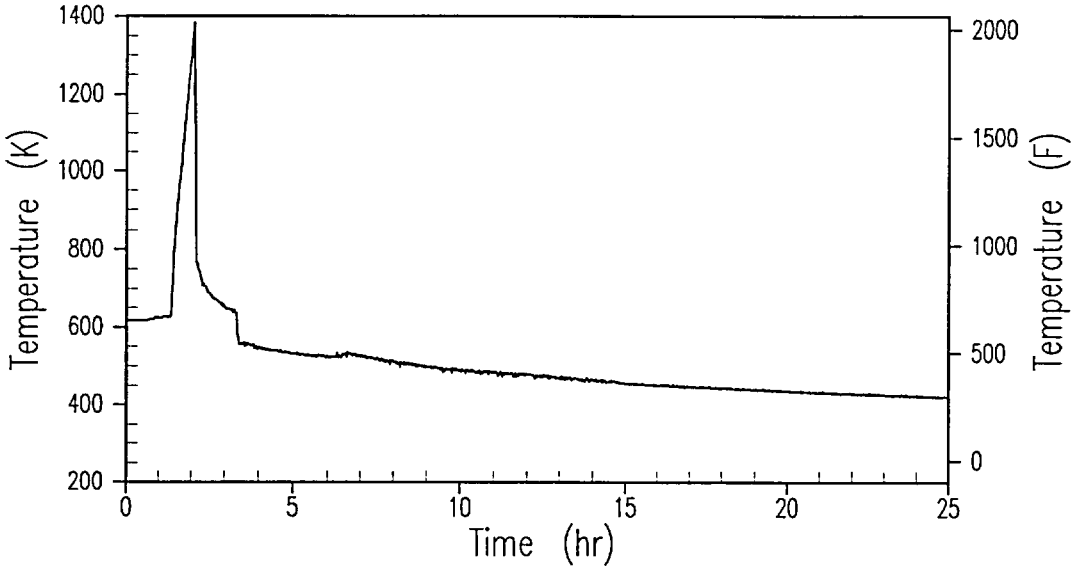

Figure 41A-308

Case 1A-4: Core-Exit Gas Temperature FW Failure with Creep of SG Tubes

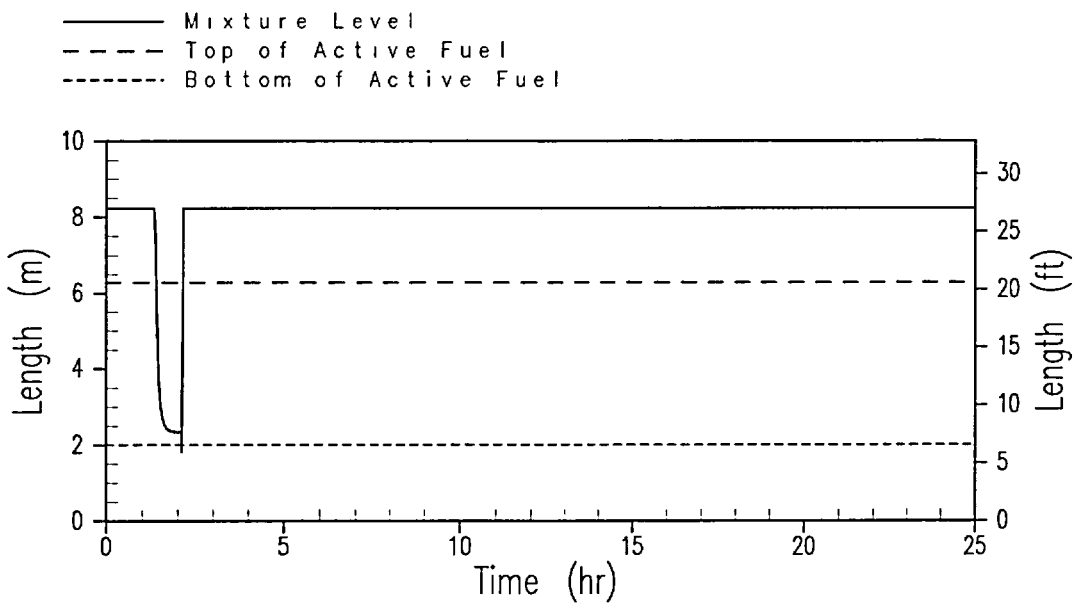

Figure 41A-309

Case 1A-4: Reactor Vessel Mixture Level FW Failure with Creep of SG Tubes

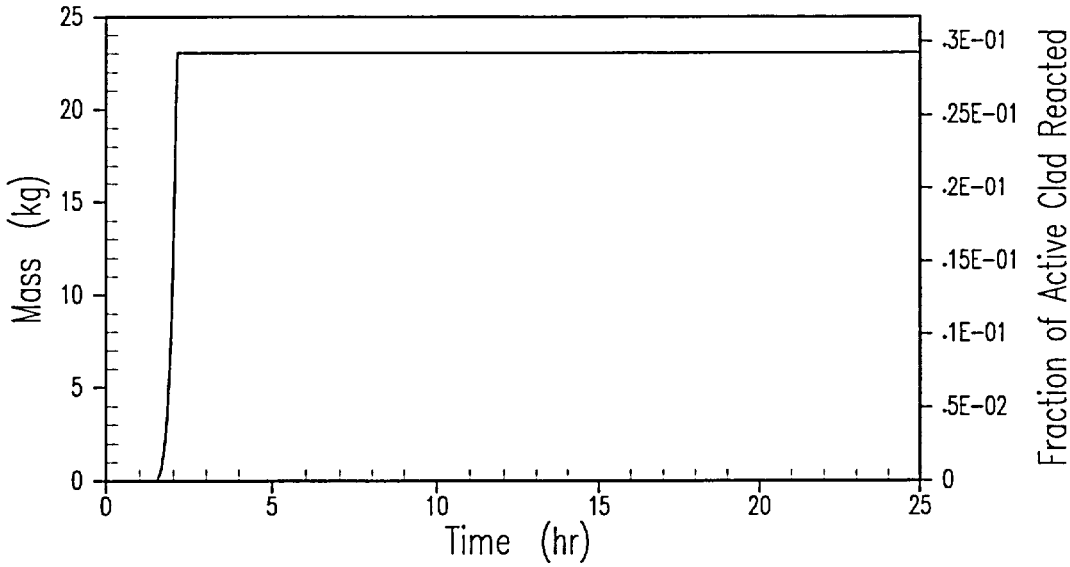

Figure 41A-310

Case 1A-4: Hydrogen Generated In-Vessel FW Failure with Creep of SG Tubes

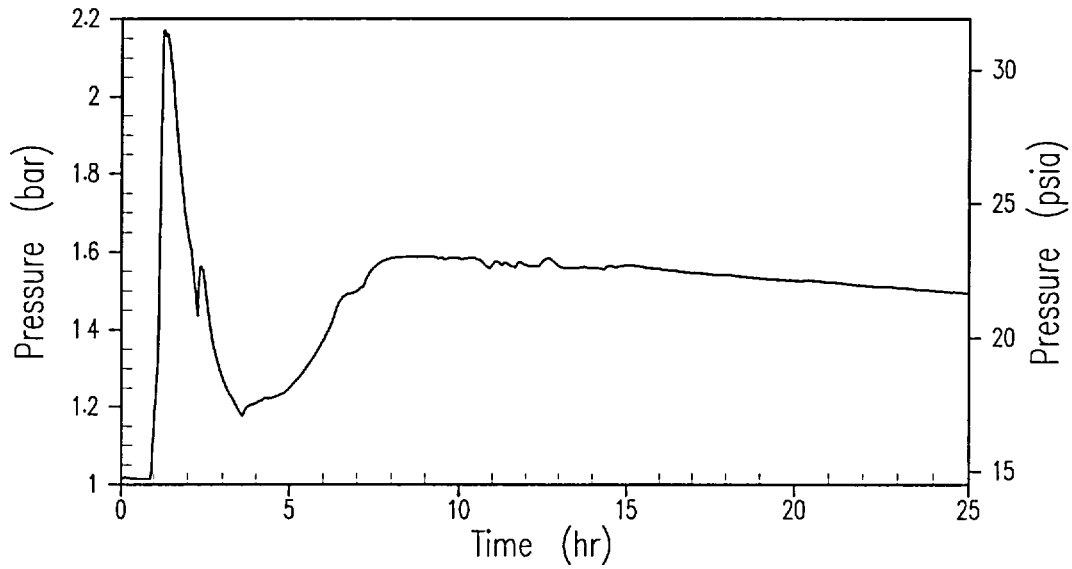

Figure 41A-311

Case 1A-4: Containment Pressure
FW Failure with Creep of SG Tubes

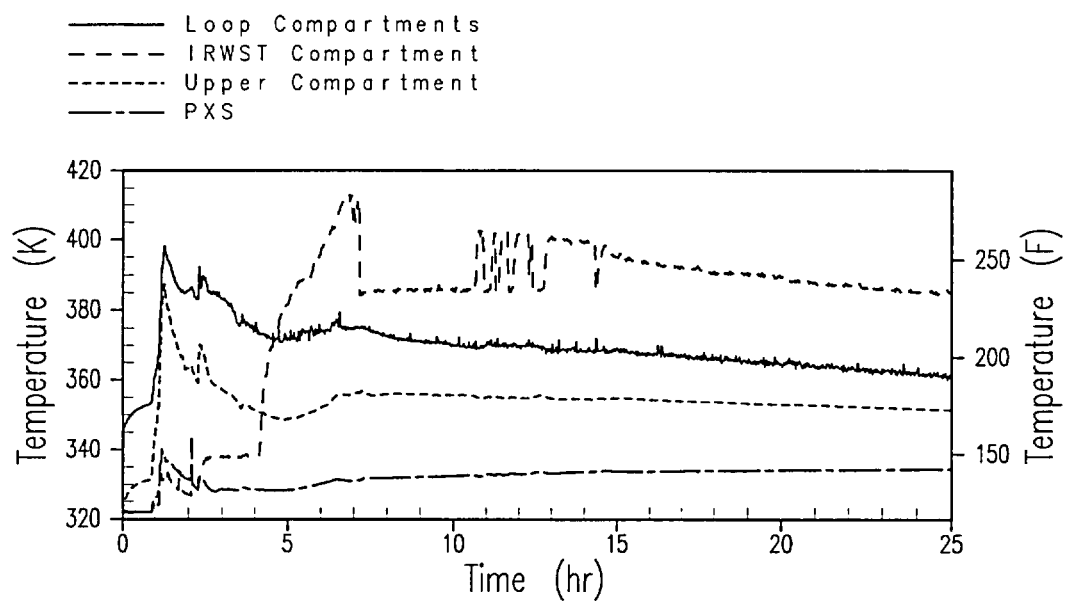

Figure 41A-312

Case 1A-4: Containment Gas Temperature
FW Failure with Creep of SG Tubes

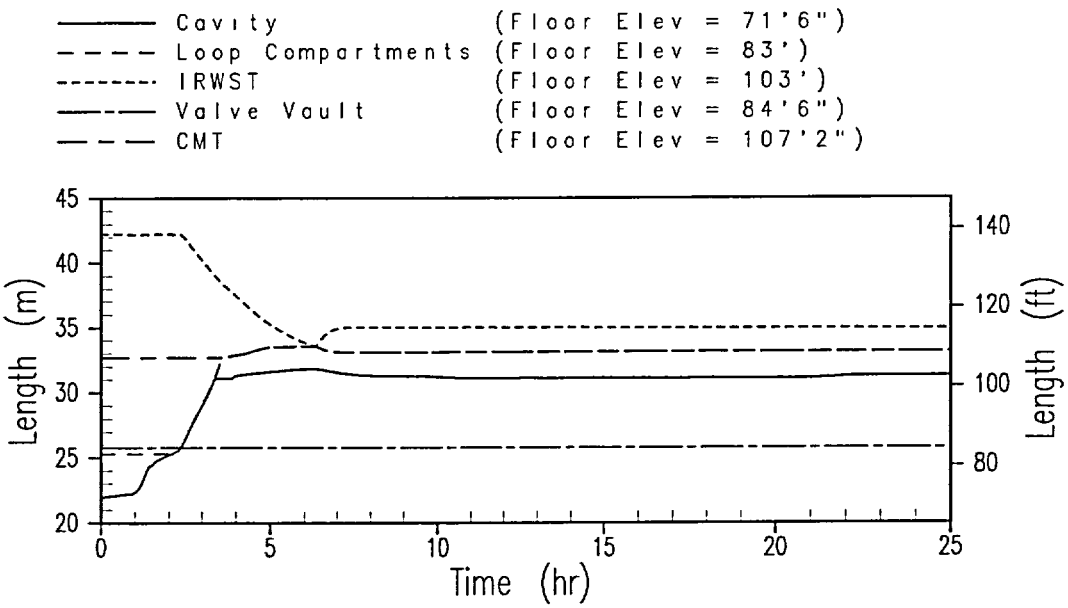

Figure 41A-313

Case 1A-4: Containment Compartments Water Level
FW Failure with Creep of SG Tubes

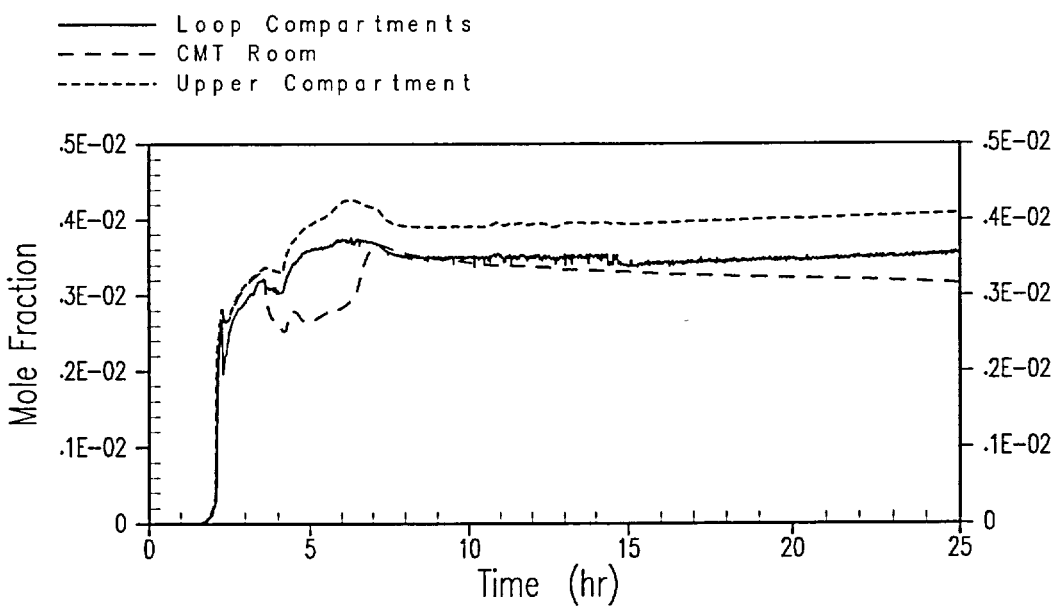

Figure 41A-314

Case 1A-4: Well-Mixed Compartment Hydrogen Concentration
FW Failure with Creep of SG Tubes

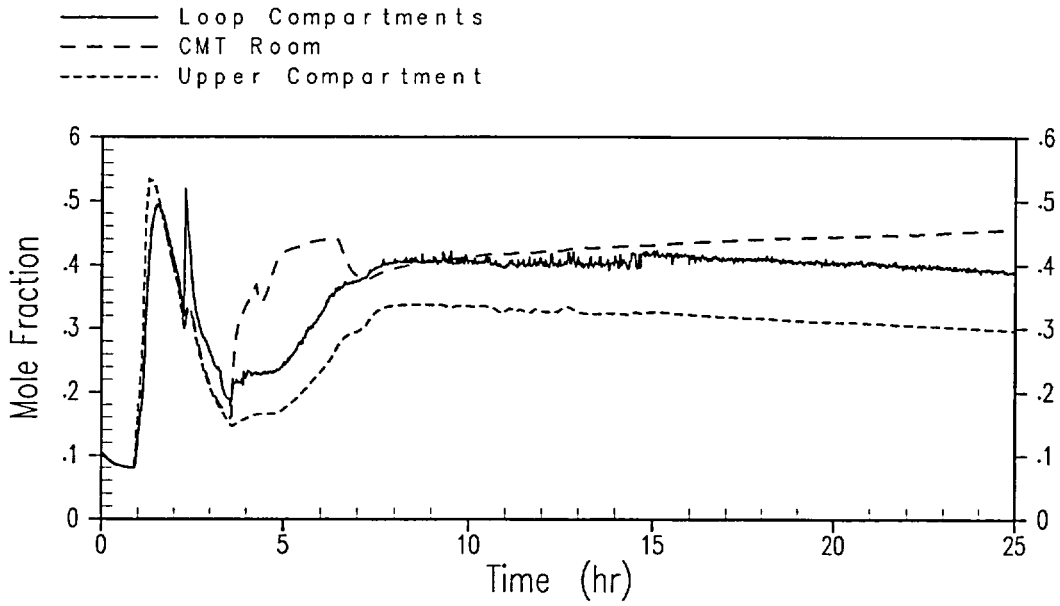

Figure 41A-315

Case 1A-4: Well-Mixed Compartment Steam Concentration FW Failure with Creep of SG Tubes

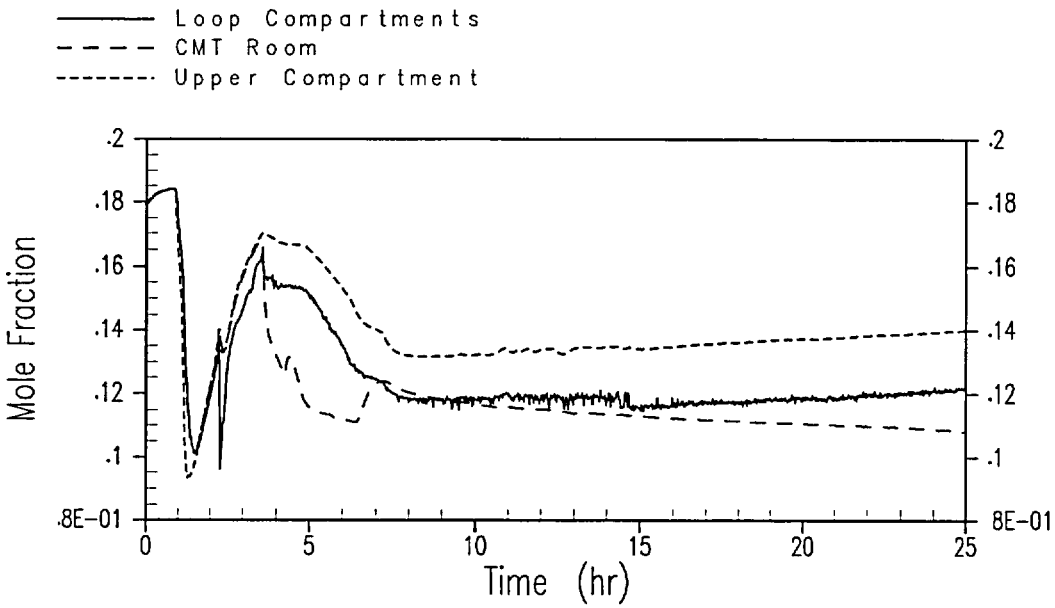

Figure 41A-316

Case 1A-4: Well-Mixed Compartment Oxygen Concentration FW Failure with Creep of SG Tubes

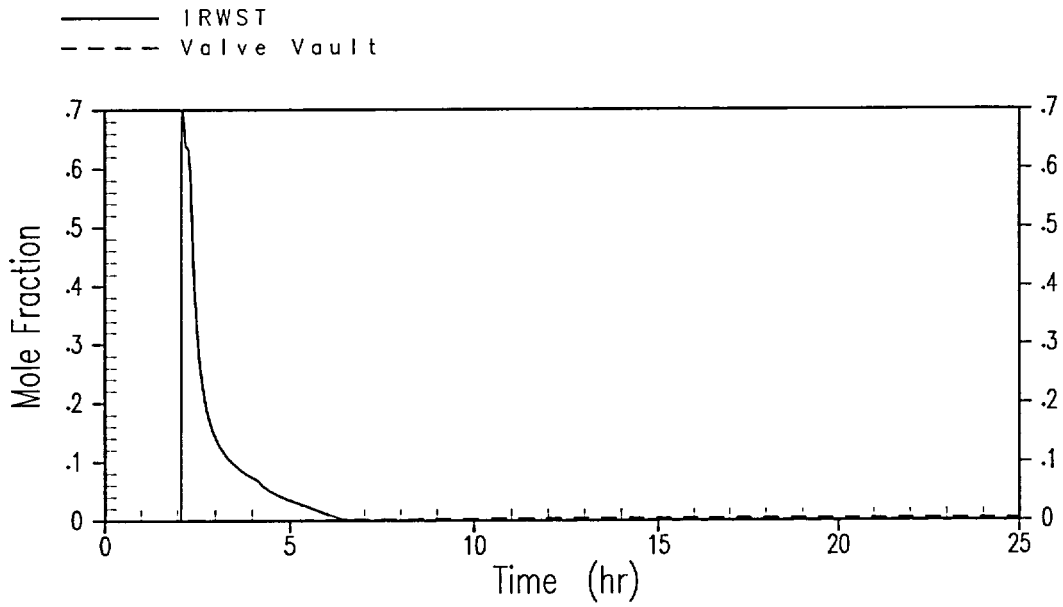

Figure 41A-317

Case 1A-4: Confined Compartment Hydrogen Concentration FW Failure with Creep of SG Tubes

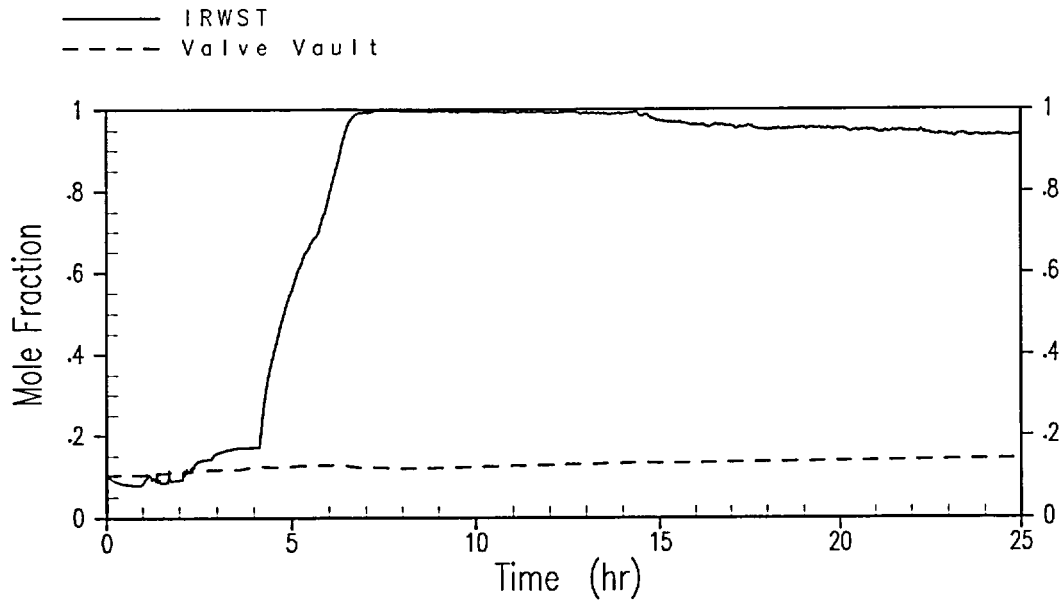

Figure 41A-318

Case 1A-4: Confined Compartment Steam Concentration FW Failure with Creep of SG Tubes

