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.: **287-8272**

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

Application Section:

Date of RAI Issue: **11/02/2015**

Question No. 09.01.02-9

The 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10CFR 52.80 (a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. Standard Review Plan (SRP) Sections 9.1.2 and 3.8.4, Appendix D describes specific SRP acceptance criteria for the review of the fuel racks that are acceptable to meet the relevant requirements of the Commission's regulations identified above. In DCD Tier 2, Section 9.1.2.2.3, “New and Spent Fuel Storage Rack Design”, the applicant stated that “The dynamic and stress analyses are performed as described in report APR1400-H-N-NR-14012-P & NP”. In SRP Section 9.1.2.III.2A, the staff is required to verify whether the new fuel vault, new fuel storage racks, spent fuel storage racks, pool, and pool liner are capable of withstanding all design loads. The staff did not find a detailed description and the structural design criteria of the spent fuel pool and the pool liner in appropriate DCD Sections 9.1.2 or 3.8.4 for its safety evaluation. In accordance with SRP Section 9.1.2.III.2A, the applicant is requested to provide this information so the staff can perform its safety evaluation of the fuel racks, spent fuel pool and the pool liner.

The applicant is requested to identify any proposed changes to and provide a mark-up of Subsections in the DCD Tier 2 and the report APR1400-H-N-NR-14012-P, Rev.0, as appropriate.

Response

The concrete spent fuel pool is designed in accordance with ACI 349, whereas the pool liner is designed in accordance with Section III,Div.2 of the ASME Code. A detailed description will be added to Section 3.8.4.1.1.

The spent fuel pool is a reinforced concrete structure and designed in accordance with ACI 349. Design criteria of concrete structure are presented in Section 3.8.4.4.1.

The design criteria for the spent pool liner will be added under new section 3.8.4.4.2.7.

Impact on DCD

DCD Tier 2 Section 3.8.4.1.1 and new section 3.8.4.4.2.7 will be revised to provide a detailed description and the structural design criteria 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.

of radioactive spent fuel assemblies. The pool is approximately 10.8 m × 12.8 m (35 ft 6 in × 42 ft) with a depth of 12.8 m (42 ft). The walls and floor of the spent fuel pool are a minimum of 1.7 m (5 ft 6 in) thick. Next Page

Fuel assemblies are transferred from the fuel handling area to the refueling pool via the refueling canal in the auxiliary building and then the fuel transfer tube in the reactor containment building. The refueling canal measures 1.8 m (6 ft) wide by 20.5 m (67 ft 3 in) long. The minimum wall thickness on the fuel pool side is 1.8 m (6 ft). An opening in the fuel pool wall allows for passage of fuel between the fuel pool and the refueling canal. A steel divider is provided for the opening. Seals are incorporated to allow draining of the refueling canal while maintaining the water level in the spent fuel pool. An overhead bridge crane with a capacity of 150 tons is provided over the shipping bay and extending over the fuel pool and refueling canal. Interlocks are provided to prevent the crane from moving over the spent fuel storage area during cask handling operations. A new fuel-handling crane, running on rails mounted over the operating floor, is provided to handle the new fuel assemblies.

The two AFW tanks consist of three stainless steel lined reinforced concrete rooms. Each room has a single tank. The tanks extend from elevation 100 ft 0 in to the underside of the floor slab at elevation 137 ft 6 in.

The auxiliary building is rectangular with maximum dimensions of 106.0 m × 107.6 m (348 ft × 353 ft). It wraps around the reactor containment building with a seismic gap of 50 mm (2 in). The auxiliary building shares common basemat structure with the reactor containment building. The auxiliary building is separated from other buildings by the isolation gap of 900 mm (3 ft).

The outlines of the auxiliary building are shown in Figures 1.2-9 through 1.2-19.

3.8.4.1.2 Emergency Diesel Generator Building

The emergency diesel generator (EDG) building block comprises two buildings, one that houses two additional generators and the other for the diesel fuel oil tank (DFOT). The two buildings are independent structures built on separate basemats – one at elevation 100 ft 0 in for the EDG building, and the other at 63 ft 0 in for the DFOT building. The two basemats are horizontally separated by an isolation gap of 900 mm (3 ft).

