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.:	**434-8352**
SRP Section:	**SRP 19**
Application Section:	**19.1**
Date of RAI Issue:	**03/08/2016**

Question No. 19-87

10 CFR 52.47(b)(1) and 10 CFR 52.80(a) require, in part, that applications for a design certification (DC) include the inspections, tests, analyses and acceptance criteria (ITAAC) necessary to demonstrate that the facility has been constructed and will be operated in conformity with the NRC regulations. In addition, Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” indicates that “the important insights and assumptions from the PRA provided in DCD Chapter 19 should be used to determine the appropriate top-level design features for inclusion in Tier 1. A discussion of how the important insights or assumptions from the PRA should be addressed in the selection of the Tier 1 material. The important integrated plant safety analyses from Tier 2 should be considered, such as analyses of internal events, fires, floods, severe accidents, and shutdown risk.”

Accordingly, in order for the staff to reach a reasonable finding that the application includes the appropriate ITAAC associated with the PRA as noted above, please describe in detail how the APR1400 PRA was used in determining the scope of ITAAC and include the discussion in the DCD. In addition, the staff reviewed APR1400 DCD and could not find any ITAAC that were derived from the important PRA assumptions and insights, therefore, please revise the DCD to identify these ITAAC.

Response

DCD Chapter 19 provides descriptions, results and insights of the analyses that include internal events, fires, floods, severe accidents, and shutdown risk.

Table 14.3.4-2 summarizes the design information particularly significant to selection of design features for Tier 1 from the PRA. DCD Section 14.3 will be reviewed again to ensure that the ITAAC derived from the important PRA assumptions and insights are appropriately included, and revise the DCD to identify these ITAAC. The important insights and assumptions from the PRA provided in DCD Chapter 19 will be used to determine the appropriate top-level design features for inclusion in Tier 1.

Impact on DCD

There is no impact on the DCD.

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 Environmental Report.

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Question 19-89

10 CFR 52.47(a)(27) states that a DC application must contain an FSAR that includes a description of the design-specific PRA and its results. In addition, SRP Chapter 19.0, draft Revision 3, Section I, "Areas of Review," states "The purpose of the staff's review is to ensure that the applicant has adequately addressed the Commission's objectives regarding the appropriate way to address consideration of severe accidents and the use of PRA in the design and operation of facilities under review."

The staff reviewed APR1400 DCD Section 19.1.1, "Uses and Applications of the PRA," and found the following statement "At the design phase, the PRA results are used as information providing input to Technical Specifications (Chapter 16), reliability assurance program (RAP) (Section 17.4), human factors engineering (Section 18.6), severe accident evaluation (Section 19.2), and other design areas." However, the staff found no explanation on how the APR1400 PRA affected these programs.

In order for the staff to reach a reasonable assurance finding that the APR1400 PRA is appropriately used during the DC stage, please describe in detail, in addition to the discussion provided in Section 19.1.3.4 "Uses of the PRA in the Design Process," how the APR1400 PRA has been used in providing input to the Technical Specifications (Chapter 16), human factors engineering (Section 18.6), and severe accident evaluation (Section 19.2) as mentioned in the APR1400 DCD and the impacts on these programs.

Response

The interface between PRA and other design discipline is controlled in accordance with internal provision and procedures. Especially, the design interface between design disciplines and PRA is procedurally controlled by Engineering Procedures for Design Interface Control. Design input information is transmitted to the related department by using Design Information Transmittal (DIT).

In the case of human factors engineering (Section 18.6), PRA provided risk important human actions (RIHAs) with additional detailed information such as HIS inventory, staffing, stress degree, procedure and time available by DIT to Human Factor Engineering.

In the case of severe accident evaluation (Section 19.2), PRA provided the dominant accident sequences by DIT for identification of best estimation scenario of severe accident analysis.

Impact on DCD

There is no impact on the DCD.

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 Environmental Report.

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Question No. 19-90

10 CFR 52.47(a)(27) states that a DC application must contain an FSAR that includes a description of the design-specific PRA and its results. In addition, Standard Review Plan (SRP) Chapter 19.0, draft Revision 3, Section IV "Evaluation Findings," Item 3 states "The PRA reasonably reflects the as-designed, as-built, and as-operated plant, and the PRA maintenance program will ensure that the PRA will continue to reflect the as-designed, as-built, and as-operated plant, consistent with its identified uses and applications."

Therefore, in order for the staff to reach an assurance finding on the conformance to SRP Chapter 19.0 regarding PRA maintenance and update, please describe the process for monitoring PRA inputs and tracking the issues/findings (e.g., design changes, peer review findings, staff review findings, model errors, etc.,) for which PRA update is needed. Also, describe the process for maintaining and upgrading the PRA to be consistent with the certified design and revise the DCD accordingly.

Response

1) Input Monitoring and Issue Tracking:

   The resolution of review findings and other model issues is controlled by the procedure for "Risk Management Engineering Peer Reviews, Independent Reviews and Self Assessments." Identified findings are entered into an appropriate tracking database for timely resolution. Minor items may be resolved by periodic updates (nominally every four years), while significant issues will be addressed more quickly.

