

SUPPLEMENTAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: 322-8393

SRP Section: 06.02.01.03 – Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents (LOCAs)

Application Section: 6.2.1.3

Date of RAI Issue: 11/30/2015

Question No. 06.02.01.03-3

Figure 2-2 in the TeR shows the unique APR1400 feature of direct vessel injection (DVI), delivering safety injection flow to the downcomer during a LOCA. According to Figure 2-2 of the TeR and Figure 5.3-8 of the DCD, the DVI nozzle elevation is well above the cold leg. In this backdrop, the applicant is requested to address the following questions.

- (a) The traditional PWR cold leg injection credits the emergency coolant injection only into three out of the four cold legs for core cooling, with the broken leg coolant added to the containment as spillage flow. The spillage flow rates for APR1400 design are given in Table 4-2 of the TeR. Please state the fraction of the coolant flow that spills out of the break into the containment. In other words, how does the spillage flow as a percentage of total safety injection compare with the 25% for the traditional PWR cold leg injection?
- (b) The safety injection into the RCS by the SITs and the safety injection pumps (SIPs) during the blowdown, refill, and the reflood phases of a LOCA are modeled by using the CEFLASH-4A and FLOOD-3 codes. Have these modeling codes been validated and approved to model DVI type injection?

Response

- (a) The spillage data for the APR1400 LOCA are given in the Table 4-2 (page 7 of 21) of TeR APR1400-Z-A-NR-14007, "LOCA Mass and Energy Release Methodology." The spillage data includes:
- the condensed steam portions,
 - the primary liquid inventory which has not passed through the core and steam generators (SGs) but through the reactor vessel (RV) annulus, and
 - the primary liquid inventory which has passed through the core and SGs that has not

evaporated into steam.

The direct spillage of one out of four safety injection (SI) lines for the traditional PWR cold leg injection is not included in the spillage data since all the safety injection tank (SIT) water of the APR1400 is injected directly into the reactor vessel through the direct vessel injection (DVI) nozzles.

The integrated SI flows in Table 1 below are calculated based on the SI flow data in Table 4-2 (pages 17 through 20 of 21) of the TeR.

The fractions of spillage flows as a percentage of total safety injection are presented in the right column of Table 1.

Table 1. The Fraction of the Spillage Flow

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- (b) The DVI type injection in the LOCA blowdown analysis is modeled in the user input of the CEFLASH-4A code by arranging the nodes and paths as presented in Figure 3-1 of the TeR. The effect of the DVI type injection during the LOCA blowdown phase is similar to that of the cold leg injection (CLI) type with the except that there is no loss of one train of SI for DVI type injection. Regardless of the safety injection type, most of the injected SIT water during the blowdown period bypasses the core support barrel and is released to the containment through the break. Both of the blowdown transients, DVI and CLI, are analyzed using the CEFLASH-4A code without any code model change.

In the FLOOD3 code, the safety injection flow is modeled as a direct input to the reactor vessel annulus. This model is the same as that of the FLOODMOD2 which is the NRC approved version. For this reason, no additional code validation and approval to model DVI type injection is necessary.

Supplemental Questions**Public Teleconference (July 7, 2016)**

The staff would like to understand how “spillage” was modeled in the containment response for the Chapter 6 calculations. Specifically, staff wants to know (using Table 6.2.1-4 as an example) how the energy release in the reflood and post-reflood phase was modeled – there is a table with a transient mass and energy release for this period of time, and then additionally, a table with an integral spillage release for the same period of time, and the spillage data does not appear to be integrated into the transient mass and energy release table presented. This is in contrast to the decay heat phase, where a transient table is presented for both steam and spillage. Staff is trying to understand if the correct energy release during the reflood and post-reflood phase is being input for the staff’s confirmatory analysis.

Public Teleconference (August 9, 2016)

The staff would like to understand how “spillage” was modeled in the containment response for the Chapter 6 calculations. Specifically, staff wants to know (using Table 6.2.1-4 as an example) how the energy release in the reflood and post-reflood phase was modeled – there is a table with a transient mass and energy release for this period of time, and then additionally, a table with an integral spillage release for the same period of time, and the spillage data does not appear to be integrated into the transient mass and energy release table presented. This is in contrast to the decay heat phase, where a transient table is presented for both steam and spillage. Staff is trying to understand if the correct energy release during the reflood and post-reflood phase is being input for the staff’s confirmatory analysis.

Public Teleconference (September 22, 2016)

As a follow-up to RAI 8393, Question 28678 (06.02.01.03-3), the staff requested the applicant in the July 9, 2016, public teleconference to clarify how spillage in the containment M&E release inputs was modeled in order to align it with the values used in the staff’s confirmatory calculations. Transient data were provided in the DCD for many of the M&E release components, but spillage data was only listed in integral form. In the August 9, 2016, public teleconference, the applicant provided the transient M&E release data for spillage. Based on the review of the tables, the staff concluded that correct M&E release is being input to the staff’s confirmatory analysis, and would find the applicant’s response to be acceptable. However, the applicant needs to submit the supplemental response to RAI 8393, Question 28678 (06.02.01.03-3) on the docket along with the mark-ups to revise the DCD M&E release tables to include the transient spillage data. Therefore, RAI 8393, Question 28678 (06.02.01.03-3) is being tracked as an open item.

Supplemental Response**Public Teleconference (July 7, 2016)**

Using DCD Table 6.2.1-4 as an example, the transient mass and energy (M/E) release data in the table (Page 1-7 of 23) are calculated for steam using quality ($= X$) of the flow leaving the break, while the “spillage” data is calculated for liquid using quality ($= 1 - X$) of the flow leaving the break, which has relatively little effect on the containment pressure and temperature (P/T). Thus, the transient M/E data do not include the “spillage” data.

The transient spillage data during the blowdown, reflood and post-reflood phases will be provided in the DCD Table 6.2.1-4, 5, 6 and 7 and TeR Table 4-2.

Public Teleconference (August 9, 2016)

The integrated spillage data in DCD Tables 6.2.1-4 through 7 will be revised with the spillage data provided in the following pages. These data have been used as the input for the containment P/T analysis.

For clarification, in the titles of the tables, “Spillage Release (Reactor Vessel Side)” is the spillage which has not passed through the core and steam generator but has passed around the annulus and comes out through the cold leg break. The title “Spillage Release (Steam Generator Side)” is the spillage which has passed through the core and steam generator and comes out through the cold leg break.

Table 6.2.1-4 (8 of 25)

Double-Ended Suction Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
28.00	0.00	0.00	0.00	0.00
28.10	701.48	1,546.51	390.64	703.18
28.20	1,438.30	3,170.92	217.00	390.63
32.20	1,274.95	2,810.80	233.78	420.83
36.20	1,151.76	2,539.21	247.58	445.66
40.20	1,053.60	2,322.81	259.77	467.61
44.20	974.39	2,148.18	270.30	486.57
48.20	909.86	2,005.91	279.16	502.52
52.20	856.97	1,889.30	286.34	515.44
56.20	813.57	1,793.62	291.82	525.30
60.20	777.94	1,715.08	295.65	532.21
63.60	752.70	1,659.42	297.70	535.90
63.70	752.01	1,657.91	297.75	535.98
63.80	0.00	0.00	0.00	0.00
124.90	0.00	0.00	0.00	0.00
125.00	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
110.20	35,368.68	77,975.00	9.360	37.144
125.00	35,368.68	77,975.00	9.360	37.144

Table 6.2.1-4 (9 of 25)

Double-Ended Suction Leg Slot Break – Maximum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
82.90	0.00	0.00	0.00	0.00
83.00	9.01	19.86	144.35	259.85
83.10	0.00	0.00	0.00	0.00
83.20	32.76	72.23	144.33	259.81
83.30	25.68	56.62	144.33	259.80
83.40	25.42	56.05	144.32	259.79
85.40	192.20	423.73	144.33	259.81
87.40	258.03	568.86	144.33	259.81
89.40	293.32	646.67	144.33	259.81
91.40	318.76	702.74	144.33	259.81
93.40	339.49	748.46	144.33	259.81
95.40	357.45	788.05	144.33	259.81
97.40	373.17	822.71	144.33	259.81
99.40	387.04	853.28	144.33	259.81
101.40	399.32	880.36	144.33	259.81
103.40	410.25	904.46	144.33	259.81
105.40	420.02	925.98	144.33	259.81
107.40	428.77	945.28	144.33	259.81
109.40	436.63	962.62	144.33	259.81
110.10	439.20	968.28	144.33	259.81
110.20	439.56	969.07	144.33	259.81
110.30	439.92	969.86	144.33	259.81
111.30	198.74	438.16	144.33	259.81
112.30	855.78	1,886.69	144.33	259.81
113.30	172.40	380.08	144.33	259.81
114.30	702.47	1,548.70	144.33	259.81
115.30	230.40	507.94	144.33	259.81
116.30	204.39	450.61	144.33	259.81

