
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.: 410-8357
SRP Section: SRP 19
Application Section: 19.1
Date of RAI Issue: 02/22/2015

Question No. 19-31

Item 11 of Section II, "Acceptance Criteria," of the (Draft) Revision 3 SRP, states, "The PRAs that meet the applicable supporting requirements for Capability Category I and meet the high level requirements as defined in the ASME PRA Standard (ASME/ANS RA-S-2008 and addenda ASME/ANS RA-Sa-2009) should generally be acceptable for DC and COL applications. Alternatively, the applicant may identify, and justify the acceptability of, alternative measures for addressing PRA quality and technical adequacy. The staff should specifically review the acceptability of these alternative measures in the context of the specific uses and applications of the PRA."

The staff reviewed the APR1400 design control document (DCD) Section 19.1.4.1.1, "Description of Level 1 Internal Events PRA for Operations at Power," and found insufficient information describing the initiating event analysis performed. Specifically, the estimated frequency for the inadvertent opening of a safety relief valve (this was included into small loss of coolant accident (SLOCA), partial loss of component cooling water (PLOCCW), partial loss of essential service water (PLOESW) and loss of instrument air (LOIA) were taken from calculations in PRA supporting documents and not taken from generic data as discussed in the DCD. Therefore, in order for the staff to reach an assurance finding on the conformance to SRP Chapter 19.0 regarding PRA technical adequacy, please resolve the inconsistency and revise the DCD accordingly.

Response

The mean frequency for a small LOCA (SLOCA) is $2.09\text{E-}03/\text{rcry}$, calculated as the sum of frequencies for a small LOCA, the expected annual frequency of the inadvertent opening of the POSRVs, and RCP seal LOCA catastrophic failure as follows;

- SLOCA frequency : $3.67\text{E-}04/\text{rcry}$ from NUREG/CR-6928
- RCP Seal LOCA frequency : $3.67\text{E-}04/\text{rcry}$ from NUREG/CR-6928 POSRVs

- Inadvertent Opening of the POSRVs : $3.88\text{E-}08/\text{hr}$ from vendor data $\times 8760\text{hr/rcry} \times 4$
POSRVs = $1.36\text{E-}03/\text{rcry}$

The support system initiating event fault tree for TLOCCW, PLOCCW, TLOESW, PLOESW and LOIA are developed to calculate supporting system initiating event frequencies. After review of both supporting system IE FT quantification results and NUREG/CR-6928 (Initiating Event Data Sheets - Update 2010), the larger value is used for each supporting system IE of APR1400 as follows;

SSIE	SSIE FT Quantification (/rcry)	NUREG/CR-6928 (/rcry)	Final SSIE Freq. (/rcy)	Remarks
PLOCCW	$4.59\text{E-}03$	$2.21\text{E-}03$	$4.36\text{E-}03$	[SSIE FT Quantification] * 0.95
TLOCCW	$1.33\text{E-}05$	$2.46\text{E-}04$	$2.34\text{E-}04$	[NUREG/CR-6928 Data] * 0.95
PLOESW	$2.65\text{E-}03$	$1.72\text{E-}03$	$2.52\text{E-}03$	[SSIE FT Quantification] * 0.95
TLOESW	$6.63\text{E-}05$	$2.46\text{E-}04$	$2.34\text{E-}04$	[NUREG/CR-6928 Data] * 0.95
LOIA	$2.83\text{E-}02$	$8.22\text{E-}03$	$2.69\text{E-}02$	[SSIE FT Quantification] * 0.95

The initiating event frequencies are described on Table 19.1-6 in DCD 19.1 and the additional information for calculation of initiating events frequencies are included as Notes on Table 19.1-6. The Notes are revised to clearly explain the calculation of initiating events frequencies.

Impact on DCD

Table 19.1-6 will be revised to reflect the response 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.