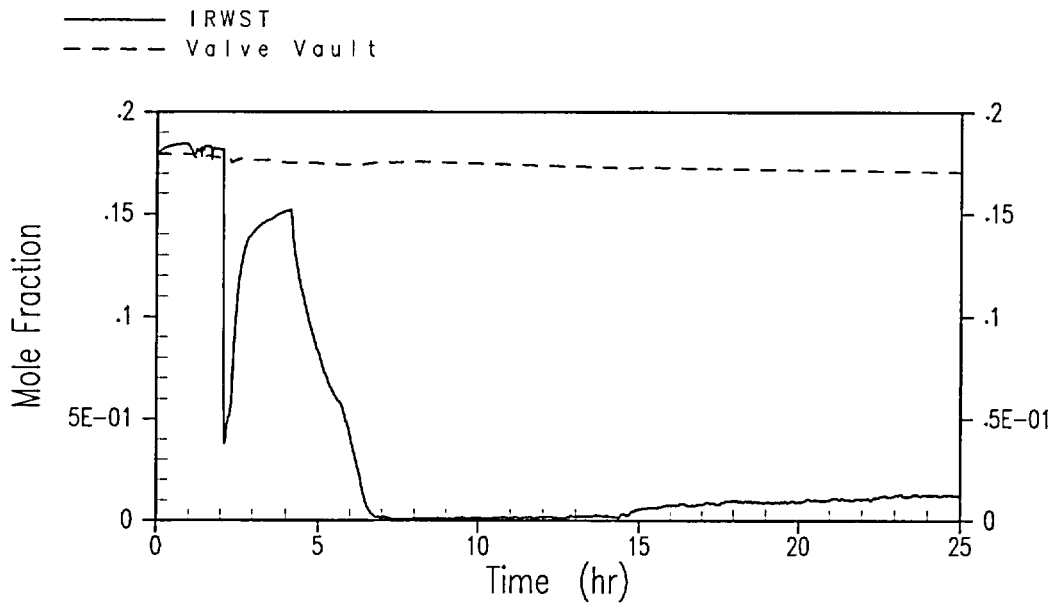

Figure 41A-319

Case 1A-4: Confined Compartment Oxygen Concentration FW Failure with Creep of SG Tubes