The stainless steel liner plates cover the entire interior surface of the Fuel Handling Area. The wall liner and its anchorage system is designed and constructed to act initially as form work during concrete placement of walls, and subsequently as a leak tight membrane.

3.8.4.4.2.3 Missile Protection

Exterior walls and roof slabs of seismic Category I structures function as missile barriers. Design of missile barriers provides reasonable assurance that the structure will not collapse under the missile load and the barrier will not be penetrated. Safety-related SSCs are protected from secondary missiles as a result of backface scabbing. Interior walls and floors are designed to function as missile barriers when it is evaluated to be necessary.

The design of seismic Category I structures for internally generated and externally generated missiles conforms with the procedures described in Section 3.5.

3.8.4.4.2.4 Flooding

Flooding is addressed in Section 3.4.

3.8.4.4.2.5 Wall/Floor Penetrations

Openings are acceptable without analysis if they meet the criteria in ACI 349, Section 13.5.2.

Penetration sleeves usually consist of a pipe embedded in a concrete wall or concrete floor with a short projection at one of both faces. As a minimum, penetration sleeves have sufficient thickness to maintain roundness during concrete pouring of other construction. Penetration sleeves are designed in accordance with ACI 349 and AISC N690.

Each corner of rectangular openings in walls or slabs is provided with additional reinforcing to reduce cracking due to stress concentration at these locations in accordance with ACI 349, Section 14.3.7.

3.8.4.4.2.6 Embedment Plates

Embedment plates are located throughout the plant to provide sufficient and efficient support for the various structures and components. The plate is designed in accordance with AISC N690. The anchorage to concrete is designed in accordance with ACI 349-97, including Appendix B (2001), and NRC RG 1.199.

Next Page

3.8.4.4.2.7 Stainless Steel Liner Design

The design of stainless steel liners is similar to the containment liner design as described in Subsection 3.8.1.4.10. The allowable stresses and strains for the liner are consistent with ASME Section III , Div.2, CC-3000.

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Docket No. 52-046

RAI No.: **287-8272**

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

Application Section: **9.1.2**

Date of RAI Issue: **11/02/2015**

Question No. 09.01.02-45

1. The 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10CFR 50.68 provide the regulatory requirements for the design of the new and spent fuel storage facilities. Standard Review Plan (SRP) Section 3.8.4, Appendix D, and Section 9.1.2 describes specific SRP acceptance criteria for the review of the fuel racks that are acceptable to meet the relevant requirements of the Commission's regulations identified above. In SRP Section 9.1.2 III.6, “The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR”. In DCD Tier 2, Section 9.1.2, the staff did not find any Combined License Information items identified for the dynamic and structural analyses of the new and spent fuel storage racks. In accordance with the SRP Section 9.1.2 III.6, the applicant is requested to provide a justification for not including any Combined License Information items. The structural, dynamic, and impact analysis of the fuel racks is highly dependent on the specific rack design. The COL applicant is required to perform a confirmatory structural dynamic and stress analysis for the spent fuel rack including reconciliation of loads imposed by the spent fuel rack on the spent fuel pool structure.

Response

A COL item will be added for performing a confirmatory structural dynamic and stress analysis for the new and spent fuel racks including reconciliation of loads imposed by the new and spent fuel racks on the new fuel pit and spent fuel pool structure, considering the site specific condition such as a safe shutdown earthquake in DCD Tier 2 subsection 9.1.2.2.3.

Impact on DCD

DCD Tier 2 Section 9.1.2.2.3, 9.1.6 and Table 1.8-2 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.

The dynamic and stress analyses are performed as described in the technical report APR1400-H-N-NR-14012-P & NP (Reference 20). Loads and load combinations considered in the structural design and stress analysis are shown in Table 3.8-9C and are based on SRP, Section 3.8.4, Appendix D.

An uplift force analysis is conducted for new and spent fuel storage racks design and is described in the technical report APR1400-H-N-NR-14012-P & NP. Each rack is evaluated for its ability to withstand a maximum uplift force of 2,268 kg (5,000 lb) based on the lifting capacity of the suspension hoist and the fuel handling machine. Structural analysis is conducted to verify that the resultant stress in the critical part of the rack is within acceptable stress limits and that the deformation of the rack array is limited to maintain a subcritical array.

