
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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

Docket No. 52-046

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Question No. 19-56

10 CFR 52.47(a)(27) requires that a standard design certification applicant provide a description of the design-specific PRA and its results.

APR1400 design control document (DCD) Rev. 0, Tables 19.1-29 and -30, provide Summary of Source Term Evaluation and Source Term Category Frequencies and Contributions to large release frequency (LRF) for internal events. However, similar information is not provided in the DCD for internal fire and internal flooding. Update the DCD providing similar tables for internal fire and internal flooding.

Response

The Table 19.1-29 shows the summary of source term evaluation not only for internal events, but also for internal fire & flooding events. In the APR1400 At-power Level 2 PRA, the accident scenarios for internal fire events and internal flooding events are assigned to the same STC (i.e., source term category) grouping logic which is used for internal events. Per the definition of source term category, a particular release category includes the accident scenarios which have similar source term governing characteristics. The source term is the result of the MAAP analysis and presents the release fraction of the initial core inventory which is released to the environment as a function of time. To characterize the source term associated with each release category, a single representative sequence was chosen for each release category by using MAAP code. Therefore, the source term for each STC represent various sequences assigned to each STC resulting from the internal events as well as internal fire & flooding events.

New tables regarding the summary of STC frequencies for At-power Internal Fire Events and Internal Flooding Events (i.e., similar information with Table 19.1-30) will be included in APR1400 DCD 19.1 as shown in the Attachment.

Impact on DCD

The DCD will be revised to reflect the response of this RAI as shown in the Attachment.

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

There is no impact on any Technical, Topical, or Environment Report.

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due to steam overpressurization. In this category, there is no significant fission product release to the environment due to a wet cavity. However, the releases are not scrubbed by the containment sprays.

The summary of the MAAP results (release magnitude and timing) and release categorization (i.e., large release, large early release, or not large release) is presented in Table 19.1-29 and ~~Table 19.1-30.~~

through 19.1-30b

19.1.4.2.2 Results from Level 2 Internal Events PRA for Operations at Power

It should be noted that units for CDF and LRF are expressed in terms of “reactor calendar year” (shortened to “/year” when displayed in the text in this section).

19.1.4.2.2.1 Risk Metrics

Total LRF from internal events is 1.1×10^{-7} /year. This is well below the NRC goal for LRF below 1×10^{-6} /year. Mean value and associated uncertainty distribution can be found in Subsection 19.1.4.2.2.7.

The conditional containment failure probability (CCFP) from all internal events (at power) in large release sequences is 8.4×10^{-2} . This meets the NRC goal of no more than approximately 0.1 for CCFP. This CCFP is the conditional probability of a large release (CPLR) for operations at power.

19.1.4.2.2.2 Internal Events Core Damage Release Category Results

The relative contributions of the release categories to the total STC frequency are shown in Figure 19.1-49. Figure 19.1-50 groups the categories further into no containment failure, large release, and small release.

Approximately 49 percent of the LRF for internal events is from STC 1, which are unmitigated, unisolated SGTR releases (both SGTR initiating event and induced SGTR). The next-highest frequency STC is a late rupture with no containment sprays (27 percent), followed by containment failure (rupture) prior to core damage (12 percent), and containment failure (leak) prior to core damage (10 percent). Early containment rupture

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Table 19.1-30 (1 of 2)

Source Term Category Frequencies and Contributions to LRF for Internal Events

Source Term Category	Description	LRF, LERF or non-LRF	Frequency	% of total STC freq	% of total LRF
STC 1	SGTR w/o scrubbing	LRF / LERF	5.33E-08	4.1	48.5
STC 21	Late containment failure with a rupture failure size	LRF	2.96E-08	2.3	26.9
STC 8	CFBRB with a rupture failure size	LRF / LERF	1.30E-08	1.0	11.8
STC 7	CFBRB with a leak failure size	LRF	1.14E-08	0.9	10.4
STC 13	Early containment failure with a rupture failure size	LRF / LERF	1.79E-09	0.1	1.6
STC 6	Not isolation w/o CS	LRF / LERF	1.23E-09	0.1	1.1
STC 4	ISLOCA with scrubbing	LRF / LERF	6.49E-11	0.0	5.9E-02
STC 3	ISLOCA w/o scrubbing	LRF / LERF	5.31E-11	0.0	4.8E-02
STC 20	Late containment failure with a rupture failure size	LRF	1.19E-11	0.0	1.1E-02
STC 2	SGTR with scrubbing	Non-LRF	2.41E-08	1.8	
STC 5	Not isolation with CS	Non-LRF	2.46E-09	0.2	
STC 9	Intact containment w/o RPV breach	Non-LRF	3.67E-07	28	
STC 10	Intact containment with RPV breach	Non-LRF	7.64E-07	58.2	
STC 11	Basemat Melt-through	Non-LRF	1.33E-08	1.0	
STC 12	Early containment failure with a leak failure size	Non-LRF	0.00	0.0	
STC 14	Late containment failure with a leak failure size	Non-LRF	4.28E-11	0.0	