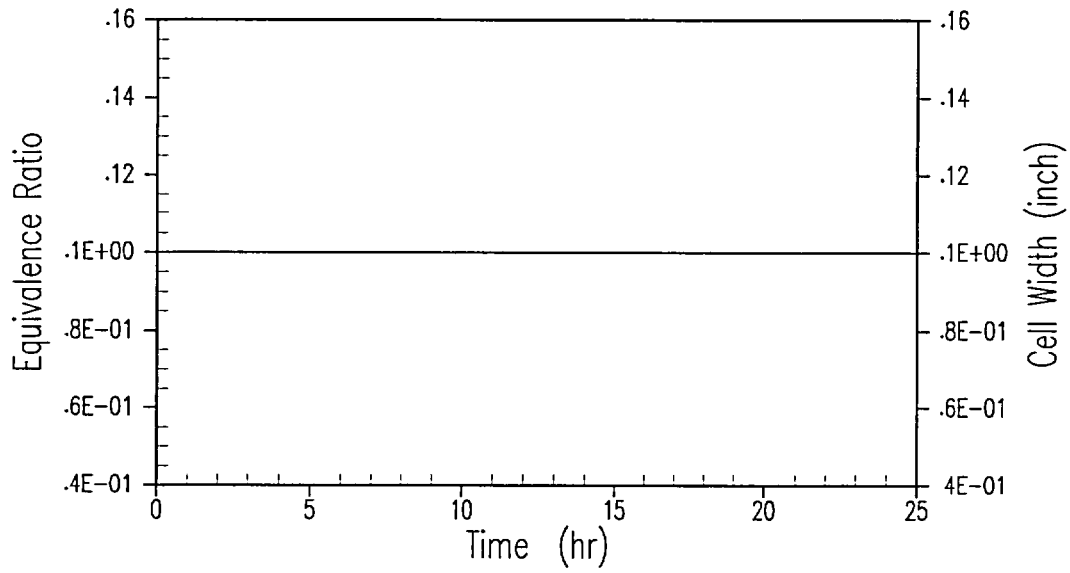

Figure 41A-320

Case 1A-4: Equivalence Ratio in SG Room FW Failure with Creep of SG Tubes

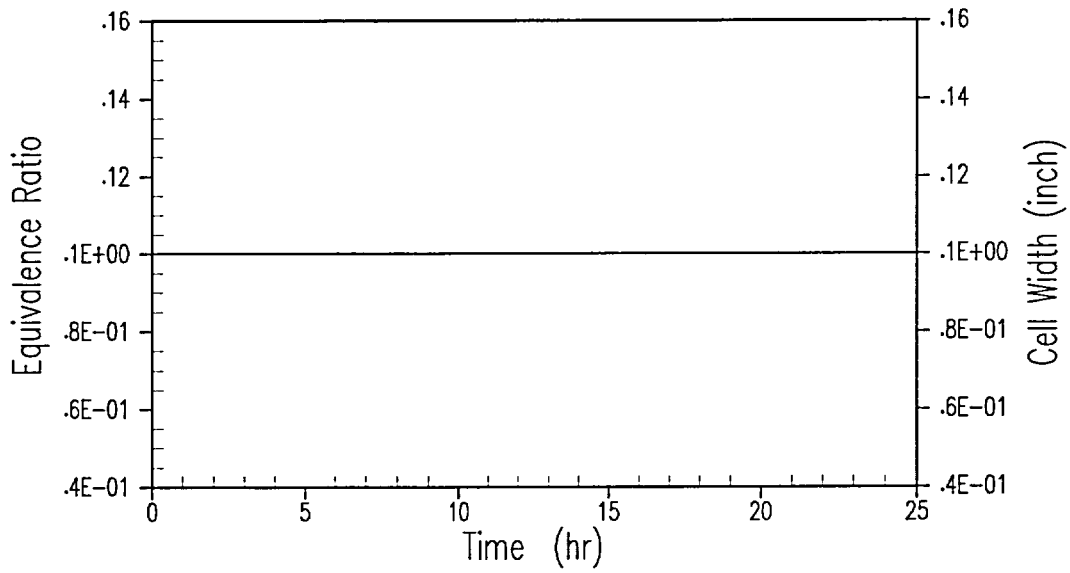

Figure 41A-321

Case 1A-4: Equivalence Ratio in CMT Room FW Failure with Creep of SG Tubes

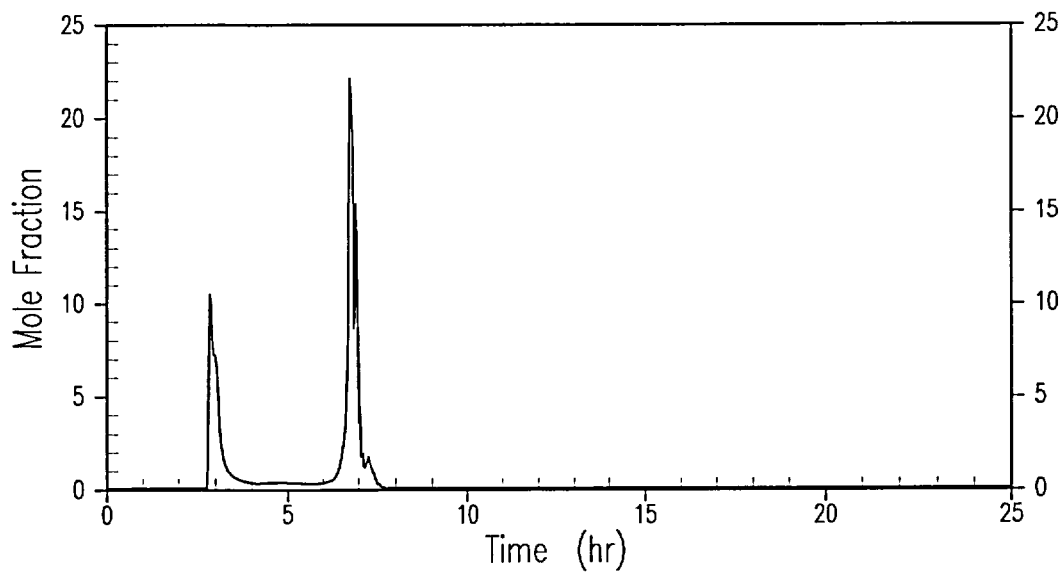

Figure 41A-322

Case 1A-4: Equivalence Ratio in IRWST FW Failure with Creep of SG Tubes

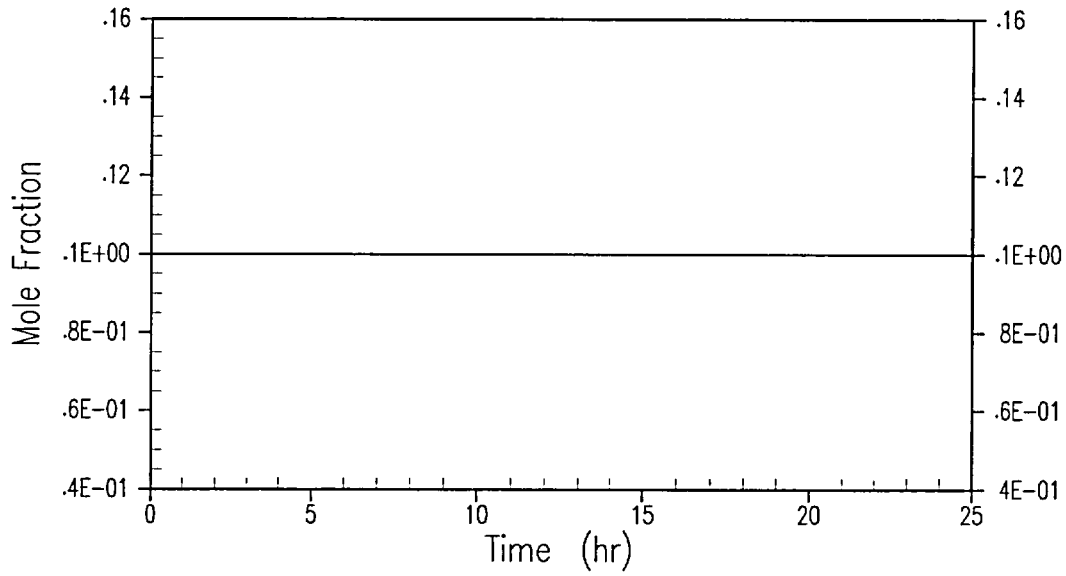

Figure 41A-323

Case 1A-4: Equivalence Ratio in PXS FW Failure with Creep of SG Tubes

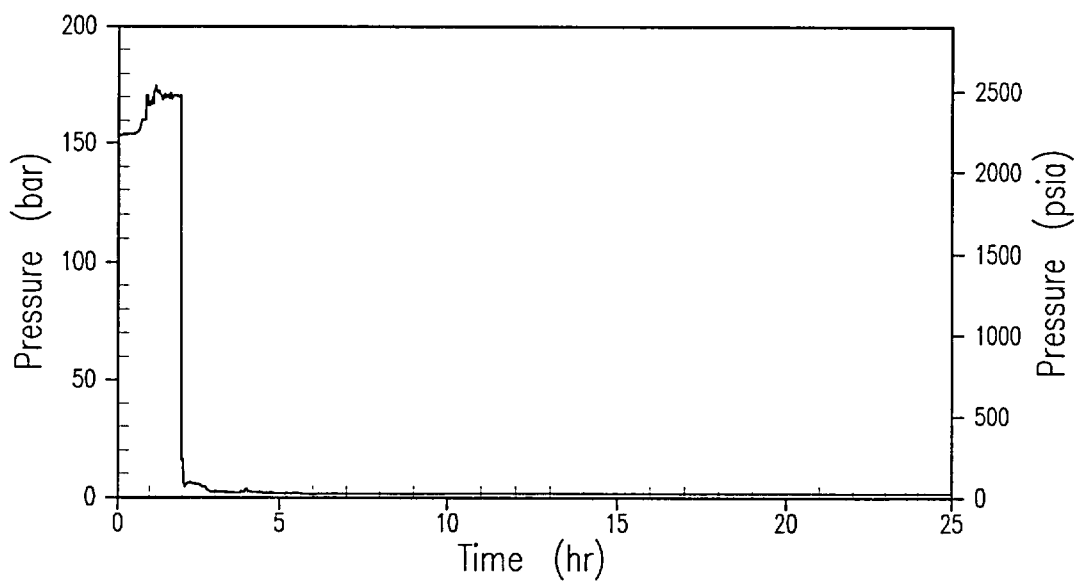

Figure 41A-324

Case 1A-4a: Reactor Coolant System Pressure Transient with Creep of SG Tubes

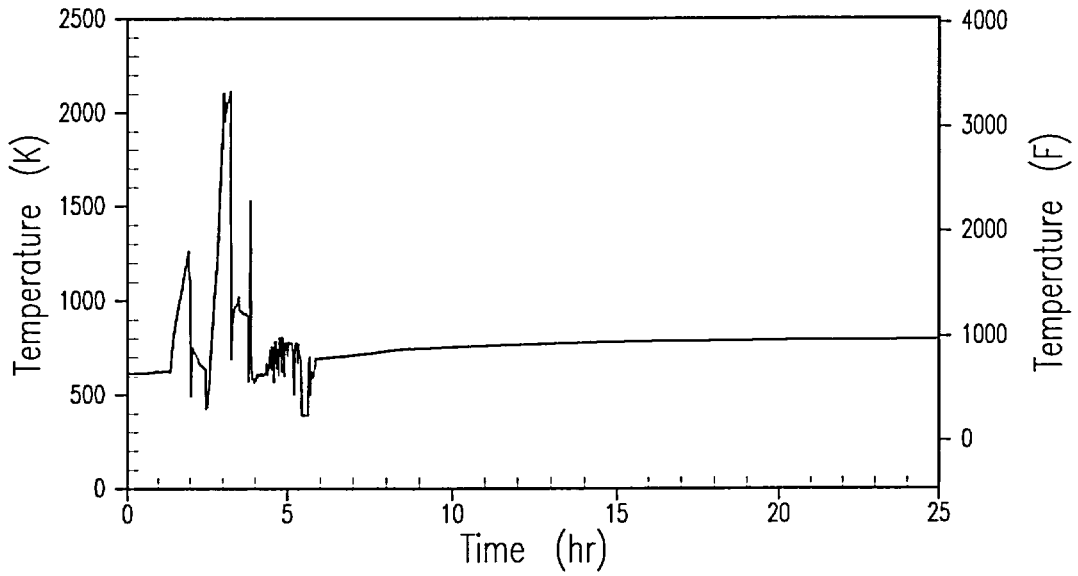

Figure 41A-325

Case 1A-4a: Core-Exit Gas Temperature Transient with Creep of SG Tubes

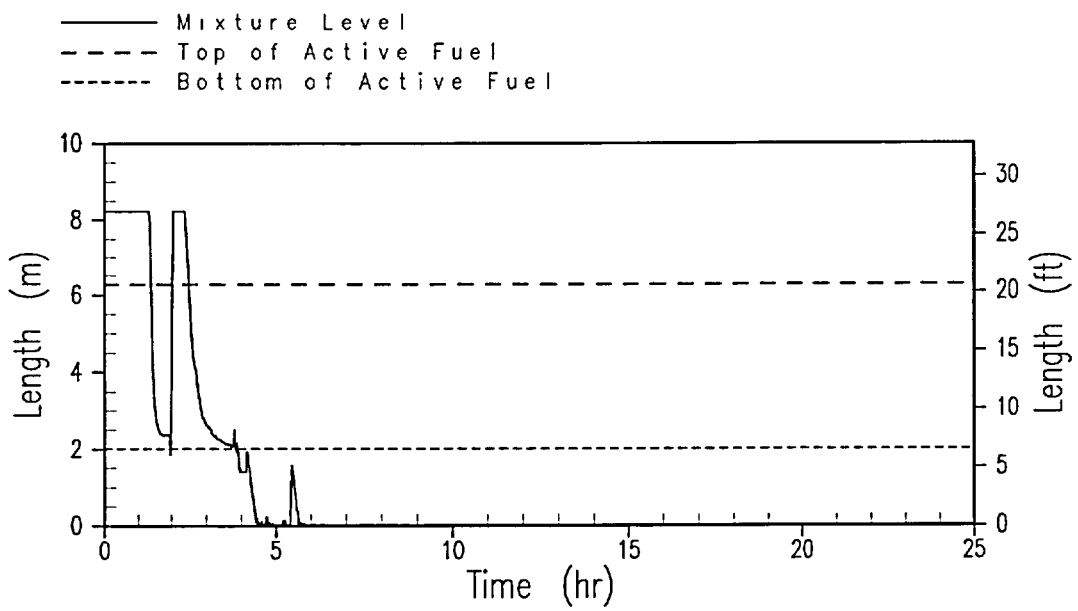

Figure 41A-326

Case 1A-4a: Reactor Vessel Mixture Level Transient with Creep of SG Tubes

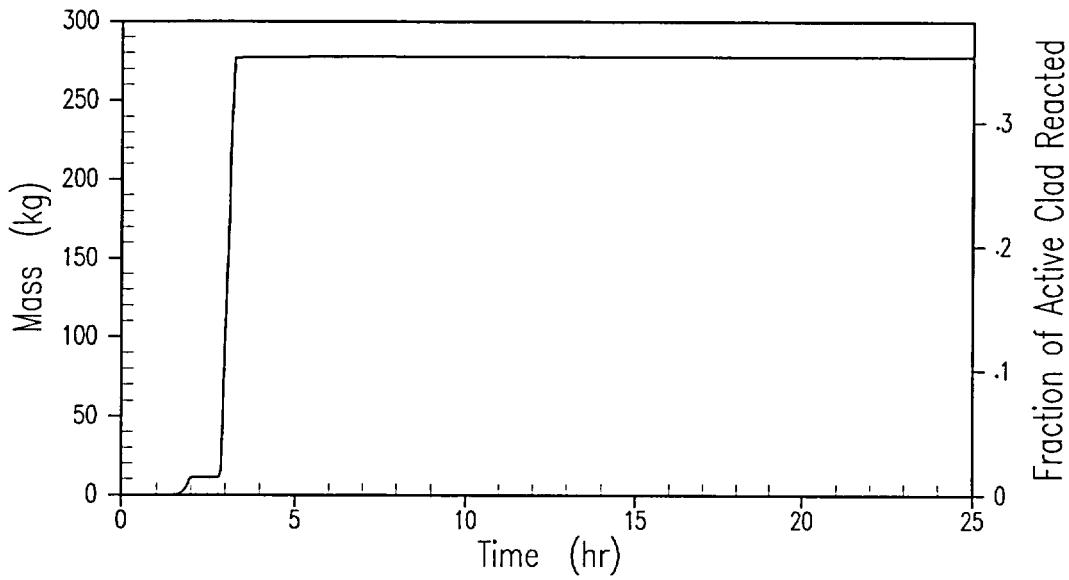

Figure 41A-327

Case 1A-4a: Hydrogen Generated In-Vessel Transient with Creep of SG Tubes

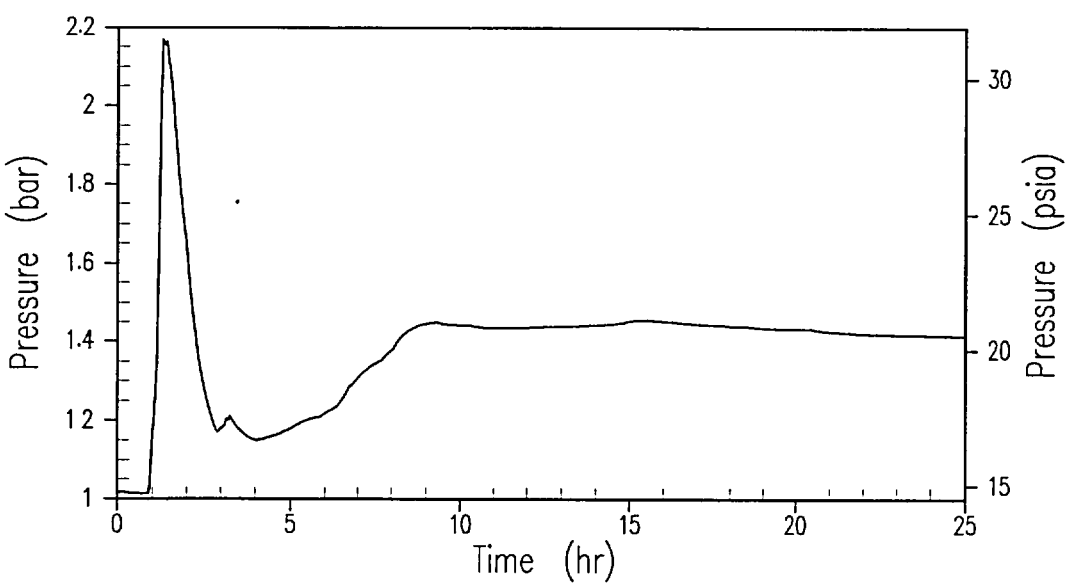

Figure 41A-328

Case 1A-4a: Containment Pressure Transient with Creep of SG Tubes

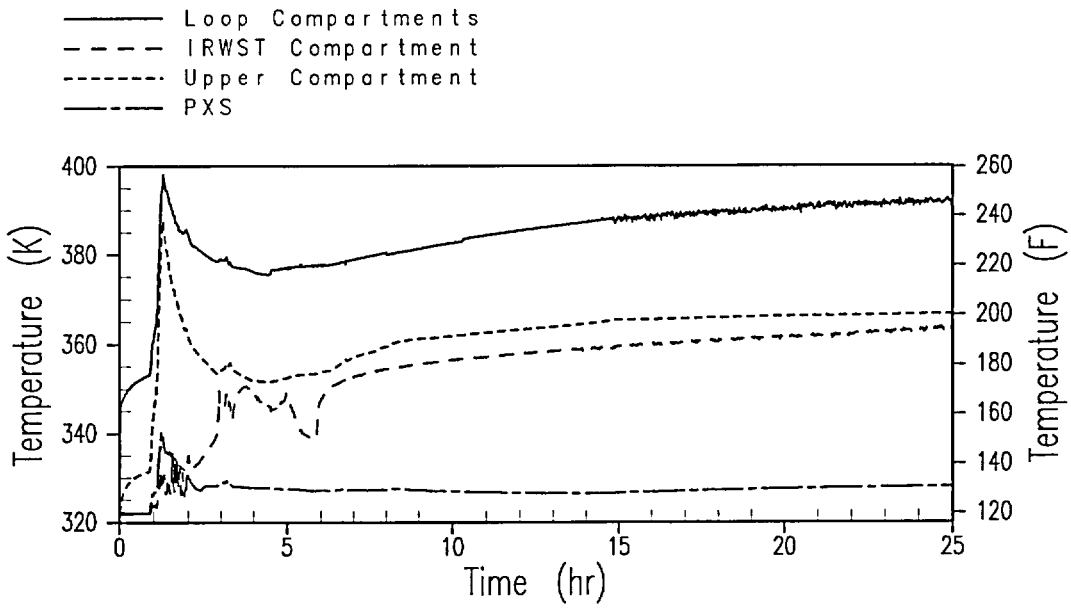

Figure 41A-329

Case 1A-4a: Containment Gas Temperature Transient with Creep of SG Tubes

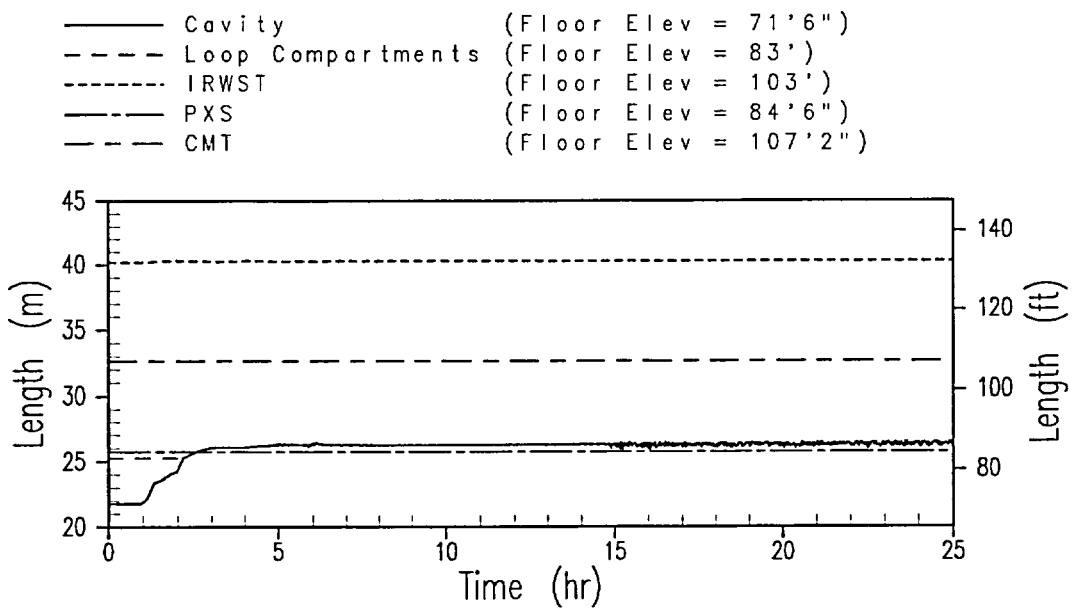

Figure 41A-330

Case 1A-4a: Containment Compartments Water Level Transient with Creep of SG Tubes

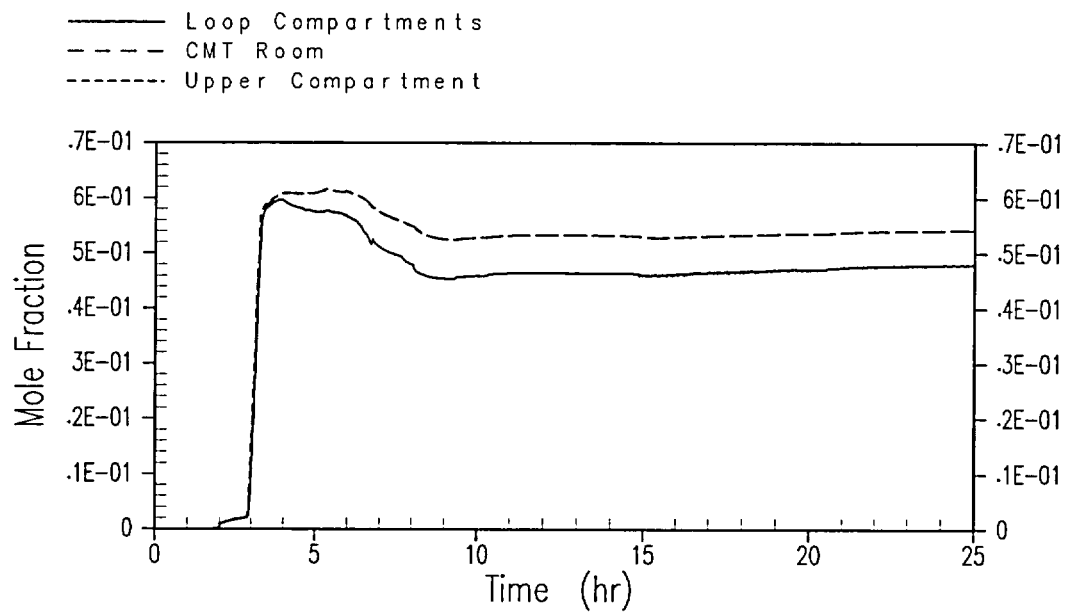

Figure 41A-331

Case 1A-4a: Well-Mixed Compartment Hydrogen Concentration Transient with Creep of SG Tubes

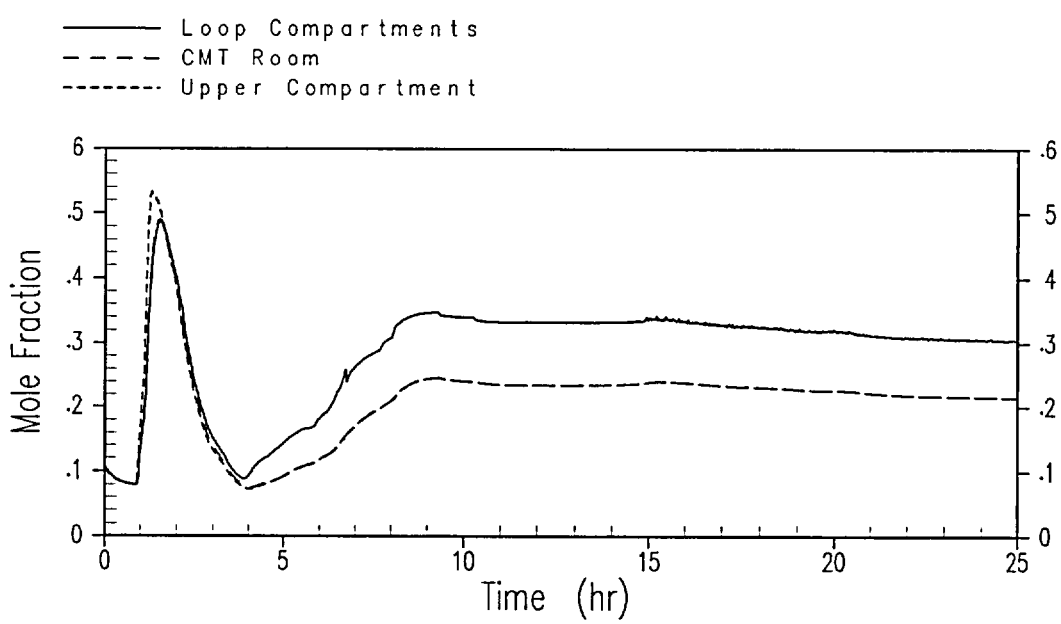

Figure 41A-332

Case 1A-4a: Well-Mixed Compartment Steam Concentration Transient with Creep of SG Tubes

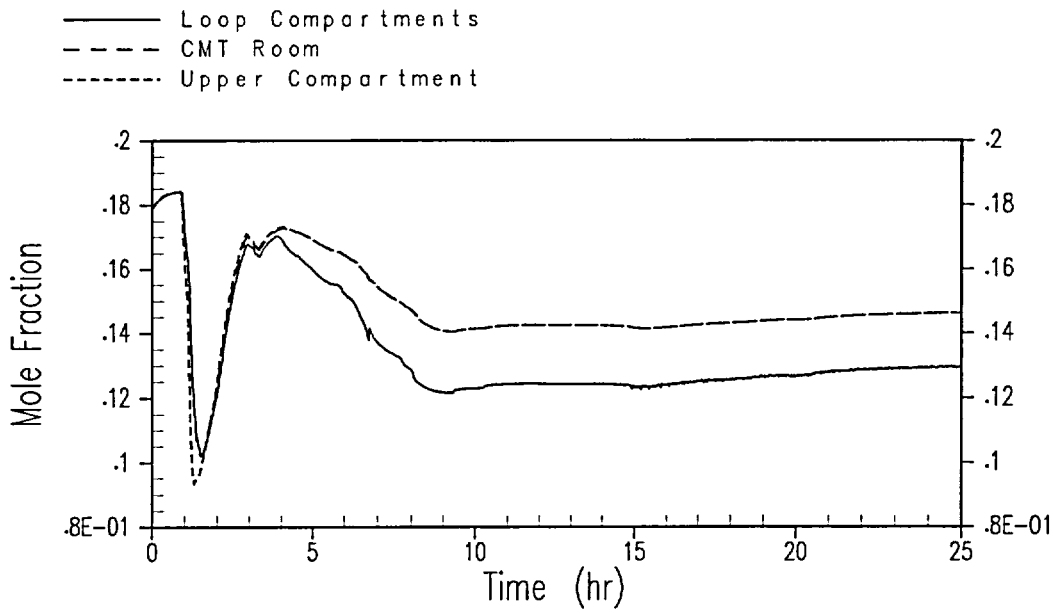

Figure 41A-333

Case 1A-4a: Well-Mixed Compartment Oxygen Concentration Transient with Creep of SG Tubes

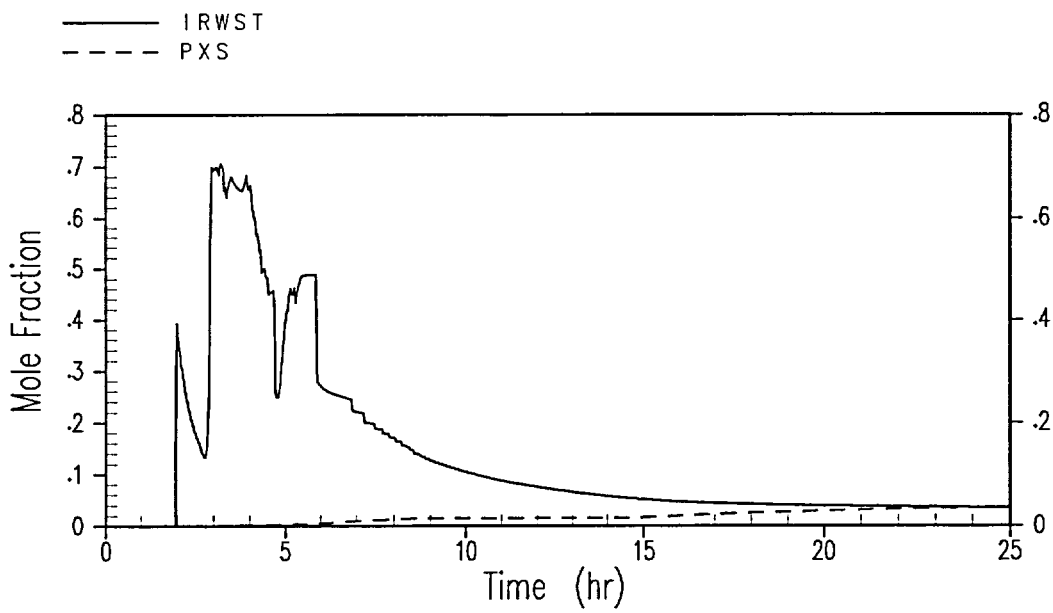

Figure 41A-334

Case 1A-4a: Confined Compartment Hydrogen Concentration Transient with Creep of SG Tubes

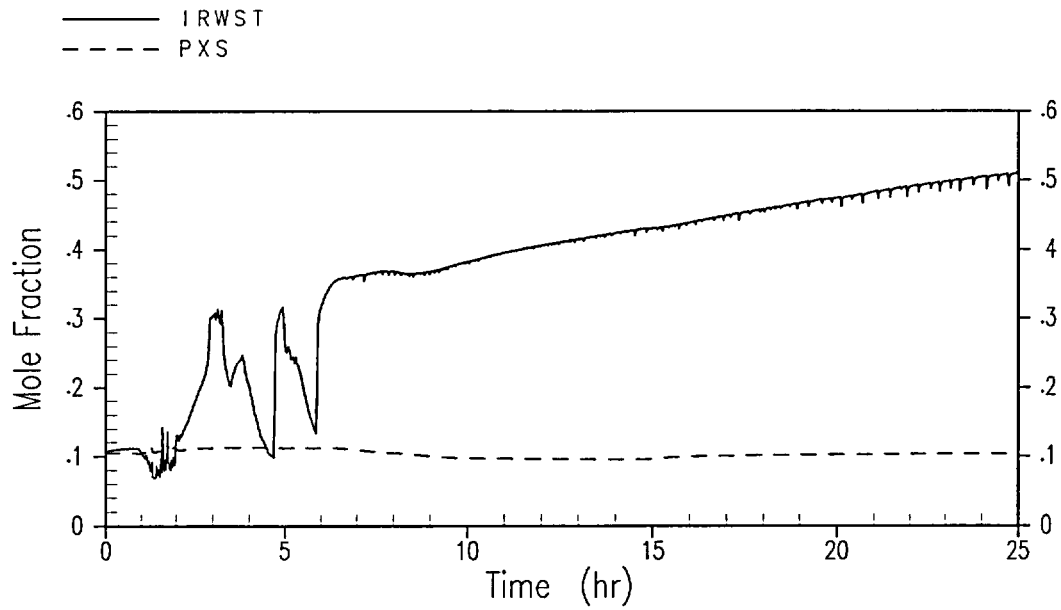

Figure 41A-335

Case 1A-4a: Confined Compartment Steam Concentration Transient with Creep of SG Tubes

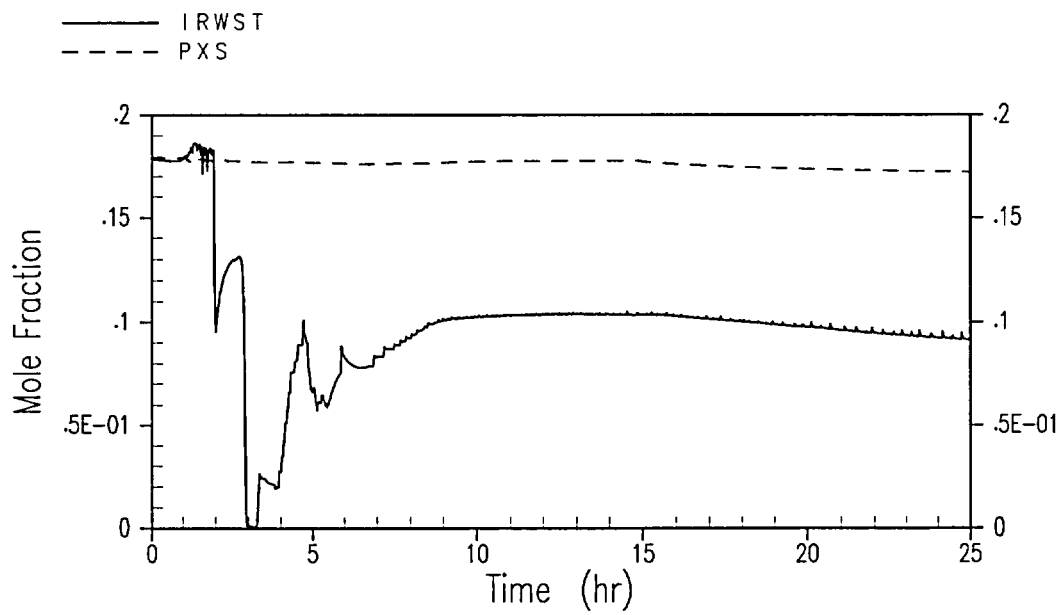

Figure 41A-336

Case 1A-4a: Confined Compartment Oxygen Concentration Transient with Creep of SG Tubes

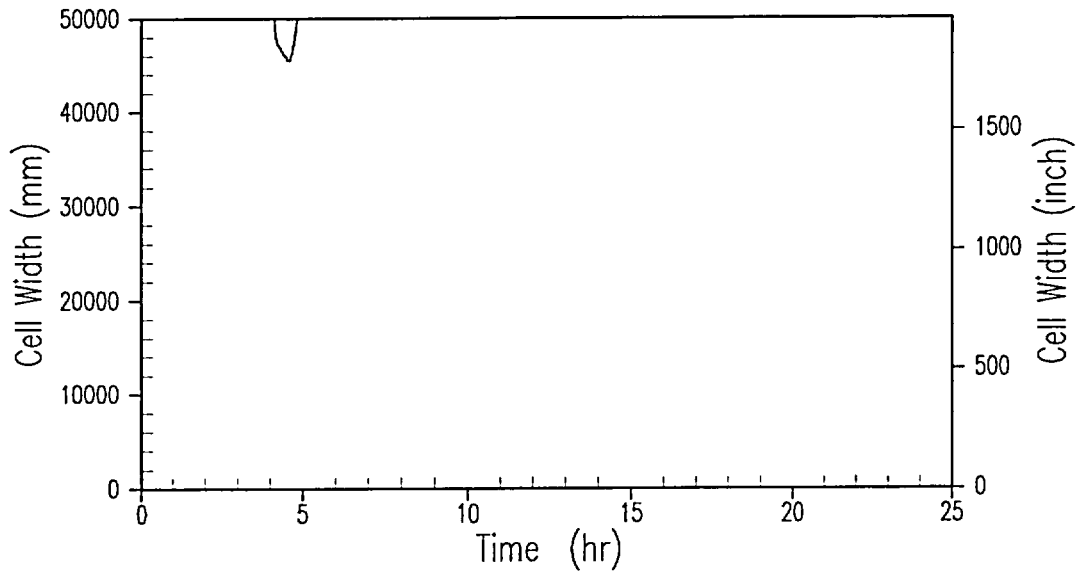

Figure 41A-337

Case 1A-4a: Approximate Detonation Cell Width in SG Room Transient with Creep of SG Tubes