Table 6.2.1-4 (10 of 25)

Double-Ended Suction Leg Slot Break – Maximum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
117.30	188.59	415.78	144.33	259.81
118.30	185.85	409.74	144.33	259.81
119.30	188.16	414.83	144.33	259.81
120.30	191.74	422.71	144.33	259.81
121.30	196.42	433.03	144.33	259.81
122.30	202.25	445.88	144.33	259.81
123.30	212.01	467.41	144.33	259.81
124.90	230.93	509.12	144.33	259.81
125.00	486.16	1,071.80	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
110.20	9,245.07	20,382.00	1.334	5.296
125.00	20,837.47	45,939.00	3.007	11.935

Table 6.2.1-5 (9 of 27)

Double-Ended Suction Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)

(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
28.80	0.00	0.00	0.00	0.00
28.90	971.13	2,140.98	296.06	532.94
29.00	1,260.87	2,779.76	240.15	432.29
31.60	1,157.02	2,550.81	253.83	456.92
34.20	1,071.15	2,361.49	266.01	478.85
36.80	997.39	2,198.89	277.61	499.73
39.40	933.64	2,058.33	288.58	519.47
42.00	878.23	1,936.18	298.86	537.97
44.60	829.89	1,829.60	308.40	555.15
47.20	787.55	1,736.27	317.17	570.94
49.80	750.33	1,654.20	325.17	585.35
52.40	717.62	1,582.09	332.33	598.22
55.00	688.86	1,518.68	338.60	609.52
57.60	663.56	1,462.90	343.99	619.22
60.20	641.30	1,413.84	348.49	627.32
62.80	621.74	1,370.71	352.11	633.84
63.50	616.87	1,359.98	352.95	635.35
63.60	616.19	1,358.47	353.07	635.56
63.70	0.00	0.00	0.00	0.00
127.50	0.00	0.00	0.00	0.00
127.60	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
117.10	29,413.04	64,845.00	8.864	35.179
127.60	29,413.04	64,845.00	8.864	35.179

Table 6.2.1-5 (10 of 27)

Double-Ended Suction Leg Slot Break – Minimum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
89.00	0.00	0.00	0.00	0.00
89.10	21.66	47.76	144.33	259.81
89.20	13.00	28.67	144.35	259.85
89.30	14.10	31.09	144.32	259.80
89.50	39.24	86.50	144.33	259.81
91.50	166.16	366.32	144.33	259.81
93.50	218.12	480.87	144.33	259.81
95.50	246.31	543.02	144.33	259.81
97.50	266.58	587.71	144.33	259.81
99.50	283.03	623.97	144.33	259.81
101.50	297.25	655.33	144.33	259.81
103.50	309.70	682.78	144.33	259.81
105.50	320.67	706.95	144.33	259.81
107.50	330.36	728.33	144.33	259.81
109.50	338.95	747.27	144.33	259.81
111.50	346.60	764.13	144.33	259.81
113.50	353.41	779.15	144.33	259.81
115.50	359.50	792.56	144.33	259.81
117.00	363.63	801.68	144.33	259.81
117.10	363.90	802.26	144.33	259.81
117.20	364.16	802.84	144.33	259.81
118.20	457.30	1,008.19	144.33	259.81
119.20	1,657.22	3,653.57	144.33	259.81
120.20	757.55	1,670.11	144.33	259.81
121.20	287.80	634.50	144.33	259.81
122.20	547.78	1,207.66	144.33	259.81
123.20	1,399.03	3,084.35	144.33	259.81
124.20	1,300.27	2,866.63	144.33	259.81

Table 6.2.1-5 (11 of 27)

Double-Ended Suction Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
125.20	1,426.74	3,145.44	144.33	259.81
126.20	276.29	609.12	144.33	259.81
127.50	206.19	454.58	144.33	259.81
127.60	427.03	941.44	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
117.10	7,994.98	17,626.00	1.154	4.579
127.60	14,758.01	32,536.00	2.130	8.453

Table 6.2.1-6 (7 of 25)

Double-Ended Discharge Leg Slot Break – Maximum SIS FlowPart A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
28.05	0.00	0.00	0.00	0.00
28.15	465.09	1,025.35	317.38	571.31
28.25	2,031.84	4,479.47	111.51	200.73
32.25	1,881.58	4,148.19	115.85	208.55
36.25	1,752.17	3,862.90	119.91	215.84
40.25	1,649.04	3,635.52	123.34	222.02
44.25	1,558.85	3,436.70	126.67	228.02
48.25	1,479.16	3,261.00	129.90	233.84
49.15	1,462.46	3,224.20	130.61	235.12
49.25	1,460.64	3,220.17	130.69	235.26
49.35	458.73	1,011.34	50.40	90.72
49.45	458.43	1,010.68	50.40	90.73
79.45	405.29	893.52	50.78	91.41
109.45	372.58	821.40	51.13	92.04
139.45	355.00	782.64	51.47	92.65
169.45	347.92	767.04	51.82	93.28
199.65	348.35	767.98	52.17	93.91
199.75	348.36	768.00	52.17	93.91
199.85	436.54	962.41	52.17	93.91
209.55	421.82	929.96	52.30	94.14
218.85	408.81	901.28	52.42	94.36
228.15	396.07	873.19	52.54	94.58
237.45	383.64	845.78	52.66	94.80
246.95	371.23	818.43	52.79	95.04
247.05	362.82	799.88	52.80	95.04
247.15	322.92	711.93	52.80	95.04
247.45	346.30	763.46	52.80	95.05
247.75	334.13	736.63	52.81	95.06
248.35	342.38	754.83	52.81	95.05

Table 6.2.1-6 (8 of 25)

Double-Ended Discharge Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)

(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
248.45	339.48	748.43	52.81	95.06
251.95	285.14	628.62	52.84	95.12
255.65	217.96	480.53	52.91	95.24
259.15	170.21	375.26	52.97	95.35
262.65	134.28	296.03	53.04	95.47
266.15	105.35	232.26	53.11	95.60
269.65	80.04	176.45	53.18	95.73
273.15	56.26	124.04	53.25	95.86
276.65	32.68	72.05	53.33	96.00
280.15	8.06	17.77	53.42	96.17
281.05	1.42	3.13	53.35	96.04
281.15	0.67	1.48	53.30	95.95
281.25	0.00	0.00	0.00	0.00
360.15	0.00	0.00	0.00	0.00
360.25	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	92,597.23	204,143.00	7.278	28.883
360.25	116,570.82	256,996.00	8.538	33.885

Table 6.2.1-6 (9 of 25)

Double-Ended Discharge Leg Slot Break – Maximum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
199.75	0.00	0.00	0.00	0.00
237.45	0.00	0.00	0.00	0.00
246.95	0.00	0.00	0.00	0.00
247.05	1.56	3.44	144.40	259.94
247.15	1.34	2.95	144.12	259.42
247.45	11.85	26.13	144.31	259.78
247.75	14.31	31.54	144.32	259.78
248.35	25.15	55.44	144.33	259.81
248.45	26.33	58.04	144.33	259.82
251.95	105.95	233.57	144.33	259.81
255.65	195.79	431.64	144.33	259.81
259.15	255.18	562.58	144.33	259.81
262.65	297.37	655.60	144.33	259.81
266.15	329.09	725.53	144.33	259.81
269.65	355.09	782.85	144.33	259.81
273.15	378.24	833.87	144.33	259.81
276.65	400.35	882.62	144.33	259.81
280.15	422.94	932.43	144.33	259.81
281.05	429.00	945.79	144.33	259.81
281.15	429.68	947.29	144.33	259.81
281.25	430.37	948.80	144.33	259.81
283.65	443.10	976.88	144.33	259.81
285.15	445.06	981.20	144.33	259.81
285.25	447.57	986.72	144.33	259.81
285.35	454.00	1,000.91	144.33	259.81
288.85	393.41	867.32	144.33	259.81
292.35	317.04	698.95	144.33	259.81
295.85	590.86	1,302.64	144.33	259.81
299.35	708.55	1,562.09	144.33	259.81

Table 6.2.1-6 (10 of 25)

