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.:	**454-8561**
SRP Section:	**09.01.01 – Criticality Safety of Fresh and Spent Fuel Storage and Handling**
Application Section:	
Date of RAI Issue:	**03/30/2016**

Question No. 09.01.01-35

In RAI 8190, Question 09.01.01-18, the staff noted lack of information in the Tier 1 material related to new and spent fuel storage racks (DCD Tier 1, Section 2.7.4). The response to RAI 8190, Question 09.01.01-18 provided a markup of the design description in Tier 1, Subsection 2.7.4.2 and Tables 2.7.4.1-1 and 2.7.4.2-1 as well as a markup of Tier 2, Table 14.3.4-6. The staff evaluated the applicant's responses and determined that, while the markups of the design description in Tier 1, Subsection 2.7.4.2 and Tier 2, Table 14.3.4-6 and the removal of the analysis portion of the ITAAC in Tier 1, Tables 2.7.4.1-1 and 2.7.4.2-1 are satisfactory, the applicant's approach for the ITAAC in Tables 2.7.4.1-1 and 2.7.4.2-1 is not consistent with established guidance on ITAAC, as described further below.

10 CFR 52.47(b)(1) requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and should operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.

In addition, based on the review of recent ITAAC submittals to the NRC, the staff identified four areas in which ITAAC could be improved in RIS 2008-05, “Lessons Learned to Improve Inspections, Tests, Analyses, and Acceptance Criteria Submittal,” dated February 27, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML073190162). RIS 2008-05, Revision 1 (ADAMS Accession No. ML102500244) expanded on these issues and identified several new issues. Additional information appears in Regulatory Guide (RG) 1.215, “Guidance for ITAAC Closure Under 10 CFR Part 52” (ADAMS Accession No. ML091480076), which endorses the methodologies described in the industry guidance document NEI 08-01, Rev. 3, “Industry Guideline for the ITAAC Closure Process Under 10 CFR Part 52," Rev. 3.

RIS-2008-05, Rev.1 identified that applicants:

- should clearly define all terms used in an ITAAC
- should avoid subjective terms, such as “inclined sufficiently,” “acceptable level,” and “adequate thickness”
- should avoid applying a single ITAAC to a large area of construction or to activities that are likely to be widely separated in time
- should consider the timing and sequence of construction activities in the development of related ITAAC
- should avoid expanding the ITAAC for functional arrangement of a system beyond the definition of functional arrangement as a physical arrangement of SSCs (it does not include testing, qualification, and analytical attributes)

For compliance with 10 CFR 52.47(b)(1) and for the clarity and completeness desired for the ITAAC closure process, the staff requests the applicant to update Tier 1 with respect to the following:

1. Design Commitment 2 in DCD Tier 1, Tables 2.7.4.1-1 and 2.7.4.2-1 states that “The spent fuel storage racks maintain the effective multiplication factor, Keff, less than or equal to criticality limits during normal operation and the postulated accident conditions.” However, it is unclear what these “criticality limits” are. Please specify in Tier 1 and the ITAAC the regulatory limits in 10 CFR 50.68.

2. The markup of Acceptance Criteria 2.a and 2.b for Design Commitment 2 in DCD Tier 1, Tables 2.7.4.1-1 and 2.7.4.2-1 refers to as-built dimensions and materials being consistent with or conforming to those used in the criticality analysis. The staff notes that the criticality analysis assumes non-design values for a variety of parameters for the purposes of conservatism and/or sensitivity studies. For example, sensitivity studies in the criticality analysis vary rack dimensions and spacing. The analysis also assumes 75% of the design value of B-10 areal density in the neutron absorbing panels. If the new and spent fuel storage facilities were consistent with and conformed to these assumptions, they would not be built as designed. Therefore, please clarify in Tier 1 and the ITAAC that the dimensions and materials and their tolerances conform to design values, as shown to be acceptable in the approved criticality and seismic and structural analyses.

3. The markup of Acceptance Criterion 2.a for Design Commitment 2 in DCD Tier 1, Tables 2.7.4.1-1 and 2.7.4.2-1 refers to as-built dimensions for the racks, including center-to-center spacing, being consistent with those used in the criticality analysis and the structural and seismic analysis. The staff notes that, in addition to spacing within each rack, rack-to-rack spacing and rack-to-wall spacing are also important parameters for the criticality analyses. As such, please update the Tier 1 information and the ITAAC to consider not just dimensions within each rack, but the spacing between adjacent racks and between racks and walls.

4. The staff notes that inspection of associated documentation would be expected for the inspection, tests, and analyses in DCD Tier 1, Tables 2.7.4.1-1 and 2.7.4.2-1. Please update the Tier 1 information and ITAAC to include inspection of associated documentation.

