REVISED 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.:	**417-8359**
SRP Section:	**SRP 19**
Application Section:	**19.1**
Date of RAI Issue:	**02/23/2016**

Question No. 19-42

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 success criteria analysis performed. Specifically, the applicant did not describe the reasonableness and acceptability of success criteria developed which were different from design basis analysis and success criteria analysis notebook referenced in the PRA summary report, APR1400-E-P-NR-14001-P. As an example, the large loss of coolant accident (LLOCA) PRA success criteria for safety injection pumps requires more pumps than the design basis requirement (ASME PRA Standard – SC-B5). Therefore, in order for the staff to reach an assurance finding on the conformance to SRP Chapter 19.0 regarding PRA technical adequacy, please provide an explanation for the differences and revise the DCD accordingly.

Response – (Rev.4)

During a consistency review of the DCD, it was identified that several items in DCD Table 19.1-8 were not up to date with respect to the APR1400 DC PRA latest success criteria analysis. These success criteria changes and clarifications were identified during both internal review of the PRA model, and the RAI process.

- The first change had to do with the losses of the ultimate heat sink (UHS) initiators (PLOCCW, PLOESW, TLOCCW and TLOESW). The initial APR1400 PRA model, based

on the reference plant PRA, only included SI pump room cooling via the cubicle coolers which are ultimately cooled via the UHS; hence, UHS failures directly impacted the SI pumps in the initial PRA model. However, for the APR1400 PRA updated model, SI pump room cooling can be adequately supplied by either the cubicle coolers, or the Auxiliary Building Controlled Area HVAC System (VK) which is independent of the UHS, and only requires electric power. Therefore, the PLOCCW, PLOESW, TLOCCW and TLOESW initiating events do not impact the SI pump success criteria. This is reflected in DCD Table 19.1-8 which adds PLOCCW, PLOESW, TLOCCW and TLOESW in the "Event Tree" column of the "1 of 4 SI pumps" success criteria row, and removes PLOCCW, PLOESW from the "Event Tree" column of the "1 of 2 SI pumps" success criteria row since all 4 SIPs are available for these initiators, so the success criteria is 1 of 4 SIPs. In addition, the original Note 1 which discussed this issue was removed.

- A new Note 1 was added to clarify that DVI LLOCAs affect the SIT and SIP LLOCA success criteria since these both inject via the DVI lines. Hence, if the LLOCA is in the DVI line, then 1 SIT and 1 SIP associated with the broken DVI line is lost out of the break, and the success criteria effectively changes to 2 of 3 available SITs and 2 of 3 available SIPs.

- Another change had to do with the design change modeled in the PRA update wherein the alternate AC (AAC) gas turbine generator can only supply power to either 1E 4kV SWGR SW01A or SW01B. Therefore, during SBO events (SBO or GRID-SBO), only the "A" and "B" SI pumps are available as the "C" and "D" SI pumps have no power source. This is reflected in DCD Table 19.1-8 which adds SBO and GRID-SBO in the "Event Tree" column of the "1 of 2 SI pumps" success criteria row, and also in the edited version of Note 2 which provides this clarification.

- Finally, to keep the table notes in order from top to bottom of the table, the new "Note 2" described above was added to the table. This resulted in the DCD Table 19.1-8 notes 2 and 3, being changed to notes 3 and 4. Notes 3 and 4 were also slightly edited to provide consistency in wording in the four notes (i.e., Condition A impacts component B. Therefore, the success criteria is effectively X of Y available components). Finally, Note 4 was also edited to provide clarification with respect to the conservative hot leg injection criteria used in the PRA.

Impact on DCD

The DCD Tier 2, Table19.1-8 and Table 19.1-12 will be marked up as shown in the Attachment 1 and Attachment 2.