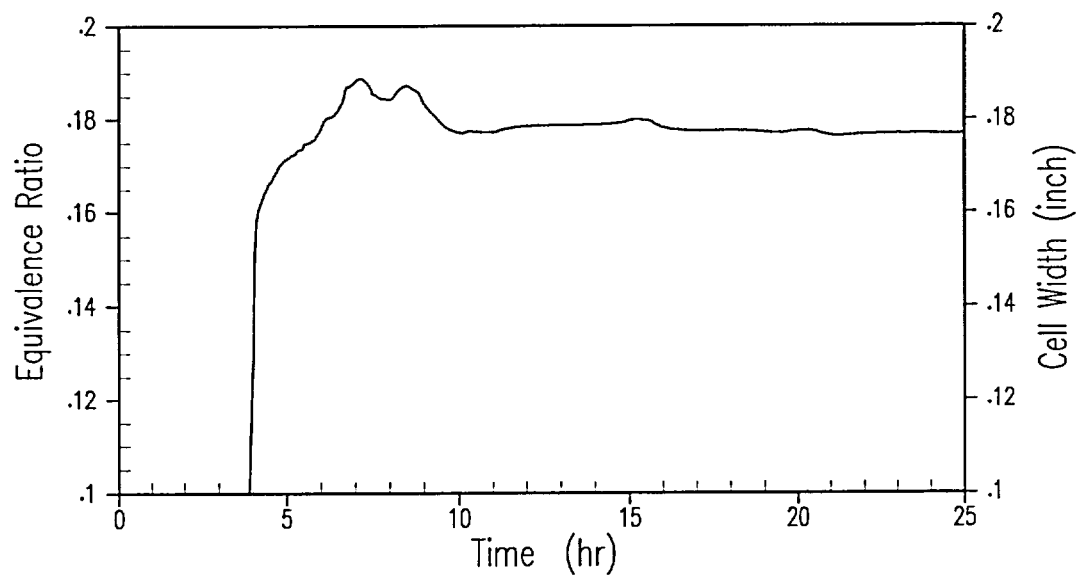

Figure 41A-338

Case 1A-4a: Equivalence Ratio in CMT Room Transient with Creep of SG Tubes

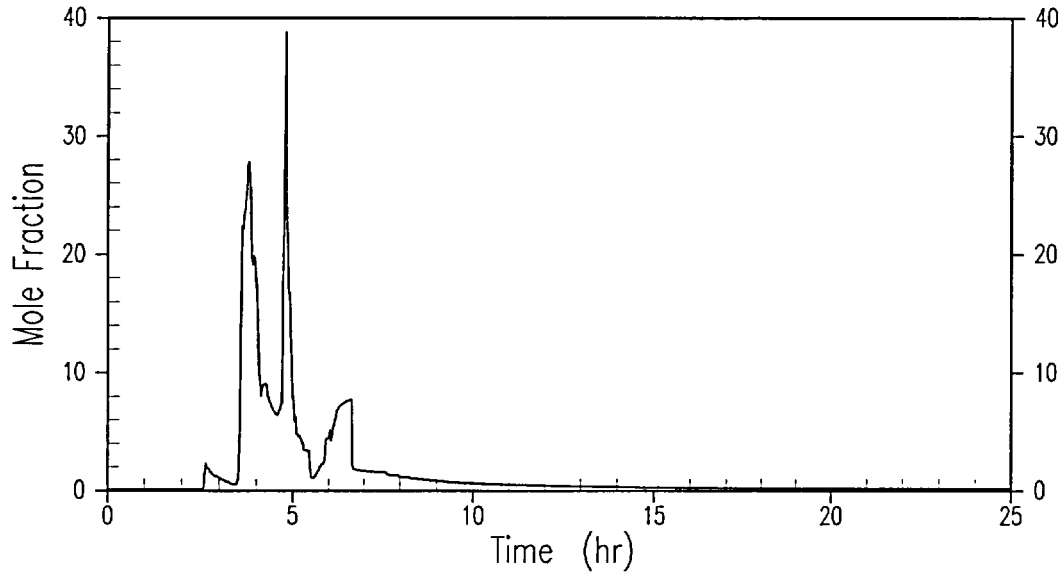

Figure 41A-339

Case 1A-4a: Equivalence Ratio in IRWST Transient with Creep of SG Tubes

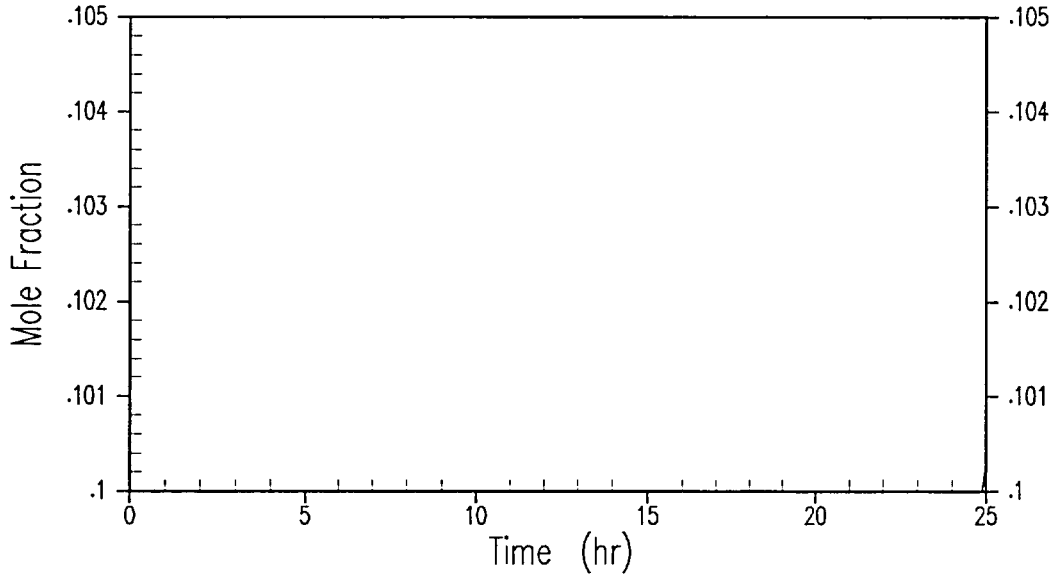

Figure 41A-340

Case 1A-4a: Equivalence Ratio in PXS Transient with Creep of SG Tubes

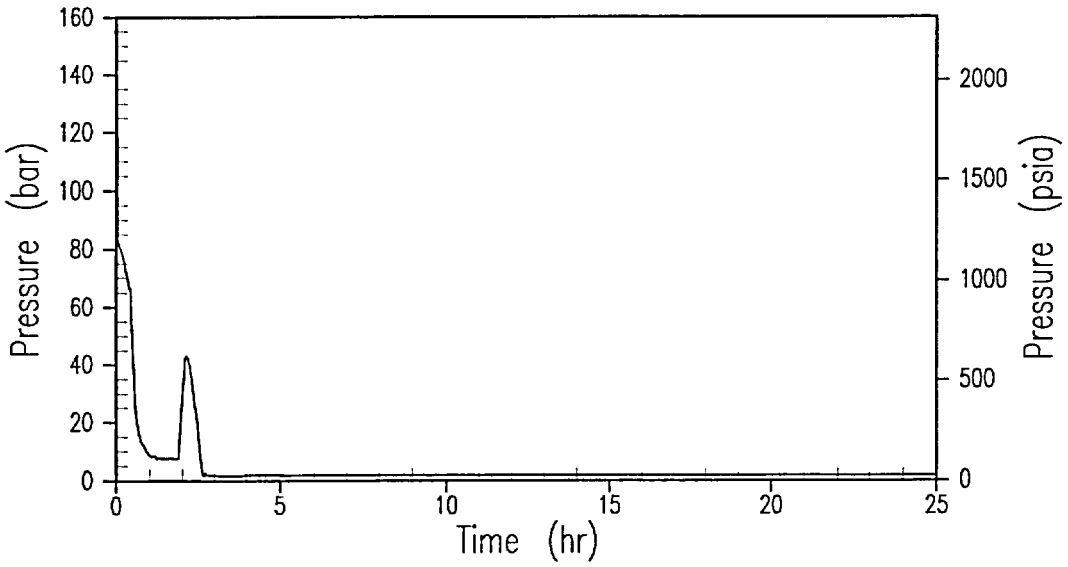

Figure 41A-341

Case 1AP-3: Reactor Coolant System Pressure SBLOCA, Failed PRHR and CMTs

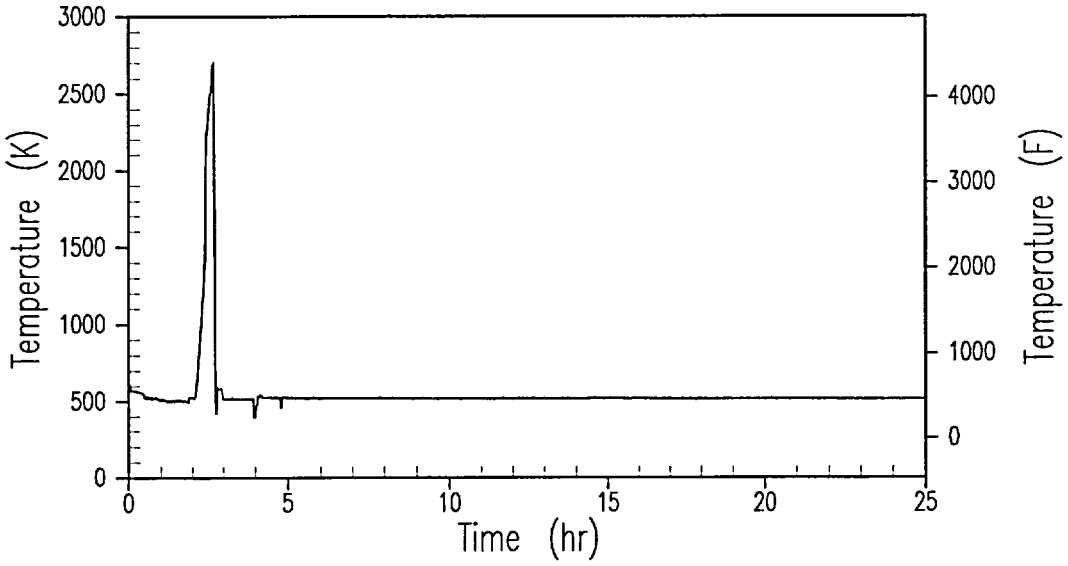

Figure 41A-342

Case 1AP-3: Core-Exit Gas Temperature SBLOCA, Failed PRHR and CMTs

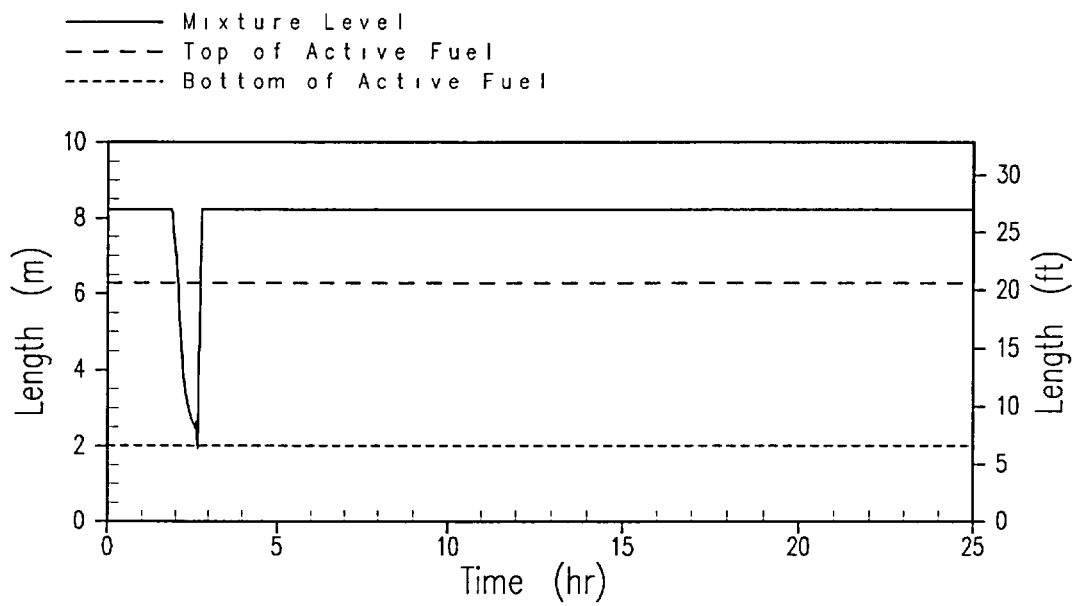

Figure 41A-343

Case 1AP-3: Reactor Vessel Mixture Level SBLOCA, Failed PRHR and CMTs

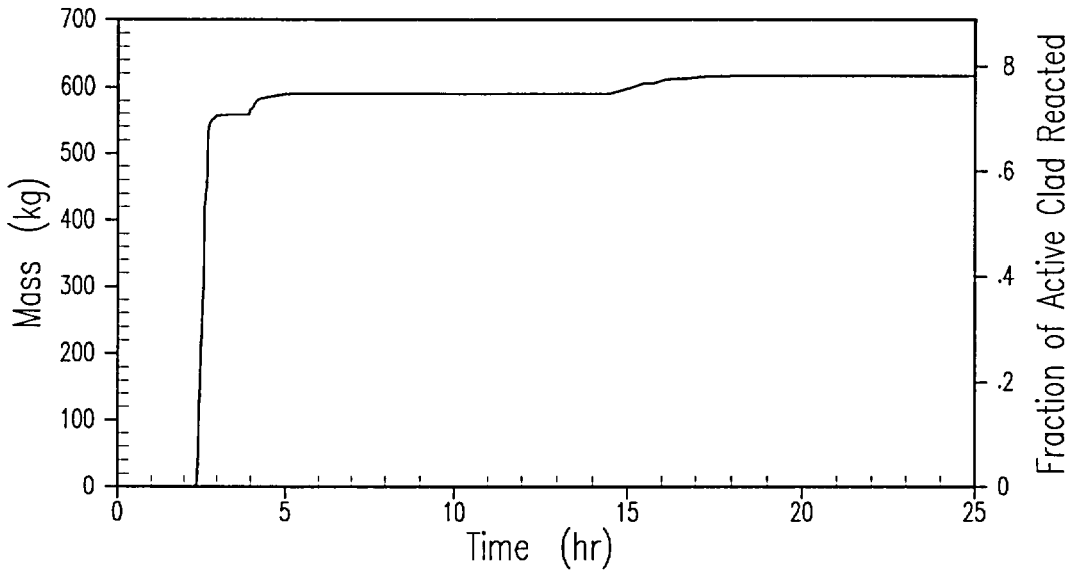

Figure 41A-344

Case 1AP-3: Hydrogen Generated In-Vessel SBLOCA, Failed PRHR and CMTs

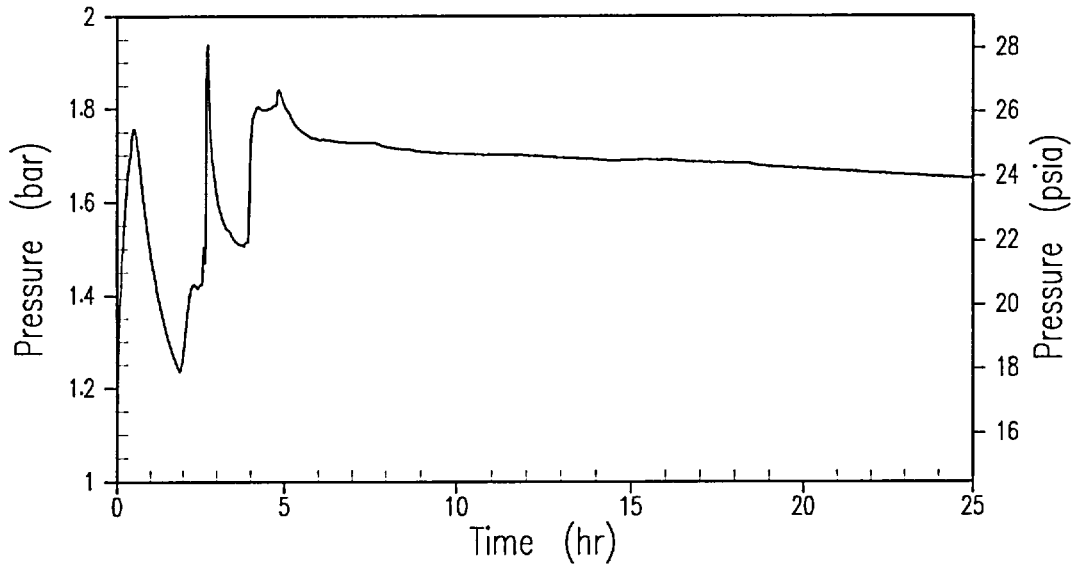

Figure 41A-345

Case 1AP-3: Containment Pressure SBLOCA, Failed PRHR and CMTs

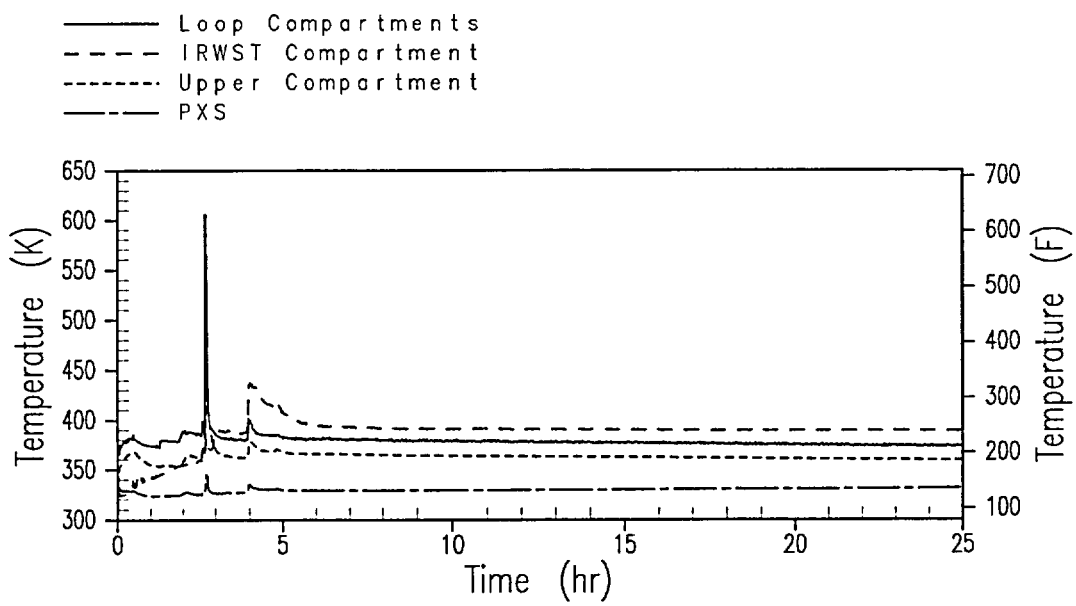

Figure 41A-346

Case 1AP-3: Containment Gas Temperature SBLOCA, Failed PRHR and CMTs

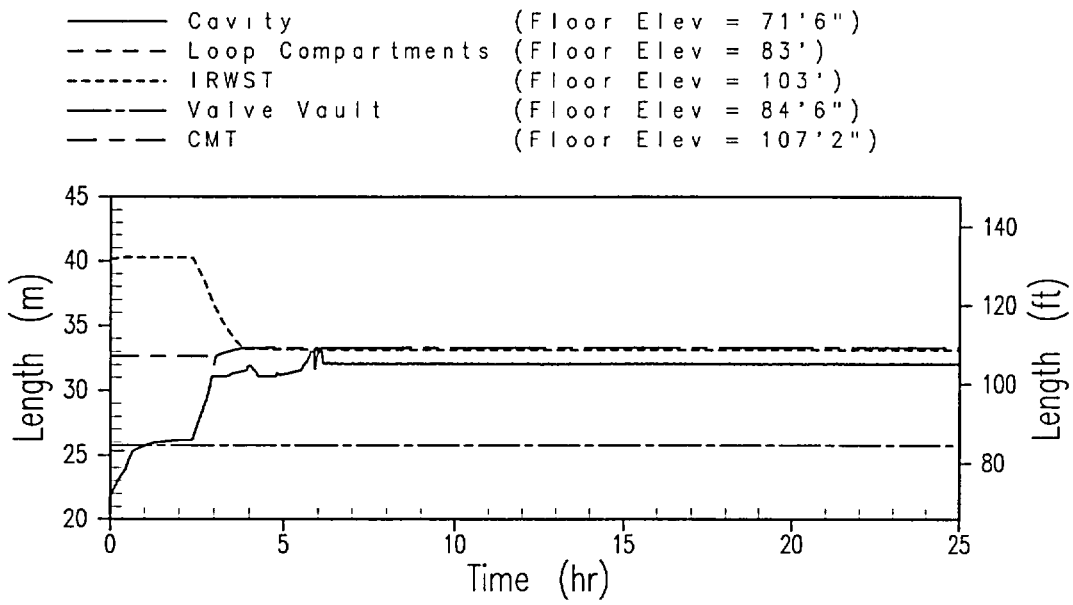

Figure 41A-347

Case 1AP-3: Containment Compartments Water Level SBLOCA, Failed PRHR and CMTs

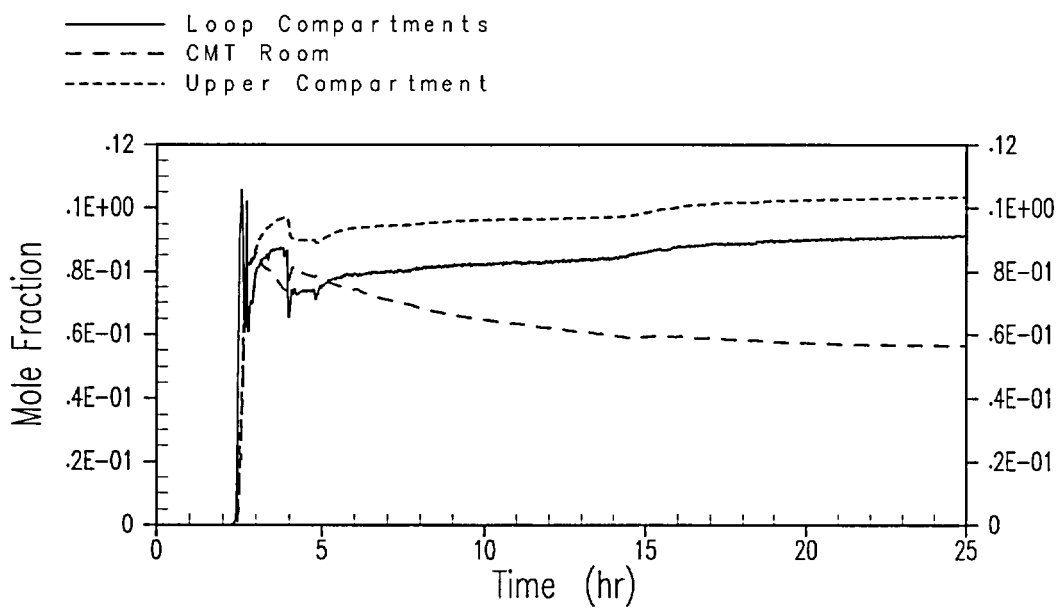

Figure 41A-348

Case 1AP-3: Well-Mixed Compartment Hydrogen Concentration SBLOCA, Failed PRHR and CMTs

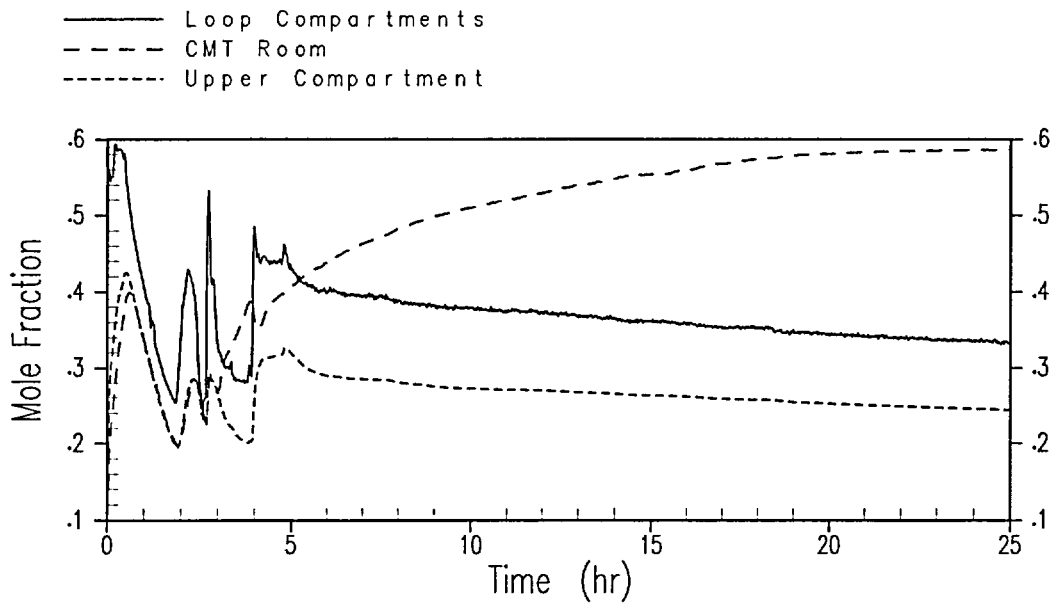

Figure 41A-349

Case 1AP-3: Well-Mixed Compartment Steam Concentration SBLOCA, Failed PRHR and CMTs