A fuel assembly drop analysis is conducted for each fuel rack to maintain a subcritical array. Drop weight is determined from the fuel assembly weight along with the handling tool (total weight 1,100 kg [2,425 lb]). The drop height is determined from the higher value of 0.61 m (2 ft) or the design height for handling fuel above each rack.

The COL applicant is to perform a confirmatory structural dynamic and stress analysis for the new and spent fuel racks including reconciliation of loads imposed by the new and spent fuel racks on the new fuel pit and the spent fuel pool structure, considering the site specific condition such as a safe shutdown earthquake (COL 9.1(8)).

9.1.2.3 Safety Evaluation

9.1.2.3.1 New Fuel Storage Racks

The new fuel storage racks are designed to seismic Category I requirements and are capable of withstanding normal and postulated dead loads, live loads, and loads caused by an SSE.

The new fuel storage rack is located in the new fuel storage pit. No loads are required to be carried over the new fuel storage pit while the cover is in place. The cover is designed so that it will not fall and damage the fuel or fuel rack during a seismic event. Administrative controls are used when the cover is removed for new fuel transfer operations to limit the potential for dropped object damage.

Materials used in rack fabrication are compatible with the storage pit environment and surfaces that come into contact with the fuel assemblies are made of annealed austenitic stainless steel. Structural materials are corrosion resistant and will not contaminate the fuel assemblies or pit environment.

COL 9.1(4) The COL applicant is to provide plant procedures for preventing and mitigating inadvertent reactor cavity drain down events, maintenance procedures for the maintenance and inspection of refueling pool seal, and emergency response procedures for the proper measures during pool drain down events.

COL 9.1(5) The COL applicant is to provide plant operating procedure guidelines for preoperational load testing and checks of interlocks, blocks, hoisting cables, control circuitry, and lubrication of fuel handling equipment.

9.1.7 References

1. 10 CFR Part 50, Appendix A, General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handing," U.S. Nuclear Regulatory Commission.

2. 10 CFR 50.68, "Criticality Accident Requirements," U.S. Nuclear Regulatory Commission, November 1998.

3. DSS-ISG-2010-01, "Staff Guidance Regarding the Nuclear Criticality Safety Analysis for Spent Fuel Pools," U.S. Nuclear Regulatory Commission, October 2011.

4. NUREG/CR-6698, "Guide for Validation of Nuclear Criticality Safety Calculational Methodology," U.S. Nuclear Regulatory Commission, January 2001.

5. ORNL/TM-2005/39, "Scale: A Comprehensive Modeling and Simulation Suite for Nuclear Safety Analysis and Design," Version 6.1, ORNL, June 2011.

6. M. B. Chadwick et al., "ENDF/B-VII.0 Next Generation Evaluated Nuclear Data Library for Nuclear Science and Technology," Special Issue on Evaluated Nuclear Data File ENDF/B-VII.0 Nuclear Data Sheets, 107(12), 2931-3059, December 2006.

7. NEA/NSC/DOC(95), "International Handbook of Evaluated Criticality Safety Benchmark Experiments," OECD NEA Nuclear Science Committee, September 2008.

8. NUREG/CR-6361, "Criticality Benchmark Guide for LWR Fuel in Transportation and Storage Packages," U.S. Nuclear Regulatory Commission, September 2008.

COL 9.1(8) The COL applicant is to perform a confirmatory structural dynamic and stress analysis for the new and spent fuel racks including reconciliation of loads imposed by the new and spent fuel racks on the new fuel pit and the spent fuel pool structure, considering the site specific condition such as a safe shutdown earthquake.

Table 1.8-2 (12 of 29)