Double-Ended Discharge Leg Slot Break – Maximum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
302.85	258.24	569.32	144.33	259.81
306.35	616.82	1,359.86	144.33	259.81
309.85	685.57	1,511.42	144.33	259.81
313.35	272.19	600.09	144.33	259.81
316.85	646.62	1,425.56	144.33	259.81
320.35	670.59	1,478.41	144.33	259.81
323.85	282.38	622.54	144.33	259.81
327.35	667.62	1,471.85	144.33	259.81
330.85	732.92	1,615.81	144.33	259.81
334.35	311.70	687.18	144.33	259.81
337.85	825.46	1,819.83	144.33	259.81
341.35	305.77	674.11	144.33	259.81
344.85	184.18	406.04	144.33	259.81
348.35	922.54	2,033.86	144.33	259.81
351.85	685.61	1,511.51	144.33	259.81
355.35	84.80	186.95	144.33	259.81
358.85	774.68	1,707.88	144.33	259.81
360.15	772.81	1,703.77	144.33	259.81
360.25	755.90	1,666.49	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	0.00	0.00	0.000	0.000
360.25	50,583.00	111,517.00	7.301	28.973

Table 6.2.1-7 (7 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS FlowPart A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
28.65	0.00	0.00	0.00	0.00
28.75	982.13	2,165.23	176.82	318.29
28.85	1,872.03	4,127.14	116.76	210.18
32.85	1,726.42	3,806.13	121.70	219.07
36.85	1,601.07	3,529.78	126.34	227.42
40.85	1,500.09	3,307.16	130.44	234.81
44.85	1,411.63	3,112.13	134.47	242.06
48.85	1,333.32	2,939.49	138.42	249.17
49.15	1,327.80	2,927.32	138.71	249.70
49.25	1,325.98	2,923.29	138.81	249.88
49.35	324.19	714.71	50.19	90.35
49.45	323.91	714.10	50.19	90.35
79.45	270.47	596.28	50.46	90.83
109.45	237.59	523.79	50.72	91.30
139.45	219.90	484.79	50.98	91.76
169.45	212.74	469.02	51.24	92.24
199.45	213.10	469.81	51.52	92.74
199.95	213.16	469.93	51.52	92.75
200.05	213.17	469.96	51.52	92.75
200.15	301.41	664.49	51.52	92.75
211.85	283.93	625.97	51.64	92.97
223.55	267.62	590.00	51.77	93.19
235.25	251.83	555.19	51.90	93.42
246.95	235.25	518.65	52.03	93.66
247.05	227.58	501.74	52.03	93.67
247.15	186.57	411.32	52.04	93.67
247.75	198.69	438.03	52.04	93.68
248.25	208.42	459.50	52.04	93.68

Table 6.2.1-7 (8 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS FlowPart A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
249.35	199.33	439.46	52.04	93.68
253.35	121.35	267.54	52.09	93.76
257.35	55.69	122.77	52.15	93.87
261.35	8.28	18.26	52.22	94.01
262.15	0.44	0.98	52.32	94.18
262.25	0.00	0.00	0.00	0.00
549.05	0.00	0.00	0.00	0.00
549.15	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
200.05	68,418.16	150,837.00	5.952	23.619
549.15	82,592.84	182,087.00	6.686	26.533

Table 6.2.1-7 (9 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
246.95	0.00	0.00	0.00	0.00
247.05	2.51	5.53	144.38	259.89
247.15	1.81	3.99	144.26	259.67
247.75	14.24	31.40	144.31	259.77
248.25	23.79	52.44	144.33	259.81
249.35	38.51	84.91	144.33	259.81
253.35	145.68	321.17	144.33	259.80
257.35	230.21	507.52	144.33	259.81
261.35	287.14	633.04	144.33	259.81
262.15	296.14	652.89	144.33	259.81
262.25	297.23	655.28	144.33	259.81
265.35	320.26	706.05	144.33	259.81
269.35	333.38	734.97	144.33	259.81
273.35	339.04	747.47	144.33	259.81
274.85	336.76	742.44	144.33	259.81
274.95	340.46	750.60	144.33	259.81
286.65	305.12	672.68	144.33	259.81
298.35	569.95	1,256.53	144.33	259.81
310.05	527.14	1,162.15	144.33	259.81
321.75	506.43	1,116.49	144.33	259.81
333.45	491.70	1,084.01	144.33	259.81
345.15	479.51	1,057.15	144.33	259.81
356.85	469.28	1,034.58	144.33	259.81
368.55	355.57	783.90	144.33	259.81
374.35	146.61	323.22	144.33	259.81
374.45	144.26	318.05	144.33	259.81
378.95	136.87	301.74	144.33	259.81
383.45	135.81	299.41	144.33	259.81

Table 6.2.1-7 (10 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
387.95	135.90	299.60	144.33	259.81
392.45	132.30	291.68	144.33	259.80
396.95	130.69	288.12	144.33	259.81
401.45	129.71	285.97	144.33	259.81
405.85	128.89	284.15	144.33	259.81
420.95	126.41	278.68	144.33	259.81
436.05	124.27	273.96	144.33	259.81
451.15	122.39	269.82	144.33	259.81
466.25	120.73	266.17	144.33	259.80
481.35	119.26	262.93	144.33	259.81
496.45	117.96	260.06	144.33	259.81
511.55	116.81	257.53	144.33	259.81
527.25	115.76	255.21	144.33	259.81
529.25	117.75	259.60	144.33	259.81
529.45	121.82	268.57	144.33	259.81
532.45	131.37	289.62	144.33	259.81
535.45	135.70	299.17	144.33	259.81
538.45	138.36	305.04	144.33	259.80
541.45	139.91	308.44	144.33	259.81
544.45	140.79	310.38	144.33	259.80
547.45	141.29	311.49	144.33	259.81
549.05	141.47	311.90	144.33	259.81
549.15	141.48	311.92	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
200.05	0.00	0.00	0.000	0.000
549.15	65,190.41	143,721.00	9.409	37.340

Public Teleconference (September 22, 2016)

This supplemental response to RAI 8393, Question 06.02.01.03-3, provides answer to NRC staff questions based on the July 7, 2016 and August 9, 2016 public teleconference.

Impact on DCD

DCD Tier 2, Table 6.2.1-4 through 6.2.1-7 will be revised, as indicated in Attachment 1 to this response.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical Report (APR1400-Z-A-NR-14007, Re.0, "LOCA Mass and Energy Release Methodology,") Section 3.10 and Table 4-2 will be revised, as indicated in Attachment 2 and 3 to this response.

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Table 6.2.1-4 (7 of 23)

Part A: Mass and Energy Release Data (Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	keal/kg	Btu/lbm
113.30	209.65	462.21	675.49	1,215.95
114.30	130.05	286.71	692.61	1,246.78
115.30	188.18	414.87	677.48	1,219.54
116.30	261.60	576.73	669.01	1,204.29
117.30	256.62	565.75	668.68	1,203.69
118.30	247.62	545.92	668.71	1,203.75
119.30	234.21	516.34	669.12	1,204.48
120.30	224.89	495.80	669.30	1,204.81
121.30	217.46	479.43	669.39	1,204.97
122.30	212.74	469.02	669.32	1,204.85
123.30	213.77	471.29	668.89	1,204.06
124.90	94.67	208.72	690.29	1,242.59
125.00	76.66	169.01	703.26	1,265.94

~~Table 6.2.1-4 (8 of 23)~~~~Integral Mass and Energy Release at the End of Reflood and Post-reflood~~

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
110.20	41,755.23	92,055.00	28.806	114.317
125.00	44,853.70	98,886.00	30.891	122.593

~~Part A: Mass and Energy Release Data (Spillage)~~

Time (sec)	Integral Mass		Integral Energy	
	kg	Lbm	Million kcal	Million Btu
End of Blowdown at 19.203	0.00	0.00	0.000	0.000
End of Reflood at 110.20	44,613.87	98,357.25	10.694	42.439
End of Post-reflood at 125.00	56,206.13	123,913.96	12.367	49.079

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The page numbers of Table 6.2.1-4 should be readjusted as follows:

(1 of 23)-->(1 of 25)	(14 of 23)-->(16 of 25)
(2 of 23)-->(2 of 25)	(15 of 23)-->(17 of 25)
(3 of 23)-->(3 of 25)	(16 of 23)-->(18 of 25)
(4 of 23)-->(4 of 25)	(17 of 23)-->(19 of 25)
(5 of 23)-->(5 of 25)	(18 of 23)-->(20 of 25)
(6 of 23)-->(6 of 25)	(19 of 23)-->(21 of 25)
(7 of 23)-->(7 of 25)	(20 of 23)-->(22 of 25)
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Table 6.2.1-4 (7 of 25)