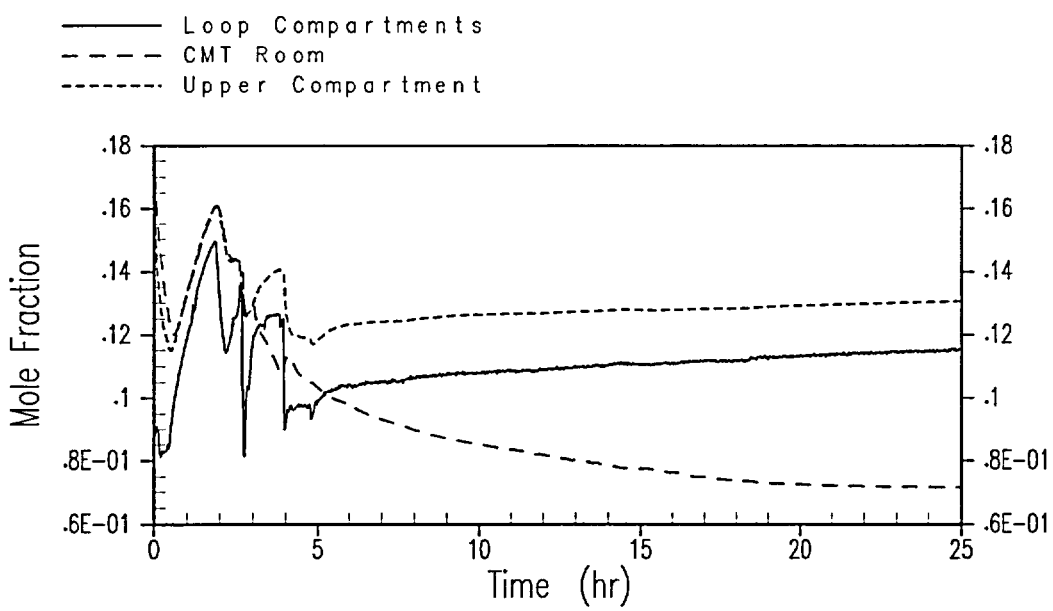

Figure 41A-350

Case 1AP-3: Well-Mixed Compartment Oxygen Concentration SBLOCA, Failed PRHR and CMTs

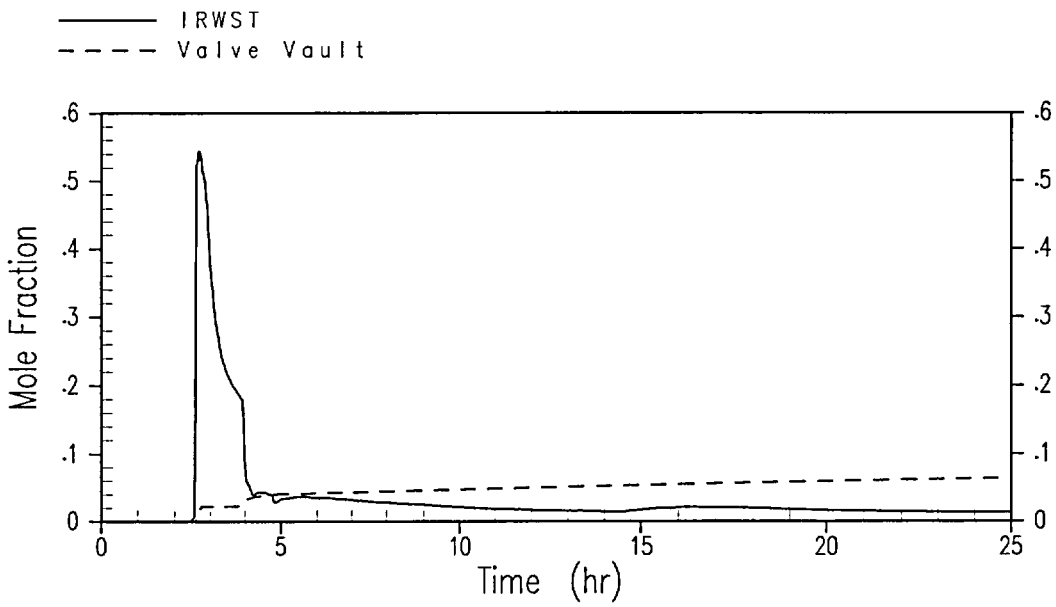

Figure 41A-351

Case 1AP-3: Confined Compartment Hydrogen Concentration SBLOCA, Failed PRHR and CMTs

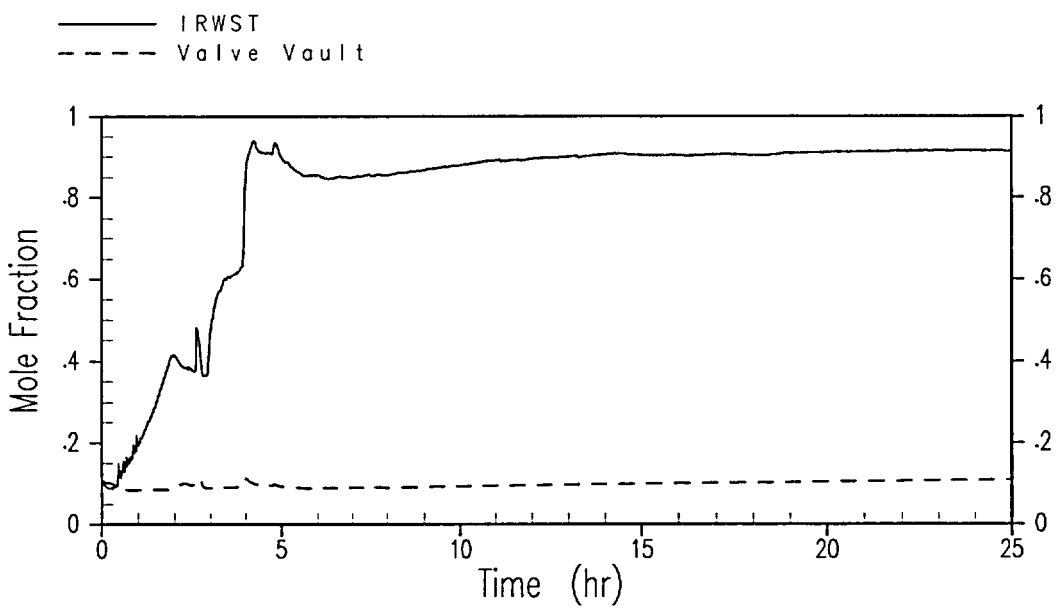

Figure 41A-352

Case 1AP-3: Confined Compartment Steam Concentration SBLOCA, Failed PRHR and CMTs

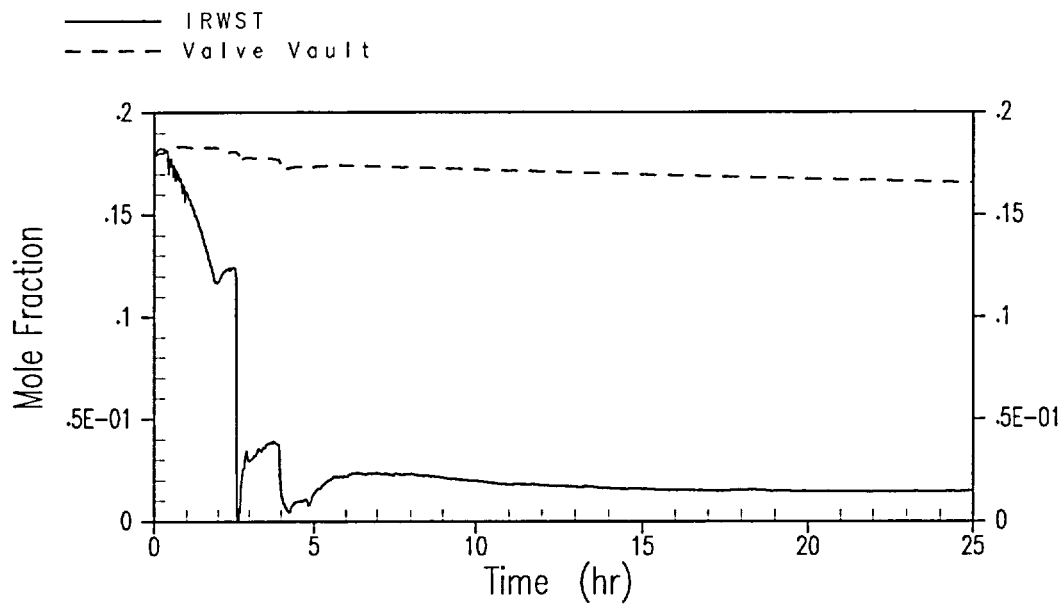

Figure 41A-353

Case 1AP-3: Confined Compartment Oxygen Concentration SBLOCA, Failed PRHR and CMTs