2) PRA Maintenance and Upgrade:

   The "Risk Management Engineering Procedure," specifies that the scope, level of detail, and capability of each risk model shall be commensurate with its intended use. Procedure for "Risk Management Engineering Configuration Control," monitors and

controls PRA model conformance with the ASME/ANS standards and Regulatory Guide 1.200. This procedure explicitly requires that the risk models shall represent the "…as-designed, as-built, as-operated…plant to the extent needed to support the risk applications." Periodic risk model upgrades will be evaluated to support this ongoing requirement. Model documentation is controlled by the Procedure for "Risk Management Engineering Documentation." PRA staff qualifications are controlled by the Procedure for "Risk Management Engineering Training and Certification." Model use is controlled by the Procedure (DC-DG-03-24) for "Risk Management Procedure," for risk assessments, risk applications and risk management configuration control which ensures compliance with applicable regulatory requirements, codes & standards for a design certification application.

Impact on DCD

The DCD will be revised 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 Environmental Report.

a. Monitor PRA inputs and collect any new information relevant to the PRA.

b. Maintain and upgrade the PRA to be consistent with the design.

c. Consider cumulative impacts of pending changes when applying the PRA.

d. Consider impacts of changes for previously implemented risk-informed decisions that used the PRA (e.g., RAP).

e. Maintain configuration control of the computational methods used to support the PRA.

f. Document the PRA model and processes.

To meet the guidance of NRC RG 1.206 (Reference 10), the PRA should be maintained to provide reasonable assurance that it reasonably reflects as-designed, as-to-be-built, and as-to-be-operated conditions. A COL applicant that references the APR1400 design certification needs to describe the plant-specific PRA maintenance and upgrade program.

Insert A in next page

19.1.3 Special Design/Operational Features

Design and operational characteristics of the APR1400 that result in improved plant safety as compared to currently operating nuclear power plants, include the following:

a. An in-containment refueling water storage tank (IRWST)

b. A four-train safety injection system (SIS) that injects borated water directly into the reactor vessel (RV) through direct vessel injection (DVI) nozzles

c. Four pumps for component cooling water and essential service water systems (CCWS and ESWS)

d. An emergency containment spray backup system (ECSBS)

e. A cavity flooding system (CFS)

f. A hydrogen control system (HG)

The PRA has influenced the selection of design changes such as:

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In order to achieve these objectives, the following controls are established to track and correct identified model issues by DC-DG-03-24, "Risk Management Procedure" (Reference 59).

Input Monitoring and Issue Tracking: The resolution of review findings and other model issues is controlled by the procedure, "Risk Management Engineering Peer Reviews, Independent Reviews and Self Assessments" (Reference 59). Identified findings are entered into an appropriate tracking database for timely resolution. Minor items may be resolved by periodic updates, while significant issues will be addressed more quickly.

PRA Maintenance and Upgrade: the "Risk Management Engineering Procedure" (Reference 59), specifies that the scope, level of detail, and capability of each risk model to be commensurate with its intended use. Therefore, "Risk Management Engineering Configuration Control" (Reference 59), monitors and controls PRA model conformance with the ASME/ANS standards and Regulatory Guide 1.200. This procedure explicitly requires that the risk models shall represent the "…as-designed, as-built, as-operated…plant to the extent needed to support the risk applications." Periodic risk model upgrades will be evaluated to support this ongoing requirement. Model documentation is controlled by "Risk Management Engineering Documentation" (Reference 59). PRA staff qualifications are controlled by "Risk Management Engineering Training and Certification" (Reference 59). Model use is controlled by DC-DG-03-24, "Risk Management Procedure" (Reference 59), for risk assessments, risk applications and risk management configuration control.

42. NUREG-1921, "EPRI/NRC-RES Fire Human Reliability Analysis Guidelines," U.S. Nuclear Regulatory Commission, November 2009.

43. EPRI 1016735, "Fire PRA Methods Enhancements: Additions, Clarifications, and Refinements to EPRI 1019189," Electric Power Research Institute, December 2008.

44. NUREG/CR-4527, "An Experimental Investigation of Internally Ignited Fires in Nuclear Power Plant Control Cabinets, Part II: Room Effects Tests," U.S. Nuclear Regulatory Commission, April 1987.

45. Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, September 1976.

46. EPRI 1021086, "Pipe Rupture Frequencies for Internal Flooding Probabilistic Risk Assessments (PRAs)," Electric Power Research Institute, October 2010.

47. NUREG/CR-6144 (BNL-NUREG-52399), "Evaluation of Potential Severe Accidents During Low Power and Shutdown Operations at Surry, Unit 1," U.S. Nuclear Regulatory Commission, June 1994.

48. Inspection Manual Chapter 0609, Appendix G, "Shutdown Operations Significance Determination Process," U.S. Nuclear Regulatory Commission, February 2005.

49. NUMARC 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Nuclear Energy Institute, July 2000.

50. NEI 00-04, "10 CFR 50.69 SSC Categorization Guideline," Rev. 0, Nuclear Energy Institute, July 2005.

51. CAFTA 6.0b, Software Manual, EPRI, Palo Alto, CA, 2014.

52. NUREG/CR-7114, "A Framework for Low Power/Shutdown Fire PRA," U.S. Nuclear Regulatory Commission, September 2013.

53. NUREG/CR-7150, "Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE)," May 2014.

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59. Procedure DC-DG-03-24, "Risk Management Procedure."