Double-Ended Suction Leg Slot Break – Maximum SIS Flow

Part A: Mass and Energy Release Data (Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
117.30	256.62	565.75	668.68	1,203.69
118.30	247.62	545.92	668.71	1,203.75
119.30	234.21	516.34	669.12	1,204.48
120.30	224.89	495.80	669.30	1,204.81
121.30	217.46	479.43	669.39	1,204.97
122.30	212.74	469.02	669.32	1,204.85
123.30	213.77	471.29	668.89	1,204.06
124.90	94.67	208.72	690.29	1,242.59
125.00	76.66	169.01	703.26	1,265.94

Integral Mass and Energy Release at the End of Reflood and Post-reflood

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
110.20	41,755.23	92,055.00	28.806	114.317
125.00	44,853.70	98,886.00	30.891	122.593

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Table 6.2.1-4 (8 of 25)

Double-Ended Suction Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
28.00	0.00	0.00	0.00	0.00
28.10	701.48	1,546.51	390.64	703.18
28.20	1,438.30	3,170.92	217.00	390.63
32.20	1,274.95	2,810.80	233.78	420.83
36.20	1,151.76	2,539.21	247.58	445.66
40.20	1,053.60	2,322.81	259.77	467.61
44.20	974.39	2,148.18	270.30	486.57
48.20	909.86	2,005.91	279.16	502.52
52.20	856.97	1,889.30	286.34	515.44
56.20	813.57	1,793.62	291.82	525.30
60.20	777.94	1,715.08	295.65	532.21
63.60	752.70	1,659.42	297.70	535.90
63.70	752.01	1,657.91	297.75	535.98
63.80	0.00	0.00	0.00	0.00
124.90	0.00	0.00	0.00	0.00
125.00	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
110.20	35,368.68	77,975.00	9.360	37.144
125.00	35,368.68	77,975.00	9.360	37.144

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Table 6.2.1-4 (9 of 25)

Double-Ended Suction Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
82.90	0.00	0.00	0.00	0.00
83.00	9.01	19.86	144.35	259.85
83.10	0.00	0.00	0.00	0.00
83.20	32.76	72.23	144.33	259.81
83.30	25.68	56.62	144.33	259.80
83.40	25.42	56.05	144.32	259.79
85.40	192.20	423.73	144.33	259.81
87.40	258.03	568.86	144.33	259.81
89.40	293.32	646.67	144.33	259.81
91.40	318.76	702.74	144.33	259.81
93.40	339.49	748.46	144.33	259.81
95.40	357.45	788.05	144.33	259.81
97.40	373.17	822.71	144.33	259.81
99.40	387.04	853.28	144.33	259.81
101.40	399.32	880.36	144.33	259.81
103.40	410.25	904.46	144.33	259.81
105.40	420.02	925.98	144.33	259.81
107.40	428.77	945.28	144.33	259.81
109.40	436.63	962.62	144.33	259.81
110.10	439.20	968.28	144.33	259.81
110.20	439.56	969.07	144.33	259.81
110.30	439.92	969.86	144.33	259.81
111.30	198.74	438.16	144.33	259.81
112.30	855.78	1,886.69	144.33	259.81
113.30	172.40	380.08	144.33	259.81
114.30	702.47	1,548.70	144.33	259.81
115.30	230.40	507.94	144.33	259.81
116.30	204.39	450.61	144.33	259.81

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Table 6.2.1-4 (10 of 25)

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Double-Ended Suction Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
117.30	188.59	415.78	144.33	259.81
118.30	185.85	409.74	144.33	259.81
119.30	188.16	414.83	144.33	259.81
120.30	191.74	422.71	144.33	259.81
121.30	196.42	433.03	144.33	259.81
122.30	202.25	445.88	144.33	259.81
123.30	212.01	467.41	144.33	259.81
124.90	230.93	509.12	144.33	259.81
125.00	486.16	1,071.80	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
110.20	9,245.07	20,382.00	1.334	5.296
125.00	20,837.47	45,939.00	3.007	11.935

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Table 6.2.1-5 (8 of 25)

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**Part A: Mass and Energy Release Data
(Reflood and Post-reflood Period)**

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	keal/kg	Btu/lbm
107.50	249.75	550.60	675.45	1,215.87
109.50	235.97	520.22	675.94	1,216.76
111.50	223.33	492.36	676.42	1,217.62
113.50	211.70	466.73	676.89	1,218.48
115.50	200.98	443.09	677.35	1,219.30
117.00	193.47	426.53	677.70	1,219.93
117.10	192.98	425.46	677.72	1,219.97
117.20	192.50	424.39	677.75	1,220.02
118.20	160.97	354.88	682.73	1,228.99
119.20	433.91	956.61	663.25	1,193.93
120.20	94.59	208.53	701.96	1,263.60
121.20	173.41	382.31	677.72	1,219.96
122.20	132.67	292.49	686.52	1,235.80
123.20	515.95	1,137.48	661.26	1,190.33
124.20	506.65	1,116.98	660.92	1,189.72
125.20	394.68	870.13	662.55	1,192.66
126.20	128.13	282.47	683.18	1,229.79
127.50	101.43	223.61	688.12	1,238.68
127.60	76.44	168.52	702.72	1,264.96

~~Table 6.2.1-5 (9 of 25)~~~~Integral Mass and Energy Release at the End of Reflood and Post-reflood~~

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
117.10	43,315.58	95,495.00	29.90	118.66
127.60	45,246.51	99,752.00	31.20	123.84

~~Part A: Mass and Energy Release Data (Spillage)~~

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
End of Blowdown at 19.203	0.00	0.00	0.000	0.000
End of Reflood at 117.10	37,408.24	82,471.48	10.018	39.759
End of Post-reflood at 127.60	44,170.94	97,380.76	10.994	43.632

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The page numbers of Table 6.2.1-5 should be readjusted as follows:

(1 of 25)-->(1 of 27)	(14 of 25)-->(16 of 27)
(2 of 25)-->(2 of 27)	(15 of 25)-->(17 of 27)
(3 of 25)-->(3 of 27)	(16 of 25)-->(18 of 27)
(4 of 25)-->(4 of 27)	(17 of 25)-->(19 of 27)
(5 of 25)-->(5 of 27)	(18 of 25)-->(20 of 27)
(6 of 25)-->(6 of 27)	(19 of 25)-->(21 of 27)
(7 of 25)-->(7 of 27)	(20 of 25)-->(22 of 27)
(8 of 25)-->(8 of 27)	(21 of 25)-->(23 of 27)
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(11 of 25)-->(13 of 27)	
(12 of 25)-->(14 of 27)	
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Table 6.2.1-5 (8 of 27)

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Double-Ended Suction Leg Slot Break – Minimum SIS Flow

Part A: Mass and Energy Release Data (Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
117.10	192.98	425.46	677.72	1,219.97
117.20	192.50	424.39	677.75	1,220.02
118.20	160.97	354.88	682.73	1,228.99
119.20	433.91	956.61	663.25	1,193.93
120.20	94.59	208.53	701.96	1,263.60
121.20	173.41	382.31	677.72	1,219.96
122.20	132.67	292.49	686.52	1,235.80
123.20	515.95	1,137.48	661.26	1,190.33
124.20	506.65	1,116.98	660.92	1,189.72
125.20	394.68	870.13	662.55	1,192.66
126.20	128.13	282.47	683.18	1,229.79
127.50	101.43	223.61	688.12	1,238.68
127.60	76.44	168.52	702.72	1,264.96

Integral Mass and Energy Release at the End of Reflood and Post-reflood

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
117.10	43,315.58	95,495.00	29.90	118.66
127.60	45,246.51	99,752.00	31.20	123.84

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Table 6.2.1-5 (9 of 27)

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Double-Ended Suction Leg Slot Break – Minimum SIS FlowPart A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
28.80	0.00	0.00	0.00	0.00
28.90	971.13	2,140.98	296.06	532.94
29.00	1,260.87	2,779.76	240.15	432.29
31.60	1,157.02	2,550.81	253.83	456.92
34.20	1,071.15	2,361.49	266.01	478.85
36.80	997.39	2,198.89	277.61	499.73
39.40	933.64	2,058.33	288.58	519.47
42.00	878.23	1,936.18	298.86	537.97
44.60	829.89	1,829.60	308.40	555.15
47.20	787.55	1,736.27	317.17	570.94
49.80	750.33	1,654.20	325.17	585.35
52.40	717.62	1,582.09	332.33	598.22
55.00	688.86	1,518.68	338.60	609.52
57.60	663.56	1,462.90	343.99	619.22
60.20	641.30	1,413.84	348.49	627.32
62.80	621.74	1,370.71	352.11	633.84
63.50	616.87	1,359.98	352.95	635.35
63.60	616.19	1,358.47	353.07	635.56
63.70	0.00	0.00	0.00	0.00
127.50	0.00	0.00	0.00	0.00
127.60	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
117.10	29,413.04	64,845.00	8.864	35.179
127.60	29,413.04	64,845.00	8.864	35.179