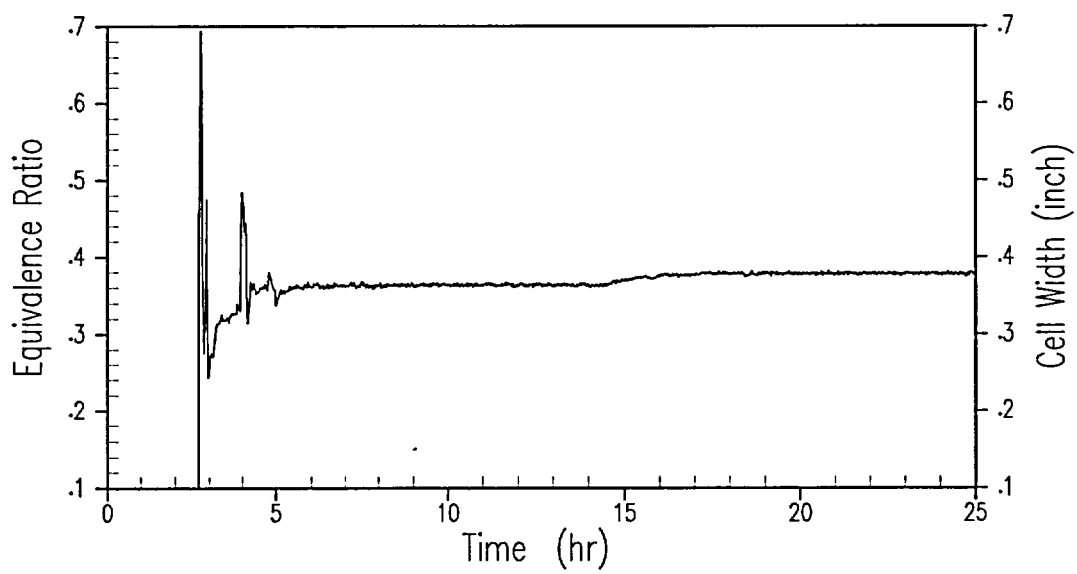

Figure 41A-354

Case 1AP-3: Equivalence Ratio in SG Room SBLOCA, Failed PRHR and CMTs

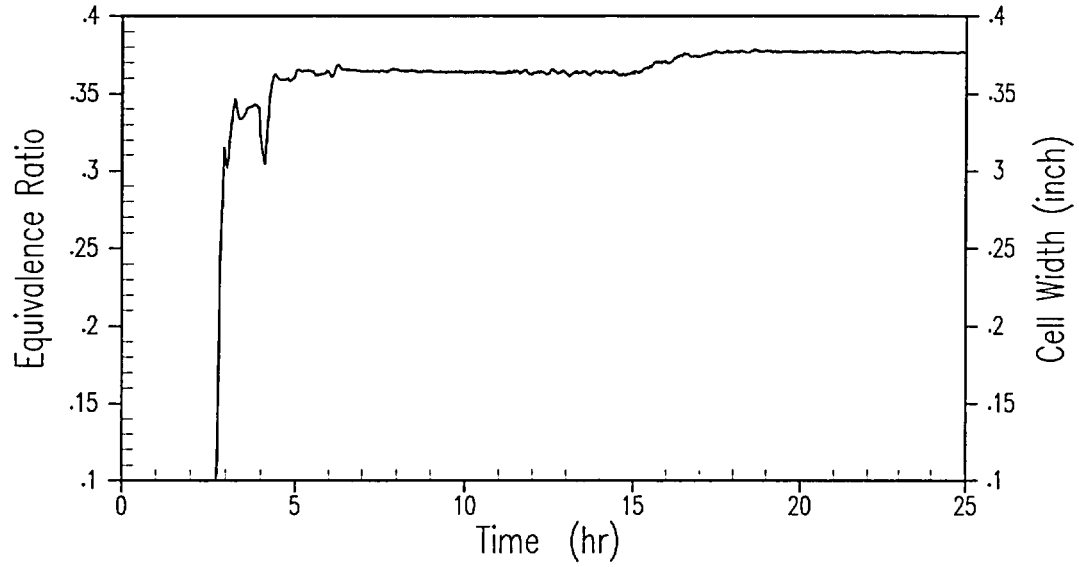

Figure 41A-355

Case 1AP-3: Equivalence Ratio in CMT Room SBLOCA, Failed PRHR and CMTs

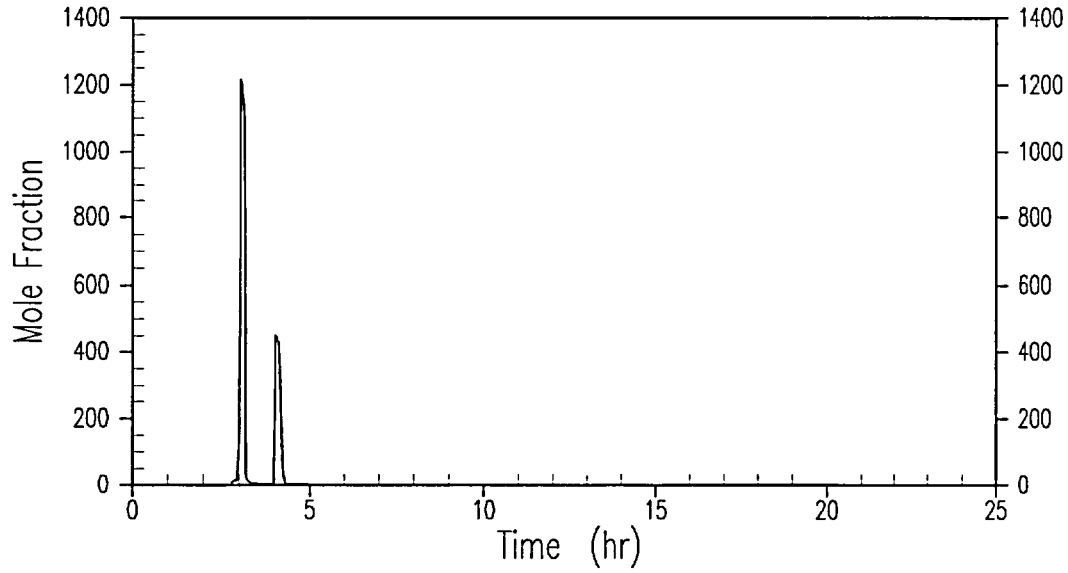

Figure 41A-356

Case 1AP-3: Equivalence Ratio in IRWST SBLOCA, Failed PRHR and CMTs

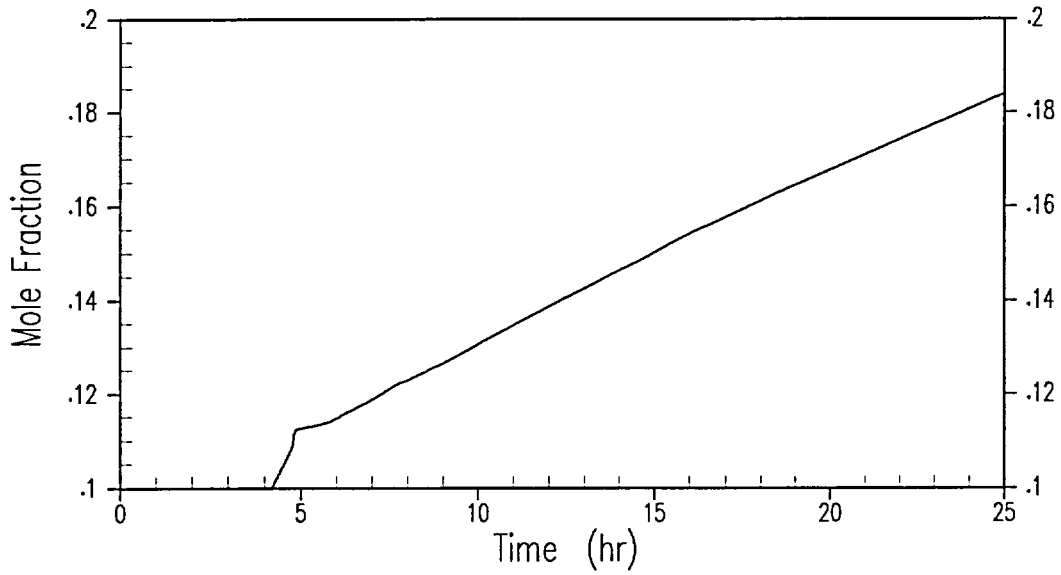

Figure 41A-357

Case 1AP-3: Equivalence Ratio in PXS SBLOCA, Failed PRHR and CMTs

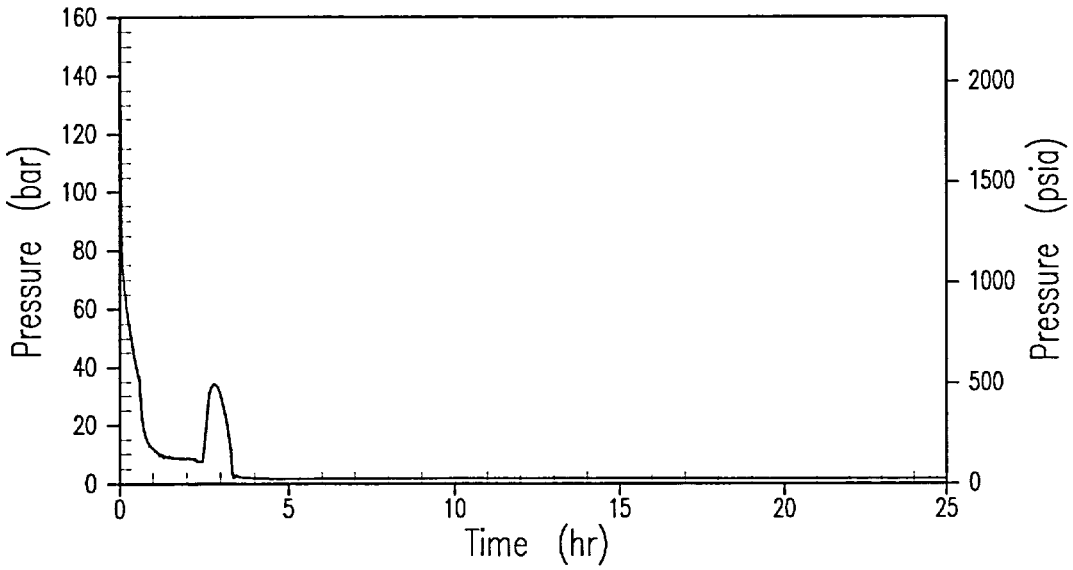

Figure 41A-358

Case 1AP-4: Reactor Coolant System Pressure SBLOCA with Failed PRHR and ADS

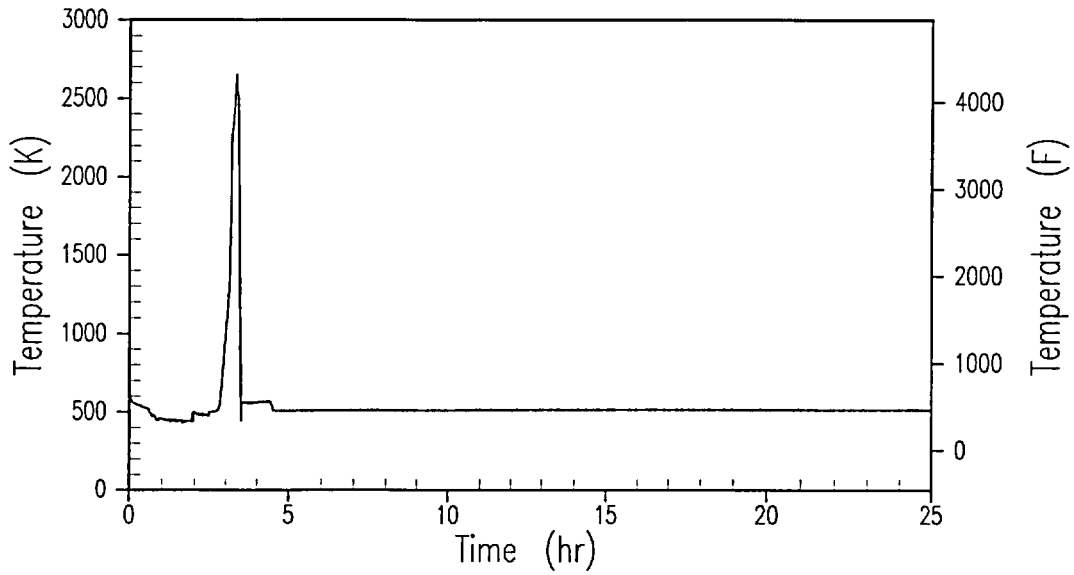

Figure 41A-359

Case 1AP-4: Core-Exit Gas Temperature SBLOCA with Failed PRHR and ADS

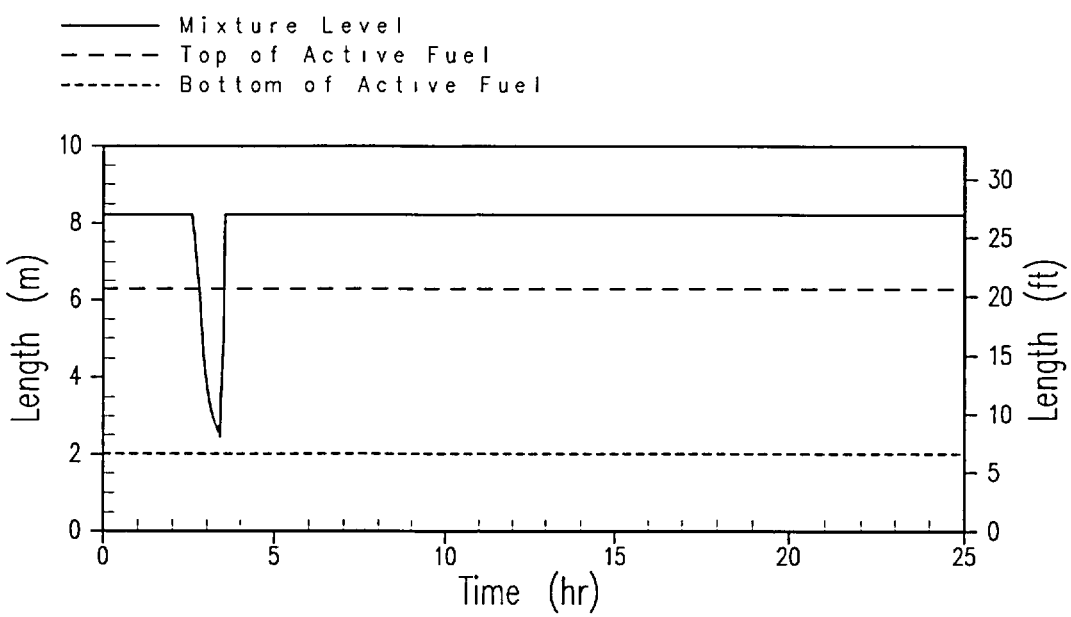

Figure 41A-360

Case 1AP-4: Reactor Vessel Mixture Level SBLOCA with Failed PRHR and ADS

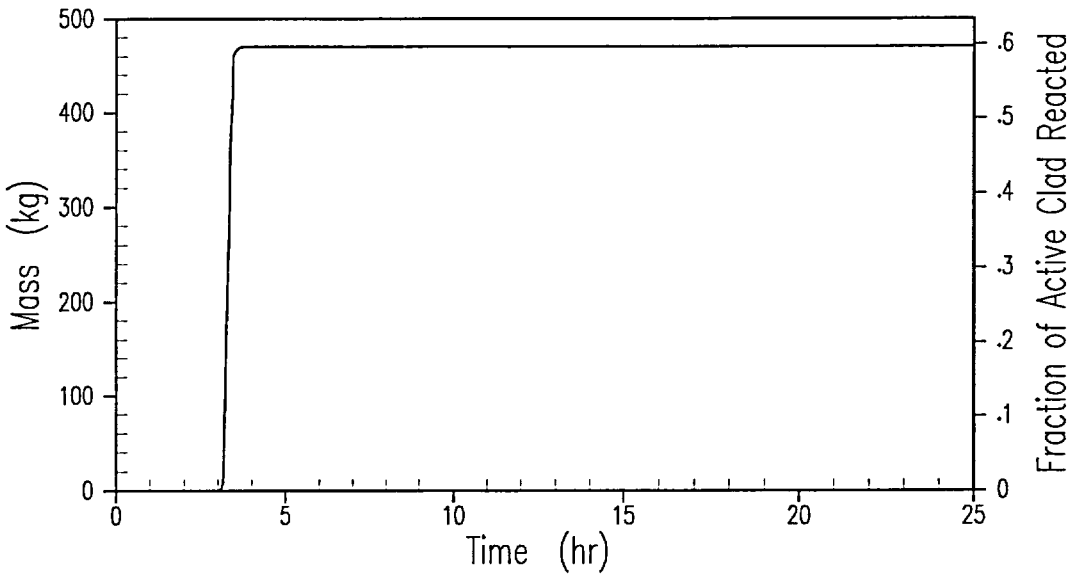

Figure 41A-361

Case 1AP-4: Hydrogen Generated In-Vessel SBLOCA with Failed PRHR and ADS

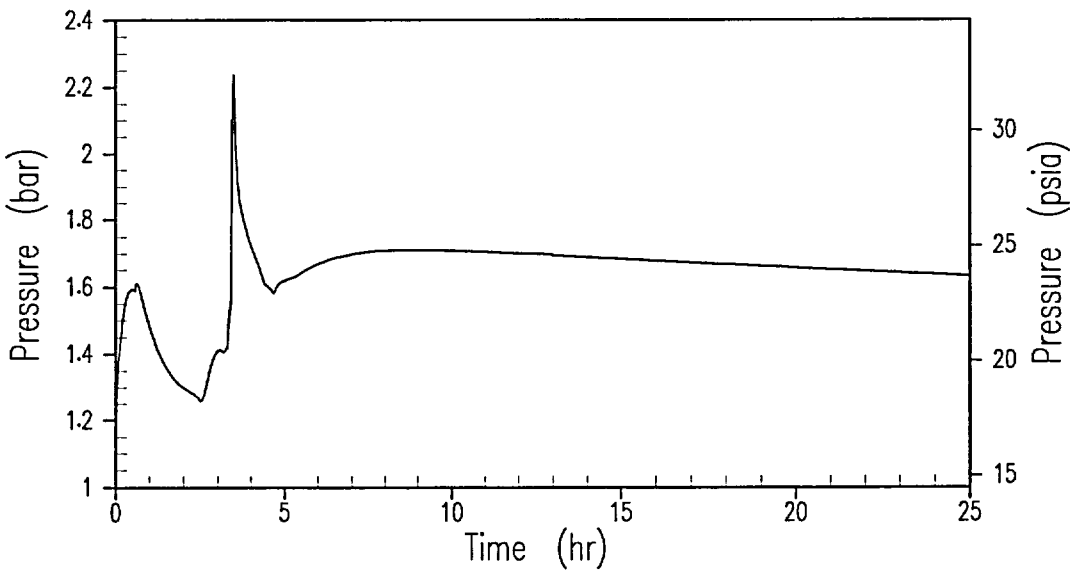

Figure 41A-362

Case 1AP-4: Containment Pressure SBLOCA with Failed PRHR and ADS

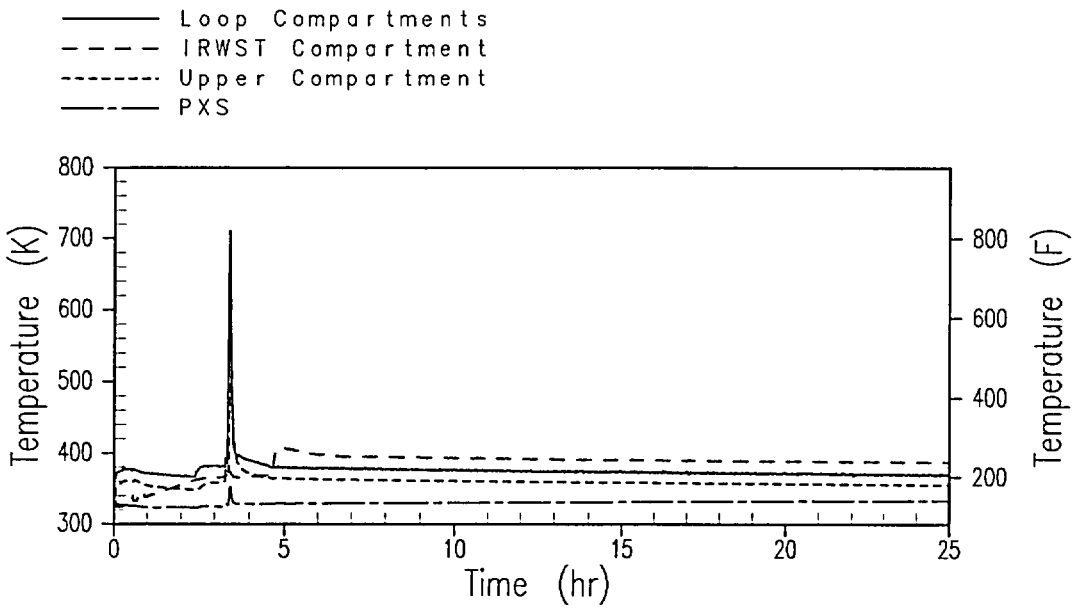

Figure 41A-363

Case 1AP-4: Containment Gas Temperature SBLOCA with Failed PRHR and ADS

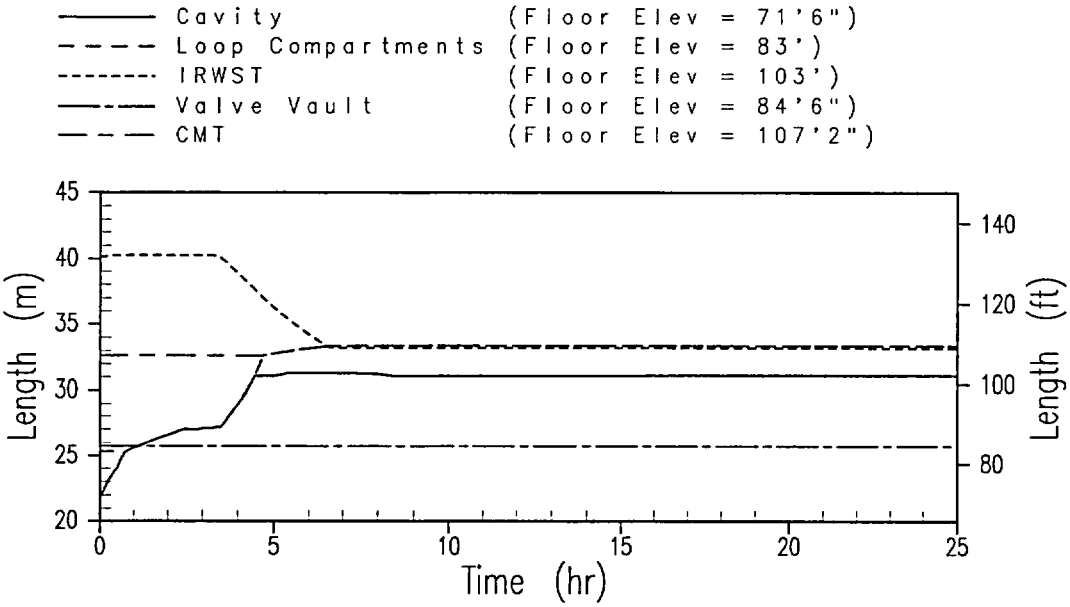

Figure 41A-364

Case 1AP-4: Containment Compartments Water Level SBLOCA with Failed PRHR and ADS

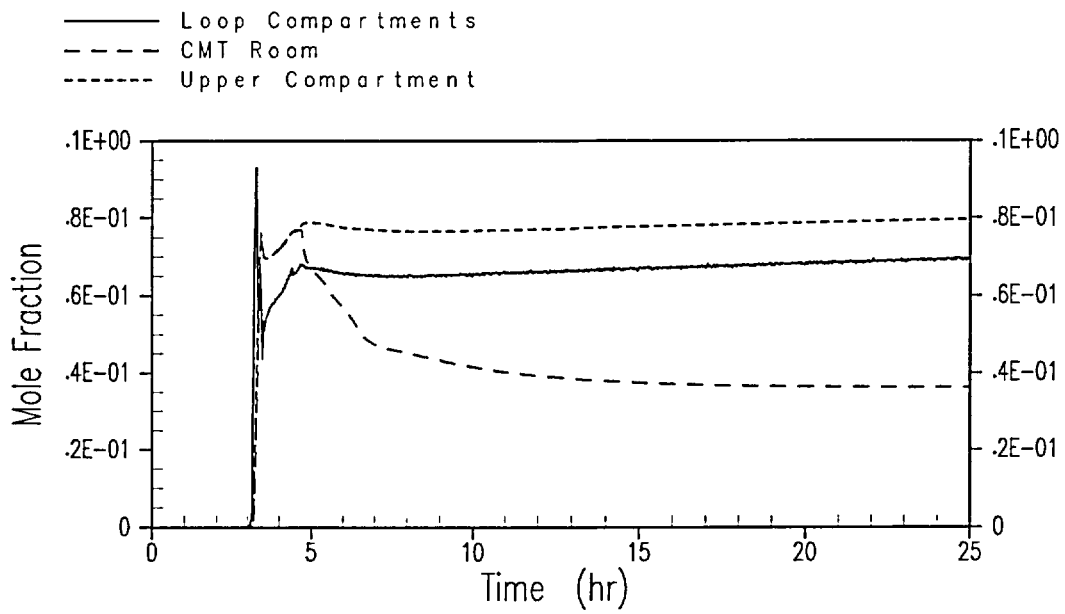

Figure 41A-365

Case 1AP-4: Well-Mixed Compartment Hydrogen Concentration SBLOCA with Failed PRHR and ADS

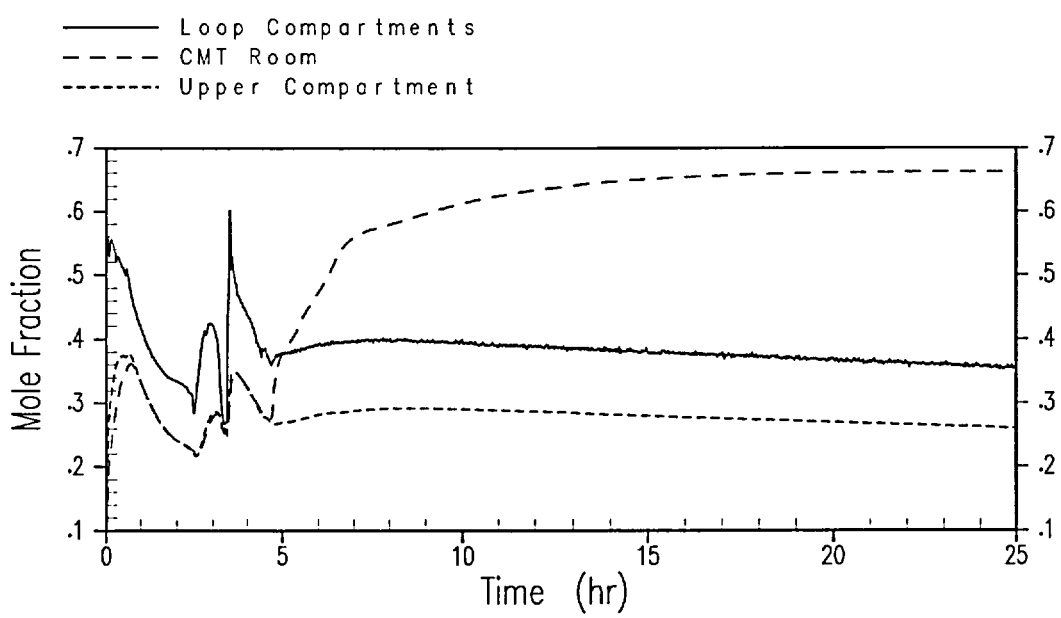

Figure 41A-366

Case 1AP-4: Well-Mixed Compartment Steam Concentration SBLOCA with Failed PRHR and ADS

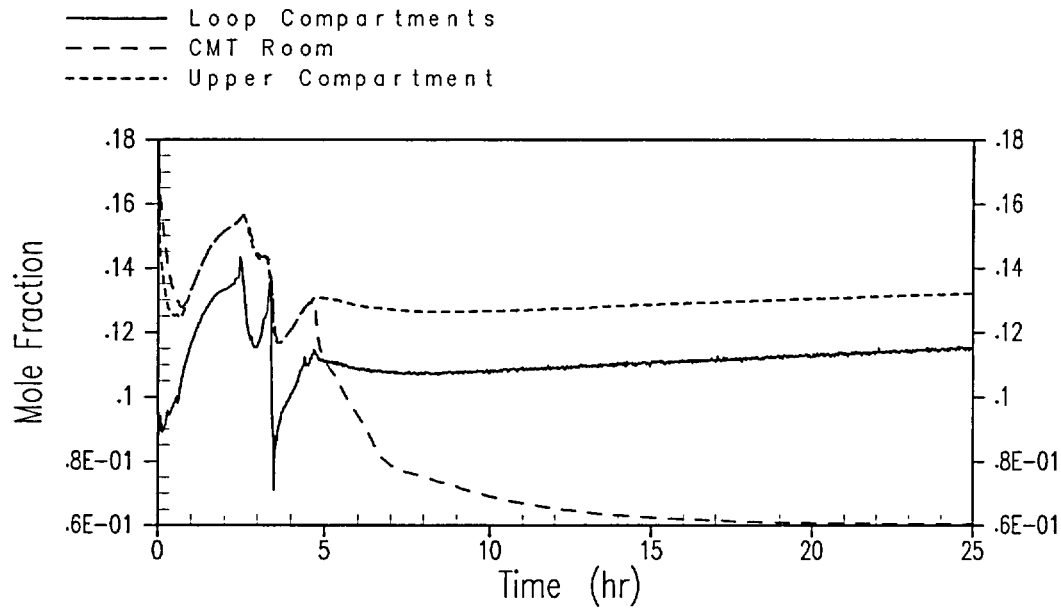

Figure 41A-367

Case 1AP-4: Well-Mixed Compartment Oxygen Concentration SBLOCA with Failed PRHR and ADS

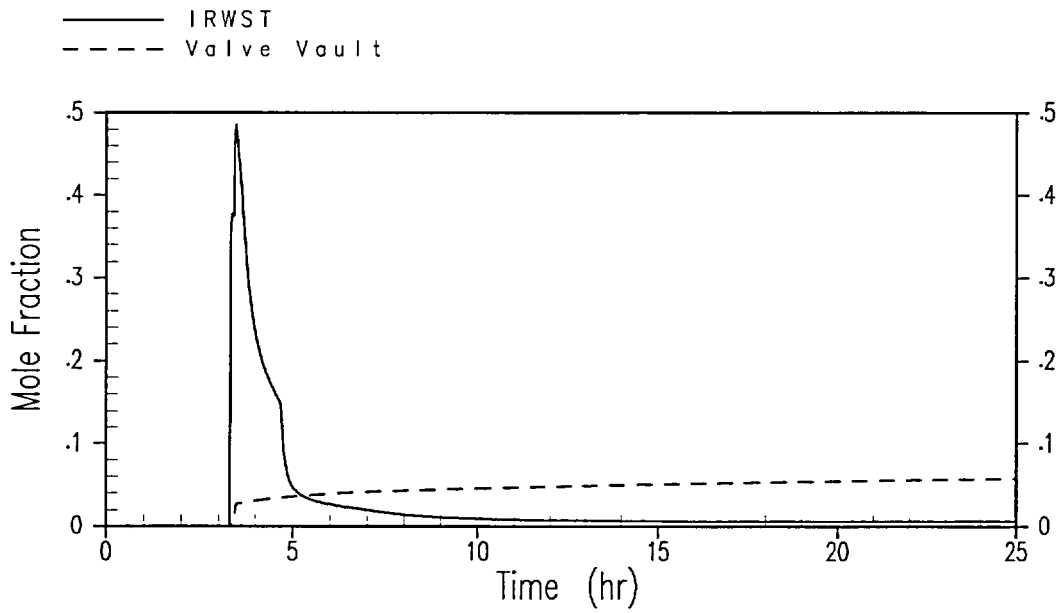

Figure 41A-368

Case 1AP-4: Confined Compartment Hydrogen Concentration SBLOCA with Failed PRHR and ADS

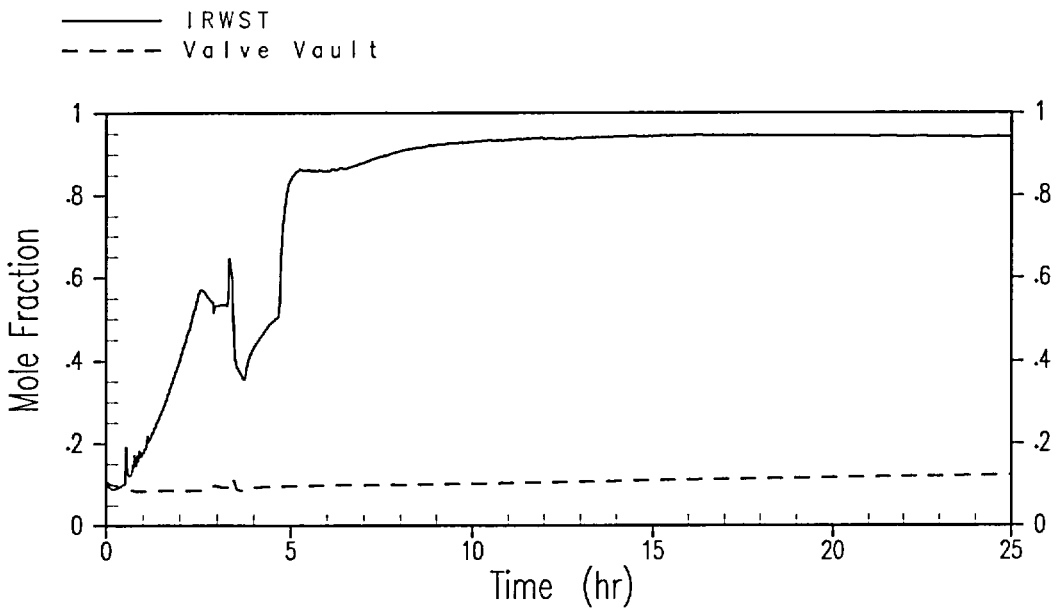

Figure 41A-369

Case 1AP-4: Confined Compartment Steam Concentration SBLOCA with Failed PRHR and ADS

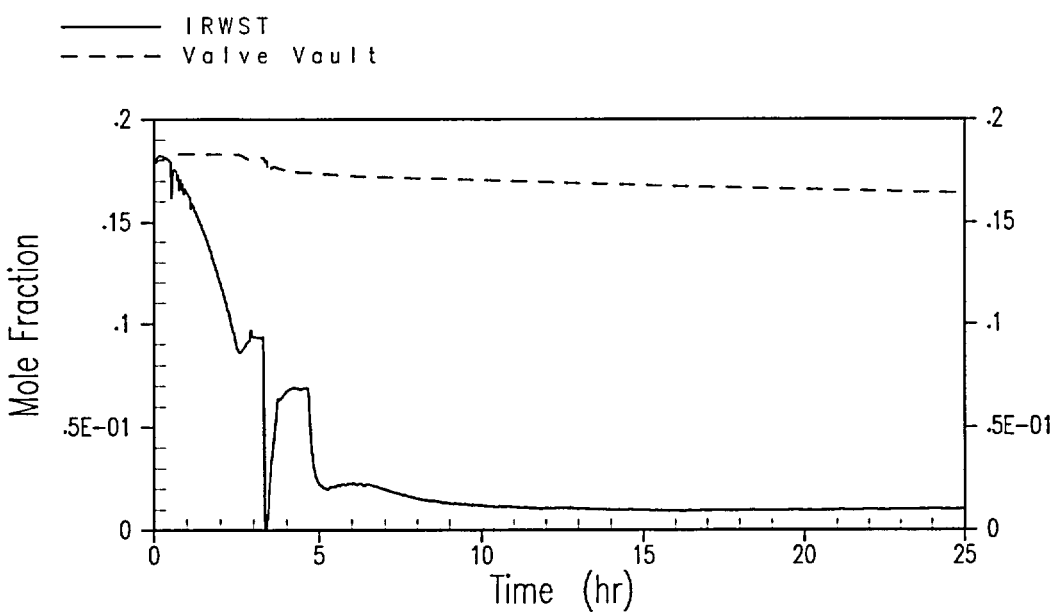

Figure 41A-370

Case 1AP-4: Confined Compartment Oxygen Concentration SBLOCA with Failed PRHR and ADS

