

A Preliminary Analysis on the Fission Product Release Behavior Following a LOCA for Korean Standard Nuclear Power Plants

19

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56-1

NUREG- 1465

가

가

LOCA

MELCOR (Version 1.8.4)

NUREG- 1465

, Te

가

, ECCS

가

Abstract

In order to provide a technical base for evaluation of the applicability of NUREG-1465 source term, which the domestic nuclear industry has tried to use for the KNGR design as well as other cases, postulated large break LOCA-induced core-melt scenarios, not accompanying recovery through core reflooding, have been analyzed for the KSNP. For this purpose the MELCOR code (Version 1.8.4) was used to estimate the characteristics and the quantity of fission product release. Sensitivity analysis for some parameters were done. Comparison of these results with the realistic source term showed that the durations of fission product release into containment during the design basis accident phases were longer than those of NUREG-1465 and the release fractions of alkali metals, halogens and the tellurium group were bigger than those of NUREG-1465. Further supporting calculations for this study and additional sensitivity analyses, e.g. for the accident sequences terminated by injection of ECCS, are required.

1.

(NUREG-1465) [5]

LOCA

MELCOR
가

(Version 1.8.4)[6]

가

LOCA

LOCA

[1,2]

2.

(160,000)

11

MELCOR

[3]

TLOFW, SBO, SBLOCA

(ISUP)

4

1

2

가
LOCA가
(7, 3.4
,
가
가(100) (0)
가
PSA LL 5)
(ESF)
가
ESF
2
가
441.2 kPa(g)
가

MELCOR Default . MELCOR 2,825 MWt PWR ORIGEN

13 NUREG-1465 8 가 가
1 MELCOR

CsI (12.161 kg) CsI (24.897 kg) Cs (144.626 kg)
(132.905/ 126.9044) Cs
Rb (157.362 kg) CsI

Section 5 , 가 ,
 1.0E-7 m, 5.0E-4 m , Default (1000 kg/m³) .
 Default .
 CORSOR . -
 Default 1173 K .
 NUREG- 1465 5% , Cs 5% , I(CsI) 5% 가 .

3.
 4 2 .
 NUREG- 1465 3 . 3 , ,
 () , ,
 , 4 7 . 8
 9 .
 가. , .
 - 3 3.9
 . Xe, Cs, CsI
 . 330 . 가 가
 5% . 가 가
 3,932 Te, Ba, Ce 가
 가 .
 3 0.1
 NUREG- 1465(0.5)
 (0.98) NUREG- 1465(1.3) .
 Surry(215) Sequoyah(73)
 [5] 가 .
 .
 3 8
 NUREG- 1465 . CsI
 (Cs), Te , Ba ,
 NUREG- 1465, App. B STCP .

4.
 가.
 . NUREG- 1465
 pellet Bulk 가 가

, Cs, I (5 %)
10 4 Case 3

900

Te Matrix

NUREG- 1465

NUREG- 1465

TLOFW

가 4 2가

(LB LOCA 100%)

(ISUP)

5

6

NUREG- 1465

NUREG- 1465

NUREG- 1465

ISUP

35%

가 NUREG- 1465

가 가

5

()

NUREG- 1465 (40 %)

5 100 %

890 970 ,
LOCA

15 35 %

23

NUREG- 1465

200 %

15

가

NUREG- 1465

가

5.

가 LOCA

DBA

, Te

NUREG- 1465

NUREG- 1465

가

, ECCS

가

가

, 가

가

DBA

가

NUREG- 1465

1. , : , KINS/AR-626, 1998. 12.
2. , 가, , , 1999. 12. 17.
3. , MELCOR , KAERI/TR-810/97, 1997. 2
4. , 3,4
5. L. Soffers et al., "Accident Source Terms for Light-Water Nuclear Power Plants," NUREG-1465, Final Report, U.S. Nuclear Regulatory Commission, February 1995.
6. R. O. Gauntt et al., "MELCOR Computer Code Manuals," (Sandia National Laboratories), SAND 97-2398, NUREG/CR-6119, Rev.1. July 1997.5
7. KEPCO, Ulchin Unit 3&4 Final Probabilistic Safety Assessment Report, Ch.4.