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Table 6.2.1-5 (10 of 27)

Double-Ended Suction Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.20	0.00	0.00	0.00	0.00
19.30	0.00	0.00	0.00	0.00
89.00	0.00	0.00	0.00	0.00
89.10	21.66	47.76	144.33	259.81
89.20	13.00	28.67	144.35	259.85
89.30	14.10	31.09	144.32	259.80
89.50	39.24	86.50	144.33	259.81
91.50	166.16	366.32	144.33	259.81
93.50	218.12	480.87	144.33	259.81
95.50	246.31	543.02	144.33	259.81
97.50	266.58	587.71	144.33	259.81
99.50	283.03	623.97	144.33	259.81
101.50	297.25	655.33	144.33	259.81
103.50	309.70	682.78	144.33	259.81
105.50	320.67	706.95	144.33	259.81
107.50	330.36	728.33	144.33	259.81
109.50	338.95	747.27	144.33	259.81
111.50	346.60	764.13	144.33	259.81
113.50	353.41	779.15	144.33	259.81
115.50	359.50	792.56	144.33	259.81
117.00	363.63	801.68	144.33	259.81
117.10	363.90	802.26	144.33	259.81
117.20	364.16	802.84	144.33	259.81
118.20	457.30	1,008.19	144.33	259.81
119.20	1,657.22	3,653.57	144.33	259.81
120.20	757.55	1,670.11	144.33	259.81
121.20	287.80	634.50	144.33	259.81
122.20	547.78	1,207.66	144.33	259.81
123.20	1,399.03	3,084.35	144.33	259.81
124.20	1,300.27	2,866.63	144.33	259.81

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Table 6.2.1-5 (11 of 27)

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Double-Ended Suction Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
125.20	1,426.74	3,145.44	144.33	259.81
126.20	276.29	609.12	144.33	259.81
127.50	206.19	454.58	144.33	259.81
127.60	427.03	941.44	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
117.10	7,994.98	17,626.00	1.154	4.579
127.60	14,758.01	32,536.00	2.130	8.453

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Table 6.2.1-6 (6 of 22)

Part A: Mass and Energy Release Data
(Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
299.35	126.94	279.85	653.81	1,176.92
302.85	121.21	267.22	653.80	1,176.91
306.35	258.13	569.09	653.81	1,176.93
309.85	113.77	250.83	653.80	1,176.92
313.35	109.25	240.86	653.81	1,176.93
316.85	206.98	456.31	653.82	1,176.94
320.35	102.22	225.36	653.83	1,176.96
323.85	98.81	217.83	653.82	1,176.95
327.35	184.79	407.40	653.81	1,176.93
330.85	93.68	206.52	653.81	1,176.93
334.35	92.15	203.15	653.82	1,176.95
337.85	124.24	273.90	653.81	1,176.93
341.35	130.69	288.13	653.81	1,176.93
344.85	111.96	246.84	653.81	1,176.93
348.35	72.51	159.86	653.81	1,176.93
351.85	72.00	158.74	653.80	1,176.90
355.35	116.68	257.24	653.81	1,176.92
358.85	62.06	136.83	653.80	1,176.91
360.15	61.54	135.67	653.82	1,176.94
360.25	60.92	134.31	653.81	1,176.92

~~Table 6.2.1-6 (7 of 22)~~

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	58,868.73	129,784.00	42.157	167.303
360.25	89,568.60	197,466.00	62.874	249.519

~~Part A: Mass and Energy Release Data (Spillage)~~

Time (sec)	Integral Mass		Integral Energy	
	kg	Lbm	Million kcal	Million Btu
End of Blowdown at 19.752	0.00	0.00	0.000	0.000
End of Reflood at 199.75	92,597.37	204,143.33	9.303	36.919
End of Post-reflood at 360.25	167,154.03	368,513.48	14.869	59.008

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The page numbers of Table 6.2.1-6 should be readjusted as follows:

(1 of 22)-->(1 of 25)	(13 of 22)-->(16 of 25)
(2 of 22)-->(2 of 25)	(14 of 22)-->(17 of 25)
(3 of 22)-->(3 of 25)	(15 of 22)-->(18 of 25)
(4 of 22)-->(4 of 25)	(16 of 22)-->(19 of 25)
(5 of 22)-->(5 of 25)	(17 of 22)-->(20 of 25)
(6 of 22)-->(6 of 25)	(18 of 22)-->(21 of 25)
(7 of 22)-->(7 of 25)	(19 of 22)-->(22 of 25)
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(8 of 22)-->(11 of 25)	
(9 of 22)-->(12 of 25)	
(10 of 22)-->(13 of 25)	
(11 of 22)-->(14 of 25)	
(12 of 22)-->(15 of 25)	

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Table 6.2.1-6 (6 of 25)

Double-Ended Discharge Leg Slot Break – Maximum SIS Flow

Part A: Mass and Energy Release Data (Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
313.35	109.25	240.86	653.81	1,176.93
316.85	206.98	456.31	653.82	1,176.94
320.35	102.22	225.36	653.83	1,176.96
323.85	98.81	217.83	653.82	1,176.95
327.35	184.79	407.40	653.81	1,176.93
330.85	93.68	206.52	653.81	1,176.93
334.35	92.15	203.15	653.82	1,176.95
337.85	124.24	273.90	653.81	1,176.93
341.35	130.69	288.13	653.81	1,176.93
344.85	111.96	246.84	653.81	1,176.93
348.35	72.51	159.86	653.81	1,176.93
351.85	72.00	158.74	653.80	1,176.90
355.35	116.68	257.24	653.81	1,176.92
358.85	62.06	136.83	653.80	1,176.91
360.15	61.54	135.67	653.82	1,176.94
360.25	60.92	134.31	653.81	1,176.92

Integral Mass and Energy Release at the End of Reflood and Post-reflood

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	58,868.73	129,784.00	42.157	167.303
360.25	89,568.60	197,466.00	62.874	249.519

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Table 6.2.1-6 (7 of 25)

Double-Ended Discharge Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
28.05	0.00	0.00	0.00	0.00
28.15	465.09	1,025.35	317.38	571.31
28.25	2,031.84	4,479.47	111.51	200.73
32.25	1,881.58	4,148.19	115.85	208.55
36.25	1,752.17	3,862.90	119.91	215.84
40.25	1,649.04	3,635.52	123.34	222.02
44.25	1,558.85	3,436.70	126.67	228.02
48.25	1,479.16	3,261.00	129.90	233.84
49.15	1,462.46	3,224.20	130.61	235.12
49.25	1,460.64	3,220.17	130.69	235.26
49.35	458.73	1,011.34	50.40	90.72
49.45	458.43	1,010.68	50.40	90.73
79.45	405.29	893.52	50.78	91.41
109.45	372.58	821.40	51.13	92.04
139.45	355.00	782.64	51.47	92.65
169.45	347.92	767.04	51.82	93.28
199.65	348.35	767.98	52.17	93.91
199.75	348.36	768.00	52.17	93.91
199.85	436.54	962.41	52.17	93.91
209.55	421.82	929.96	52.30	94.14
218.85	408.81	901.28	52.42	94.36
228.15	396.07	873.19	52.54	94.58
237.45	383.64	845.78	52.66	94.80
246.95	371.23	818.43	52.79	95.04
247.05	362.82	799.88	52.80	95.04
247.15	322.92	711.93	52.80	95.04
247.45	346.30	763.46	52.80	95.05
247.75	334.13	736.63	52.81	95.06
248.35	342.38	754.83	52.81	95.05

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Table 6.2.1-6 (8 of 25)

