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.:	**458-8569**
SRP Section:	**09.01.02 – New and Spent Fuel Storage**
Application Section:	**9.1.2**
Date of RAI Issue:	**04/13/2016**

Question No. 09.01.02-52

In RAI 79-7990, Question 9.1.2-4, the staff requested the applicant to modify DCD Tier 1 Section 2.7.4.1, ” New Fuel Storage (NFS),” in order to add detailed information to the system description section and to create new specific ITAAC. Question 9.1.2-7, requested similar actions to be taken for Section 2.7.4.2, “Spent Fuel Storage (SFS).”

The applicant responded to the RAI by adding clarifications to the system description section and proposing to use a single functional arrangement ITAAC to address all of the staff’s concerns.

The staff evaluated the applicant’s responses and determined that the proposed ITAAC is unacceptable. The applicant is using generic terms such as “sufficient” or “approximately” which are not conducive to the successful application of the ITAAC process.

This issue is not pertinent to KHNP only. In fact, the staff observed other ITAAC submittals with similar problems, which led the staff to issue two regulatory issue summaries (RIS). 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), the staff discussed 4 areas in which ITAACs could be improved. The staff later issued Revision 1 to RIS 2008-05 (Accession No. ML102500244) by identifying even more issues with proposed ITAAC.

Examples of issues identified in RIS-2008-05 and its Revision 1 are:

- applicants should avoid the integration of several different engineering or construction areas into a single ITAAC;
- applicants should avoid applying a single ITAAC to a large area of construction or to activities that are likely to be widely separated in time;

- applicants should consider the timing and sequence of construction activities in the development of related ITAAC
- applicants 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
- applicants should avoid subjective terms, such as “inclined sufficiently,” “acceptable level,” and “adequate thickness.”

Therefore the staff requests the applicant to:

a. update Tier 1 Section to include a description of the anti-flooding features credited to prevent flooding of the NFSP (pit drainage back-flow protection) and create an ITAAC to confirm the proper construction and installation of these features;

b. update Tier 1 Section to include a description of the anti-tipping feature of the NFS racks (bolted to the floor) and an ITAAC to confirm that the racks are adequately installed (and bolted);

c. create a new ITAAC that verifies that no non-Seismic Category I component is located in an area where its failure could impact NFSP racks or stored fuel (see proposed Standard ITAAC S02 as an example);

d. create a new ITAAC that verifies that no non-Seismic Category I component is located in an area where its failure could impact a SFP safety-related SSC, the racks, or stored fuel (see proposed Standard ITAAC S02 as an example).

Response

As part of the response to Question 09.01.02-04 in RAI 79-7990, the anti-flooding features in the NFSP have been included in DCD Tier 1, Subsection 2.7.4.1.

Tier 1 will also be updated to include the detailed design description concerning the anti-tipping provisions with the anchor design of the rack and the protection of NFSR from non-Seismic Category I component failures.

These provisions can be inspected and verified by means of examination the as-built design specially, the finalized construction of the pit (pool) and installation of the racks. For this reason, the ITAAC #1 in Table 2.7.4.1-1 and 2.7.4.2-1 will be updated to include the detailed inspection item.

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.

2.7.4 New and Spent Fuel Handling System

2.7.4.1 New Fuel Storage

2.7.4.1.1 Design Description

It is designed that non-seismic Category I component located near the area of NFSP will not impact NFSP racks and stored fuel due to its failure during SSE.

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.

The racks are also designed and constructed to prevent tipping of the racks in the event of an SSE earthquake by means of fixation to the floor.

1. The functional arrangement of the new fuel storage racks is 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.

2.7.4.1.2 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.

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.

including;
- Anti-flooding provisions with drain feature
- Anti-tipping provisions with anchor bolt design
- Non-seismic Category I component around the pit and racks will not impact NFSP racks and stored fuel due to its failure during SSE

2.7.4.2 Spent Fuel Storage

It is designed that non-seismic Category I component located near the area of SFP will not impact SFP safety-related SSC, the racks, or stored fuel due to its failure during SSE.

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.

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.

1. The functional arrangement of the spent fuel storage racks is 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 during normal operation and the postulated accident conditions.

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.

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 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 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.	2.b The materials of the as built spent fuel storage racks conform with the criticality analysis of the spent fuel storage racks.

including;
- Non-seismic Category I component around the pool and racks will not impact SFP safety-related SSC, the racks, or stored fuel due to its failure during SSE

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RAI No.: **458-8569**

SRP Section: **09.01.02 – New and Spent Fuel Storage**

Application Section: **9.1.2**

Date of RAI Issue: **04/13/2016**

Question No. 09.01.02-53

As discussed in RAI 9.1.2-10, the staff finds that the proposed NFS, and SFP ITAACs are inadequate.