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						(kg)
Xe	XE 261.801	KR 205.500				282.351
Cs	CS 137.938	RB 194.240				157.362
Ba	BA 70.3767	SR 53.4863				123.863
I	II 10.9788	BR 1.18233				12.16113
Te	TE 21.6760	SE 3.09658				24.77
Ru	RU 106.973	PD 47.8562	RH 19.4240			174.25
Mo	MO 160.459	NB 2.81507	TC 42.2260			205.5
Ce	CE 149.199	ZR 188.610	NP 24.7726			362.5816
La	LA 61.9315	Y 27.0247	PM 8.16370	PR 56.3014	ND 182.980	336.4
U	U 7,0376.8					70376.8
Cd	SB 0.816370	AS 0.006.47466				0.822845
Sn	SN 2.19575	AG 2.47726				4.67301

2

Events	Time (seconds) []	Time (seconds) [Case 2]
HPSI, LPSI, spray, and fan cooler off	0.0	0.0
Start core uncovered	0.116	0.183
Reactor trip	1.55	1.533
SII-Loop1A start injection	12.4	34.983
Core dryout	18.81	39.08
Gap release in radial ring 3,1,2,4	3.9~314.2	529.95~860
Start to melt fuel	1,088	1,432.46
Main FW fail	1,194	1,075.58
UO ₂ relocated to lower head	3,882	4,179.5
Lower head penetration fail 1~4	3,932~5,493	4,360~4,808
Beginning of debris ejection to cavity	3,932	4,399.9

	Gap Release		Early In-Vessel		Total (This study)
	This Study	NUREG-1465	This Study	NUREG-1465	
Duration (hrs)	3.9 330s (0.091)	(0.5)	330 3,932s (0.98)	(1.3)	1.07
Noble Gases	0.05	0.05	0.74	0.95	0.79
Halogens	0.05	0.05	0.72	0.35	0.77
Alkali Metals	0.05	0.05	0.72	0.25	0.77
Tellurium group	-	0	0.24	0.05	0.24
Ba, Sr	-	0	0.28	0.02	0.28
Noble Metals	-	0	0.014	0.0025	0.014
Cerium group	-	0	0.00024	0.005	0.00024
Lanthanides	-	0	0.0061	0.005	0.0061

4 Case

		Case 1	Case 2	Case 3	Case 4	Case 5
	*1	*2	*1	*3	*1	*1
	100 %	100 %	34.6 %	34.6 %	34.6 %	34.6 %
SI	100 %	100 %	100 %	100 %	100 %	50 %

1.

, Cell
Cell ,

가

2.

Cell ,

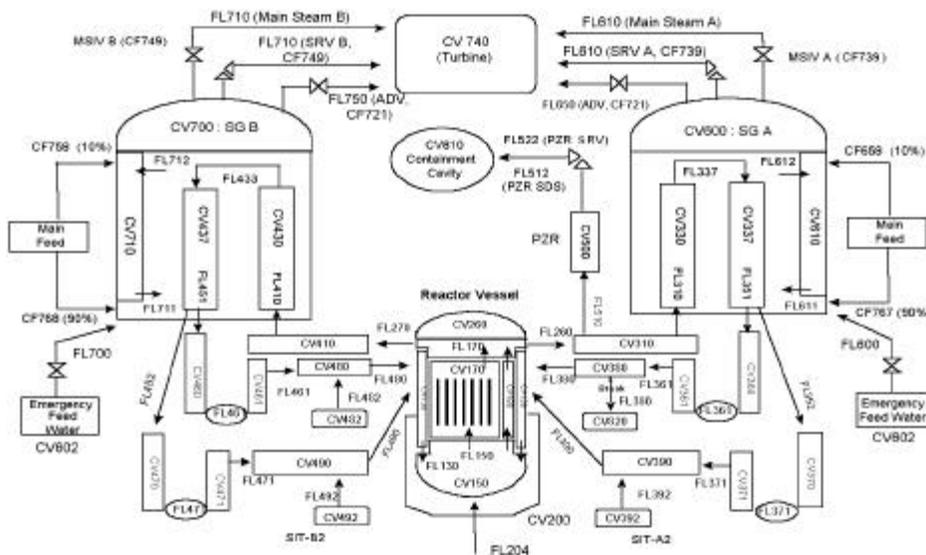
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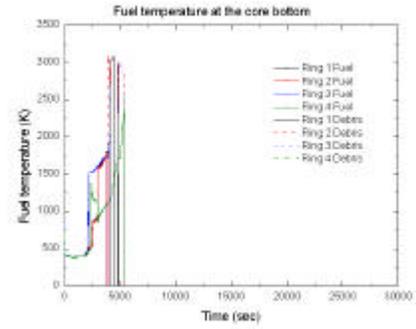
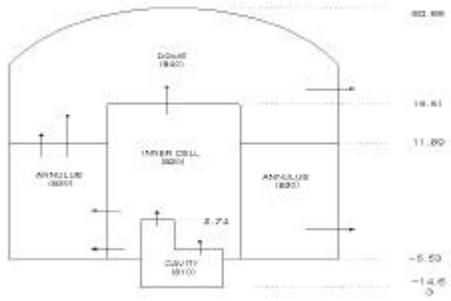
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3.