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Double-Ended Discharge Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
248.45	339.48	748.43	52.81	95.06
251.95	285.14	628.62	52.84	95.12
255.65	217.96	480.53	52.91	95.24
259.15	170.21	375.26	52.97	95.35
262.65	134.28	296.03	53.04	95.47
266.15	105.35	232.26	53.11	95.60
269.65	80.04	176.45	53.18	95.73
273.15	56.26	124.04	53.25	95.86
276.65	32.68	72.05	53.33	96.00
280.15	8.06	17.77	53.42	96.17
281.05	1.42	3.13	53.35	96.04
281.15	0.67	1.48	53.30	95.95
281.25	0.00	0.00	0.00	0.00
360.15	0.00	0.00	0.00	0.00
360.25	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	92,597.23	204,143.00	7.278	28.883
360.25	116,570.82	256,996.00	8.538	33.885

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Table 6.2.1-6 (9 of 25)

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Double-Ended Discharge Leg Slot Break – Maximum SIS FlowPart A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
199.75	0.00	0.00	0.00	0.00
237.45	0.00	0.00	0.00	0.00
246.95	0.00	0.00	0.00	0.00
247.05	1.56	3.44	144.40	259.94
247.15	1.34	2.95	144.12	259.42
247.45	11.85	26.13	144.31	259.78
247.75	14.31	31.54	144.32	259.78
248.35	25.15	55.44	144.33	259.81
248.45	26.33	58.04	144.33	259.82
251.95	105.95	233.57	144.33	259.81
255.65	195.79	431.64	144.33	259.81
259.15	255.18	562.58	144.33	259.81
262.65	297.37	655.60	144.33	259.81
266.15	329.09	725.53	144.33	259.81
269.65	355.09	782.85	144.33	259.81
273.15	378.24	833.87	144.33	259.81
276.65	400.35	882.62	144.33	259.81
280.15	422.94	932.43	144.33	259.81
281.05	429.00	945.79	144.33	259.81
281.15	429.68	947.29	144.33	259.81
281.25	430.37	948.80	144.33	259.81
283.65	443.10	976.88	144.33	259.81
285.15	445.06	981.20	144.33	259.81
285.25	447.57	986.72	144.33	259.81
285.35	454.00	1,000.91	144.33	259.81
288.85	393.41	867.32	144.33	259.81
292.35	317.04	698.95	144.33	259.81
295.85	590.86	1,302.64	144.33	259.81
299.35	708.55	1,562.09	144.33	259.81

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Table 6.2.1-6 (10 of 25)

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Double-Ended Discharge Leg Slot Break – Maximum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
302.85	258.24	569.32	144.33	259.81
306.35	616.82	1,359.86	144.33	259.81
309.85	685.57	1,511.42	144.33	259.81
313.35	272.19	600.09	144.33	259.81
316.85	646.62	1,425.56	144.33	259.81
320.35	670.59	1,478.41	144.33	259.81
323.85	282.38	622.54	144.33	259.81
327.35	667.62	1,471.85	144.33	259.81
330.85	732.92	1,615.81	144.33	259.81
334.35	311.70	687.18	144.33	259.81
337.85	825.46	1,819.83	144.33	259.81
341.35	305.77	674.11	144.33	259.81
344.85	184.18	406.04	144.33	259.81
348.35	922.54	2,033.86	144.33	259.81
351.85	685.61	1,511.51	144.33	259.81
355.35	84.80	186.95	144.33	259.81
358.85	774.68	1,707.88	144.33	259.81
360.15	772.81	1,703.77	144.33	259.81
360.25	755.90	1,666.49	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	0.00	0.00	0.000	0.000
360.25	50,583.00	111,517.00	7.301	28.973

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Table 6.2.1-7 (6 of 20)

Part A: Mass and Energy Release Data
(Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	keal/kg	Btu/lbm
378.95	75.53	166.52	653.81	1,176.93
383.45	71.64	157.95	653.80	1,176.91
387.95	68.51	151.03	653.83	1,176.96
392.45	66.45	146.49	653.82	1,176.94
396.95	65.09	143.50	653.80	1,176.90
401.45	64.25	141.65	653.82	1,176.94
405.85	63.82	140.70	653.82	1,176.95
420.95	64.11	141.33	653.82	1,176.94
436.05	65.64	144.71	653.83	1,176.96
451.15	67.51	148.83	653.82	1,176.95
466.25	69.38	152.95	653.82	1,176.95
481.35	71.13	156.82	653.79	1,176.90
496.45	72.73	160.35	653.80	1,176.90
511.55	74.18	163.53	653.82	1,176.95
527.25	75.52	166.50	653.80	1,176.90
529.25	76.85	169.42	653.83	1,176.96
529.45	74.65	164.57	653.80	1,176.90
532.45	68.85	151.79	653.79	1,176.90
535.45	64.72	142.68	653.79	1,176.90
538.45	61.84	136.33	653.81	1,176.92
541.45	59.72	131.67	653.82	1,176.95
544.45	58.10	128.10	653.80	1,176.90
547.45	56.81	125.25	653.82	1,176.95
549.05	56.22	123.95	653.84	1,176.98
549.15	56.19	123.88	653.80	1,176.91

~~Table 6.2.1-7 (7 of 20)~~~~Integral Mass and Energy Release at the End of Reflood and Post-reflood~~

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
200.05	59,016.59	130,110.00	42.263	167.725
549.15	102,624.29	226,249.00	71.416	283.419

~~Part A: Mass and Energy Release Data (Spillage)~~

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
End of Blowdown at 19.752	0.00	0.00	0.000	0.000
End of Reflood at 200.05	68,418.02	150,836.71	5.952	23.619
End of Post-reflood at 549.15	147,783.03	325,807.51	13.702	54.378

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The page numbers of Table 6.2.1-7 should be readjusted as follows:

(1 of 20)-->(1 of 23)	(13 of 20)-->(16 of 23)
(2 of 20)-->(2 of 23)	(14 of 20)-->(17 of 23)
(3 of 20)-->(3 of 23)	(15 of 20)-->(18 of 23)
(4 of 20)-->(4 of 23)	(16 of 20)-->(19 of 23)
(5 of 20)-->(5 of 23)	(17 of 20)-->(20 of 23)
(6 of 20)-->(6 of 23)	(18 of 20)-->(21 of 23)
(7 of 20)-->(7 of 23)	(19 of 20)-->(22 of 23)
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(9 of 20)-->(12 of 23)	
(10 of 20)-->(13 of 23)	
(11 of 20)-->(14 of 23)	
(12 of 20)-->(15 of 23)	

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Table 6.2.1-7 (6 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS Flow

Part A: Mass and Energy Release Data (Reflood and Post-reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
396.95	65.09	143.50	653.80	1,176.90
401.45	64.25	141.65	653.82	1,176.94
405.85	63.82	140.70	653.82	1,176.95
420.95	64.11	141.33	653.82	1,176.94
436.05	65.64	144.71	653.83	1,176.96
451.15	67.51	148.83	653.82	1,176.95
466.25	69.38	152.95	653.82	1,176.95
481.35	71.13	156.82	653.79	1,176.90
496.45	72.73	160.35	653.80	1,176.90
511.55	74.18	163.53	653.82	1,176.95
527.25	75.52	166.50	653.80	1,176.90
529.25	76.85	169.42	653.83	1,176.96
529.45	74.65	164.57	653.80	1,176.90
532.45	68.85	151.79	653.79	1,176.90
535.45	64.72	142.68	653.79	1,176.90
538.45	61.84	136.33	653.81	1,176.92
541.45	59.72	131.67	653.82	1,176.95
544.45	58.10	128.10	653.80	1,176.90
547.45	56.81	125.25	653.82	1,176.95
549.05	56.22	123.95	653.84	1,176.98
549.15	56.19	123.88	653.80	1,176.91

Integral Mass and Energy Release at the End of Reflood and Post-reflood

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
200.05	59,016.59	130,110.00	42.263	167.725
549.15	102,624.29	226,249.00	71.416	283.419

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Table 6.2.1-7 (7 of 23)

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Double-Ended Discharge Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
28.65	0.00	0.00	0.00	0.00
28.75	982.13	2,165.23	176.82	318.29
28.85	1,872.03	4,127.14	116.76	210.18
32.85	1,726.42	3,806.13	121.70	219.07
36.85	1,601.07	3,529.78	126.34	227.42
40.85	1,500.09	3,307.16	130.44	234.81
44.85	1,411.63	3,112.13	134.47	242.06
48.85	1,333.32	2,939.49	138.42	249.17
49.15	1,327.80	2,927.32	138.71	249.70
49.25	1,325.98	2,923.29	138.81	249.88
49.35	324.19	714.71	50.19	90.35
49.45	323.91	714.10	50.19	90.35
79.45	270.47	596.28	50.46	90.83
109.45	237.59	523.79	50.72	91.30
139.45	219.90	484.79	50.98	91.76
169.45	212.74	469.02	51.24	92.24
199.45	213.10	469.81	51.52	92.74
199.95	213.16	469.93	51.52	92.75
200.05	213.17	469.96	51.52	92.75
200.15	301.41	664.49	51.52	92.75
211.85	283.93	625.97	51.64	92.97
223.55	267.62	590.00	51.77	93.19
235.25	251.83	555.19	51.90	93.42
246.95	235.25	518.65	52.03	93.66
247.05	227.58	501.74	52.03	93.67
247.15	186.57	411.32	52.04	93.67
247.75	198.69	438.03	52.04	93.68
248.25	208.42	459.50	52.04	93.68