Therefore the staff requests the applicant to:

a. update Tier 1 Section to include a detailed description (or a figure) that identifies the elevations of all pipes, gates, drains, openings, and anti-siphon devices in the SFP, and create an ITAAC to verify that the components has been installed as described (at correct location and elevation);

b. update Tier 1 Section to include a detailed description (or a figure) that identifies the pool dimensions and create an ITAAC to verify the as-built pool has been built as designed.

Response

ITAAC in DCD Tier 1 Table 2.7.4.2-1 will be revised to verify the following SFP configuration has been built as designed.

- As-built pipes, gates, drains, openings, and anti-siphon devices in the SFP, and
- As-built pool dimensions

Impact on DCD

DCD Tier 1, Table 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.

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 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 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.	2.b The materials of the as built spent fuel storage racks conform with the criticality analysis of the spent fuel storage racks.

including;
- Non-seismic Category I component around the pool and racks will not impact SFP safety-related SSC, the racks, or stored fuel due to its failure during SSE
- Spent fuel pool configuration including;
· locations and elevations of as-built pipes, gates, drains, openings, and anti-siphon devices in the SFP
· dimensions of as-built SFP

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Application Section: **9.1.2**

Date of RAI Issue: **04/13/2016**

Question No. 09.01.02-54

In RAI 98-8051, Question 9.1.2-8, the staff requested the applicant to discuss in the DCD the volume (sizing) of the adjacent fuel handling areas, such that the leakage into these areas, while drained, would not reduce the coolant inventory to less than 3 meters (10 feet) above the top of the fuel assemblies.

The applicant's response provides a summary of the volume calculation that demonstrates that, after a gate failure, the SFP water level still remains more than 3 meters (10 feet) above the top of the fuel assemblies.

The staff evaluated the applicant's response and determined that additional information is needed. The staff does not find clear indication that the applicant has taken into consideration the added volume available due to the cask decontamination pit.

Therefore the staff requests the applicant to:

a. clarify if the cask decontamination pit volume was taken into consideration in the pool draindown calculation;

b. reevaluate the pool draindown calculation, if necessary.

Response

Cask decontamination pit is connected only to the cask loading pit and is not connected to the SFP directly. A gate is located between SFP and cask loading pit and another gate is located between cask loading pit and cask decontamination pit.

In addition, the gate between the cask loading pit and the cask decontamination pit is designed as seismic Category I.

Therefore, the SFP water level will not be influenced in the event of single gate failure for the cask decontamination pit and the volume of cask decontamination pit needs not be considered in the pool draindown calculation.

For this reason, it is not required to revise the pool draindown calculation presented in the response to Question 09.01.02-8 of RAI 98-8051.

Impact on DCD

DCD Tier 2, Subsection 9.1.2.2.2 will be revised as indicated in the attached markup.

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.

including related connections to the SFP is described in Subsection 9.1.3. Each area can be sealed from its adjacent area by a hinged gate equipped with elastomer seals. The gates are designed as seismic Category I and allow the spent fuel cask loading pit and the fuel transfer canal to be drained without affecting the water level in the SFP. The gates are designed to withstand the water pressure in the SFP when the adjacent areas are dewatered.

The fuel transfer canal contains the fuel transfer system that is used for transporting fuel assemblies to and from the containment building. The spent fuel cask loading pit contains the spent fuel cask that is used for the transport of spent fuel assemblies from the fuel storage area in the auxiliary building. The gate between the cask loading pit and the cask decontamination pit is designed as seismic Category I.

All the preceding areas are stainless-steel-lined and concrete-walled pools that are integral parts of the fuel handling area building structure.

The SFP is approximately 7.31 m (42 ft) deep and made of reinforced concrete lined with stainless steel plate. The SFP is sufficiently deep that when a spent fuel assembly is being carried over the spent fuel storage racks by the spent fuel handling machine (SFHM) at its maximum lift height, there is sufficient water coverage to provide reasonable assurance that personnel on the SFHM or on the operating floor around the pool are not exposed to radiation levels exceeding 0.025 mSv per hour.

Piping penetrations to the SFP are at least 3.05 m (10 ft) above the top of the fuel assemblies seated in the spent fuel storage racks. The bottom of the gates that lead from the SFP to the fuel transfer canal and the spent fuel cask loading pit are above the top of the stored fuel assemblies. The spent fuel storage racks and the pool floor are designed to withstand the maximum impact energy of a fuel handling tool or a fuel assembly with its handling tool dropped from the maximum lift height. Redundant low- and high-level water alarms and temperature measurement instruments, as described in Subsection 9.1.3.5, minimize the potential for overfilling the pool. The ventilation system for the SFP area is described in Subsection 9.1.3.1.

Pipes that discharge into the spent fuel pool include siphon breaker holes as an anti-siphon device between the normal water level and the level of the SFP pumps' suction connection.

The makeup water to the SFP is provided by a safety Class 3, seismic Category I water supply, as described in Subsection 9.1.3.2.