Response – (Rev. 1)

1. Design Commitment 2 in DCD Tier 1, Table 2.7.4.1-1 and 2.7.4.2-1 will be revised in order to specify the criticality limits.

2. Acceptance Criteria 2.a and 2.b in DCD Tier 1, Table 2.7.4.1-1 and 2.7.4.2-1 will be revised in order to clarify that as-built dimensions and materials and their tolerances conform to the design value.

3. Acceptance Criteria 2.a in DCD Tier 1, Table 2.7.4.1-1 and 2.7.4.2-1 will be updated in order to consider the dimensions within each rack, the spacing between adjacent racks and between racks and walls.

4. Inspection of associated documentation would not be expected for the inspection, tests, and analyses in DCD Tier 1 because the inspection of the as-built racks will be performed as the subcriticality configuration determined by the calculation and analysis.

Impact on DCD

DCD Tier 1, Subsection 2.7.4.1 and 2.7.4.2 and Table 2.7.4.1-1 and 2.7.4.2-1 will be revised as indicated in the attached markups.

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.

RAI 79-7990 - Question 09.01.02-4

RAI 454-8561 - Question 09.01.01-35

2.7.4 New and Spent Fuel Handling System

2.7.4.1 New Fuel Storage

2.7.4.1.1 Design Description

A drain system with a provision preventing backflow from other drains is included in the new fuel storage pit and curbs are installed around the top edge of the pit for preventing the water in-flow in the event of flooding in the adjacent fuel handling areas.

The new fuel storage racks are non safety-related, but seismic Category I for integrity of the new fuel assemblies. The new fuel storage racks provide on-site dry storage for nuclear fuel assemblies. The new fuel storage racks are located in the new fuel storage pit in the fuel handling area of the auxiliary building.

The new fuel storage racks are designed and constructed to accommodate design basis load and load combinations including impact due to postulated fuel handling accidents in a sub-critical configuration.

to prevent tipping of the racks in the event of an SSE earthquake.

1. The functional arrangement of the new fuel storage racks is as described in the Design Description of Subsection 2.7.4.1.1.

   the new fuel storage facility including

2. The new fuel storage racks maintain the effective multiplication factor, K_{eff}, less than or equal to ~~criticality limits~~ during normal operation and the postulated accident conditions.

   the regulatory limits in 10 CFR 50.68

2.7.4.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.4.1-1 specifies the inspections, tests, analyses, and associated acceptance criteria for the new fuel storage racks.

The new fuel storage racks are designed and constructed to maintain a K_{eff} no greater than 0.95 under fully flooded conditions and no greater than 0.98 under optimum moderation conditions at a 95 percent probability with 95 percent confidence level in accordance with 10 CFR 50.68.

RAI 79-7990 - Question 09.01.02-4

RAI 179-8190 - Question 09.01.01-18

RAI 454-8561 - Question 09.01.01-35

RAI 454-8561 - Question 09.01.01-35_Rev.1

Table 2.7.4.1-1

New Fuel Storage ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the new fuel storage racks is as described in the Design Description of Subsection 2.7.4.1.1.	1. Inspection of the as-built new fuel storage ~~racks~~ will be performed.	1. The as-built new fuel storage ~~racks~~ conform with the functional arrangement as described in the Design Description of Subsection 2.7.4.1.1.
2. The new fuel storage racks maintain the effective multiplication factor, K_{eff}, less than or equal to ~~criticality limits~~ during normal operation and the postulated accident conditions.	2.a Inspection ~~and analysis~~ of the as-built new fuel storage racks will be performed.	2.a ~~The calculated effective multiplication factor, K_{eff}, for the new fuel storage racks is less than or equal to 0.95 during normal operation and postulated accident conditions. In case of immersion in a foam or mist of the optimum moderation density, effective multiplication factor, K_{eff}, is less than or equal to 0.98.~~
	2.b Inspections will be performed to verify that the materials of the as-built new fuel storage racks conform with the criticality analysis of the new fuel storage racks.	2.b The materials of the as-built new fuel storage racks conform with the criticality analysis of the new fuel storage racks.

the new fuel storage facility including

facility

the regulatory limits in 10 CFR 50.68

based on the associated documents such as the criticality analysis report and the structural analysis report

~~The as-built new fuel storage rack dimensions including the center-to-center spacing, the rack-to-rack spacing and the rack-to-wall spacing are consistent with the dimensions and their tolerances used in the criticality analysis and the structural and seismic analysis during normal operation and the postulated accident conditions.~~

The as-built new fuel storage rack dimensions including the center-to-center spacing, the rack-to-rack spacing and the rack-to-wall spacing are consistent with the design values for dimensions and their tolerances used in the criticality analysis and the structural and seismic analysis.