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Table 6.2.1-7 (8 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
249.35	199.33	439.46	52.04	93.68
253.35	121.35	267.54	52.09	93.76
257.35	55.69	122.77	52.15	93.87
261.35	8.28	18.26	52.22	94.01
262.15	0.44	0.98	52.32	94.18
262.25	0.00	0.00	0.00	0.00
549.05	0.00	0.00	0.00	0.00
549.15	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
200.05	68,418.16	150,837.00	5.952	23.619
549.15	82,592.84	182,087.00	6.686	26.533

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Table 6.2.1-7 (9 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
246.95	0.00	0.00	0.00	0.00
247.05	2.51	5.53	144.38	259.89
247.15	1.81	3.99	144.26	259.67
247.75	14.24	31.40	144.31	259.77
248.25	23.79	52.44	144.33	259.81
249.35	38.51	84.91	144.33	259.81
253.35	145.68	321.17	144.33	259.80
257.35	230.21	507.52	144.33	259.81
261.35	287.14	633.04	144.33	259.81
262.15	296.14	652.89	144.33	259.81
262.25	297.23	655.28	144.33	259.81
265.35	320.26	706.05	144.33	259.81
269.35	333.38	734.97	144.33	259.81
273.35	339.04	747.47	144.33	259.81
274.85	336.76	742.44	144.33	259.81
274.95	340.46	750.60	144.33	259.81
286.65	305.12	672.68	144.33	259.81
298.35	569.95	1,256.53	144.33	259.81
310.05	527.14	1,162.15	144.33	259.81
321.75	506.43	1,116.49	144.33	259.81
333.45	491.70	1,084.01	144.33	259.81
345.15	479.51	1,057.15	144.33	259.81
356.85	469.28	1,034.58	144.33	259.81
368.55	355.57	783.90	144.33	259.81
374.35	146.61	323.22	144.33	259.81
374.45	144.26	318.05	144.33	259.81
378.95	136.87	301.74	144.33	259.81
383.45	135.81	299.41	144.33	259.81

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Table 6.2.1-7 (10 of 23)

Double-Ended Discharge Leg Slot Break – Minimum SIS Flow

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
387.95	135.90	299.60	144.33	259.81
392.45	132.30	291.68	144.33	259.80
396.95	130.69	288.12	144.33	259.81
401.45	129.71	285.97	144.33	259.81
405.85	128.89	284.15	144.33	259.81
420.95	126.41	278.68	144.33	259.81
436.05	124.27	273.96	144.33	259.81
451.15	122.39	269.82	144.33	259.81
466.25	120.73	266.17	144.33	259.80
481.35	119.26	262.93	144.33	259.81
496.45	117.96	260.06	144.33	259.81
511.55	116.81	257.53	144.33	259.81
527.25	115.76	255.21	144.33	259.81
529.25	117.75	259.60	144.33	259.81
529.45	121.82	268.57	144.33	259.81
532.45	131.37	289.62	144.33	259.81
535.45	135.70	299.17	144.33	259.81
538.45	138.36	305.04	144.33	259.80
541.45	139.91	308.44	144.33	259.81
544.45	140.79	310.38	144.33	259.80
547.45	141.29	311.49	144.33	259.81
549.05	141.47	311.90	144.33	259.81
549.15	141.48	311.92	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
200.05	0.00	0.00	0.000	0.000
549.15	65,190.41	143,721.00	9.409	37.340

The cases presented in this analysis show the mass/energy source terms with maximum safety injection (no pump failure or no power source failure) and minimum safety injection (failure of one diesel generator). Since the peak containment pressure is a function of both the release rates and the containment parameters, the effects of the various single failures are estimated to find out the limiting single failure for the analysis.

3.10 Metal-Water Reaction

According to 10 CFR 50, Appendix K, the additional source energy by the metal-water reaction should be considered in LOCA mass and energy analysis. A bounding calculation, not dependent on the Appendix K metal-water correlation, assumes the maximum allowable one percent zirconium-water reaction. This bounding calculation is based on a zirconium mass in the active core of []^{TS} Using a molecular weight of 91.22 for zirconium and reaction energy of []^{TS} the 1 percent metal-water reaction produces []^{TS}

The metal-water reaction energy is added to the energy release rate and assumed to be uniformly distributed over a period no longer than 2 minutes following the end of blowdown (Reference 5). If the peak pressure time is earlier than the 2 minutes after the end of blowdown (EOB), the peak pressure time is conservatively assumed to be the end of the metal-water reaction.

The results of containment pressure and temperature (P/T) analysis with 1 percent metal-water reaction are provided in Figure 3-3 and Table 3-1. Figure 3-3 shows the results of containment P/T analysis for the limiting case (DEDLSB with maximum SI) and provides comparison with containment P/T results of the APR1400 DCD (Figure 6.2.1-3). Table 3-1 shows the results of containment P/T analysis for all cases of LOCA and comparison with those (Table 6.2.1-19) of the APR1400 DCD.

The metal-water reaction energy is less than []^{TS} of the total amount of energy released to the time of peak containment pressure during the limiting LOCA. The total energy released to the peak pressure time at []^{TS} based on Table 4-2 (sh. 21 of 21) is []^{TS} This metal-water reaction energy causes an increase of []^{TS} of the containment peak pressure. Even if this bounding metal-water reaction is assumed to occur, the metal-water reaction energy will have little effect on the containment pressures. Detailed quantitative descriptions of the metal-water reaction analysis are provided in Reference 3.

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Actually, the maximum fuel clad temperature is only []^{TS} during the limiting LOCA transient. This fuel clad temperature is not so high enough to enable the metal-water reaction to occur in this analysis. Therefore the metal-water reaction energy is not included in the mass/energy source terms of the APR1400 DCD.

3.11 Evaluation of Effects from the Advanced Design Features

3.11.1 Effect of Fluidic Device Controlled by K-Factor

In the APR1400 design, a fluidic device (FD) is employed for control of safety injection tank (SIT) flow during a large break LOCA. The fluidic device is a safety-related component and is installed in the SIT as shown in Figure 2-8. It passively controls the SIT injection flow in two operation stages, high-flow injection initially, and then low-flow injection, according to the SIT water level.

High flow : This stage occurs when the SIT water level is above the entrance of stand pipe of the fluidic device and SIT inventory is supplied into both the main port and the four control ports. The condensing fraction is assumed to be []^{TS} during the period of high-flow injection from the time that the RV annulus is full until the SIT water level decreases below the top of the stand pipe of FD.

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (6 of 21)

Part A: Mass and Energy Release Data (Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
313.35	109.25	240.86	653.81	1,176.93
316.85	206.98	456.31	653.82	1,176.94
320.35	102.22	225.36	653.83	1,176.96
323.85	98.81	217.83	653.82	1,176.95
327.35	184.79	407.40	653.81	1,176.93
330.85	93.68	206.52	653.81	1,176.93
334.35	92.15	203.15	653.82	1,176.95
337.85	124.24	273.90	653.81	1,176.93
341.35	130.69	288.13	653.81	1,176.93
344.85	111.96	246.84	653.81	1,176.93
348.35	72.51	159.86	653.81	1,176.93
351.85	72.00	158.74	653.80	1,176.90
355.35	116.68	257.24	653.81	1,176.92
358.85	62.06	136.83	653.80	1,176.91
360.15	61.54	135.67	653.82	1,176.94
360.25	60.92	134.31	653.81	1,176.92

All the pages of Table 4-2 do not contains the proprietary data.
The data in this table are based on those of Table 6.2.1-6 of
APR1400 DCD.

Delete this page and replace with the following one page.

