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. 19-39

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 how they determined the LOCA break sizes. During the PRA audit, the staff found LOCA break size information in the DCD that is inconsistent with the supporting information in the applicants PRA Notebooks. Therefore, in order for the staff to reach an assurance finding on the conformance to SRP Chapter 19.0 regarding PRA technical adequacy, please revise the DCD accordingly.

Response

Note 3 of Table 19.1-6 of the DCD states: "APR1400 LOCA break size from generic industry data" but it does not provide a source for this generic industry data. Table 19.1-6 of the DCD will be revised to identify that NUREG/CR-6928 was used as the generic industry source for the LOCA break sizes. However, note that Table 19.1-6 is already being edited in response to RAI 410-8357, Question 19-34, and Note 3 of the Table has changed. Therefore, in order to avoid confusion, this information will be added as Note 7 to the revised DCD Table 19.1-6 provided as Attachment of the response to RAI 410-8357, Question 19-34.

Impact on DCD

The DCD will be revised as stated in the response (refer to the Attachment of the response to RAI 410-8357, Question 19-34).

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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Application Section:	**19.1**
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Question No. 19-40

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 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, while the applicant identified the key operator actions in the DCD, the applicant did not describe how they determined the key operator actions. The staff did not find in the DCD where the key operator actions came from (source). The staff also did not find in the DCD the method/approach that was used to develop the key operator actions. Therefore, in order for the staff to reach an assurance finding on the conformance to SRP Chapter 19.0 regarding PRA technical adequacy, please revise the DCD accordingly.

Response

The list of "key operator actions" in paragraph d. of DCD Section 19.1.4.1.1.3 include actions that are required for success of the related functions in the accident sequences modeled in the event trees. Note that the list does not include all operator actions in the model. Rather, these operator actions play an important role in the accident sequence development, and failure of the human error is a direct contributor to the failure of its associated event tree node.

This list is relevant only to the accident sequence development, and should not be confused with the Key Operator Actions ordered by RAW and FV importance measures which are

contained in DCD Tables 19.1-24 and 19.1-25. Since not all accident sequences are equally important, some of these operator actions may not end up having a high RAW or FV.

Paragraph d. of DCD Section 19.1.4.1.1.3 will be revised to remove the word “key” and to provide additional explanation.

Impact on DCD

DCD 19.1.4.1.1.3 will be revised as stated in the response as shown in 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.

5) Heat removal from the RCS and containment

Table 19.1-8 shows the relation of these plant safety functions and the initiating events.

d. The identification of mitigating systems and operator actions

Mitigating event tree nodes (composed from system fault tree top gates) and associated success criteria are summarized in Table 19.1-8. The ~~key~~ operator actions necessary for success of event tree nodes are as follows:

Nodes	Operator Action
ASC	Operators to perform aggressive secondary cooldown
BLEED	Operators to open POSRVs for feed and bleed operation
EBR	Operators to perform emergency boration
ECLDN	Operators to cool down primary early phase during SGTR
HIN	Operators to realign SIS for hot leg injection
ISOL	Operators to isolate secondary line break
LCLDN	Operators to cool down primary late phase during SGTR
RF	Operators to refill IRWST
SCSI	Operators to perform injection using SCS
SDC	Operators to align SDC operation

e. The specification of appropriate mission time

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RAI No.: **417-8359**

SRP Section: **SRP 19**

Application Section: **19.1**

Date of RAI Issue: **02/23/2016**

Question No. 19-41

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 list of safety functions identified in the DCD success criteria analysis section is different from list of safety functions identified in the accident sequence analysis section of 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

There is not a great difference in the two safety functions as follows;

Safety Functions identified in Accident Sequence Analysis	Safety Functions identified in Success Criteria Analysis
a. Reactivity control	1) Control of reactivity
b. RCS pressure control	2) Control of RCS pressure
c. Preservation of RCS integrity	3) Preservation of RCS integrity

Safety Functions identified in Accident Sequence Analysis	Safety Functions identified in Success Criteria Analysis
d. RCS inventory control	4) Preservation of RCS inventory
e. RCS heat removal	5) Heat removal from RCS and containment
f. Containment heat removal	

Section 19.1.4.1.1.3.c of the DCD will be revised 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.

b. The specific plant parameter of core damage

The ASME/ANS PRA Standard defines core damage as the uncovery and heatup of the reactor core to the point at which prolonged oxidation and severe fuel damage are anticipated and involving enough of the core, if released, to result in offsite public health effects. For the purpose of the APR1400 PRA success criteria analysis, core damage commences at a peak clad temperature of 1,204.4 °C (2,200 °F) or greater. In the APR1400 success criteria analyses, a limit of 1,800 °F at the hottest core location was used to indicate the onset of core damage when calculated by MAAP. This value is deliberately less than the 10 CFR 50.46(b)(1) limit of 1,204.4 °C (2,200 °F) because the MAAP code used lumped core modeling, which compensates for some of the MAAP code simplifying assumptions, consistent with ASME/ANS PRA Standard requirement SC-A2. In all cases, core heat removal was either clearly lost or clearly maintained with respect to this 982.2 °C (1,800 °F) threshold.

Some success criteria calculations were performed using the RELAP code. Because the RELAP code has a detailed core model, these calculations used an acceptance criteria limit of 1,204.4 °C (2,200 °F) to identify the onset of core damage.

A containment failure could interfere with injection pathways to the point where the injection may be terminated. Containment failure is therefore considered to cause core damage.

c. The specification of core protection functions for core damage

~~Five~~ [Six] safety functions are identified and specified for each initiating event. The general safety functions specified for meeting the success criteria are as follows:

1) ~~Control of reactivity~~ [Reactivity control]

2) ~~Control of RCS pressure~~ [RCS pressure control]

3) ~~Preservation of RCS integrity~~ [Preservation of RCS integrity]

4) ~~Preservation of RCS inventory~~ [RCS inventory control]

RCS heat removal

5) ~~Heat removal from the RCS and containment~~

6) Containment heat removal

Table 19.1-8 shows the relation of these plant safety functions and the initiating events.

d. The identification of mitigating systems and operator actions

Mitigating event tree nodes (composed from system fault tree top gates) and associated success criteria are summarized in Table 19.1-8. The key operator actions are as follows:

Nodes	Operator Action
ASC	Operators to perform aggressive secondary cooldown
BLEED	Operators to open POSRVs for feed and bleed operation
EBR	Operators to perform emergency boration
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e. The specification of appropriate mission time