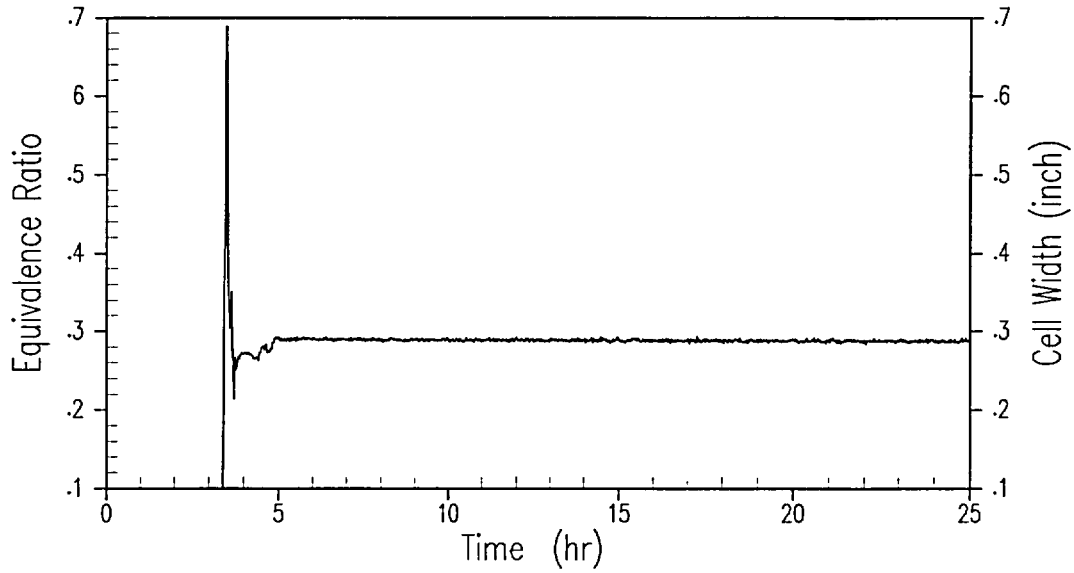

Figure 41A-371

Case 1AP-4: Equivalence Ratio in SG Room SBLOCA with Failed PRHR and ADS

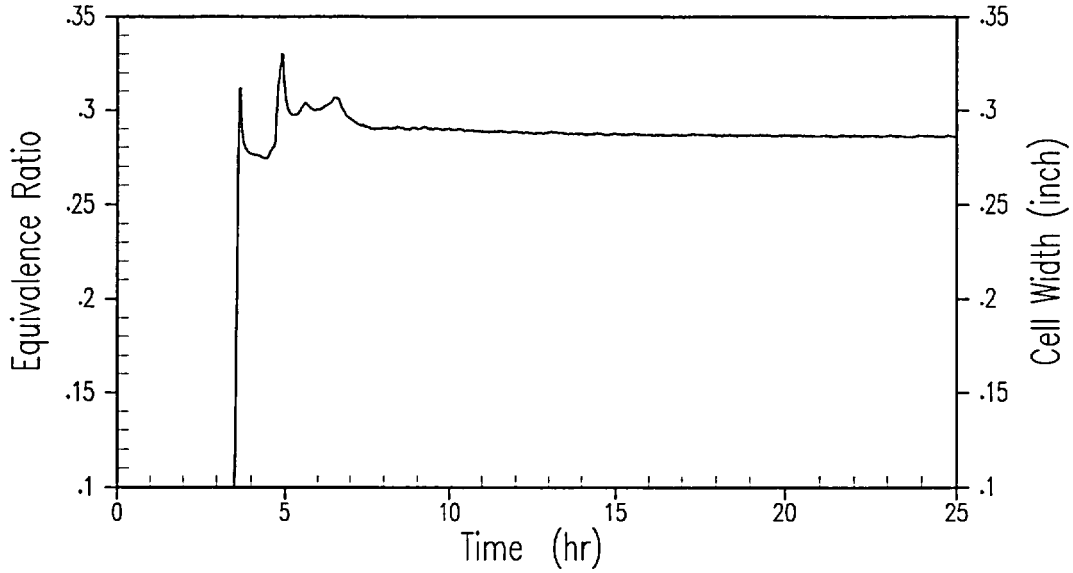

Figure 41A-372

Case 1AP-4: Equivalence Ratio in CMT Room SBLOCA with Failed PRHR and ADS

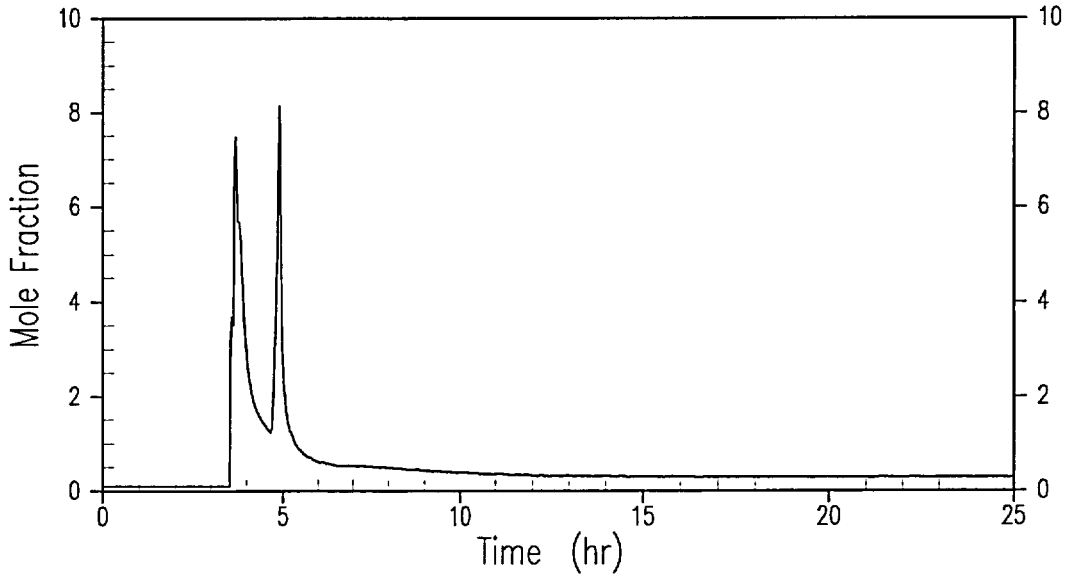

Figure 41A-373

Case 1AP-4: Equivalence Ratio in IRWST SBLOCA with Failed PRHR and ADS

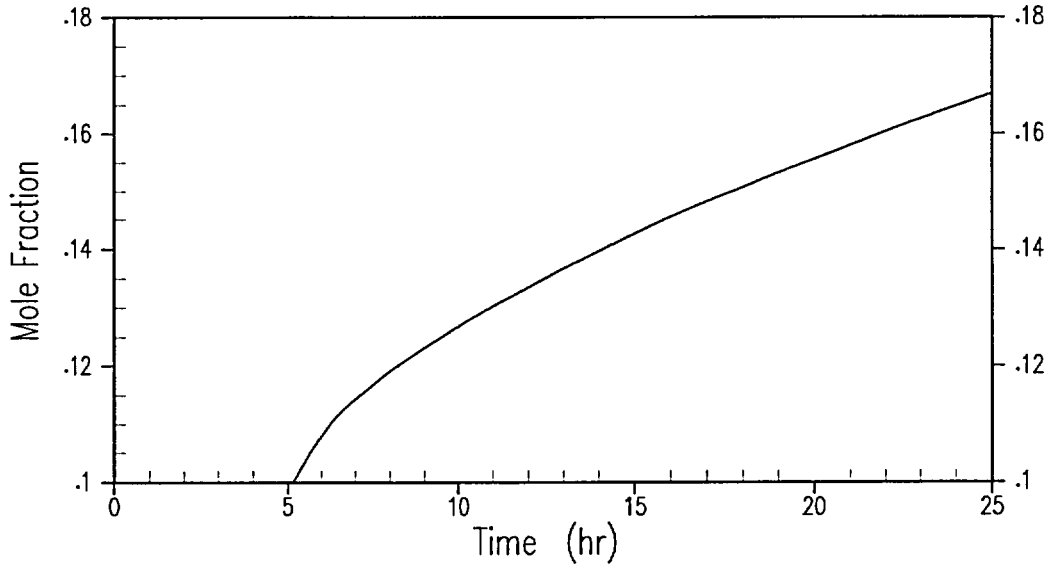

Figure 41A-374

Case 1AP-4: Equivalence Ratio in PXS SBLOCA with Failed PRHR and ADS

ATTACHMENT 41B

ANALYSIS OF HYDROGEN BURNING AT IGNITERS

This section demonstrates the effectiveness of the AP1000 hydrogen igniter system as placed in the passive containment geometry (subsection 6.2.4 of the DCD). The AP1000 containment has 64 igniters. Below the operating deck and inside the steam generator doghouses, the igniters are placed as in the AP600. Above the operating deck, in the upper compartment, the AP1000 has the same number of igniters as the AP600, but they have been redistributed to provide appropriate coverage given the taller containment shell. Igniters located in the IRWST, PXS and CVS compartments, CMT room, and various elevations in the upper compartment provide coverage for hydrogen that may be released through the IRWST, through the PXS/CVS, or in the CMT room.

The igniter system maintains the global uniform hydrogen concentration in the containment at or below lower flammability limits. In the most likely severe accidents, the hydrogen is burned primarily in a favorable location that protects the integrity of the containment and mitigative and monitoring equipment.

One MAAP4 igniter burning case is presented. The case is considered to be bounding as it releases hydrogen to the containment at an artificially rapid rate (~300 kg/min) to tax the igniter performance. Typical hydrogen release rates during a reflooded case are expected to be on the order of 100 kg/min. The case is initiated by a large loss-of-coolant accident with failure of accumulators. The core uncovers during the blowdown, and gravity injection is unable to recover it before it overheats. The accident produces 100-percent cladding reaction, much of it generated during reflooding. The reactor coolant system is depressurized before hydrogen generation. Hydrogen is released to the containment through the break as it is generated in the core.

Burning at Igniters Results and Conclusions

The MAAP4 results are presented in Figures 41B-1 through 41B-17. The reactor coolant system is depressurized (Figure 41B-1) by the break, and the core uncovers early in the accident (Figures 41B-2 and 41B-3) and is reflooded. Decay heat is high early in the accident, and the cladding is overheated at the time of the reflood. Hydrogen is produced rapidly early in the accident with some residual oxidation occurring over time (Figure 41B-4). Burning at the igniters is evident from the fluctuations in the containment pressure and temperature (Figures 41B-5 and 41B-6).

The results show that the igniters keep the overall hydrogen concentration at the lower flammability limit (Figure 41B-7), except during the large release of hydrogen and steam into the loop compartment (Figure 41B-8) before the containment mixes. During this time, the gas concentrations (Figures 41B-9, 41B-10, and 41B-11) in the loop compartment will not support combustion in this compartment. As the containment begins to mix, the loop compartment mixture becomes flammable. The steam concentration is high and the minimum detonation cell width (Figure 41B-12) in the loop compartment is large at the time when the hydrogen concentration is greater than 10 percent and the compartment is predicted to be

flammable. Therefore, there is no potential for detonation in the loop compartment during the mixing.

Hydrogen is released directly into the IRWST (Figure 41B-14) after the water level in the compartment (Figure 41B-13) drops low enough to allow flow from the pressurizer through to the spargers. The hydrogen concentration in the IRWST (Figure 41B-15) is never predicted to exceed 6 percent.

The hydrogen igniters effectively control the containment hydrogen concentration for this bounding hydrogen release case.

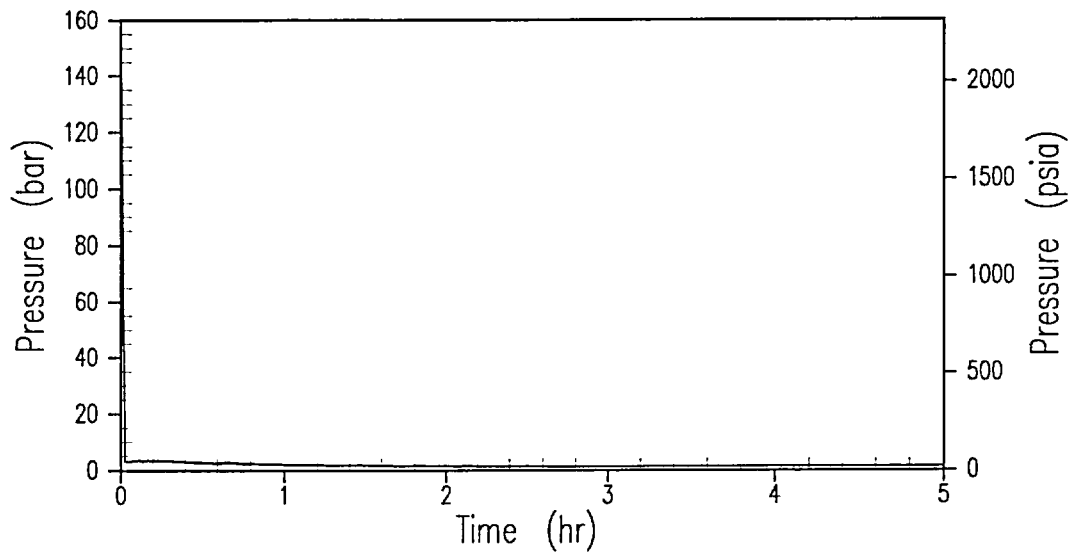

Figure 41B-1

Case 3BR – LLOCA with Accumulator Failure
Reactor Coolant System Pressure

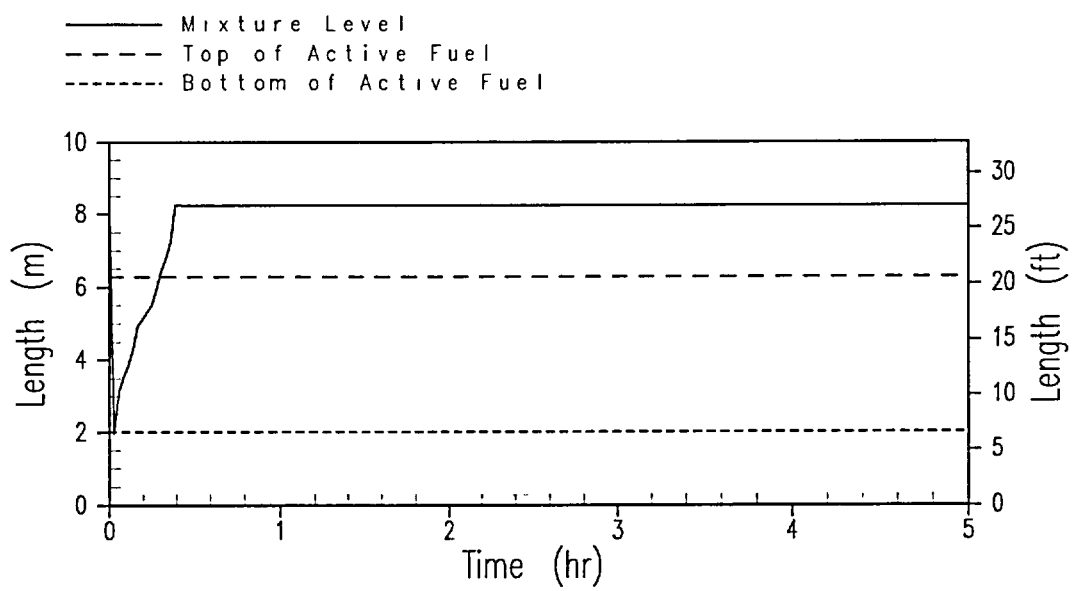

Figure 41B-2

Case 3BR – LLOCA with Accumulator Failure
Reactor Vessel Mixture Level

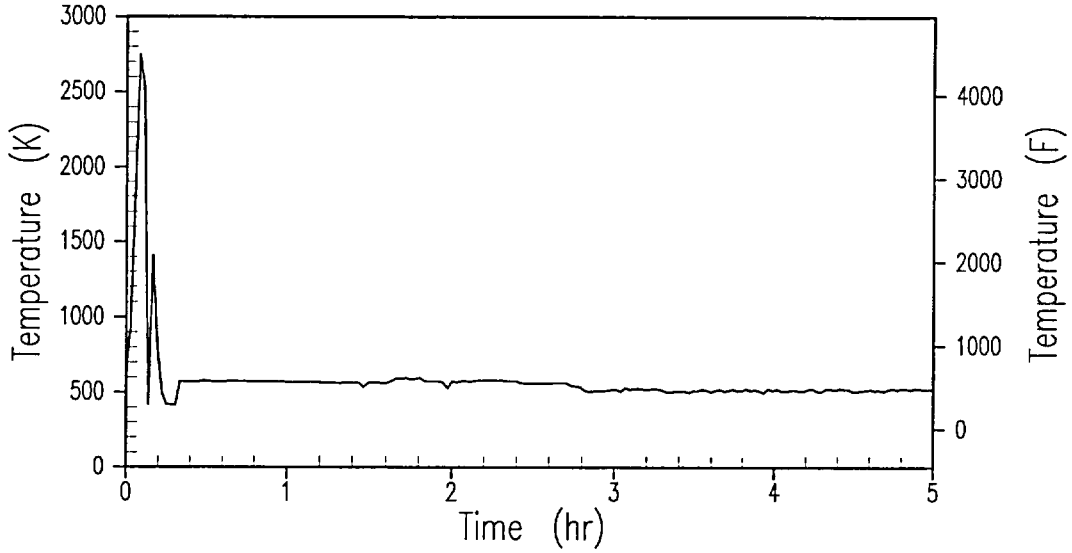

Figure 41B-3

Case 3BR – LLOCA with Accumulator Failure
Core-Exit Gas Temperature

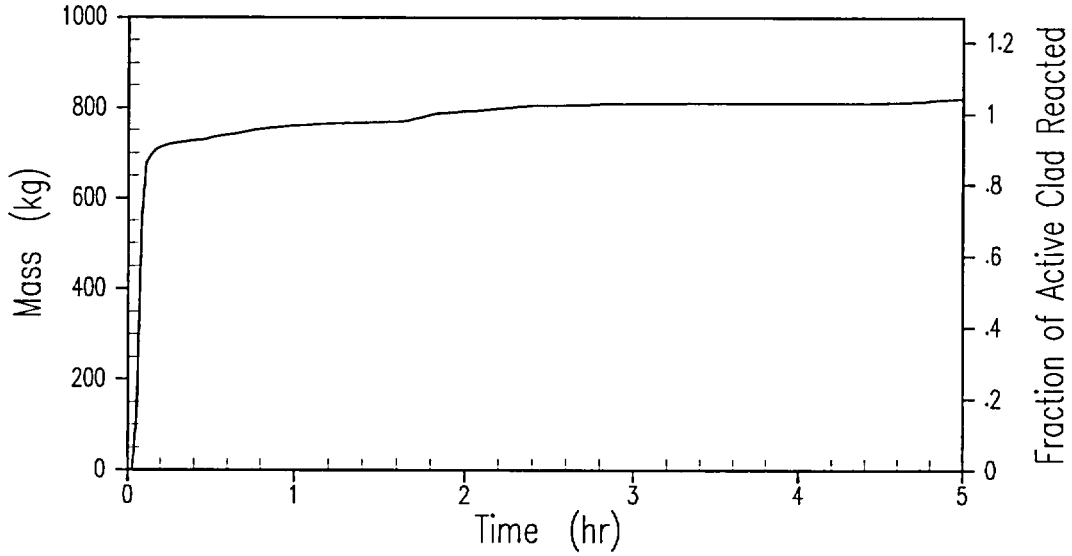

Figure 41B-4

Case 3BR – LLOCA with Accumulator Failure
Hydrogen Generated In-Vessel

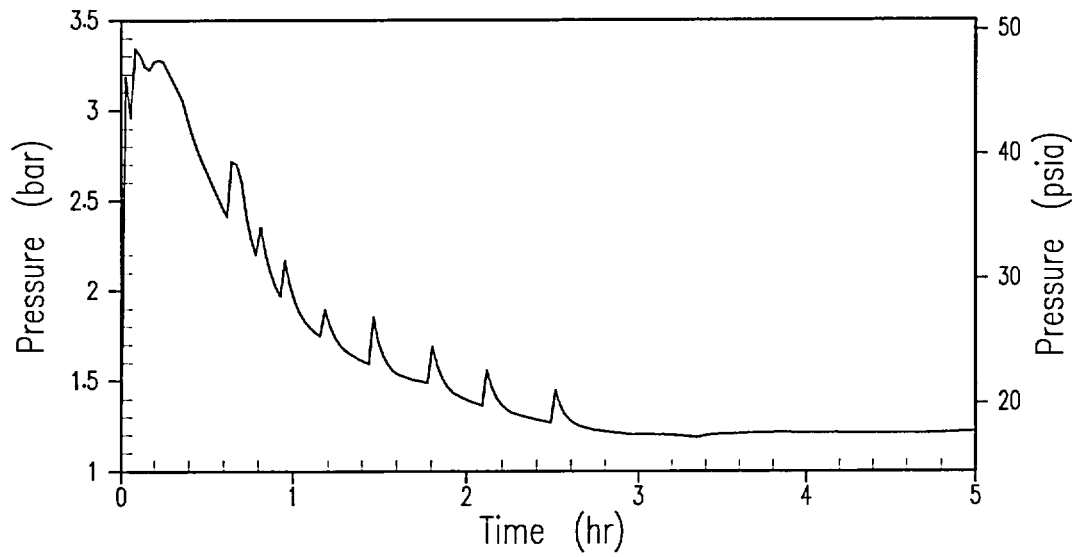

Figure 41B-5

Case 3BR – LLOCA with Accumulator Failure Containment Pressure

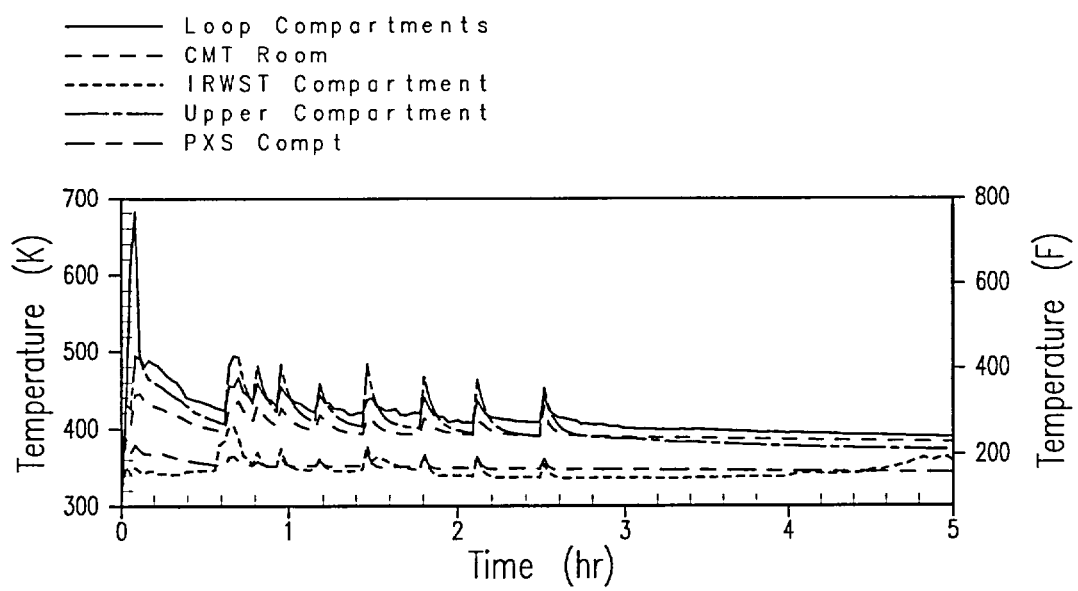

Figure 41B-6

Case 3BR – LLOCA with Accumulator Failure Containment Gas Temperature

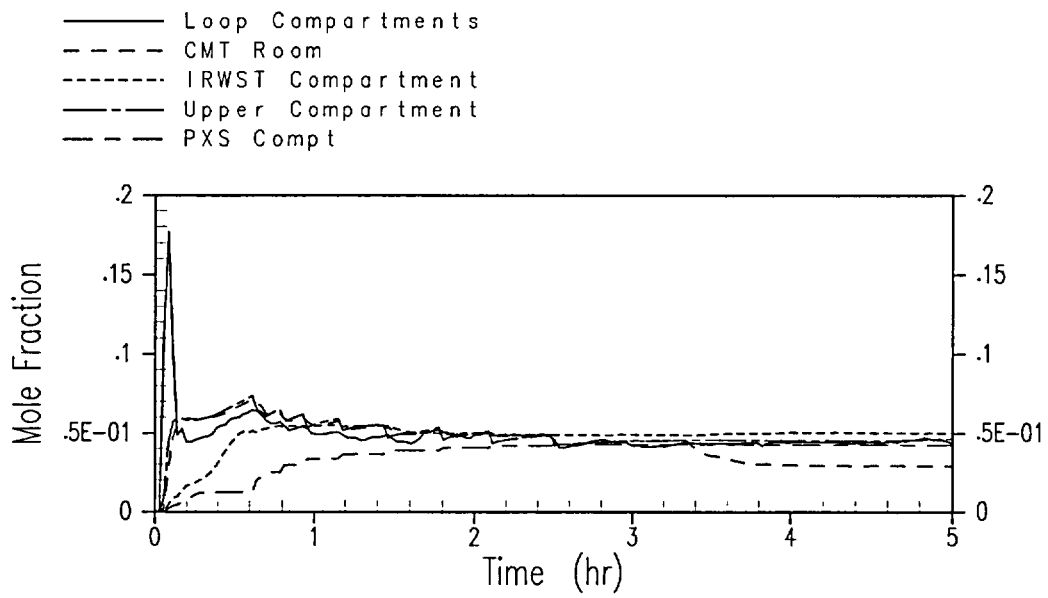

Figure 41B-7

Case 3BR – LLOCA with Accumulator Failure
Containment Compartment Hydrogen Concentration