Impact on PRA

There is an impact on the PRA. But it is very small and will not impact risk insights. This response will be reflected in the next revision of 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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Table 19.1-8 (4 of 6)

, PLOCCW, PLOESW, TLOCCW, TLOESW

Top Event	Top Event Description	Success Criteria	Event Trees
RCS Heat Removal			
SIT	Safety Injection Tanks inject borated water	2 of 4 SITs inject borated water (1)	LLOCA
SIS	SI pumps provides high pressure injection to make up lost RCS inventory	1 of 4 SI pumps provides DVI injection	FWLB, LSSB-D, LSSB-U, MLOCA, SGTR, SLOCA, PR-SL
		1 of 2 SI pumps provide DVI injection(1) (2)	~~PLOCCW, PLOESW~~ SBO, GRID-SBO
		2 of 4 SI pumps provide DVI injection (1)	LLOCA
SCSI	SC pump injection to RCS	1 of 2 SCS pumps provides injection from IRWST	SGTR, SLOCA
~~RF~~	IRWST refill during SGTR	Refill IRWST with borated water using CVCS	LSSB-D, SGTR
FEED	SI pump injection for feed and feed decay heat removal	1 of 4 SI pumps provides DVI injection	FWLB, GRID-LOOP, GTRN, LOCV, LOFW, LOIA, LSSB-D, LSSB-U LOOP, SBO, PLOCCW, PLOESW
		1 of 3 SI pumps provides DVI injection(2) (3)	LODCA, LODCB ~~LODCA(2), LODCB(2)~~
HIN	Hot leg injection to prevent boron precipitation	1 of 2 SI pumps provides hot leg injection(3) (4)	LLOCA
SDC	Shutdown cooling for long-term heat removal	1 of 2 SCS pumps provides injection from hot leg	LSSB-D, SGTR

~~(1) The division I of SI pumps are unavailable because PLOCCW or PLOESW causes the HVAC failure for division I of SI pumps. Therefore, the success criterion is 1 of 2 SI pumps on PLOCCW or PLOESW.~~

~~(2) One train of SI pumps is unavailable because LODCA or LODCB causes the starting failure of one train of SI pump. Therefore, the success criterion is 1 of 3 SI pumps on LODCA or LODCB.~~

~~(3) Two trains of SI pumps are used for Hot Leg Injection. Therefore, the success criterion is 1 of 2 SI pumps for Hot Leg Injection.~~

replace "A" in the next page

A

(1) For DVI line LLOCA, the SI Tank and Pump associated with the broken DVI line is assumed lost out of the break. ~~For cold leg LLOCA, the SI Tank and Pump which injects nearest the broken cold leg is assumed lost out of the break.~~ Hence, for ~~these two~~ DVI LLOCAs, the success criteria is effectively 2 of 3 available SI Tanks and 2 of 3 available SI pumps.

(2) The AAC can only power the A or B SI pump. Hence, for SBOs with the AAC available, the ~~the~~ criteria is effectively 1 of 2 available SI pumps.

(3) LODCA or B causes fail to start of SI pump A or B. Therefore, for LODCA or B, the success criterion is effectively 1 of 3 available SI pumps.

(4) For hot leg LLOCA, the SI Pump associated with the broken hot leg is assumed lost out of the break. Hence, for hot leg LLOCA, the success criterion is effectively 1 of 1 available SI pump.

Table 19.1-12

RELAP Thermal-Hydraulic Run Summaries

Two

Case	LOCA Size	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation
Large Break Loss of Coolant Accident – Safety Injection						
1(a)	Double-ended rupture (30 inch diameter)	~~Three~~ Safety Injection pumps Two Injection tanks	No Charging pumps No Auxiliary Feedwater pumps No Containment Spray pumps No Shutdown Cooling pumps (Sensitivity analysis with location is performed)	< 1400 K (< 2060°F)	Core damage prevented	N/A
Small Break Loss of Coolant Accident – ASC Timing						
1(b)	2 inch (0.02 ft2)	One Safety Injection tank	One AFW pump One SC pump One Atmospheric Dump Valve No Safety Injection pumps No Charging pumps No Containment Spray pumps	< 998.4 K	Core damage prevented	40 min
Double Ended Steam Generator Tube Rupture – ASC Timing						
1(c)	0.75 inch (one U-tube double-ended rupture)	MSSVs	One AFW pump One SC pump One Atmospheric Dump Valve No Safety Injection pumps No Charging pumps No Containment Spray pumps No Safety Injection Tanks	< 640 K	Core damage prevented	23 hrs
1(d)		One ADV opens on the ruptured SG		< 640 K	Core damage prevented	5 hrs