5 LBLOCA

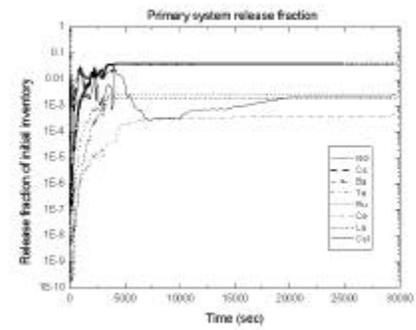
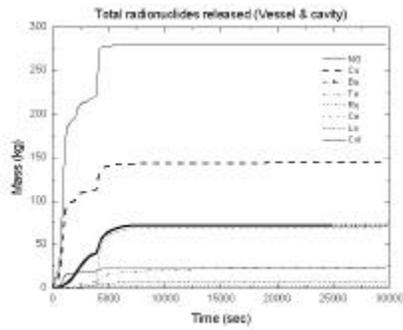
		Case 1	Case 2	Case 3	Case 4	Case 5	NUREG-1465
(s)	3.9 330 (0.091 hr)	3.9 330 (0.091 hr)	530 860 (0.092 hr)	507 850 (0.095 hr)	507 839 (0.092 hr)	688 1,040 (0.098 hr)	0(25) 1,800 0 (0.5 hr)
(s)	330 3,932 (0.98 hr)	330 10,587 (1.0 hr)	860 4,400 (0.98 hr)	850 9,094 (2.18 hr)	839 11,694 (3.02 hr)	1,040 5,282 (1.18 hr)	1,800 6,480 0 (1.3 hr)
(s)	970	955	1,400	1,415	1,400	1,630	6,480
(s)	900	890	1,330	1,350	1,330	1,550	6,480
(s)	1,088	1,081	1,432	1,484	1,494	1,697	1,800 6,480
	0.79	0.94	0.78	0.90	0.94	0.80	1.0
	0.77	0.84	0.77	0.85	0.84	0.77	0.40
	0.77	0.84	0.77	0.85	0.84	0.77	0.30
	0.24	0.27	0.15	0.33	0.24	0.19	0.05
Ba, S r	0.28	0.31	0.18	0.37	0.27	0.22	0.02
	0.00024	0.00023	0.00015	0.00003	0.00022	0.00019	0.0005
	0.0061	0.0068	0.0021	0.01	0.014	0.0045	0.005





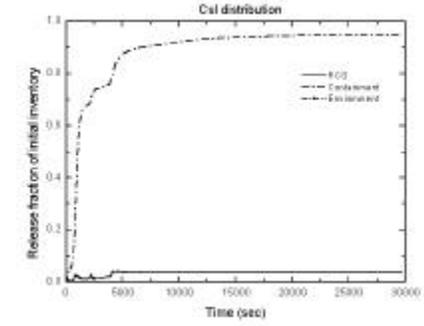
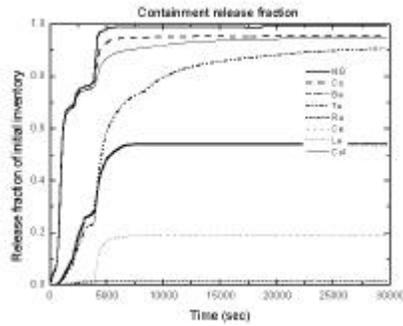
2 LOCA ()

3 ()



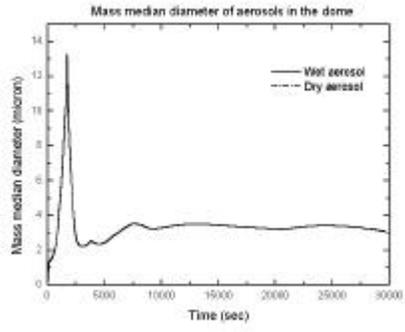
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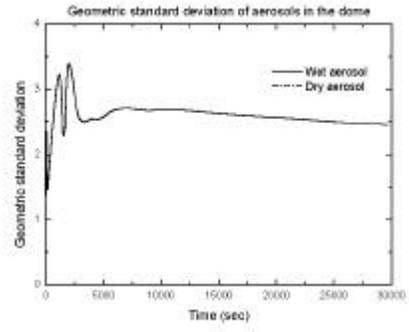


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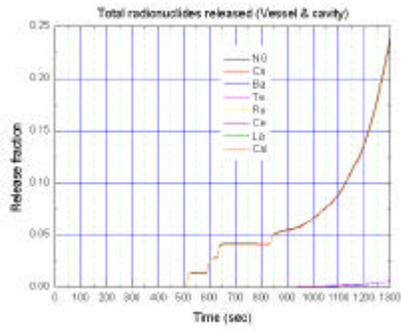
7 (CsI)



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