APR1400 DCD TIER 2

Table 19.1-6 (2 of 2)

Designator	Initiating Event Description	Mean Frequency (Per Rx Critical Year) ⁽¹⁾	Mean Frequency (Per Rx Calendar Year) ⁽²⁾	Error Factor
LOOP-WE	Weather-related	3.91E-03	3.71E-03	1.7
SBO	Station Blackout	Transferred from LOOP Event Tree		1.7
LOIA ^{(3) (4)}	Loss of Instrument Air System	2.48E-02	2.69E-02	2.1
TLOCCW ^{(3) (4)}	Total Loss of Component Cooling Water System	2.46E-04	2.34E-04	8.4
PLOCCW ^{(3) (4)}	Partial Loss of Component Cooling Water System	4.59E-03	4.36E-03	2.0
TLOESW ^{(3) (4)}	Total Loss of Essential Service Water System	2.46E-04	2.34E-04	8.4
PLOESW ^{(3) (4)}	Partial Loss of Essential Service Water System	1.72E-3	2.52E-03	2.6
RVR ^{(4) (5)}	Reactor Vessel Rupture	3.22E-08	3.06E-08	67.5
ISLOCA ^{(6) (6)}	Interfacing System Loss of Coolant Accident	1.24E-10	1.18E-10	10.0

- (1) ~~The mean frequencies for these initiating events are values presented in Reference 11 in units of per reactor critical year (rery). (Excludes frequencies for ISLOCA, and reactor vessel rupture, which are separately calculated.)~~
- (2) ~~The mean frequencies for these initiating events were adjusted to an APR1400 specific per reactor calendar year (rey). Converting to APR1400 specific reactor calendar year (rey), it was assumed the reactor is critical 95% of the year. Converting to rey, the result is:

$$(\text{Mean Initiating Event Frequency/rery}) \times (0.95 \text{ rery/rey}) = \text{Mean Initiating Event Frequency/rey}$$~~
- (3) ~~APR1400 LOCA break size from generic industry data. These LOCA initiating event frequencies are used as an estimate for APR1400 LOCA frequencies. Support system initiating event frequencies (/rery) for LOIA, TLOCCW, PLOCCW, TLOESW, and PLOESW are calculated using fault trees in the initiating event analysis for information purposes. However, industry values for these parameters are utilized in the quantified PRA model.~~
- (4) ~~Reactor Vessel Rupture frequency (2.90E-08/rey) was taken from NUREG-1829, Volume 1, Table 7-19, for break sizes > 31 inches (Reference 52). This value was treated similarly to other LOCA frequencies, converting to per reactor critical year by multiplying by 1 rey/0.9 rery.~~
- (5) ~~The ISLOCA initiating event frequency (/rey) is taken from calculation. No Error Factor (EF) is calculated for this initiating event frequency and thus an EF of 10 is assumed.~~

↖ Add A on next page

A

Notes:

1. The mean frequencies for these initiating events are values presented in Initiating Event Data Sheets -Update 2010 (Reference 11) in units of per reactor critical year (rcry).

*Excludes frequencies for fault tree calculated IEs LOIA, TLOCCW, PLOCCW, TLOESW, PLOESW, separately calculated ISLOCA, and reactor vessel rupture.
2. The mean frequencies for these initiating events were adjusted to an APR1400 specific per reactor calendar year (rcy's). Converting to APR1400 specific reactor calendar year (rcy), it was assumed the reactor is critical 95% of the year.

Converting to rcy, the result is:
$$(\text{Mean IE Frequency/rcry}) * (0.95\text{rcry/rcy}) = \text{Mean IE Frequency/rcy}$$
3. APR1400 LOCA break size definitions are unique for this plant design. These LOCA IE frequencies are used as an estimate for APR1400 LOCA frequencies.
4. Support system IE FT (/rcry) for LOIA, TLOCCW, PLOCCW, TLOESW, and PLOESW are developed to calculate supporting system IE frequencies. After review of both supporting system IE FT quantification results and Initiating Event Data Sheets - Update 2010 (Reference 11), the larger value is used for each supporting system IE of APR1400-DC. No Error Factors (EF) are calculated for these initiating event frequencies.
5. Reactor Vessel Rupture frequency (2.90E-08/rcy) was taken from NUREG-1829, Volume 1, Table 7.19 for break sizes > 31 inches. This value was treated similarly to other LOCA frequencies, converting to per reactor critical year by multiplying by 1 rcy/0.9 rcry.
6. The ISLOCA initiating event frequency is taken from the ISLOCA calculation. No Error Factor (EF) is calculated for this initiating event frequency.