The page numbers of Table 4-2 should be readjusted as follows:

(1 of 21)-->(1 of 24)	(13 of 21)-->(16 of 24)
(2 of 21)-->(2 of 24)	(14 of 21)-->(17 of 24)
(3 of 21)-->(3 of 24)	(15 of 21)-->(18 of 24)
(4 of 21)-->(4 of 24)	(16 of 21)-->(19 of 24)
(5 of 21)-->(5 of 24)	(17 of 21)-->(20 of 24)
(6 of 21)-->(6 of 24)	(18 of 21)-->(21 of 24)
(7 of 21)-->(7 of 24)	(19 of 21)-->(22 of 24)
insert (8 of 24)	(20 of 21)-->(23 of 24)
insert (9 of 24)	(21 of 21)-->(24 of 24)
insert (10 of 24)	
(8 of 21)-->(11 of 24)	
(9 of 21)-->(12 of 24)	
(10 of 21)-->(13 of 24)	
(11 of 21)-->(14 of 24)	
(12 of 21)-->(15 of 24)	

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (6 of 24)

Insert this page.

Part A: Mass and Energy Release Data (Reflood and Post-Reflood Period)

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
313.35	109.25	240.86	653.81	1,176.93
316.85	206.98	456.31	653.82	1,176.94
320.35	102.22	225.36	653.83	1,176.96
323.85	98.81	217.83	653.82	1,176.95
327.35	184.79	407.40	653.81	1,176.93
330.85	93.68	206.52	653.81	1,176.93
334.35	92.15	203.15	653.82	1,176.95
337.85	124.24	273.90	653.81	1,176.93
341.35	130.69	288.13	653.81	1,176.93
344.85	111.96	246.84	653.81	1,176.93
348.35	72.51	159.86	653.81	1,176.93
351.85	72.00	158.74	653.80	1,176.90
355.35	116.68	257.24	653.81	1,176.92
358.85	62.06	136.83	653.80	1,176.91
360.15	61.54	135.67	653.82	1,176.94
360.25	60.92	134.31	653.81	1,176.92

Integral Mass and Energy Release at the End of Reflood and Post-Reflood

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	58,868.73	129,784.00	42.157	167.303
360.25	89,568.60	197,466.00	62.874	249.519

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (7 of 21)

Integral Mass and Energy Release at the End of Reflood and Post-Reflood

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	58,868.73	129,784.00	42.157	167.303
360.25	89,568.60	197,466.00	62.874	249.519

Part A : Mass/Energy Release Data (Spillage)

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
End of Blowdown at 19.752	0.00	0.00	0.000	0.000
End of Reflood at 199.75	92,597.37	204,143.33	9.303	36.919
End of Post-Reflood at 360.25	167,154.03	368,513.48	14.869	59.008

All the pages of Table 4-2 do not contains the proprietary data.
The data in this table are based on those of Table 6.2.1-6 of
APR1400 DCD.

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subsequent page numbers should be readjusted.

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (7 of 24)

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Insert this page.

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
28.05	0.00	0.00	0.00	0.00
28.15	465.09	1,025.35	317.38	571.31
28.25	2,031.84	4,479.47	111.51	200.73
32.25	1,881.58	4,148.19	115.85	208.55
36.25	1,752.17	3,862.90	119.91	215.84
40.25	1,649.04	3,635.52	123.34	222.02
44.25	1,558.85	3,436.70	126.67	228.02
48.25	1,479.16	3,261.00	129.90	233.84
49.15	1,462.46	3,224.20	130.61	235.12
49.25	1,460.64	3,220.17	130.69	235.26
49.35	458.73	1,011.34	50.40	90.72
49.45	458.43	1,010.68	50.40	90.73
79.45	405.29	893.52	50.78	91.41
109.45	372.58	821.40	51.13	92.04
139.45	355.00	782.64	51.47	92.65
169.45	347.92	767.04	51.82	93.28
199.65	348.35	767.98	52.17	93.91
199.75	348.36	768.00	52.17	93.91
199.85	436.54	962.41	52.17	93.91
209.55	421.82	929.96	52.30	94.14
218.85	408.81	901.28	52.42	94.36
228.15	396.07	873.19	52.54	94.58
237.45	383.64	845.78	52.66	94.80
246.95	371.23	818.43	52.79	95.04
247.05	362.82	799.88	52.80	95.04
247.15	322.92	711.93	52.80	95.04
247.45	346.30	763.46	52.80	95.05
247.75	334.13	736.63	52.81	95.06
248.35	342.38	754.83	52.81	95.05

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (8 of 24)

Part A: Spillage Release Data (Reactor Vessel Side)
(Reflood and Post-Reflood Period)

Insert this page.

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
248.45	339.48	748.43	52.81	95.06
251.95	285.14	628.62	52.84	95.12
255.65	217.96	480.53	52.91	95.24
259.15	170.21	375.26	52.97	95.35
262.65	134.28	296.03	53.04	95.47
266.15	105.35	232.26	53.11	95.60
269.65	80.04	176.45	53.18	95.73
273.15	56.26	124.04	53.25	95.86
276.65	32.68	72.05	53.33	96.00
280.15	8.06	17.77	53.42	96.17
281.05	1.42	3.13	53.35	96.04
281.15	0.67	1.48	53.30	95.95
281.25	0.00	0.00	0.00	0.00
360.15	0.00	0.00	0.00	0.00
360.25	0.00	0.00	0.00	0.00

Integral Mass and Energy (Reactor Vessel Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	92,597.23	204,143.00	7.278	28.883
360.25	116,570.82	256,996.00	8.538	33.885

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (9 of 24)

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Insert this page.

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
19.75	0.00	0.00	0.00	0.00
19.85	0.00	0.00	0.00	0.00
199.75	0.00	0.00	0.00	0.00
237.45	0.00	0.00	0.00	0.00
246.95	0.00	0.00	0.00	0.00
247.05	1.56	3.44	144.40	259.94
247.15	1.34	2.95	144.12	259.42
247.45	11.85	26.13	144.31	259.78
247.75	14.31	31.54	144.32	259.78
248.35	25.15	55.44	144.33	259.81
248.45	26.33	58.04	144.33	259.82
251.95	105.95	233.57	144.33	259.81
255.65	195.79	431.64	144.33	259.81
259.15	255.18	562.58	144.33	259.81
262.65	297.37	655.60	144.33	259.81
266.15	329.09	725.53	144.33	259.81
269.65	355.09	782.85	144.33	259.81
273.15	378.24	833.87	144.33	259.81
276.65	400.35	882.62	144.33	259.81
280.15	422.94	932.43	144.33	259.81
281.05	429.00	945.79	144.33	259.81
281.15	429.68	947.29	144.33	259.81
281.25	430.37	948.80	144.33	259.81
283.65	443.10	976.88	144.33	259.81
285.15	445.06	981.20	144.33	259.81
285.25	447.57	986.72	144.33	259.81
285.35	454.00	1,000.91	144.33	259.81
288.85	393.41	867.32	144.33	259.81
292.35	317.04	698.95	144.33	259.81
295.85	590.86	1,302.64	144.33	259.81
299.35	708.55	1,562.09	144.33	259.81

Table 4-2 Double-Ended Discharge Leg Slot Break - Maximum SIS Flow (10 of 24)

Part A: Spillage Release Data (Steam Generator Side)
(Reflood and Post-Reflood Period)

Insert this page.

Time (sec)	Break Mass Flow Rate		Break Enthalpy	
	kg/sec	lbm/sec	kcal/kg	Btu/lbm
302.85	258.24	569.32	144.33	259.81
306.35	616.82	1,359.86	144.33	259.81
309.85	685.57	1,511.42	144.33	259.81
313.35	272.19	600.09	144.33	259.81
316.85	646.62	1,425.56	144.33	259.81
320.35	670.59	1,478.41	144.33	259.81
323.85	282.38	622.54	144.33	259.81
327.35	667.62	1,471.85	144.33	259.81
330.85	732.92	1,615.81	144.33	259.81
334.35	311.70	687.18	144.33	259.81
337.85	825.46	1,819.83	144.33	259.81
341.35	305.77	674.11	144.33	259.81
344.85	184.18	406.04	144.33	259.81
348.35	922.54	2,033.86	144.33	259.81
351.85	685.61	1,511.51	144.33	259.81
355.35	84.80	186.95	144.33	259.81
358.85	774.68	1,707.88	144.33	259.81
360.15	772.81	1,703.77	144.33	259.81
360.25	755.90	1,666.49	144.33	259.81

Integral Mass and Energy (Steam Generator Side Spillage) at EOR and EOPR

Time (sec)	Integral Mass		Integral Energy	
	kg	lbm	Million kcal	Million Btu
199.75	0.00	0.00	0.000	0.000
360.25	50,583.00	111,517.00	7.301	28.973