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Table 19.1-30 (2 of 2)

Source Term Category	Description	LRF, LERF or non-LRF	Frequency	% of total STC freq	% of total LRF
STC 15	Late containment failure with a leak failure size	Non-LRF	0.00	0.0	
STC 16	Late containment failure with a leak failure size	Non-LRF	7.30E-12	0.0	
STC 17	Late containment failure with a leak failure size	Non-LRF	2.70E-08	2.1	
STC 18	Late containment failure with a rupture failure size	Non-LRF	4.19E-10	0.0	
STC 19	Late containment failure with a rupture failure size	Non-LRF	4.01E-09	0.3	
Total frequency of all STCs			1.31E-06		
Total frequency of the Large Release STCs			1.10E-07		



Table Added
(19.1-30a, 19.1-30b)

Table 19.1-30a

Source Term Category Frequencies and Contributions to LRF for Internal Fire Events

Source Term Category	Description	LRF, LERF or non-LRF	Frequency	% of total STC freq	% of total LRF
STC 1	SGTR w/o scrubbing	LRF / LERF	8.31E-08	4.0	49.4
STC 21	Late containment failure with a rupture failure size	LRF	4.38E-08	2.1	26.1
STC 6	Not isolation w/o CS	LRF / LERF	2.60E-08	1.3	15.5
STC 8	CFBRB with a rupture failure size	LRF / LERF	6.16E-09	0.3	3.7
STC 7	CFBRB with a leak failure size	LRF	4.36E-09	0.2	2.6
STC 13	Early containment failure with a rupture failure size	LRF / LERF	3.71E-09	0.2	2.2
STC 20	Late containment failure with a rupture failure size	LRF	9.34E-10	0.0	0.6
STC 5	Not isolation with CS	Non-LRF	2.38E-08	1.2	
STC 9	Intact containment w/o RPV breach	Non-LRF	2.83E-07	13.7	
STC 10	Intact containment with RPV breach	Non-LRF	9.62E-07	46.6	
STC 11	Basemat Melt-through	Non-LRF	5.56E-07	26.9	
STC 14	Late containment failure with a leak failure size	Non-LRF	2.39E-09	0.1	
STC 16	Late containment failure with a leak failure size	Non-LRF	5.71E-10	0.0	
STC 17	Late containment failure with a leak failure size	Non-LRF	3.99E-08	1.9	
STC 18	Late containment failure with a rupture failure size	Non-LRF	2.34E-08	1.1	
STC 19	Late containment failure with a rupture failure size	Non-LRF	6.51E-09	0.3	
Total frequency of all STCs			2.07E-06		
Total frequency of the Large Release STCs			1.68E-07		

Table 19.1-30b

Source Term Category Frequencies and Contributions to LRF for Internal Flooding Events

Source Term Category	Description	LRF, LERF or non-LRF	Frequency	% of total STC freq	% of total LRF
STC 21	Late containment failure with a rupture failure size	LRF	8.70E-09	3.7	51.2
STC 1	SGTR w/o scrubbing	LRF / LERF	3.42E-09	1.5	20.2
STC 6	Not isolation w/o CS	LRF / LERF	3.29E-09	1.4	19.4
STC 8	CFBRB with a rupture failure size	LRF / LERF	5.94E-10	0.3	3.5
STC 7	CFBRB with a leak failure size	LRF	5.38E-10	0.2	3.2
STC 13	Early containment failure with a rupture failure size	LRF / LERF	4.33E-10	0.2	2.5
STC 20	Late containment failure with a rupture failure size	LRF	3.37E-12	0.0	2.0E-04
STC 5	Not isolation with CS	Non-LRF	3.86E-10	0.2	
STC 9	Intact containment w/o RPV breach	Non-LRF	2.39E-08	10.1	
STC 10	Intact containment with RPV breach	Non-LRF	1.82E-07	77.2	
STC 11	Basemat Melt-through	Non-LRF	2.92E-09	1.2	
STC 14	Late containment failure with a leak failure size	Non-LRF	8.73E-12	0.0	
STC 16	Late containment failure with a leak failure size	Non-LRF	2.06E-12	0.0	
STC 17	Late containment failure with a leak failure size	Non-LRF	7.93E-09	3.4	
STC 18	Late containment failure with a rupture failure size	Non-LRF	8.55E-11	0.0	
STC 19	Late containment failure with a rupture failure size	Non-LRF	1.53E-09	0.6	
Total frequency of all STCs			2.35E-07		
Total frequency of the Large Release STCs			1.70E-08		