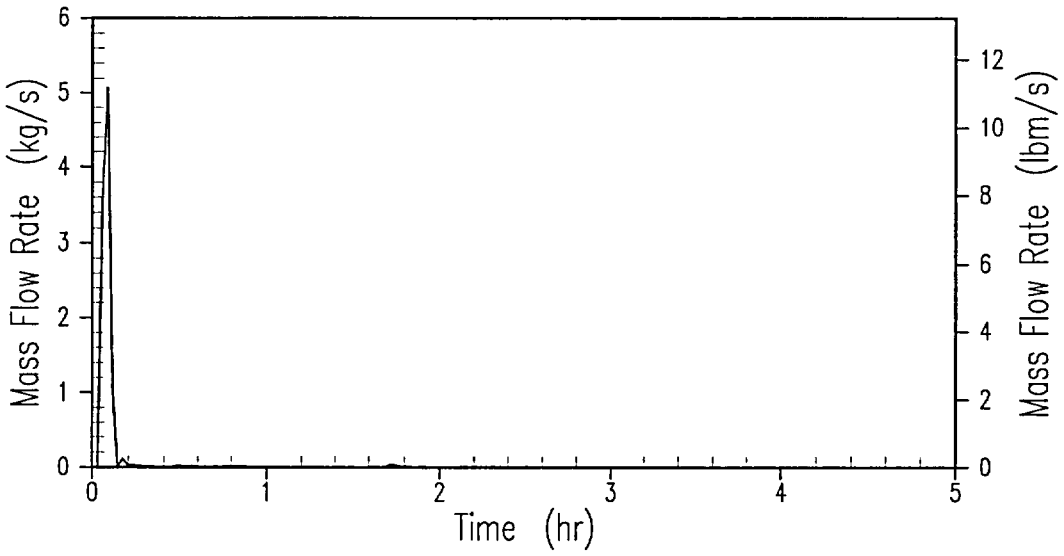

Figure 41B-8

Case 3BR – LLOCA with Accumulator Failure
Hydrogen Flow Rate Through Break

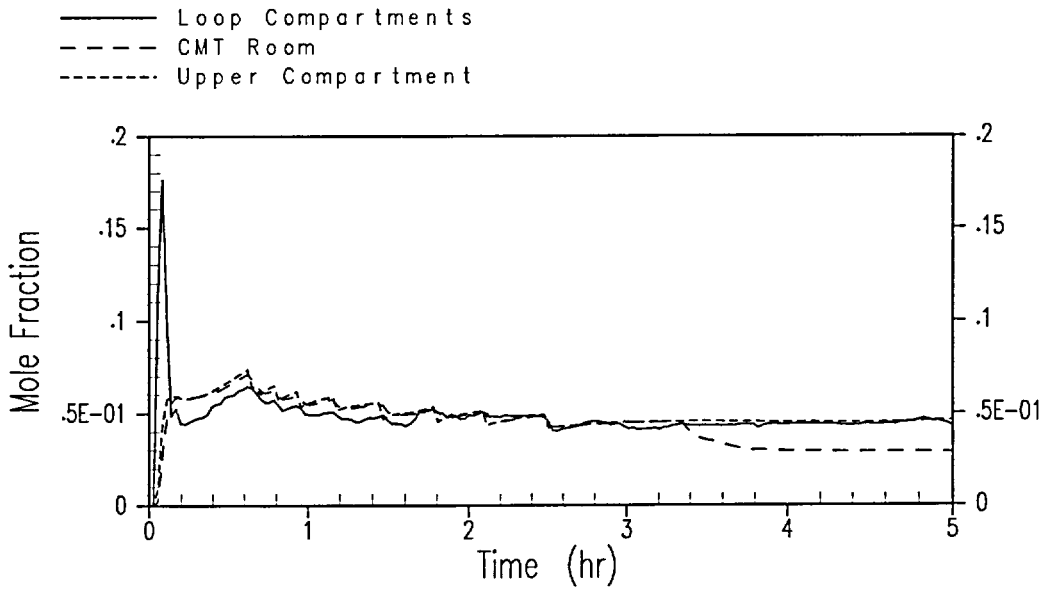

Figure 41B-9

Case 3BR – LLOCA with Accumulator Failure
Well-Mixed Compartment Hydrogen Concentration

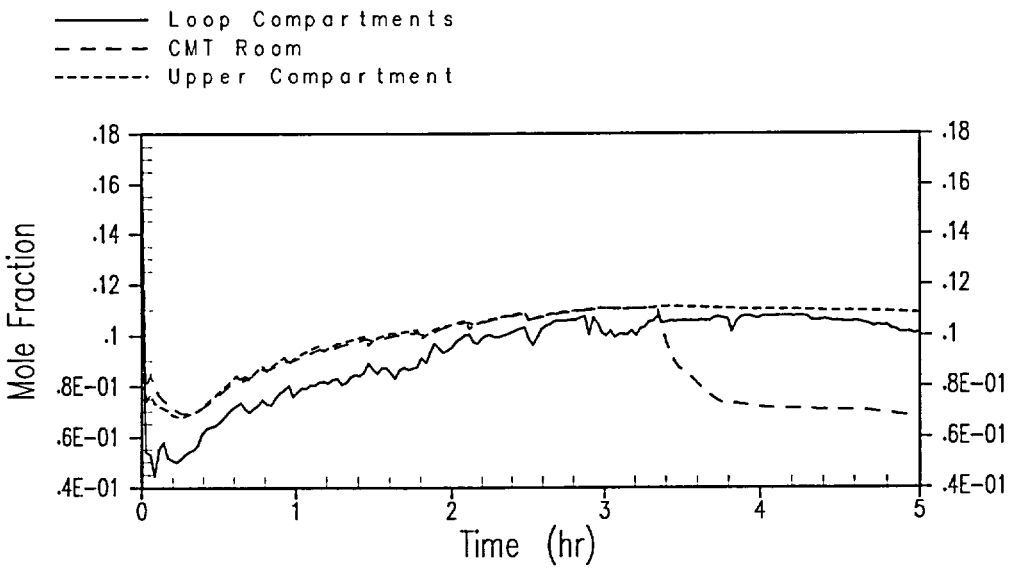

Figure 41B-10

Case 3BR – LLOCA with Accumulator Failure
Well-Mixed Compartment Oxygen Concentration

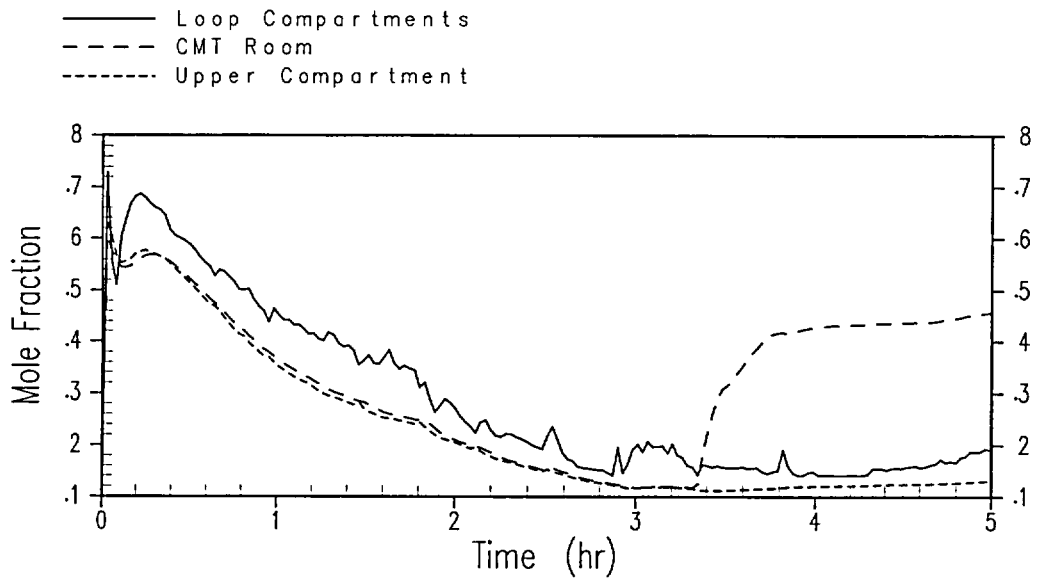

Figure 41B-11

Case 3BR – LLOCA with Accumulator Failure
Well-Mixed Compartment Steam Concentration

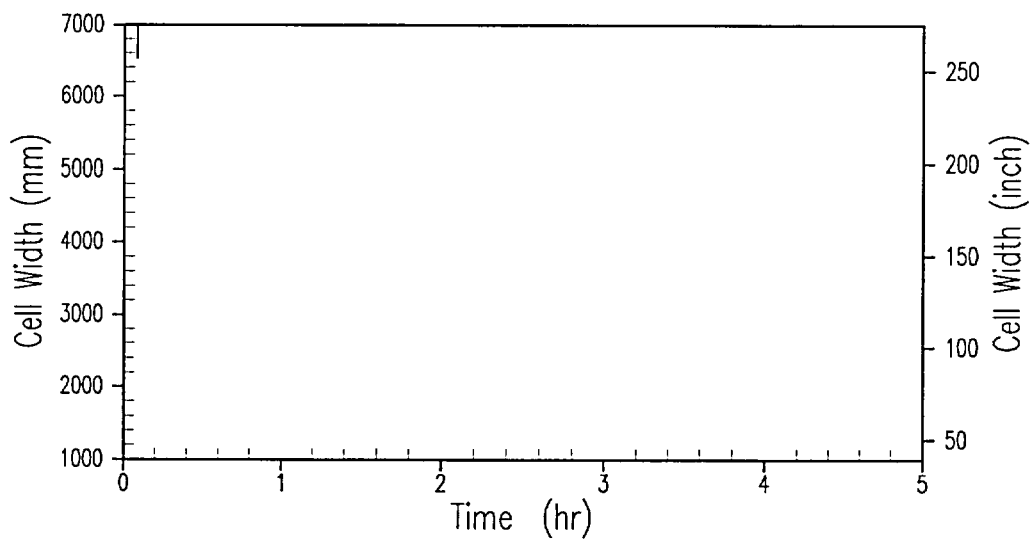

Figure 41B-12

Case 3BR – LLOCA with Accumulator Failure
Approximate Detonation Cell Width in Steam Generator Compartment

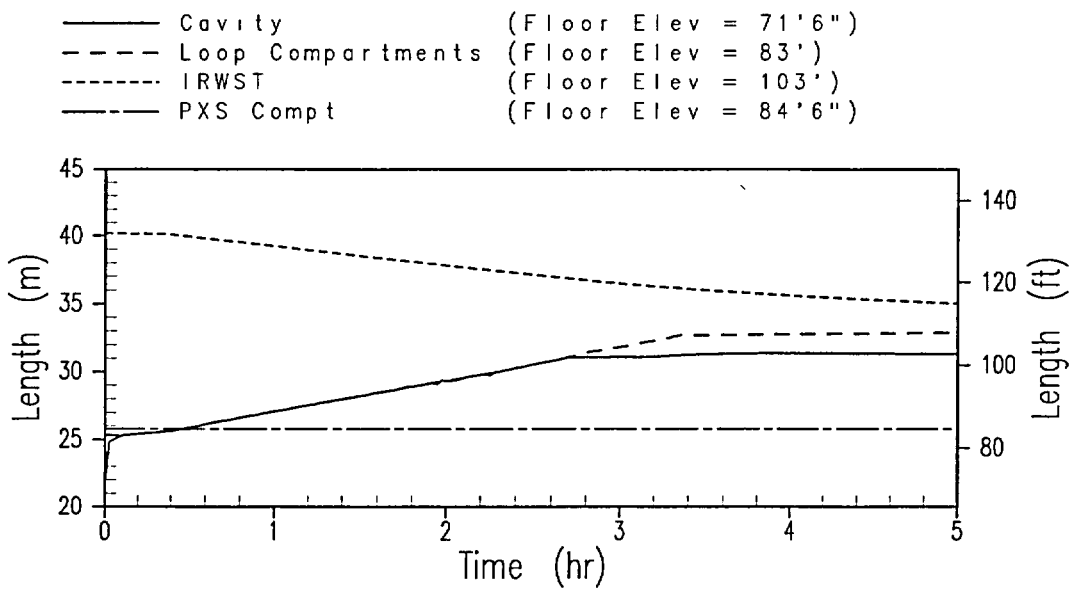

Figure 41B-13

Case 3BR – LLOCA with Accumulator Failure Containment Compartments Water Level

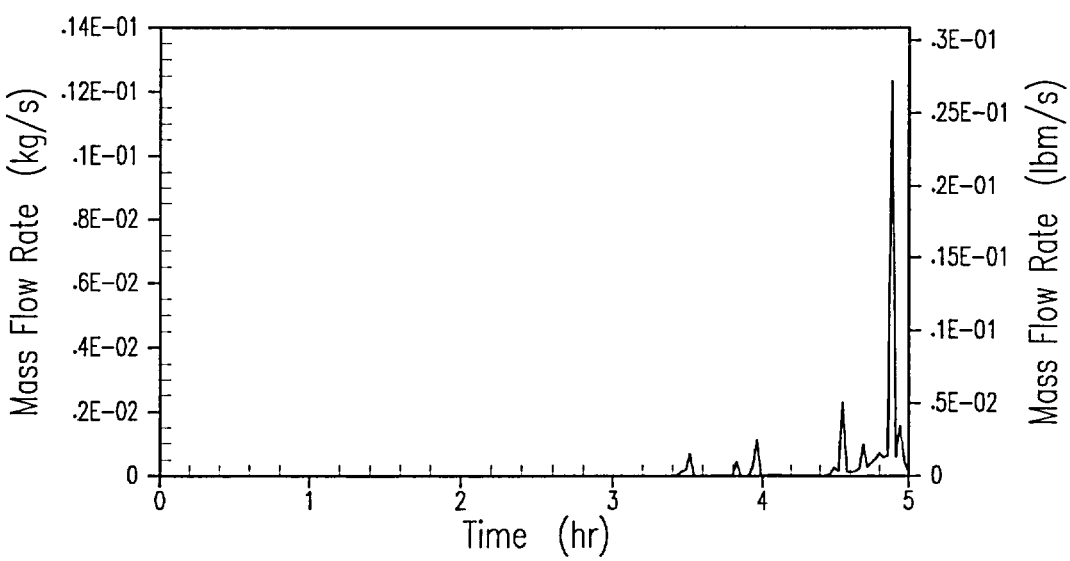

Figure 41B-14

Case 3BR – LLOCA with Accumulator Failure Hydrogen Flow Rate Through ADS to IRWST

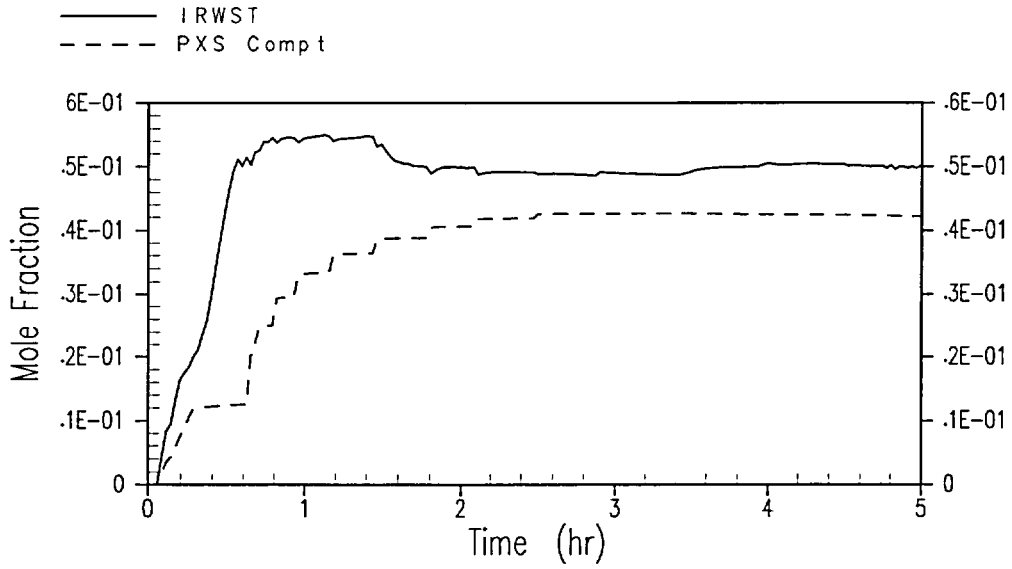

Figure 41B-15

Case 3BR – LLOCA with Accumulator Failure Confined Compartment Hydrogen Concentration

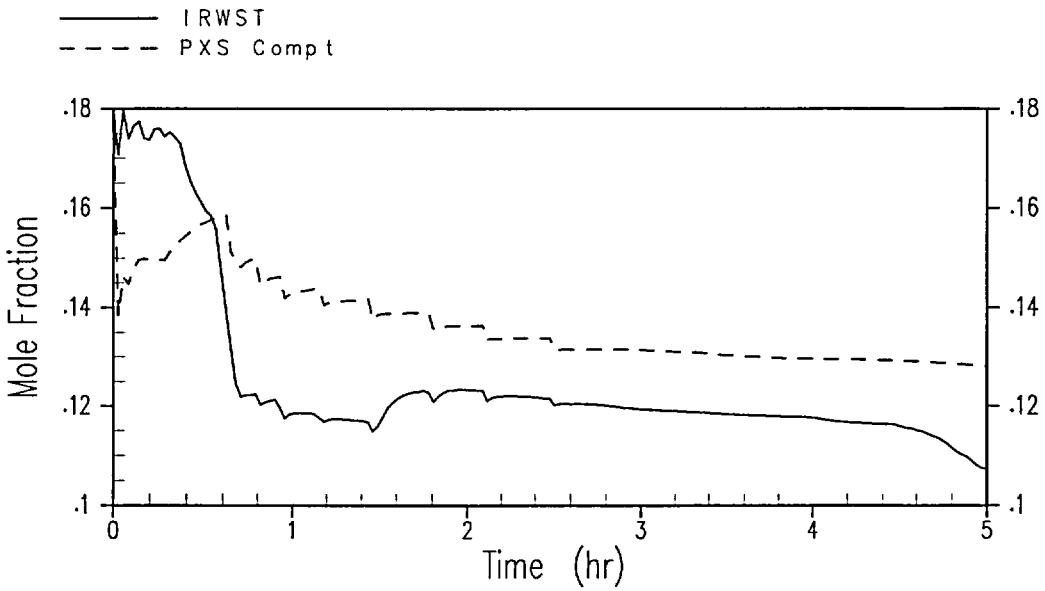

Figure 41B-16

Case 3BR – LLOCA with Accumulator Failure Confined Compartment Oxygen Concentration

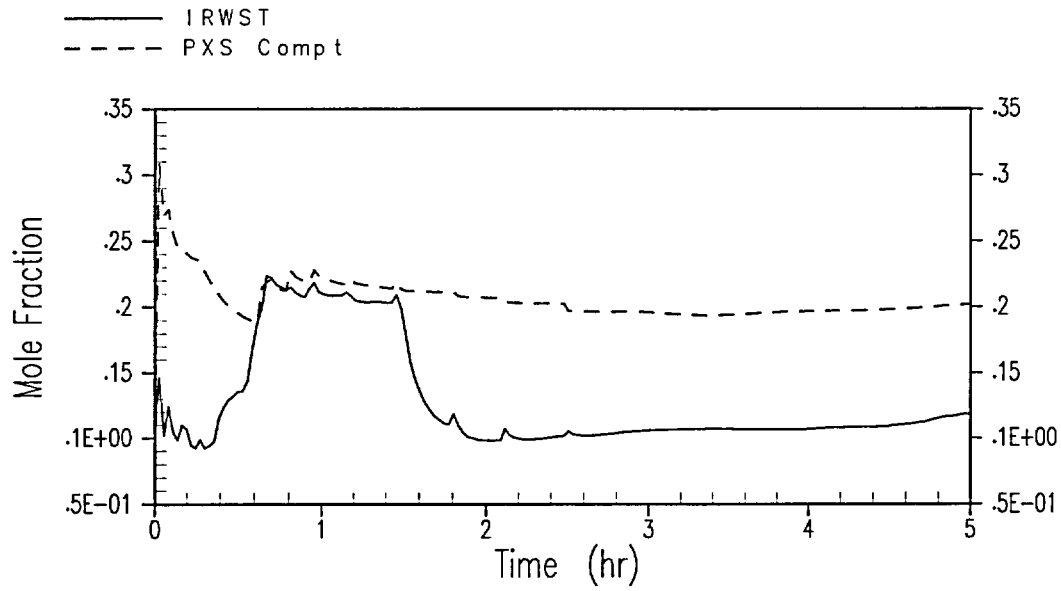

Figure 41B-17

Case 3BR – LLOCA with Accumulator Failure Confined Compartment Steam Concentration