The function of spent fuel facility is to store spent fuel in the spent fuel pool of the auxiliary building, which is seismic Category I. The spent fuel pool is designed to have sufficient dimensions to maintain the proper water level and volume for spent fuel cooling and radiation shielding. The spent fuel pool liner plate is classified as seismic Category I. The liner plate is fabricated from stainless steel material and utilizes a welded construction for minimizing potential leakage. A liner leakage collection system is provided to collect possible leakage from liner plate welds along the pool walls and floor.

2.7.4.2 Spent Fuel Storage

2.7.4.2.1 Design Description

The spent fuel storage racks are non safety-related, but seismic Category I for integrity of the spent fuel assemblies. The spent fuel storage racks provide on-site storage capability for a core offload during the design life. The spent fuel storage racks are located in the spent fuel pool ~~in the fuel handling area of the auxiliary building.~~ All piping penetrating the spent fuel pool are located approximately 3 m (10 ft) above the top of irradiated fuel assemblies seated in the storage racks, and all piping extending down into the spent fuel pool have siphon breaker holes at or above this level.

installed on the piping inside the spent fuel pool

The spent fuel storage racks are designed and constructed to accommodate design basis load and load combinations including impact due to postulated fuel handling accidents in a subcritical configuration.

the spent fuel storage facility including the spent fuel pool liner plate, gates and racks

1. The functional arrangement of ~~the spent fuel storage racks~~ is as described in the Design Description of Subsection 2.7.4.2.1.

the regulatory limits in 10 CFR 50.68

2. The spent fuel storage racks maintain the effective multiplication factor, K_{eff}, less than or equal to ~~criticality limits~~ during normal operation and the postulated accident conditions.

The spent fuel pool water level shall be 7 m (23 ft) over the top of irradiated fuel assemblies seated in the storage racks.

2.7.4.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7.4.2-1 specifies the inspections, tests, analyses, and associated acceptance criteria for the spent fuel storage racks.

. The spent fuel pool has no opening, gate, drain, or connection below the top of the stored fuel. The spent fuel pool gates for transferring fuel to the adjacent fuel handling area are seismic category I. The gates are designed to minimize potential leakage and withstand the water pressure in the spent fuel pool. The water level in the spent fuel pool remains 3 m (10 ft) above the top of fuel assemblies in the event of a single gate failure.

The spent fuel storage racks are designed and constructed to maintain a K_{eff} no greater than 0.95, at a 95 percent probability, 95 percent confidence level (95/95 level), if flooded with borated water, and a K_{eff} of less than 1.0, at a 95/95 level, if flooded with unborated water in accordance with 10 CFR 50.68.

RAI 79-7990 - Question 09.01.02-7

RAI 179-8190 - Question 09.01.01-18

RAI 454-8561 - Question 09.01.01-35

RAI 454-8561 - Question 09.01.01-35_Rev.1

the spent fuel storage facility including the spent fuel pool liner plate, gates and racks

Table 2.7.4.2-1

Spent Fuel Storage ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of ~~the spent fuel storage racks~~ is as described in the Design Description of Subsection 2.7.4.2.1.	1. Inspection of the as-built spent fuel storage ~~racks~~ facility will be performed.	1. The as-built spent fuel storage ~~racks~~ conform with the functional arrangement as described in the Design Description of Subsection 2.7.4.2.1.
2. The spent fuel storage racks maintain the effective multiplication factor, K_{eff}, less than or equal to ~~criticality limits~~ the regulatory limits in 10 CFR 50.68 during normal operation and the postulated accident conditions.	2.a Inspection ~~and analysis~~ of the as-built ~~spent fuel~~ storage racks will be performed.	2.a ~~The calculated effective multiplication factor, K_{eff}, for the spent fuel storage racks is less than or equal to 0.95 during normal operation and postulated accident conditions.~~
	2.b Inspections will be performed to verify that the materials of the as-built spent fuel storage racks conform with the criticality analysis of the spent fuel storage racks. based on the associated documents such as the criticality analysis report and the structural analysis report	2.b The materials of the as built spent fuel storage racks conform with the criticality analysis of the spent fuel storage racks. including the neutron absorbing material and their tolerances

~~The as-built spent fuel storage rack dimensions including the center-to-center spacing, the rack-to-rack spacing and the rack-to-wall spacing are consistent with the dimensions including their tolerances used in the criticality analysis and the structural and seismic analysis during normal operation and the postulated accident conditions.~~

The as-built spent fuel storage rack dimensions including the center-to-center spacing, the rack-to-rack spacing and the rack-to-wall spacing are consistent with the design values for dimensions including their tolerances used in the criticality analysis and the structural and seismic analysis.