Item No.	Description
COL 9.1(4)	The COL applicant is to provide plant procedures for preventing and mitigating inadvertent reactor cavity drain down events, maintenance procedures for the maintenance and inspection of refueling pool seal, and emergency response procedures for the proper measures during pool drain down events.
COL 9.1(5)	The COL applicant is to provide plant operating procedure guidelines for preoperational load testing and checkouts of interlocks, blocks, hoisting cables, control circuity and lubrication of fuel handling equipment.
COL 9.2(1)	The COL applicant is to develop procedures for system filling, venting, and operational procedures to minimize the potential for water hammer; to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze inadvertent water hammer events in accordance with NUREG-0927 in the ESWS.
COL 9.2(2)	The COL applicant is to develop layout of the site-specific portion of the system to minimize the potential for water hammer in the ESWS.
COL 9.2(3)	The COL applicant is to (1) to determine required pump design head, using pressure drop from the certified design portion of the plant and adding site-specific head requirements, (2) determine pump shutoff head to establish system design pressure, which is not to exceed APR1400 system design pressure, and (3) evaluate potential for vortex formation at the pump suction based on the most limiting applicable conditions in the ESWS.
COL 9.2(4)	The COL applicant is to determine the design details of the backwashing line, vent line, and their discharge locations in the ESWS.
COL 9.2(5)	The COL applicant is to provide the evaluation of the ESW pump at the high and low water levels of the UHS. In the event of approaching low UHS water level, the COL applicant is to develop a recovery procedure.
COL 9.2(6)	The COL applicant is to provide measures to prevent long-term corrosion and organic fouling that may degrade system performance in the ESWS.
COL 9.2(7)	The COL applicant is to evaluate the need and design and install freeze protection in the ESWS if required.
COL 9.2(8)	The COL applicant is to conduct periodic inspection, monitoring, maintenance, performance, and functional testing of the ESWS and UHS piping and components, including the heat transfer capability of the CCW heat exchangers based on GL 89-13 and GL 89-13 Supplement 1.

COL 9.1(8) The COL applicant is to perform a confirmatory structural dynamic and stress analysis for the new and spent fuel racks including reconciliation of loads imposed by the new and spent fuel racks on the new fuel pit and the spent fuel pool structure, considering the site specific condition such as a safe shutdown earthquake.

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Docket No. 52-046

RAI No.:	**287-8272**
SRP Section:	**09.01.02 – New and Spent Fuel Storage**
Application Section:	**9.1.2**
Date of RAI Issue:	**11/02/2015**

Question No. 09.01.02-47

The 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. Standard Review Plan (SRP) Sections 9.1.2 and 3.8.4, Appendix D describes specific SRP acceptance criteria for the review of the fuel racks that are acceptable to meet the relevant requirements of the Commission's regulations identified above. In DCD Tier 1 Subsections 2.7.4.1.1 and 2.7.4.2.1, the new and the spent fuel racks respectively, are stated as “non-safety related, but seismic Category I for integrity of the spent fuel assemblies”. SRP Section 3.8.4, Appendix D states that “The Regulatory Guide 1.29, “Seismic Design Classification” classifies spent fuel pool racks as seismic Category I structures. Spent fuel pool racks should be treated as safety-related components for determining Quality Assurance requirements (10 CFR Part 50, Appendix B) and periodic condition monitoring requirements (10 CFR 50.65 “Maintenance Rule”)”. In accordance with SRP 3.8.4 Appendix D, and Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 5, 61, 63, the applicant is requested to provide justification for treating the racks as non-safety related components and provide the basis for determining the Quality Assurance requirements (10 CFR Part 50, Appendix B) and periodic condition monitoring requirements (10 CFR 50.65 “Maintenance Rule”)” for the racks.

The applicant is requested to identify any proposed changes to and provide a mark-up of Subsections in the DCD Tier 1 and 2 and the report APR1400-H-N-NR-14012-P, Rev.0, as appropriate.

Response

The new and spent fuel storage racks are treated as safety-related components by designing the racks in accordance with the requirements of the RG 1.13, SRP 3.8.4 Appendix D and SRP 9.1.2 for the compliance with the Appendix A to 10 CFR Part 50, General Design Criteria 1, 2, 4, 5, 61 and 63, as described in DCD, Tier 2, Section 9.1.2. In addition, as indicated in DCD Tier 2, Table 3.2-1 (28 of 36), the quality assurance of the 10 CFR 50 Appendix B are applied to new and spent fuel storage rack like as safety-related components.

The racks are designed as a seismic category I structure and located in the auxiliary building designed as a safety-related concrete structure, in order to maintain the fuel in a safe and subcritical array during all anticipated operating and accident condition.

For spent fuel racks, the neutron absorbing material (METAMIC) is monitored periodically by the surveillance program over the lifetime of the racks as described in DCD Tier 2, Subsection 9.1.2.4.

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.