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.:	**124-8071**
SRP Section:	**09.01.05 – Overhead Heavy Load Handling Systems**
Application Section:	**09.01.05**
Date of RAI Issue:	**08/04/2015**

Question No. 09.01.05-2

GDC 4 applies to heavy load handling for protection against the effects of internally-generated missiles (i.e., dropped loads). A dropped heavy load in a critical area could cause a release of radioactive materials, a criticality accident, or inability to cool fuel within the reactor vessel or spent fuel pool or could prevent safe shutdown of the reactor. To accomplish this, SRP 9.1.5 and NUREG-0612 requests the applicant to describe a method for satisfying one of the following criteria: A) Mechanical stops or electrical interlocks to prevent movement of heavy loads over irradiated fuel or in the proximity of equipment essential for safe shutdown (i.e., a single load drop should not disable redundant trains of a system necessary for safe shutdown), B) The effects of drops of heavy loads should be analyzed and shown to satisfy the evaluation criteria of Section 5.1 of NUREG-0612 or, C) The likelihood of failure is extremely low due to a single failure-proof handling system.

When using interlocks to restrict movement of hoist over spent fuel, NUREG-0612 (Section 5.1.2) provides guidance on specific aspects for the applicant to address. These include:

(a) Mechanical stops or electrical interlocks should be provided that prevent movement of the overhead crane load block over or within 15 feet horizontal (4.5 meters) of the spent fuel pool. These mechanical stops or electrical interlocks should not be bypassed when the pool contains "hot" spent fuel, and should not be bypassed without approval from the shift supervisor (or other designated plant management personnel). The mechanical stops and electrical interlocks should be verified to be in place and operational prior to placing "hot" spent fuel in the pool.

(b) The mechanical stops or electrical interlocks mentioned in NUREG-0612, Section 5.1.2(2)(a), should also not be bypassed unless an analysis has demonstrated that damage due to postulated load drops would not result in criticality or cause leakage that could uncover the fuel.

(c) To preclude rolling if dropped, the cask should not be carried at a height higher than necessary and in no case more than six (6) inches (15 cm) above the operating floor level of the refueling building or other components and structures along the path of travel.

(d) Mechanical stops or electrical interlocks should be provided to preclude crane travel from areas where a postulated load drop could damage equipment from redundant or alternate safe shutdown paths.

(e) Analyses should conform to the guidelines of NUREG-0612, Appendix A.

As indicated in DCD Tier 1, Section 2.7.4.5.1, the fuel handling area overhead crane contains hoists with interlocks to prohibit movement over specific areas. The fuel handling hoist is interlocked to prevent moving new fuel over the spent fuel storage racks. The cask handling hoist is interlocked and equipped with mechanical stops to prevent moving a cask over the spent fuel storage racks and the new fuel storage racks. Therefore, the APR1400 includes mechanical stops or electrical interlocks for the Fuel Handling Area Overhead Crane to prevent movement of heavy loads over irradiated fuel.

The DCD also indicates that a shipping cask is prevented from traveling over the new fuel storage racks and the spent fuel storage racks by mechanical stops and electrical interlocks and the defined load path prevents the shipping cask from traveling within 4 m (13 ft) of the edge of the SFP, which is 2 feet closer than the recommended value in NUREG-0612.

The staff finds that the DCD does not address the potential for bypass of interlocks and how they are controlled.

The applicant is requested to address the following issues for the non-single failure proof fuel handling area overhead crane:

1) Justify not meeting the NUREG-0612 allowable travel to edge of SFP and define any restriction on the lift height for handling cask

2) Verify whether interlocks can be bypassed and explain any controls in-place to prevent bypass for the cask handling hoist and fuel handling hoist

3) Describe any lift height restrictions when moving heavy loads (i.e., cask)

4) Describe features provided to preclude crane travel in areas where a postulated load drop could damage safety related equipment

Response

1) Mechanical stops or electrical interlocks of the fuel handling area overhead crane will be provided to prevent movement of the overhead crane load block over or within 15 feet horizontal (4.5 meters) of the spent fuel pool in accordance to NUREG-0612 Section 5.1.2 Item (2)(a).

   Also, for travel restrictions when moving heavy loads the fuel handling area overhead crane is interlocked and equipped with mechanical stops to prevent moving a cask over

the spent fuel storage racks in the spent fuel pool, and interlocked to prevent moving a cask over the new fuel storage racks. The description of light load handling and limitation of the impact energy of postulated dropped loads on the new fuel storage racks and spent fuel storage racks will be deleted in DCD Tier 2, Section 9.1.5.2.1.

The lift height of the shipping cask is restricted to be lower than 6 inches above the operating floor in accordance to NUREG-0612 Section 5.1.2 Item (2)(c).

These travel restrictions will be clearly defined on the revised in DCD Section 9.1.5.2.1.

2) Interlocks for the fuel handling area overhead crane cannot be bypassed. Once fuel assemblies are onsite, mechanical stops are installed permanently to restrict movement of the crane over the spent fuel pool area.

3) The lift height of the shipping cask is restricted to be lower than 6 inches above the operating floor in accordance to NUREG-0612 Section 5.1.2 Item (2)(c) to preclude rolling it if dropped. Other heavy loads handled by the fuel handling area overhead crane will be restricted to the same height as the cask.

4) There is no safe shutdown equipment within vicinity of the travel path of the overhead crane in the fuel handling area. Interlocks or mechanical stops are provided for overhead crane to prevent a cask from travelling over the spent fuel storage racks and the new fuel storage racks.

Impact on DCD

DCD Tier 2, Subsection 9.1.5.2.1 will be revised as indicated on 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 shipping cask is prevented from traveling over the new fuel storage racks by electrical interlocks, and the spent fuel storage racks by mechanical stops and electrical interlocks.

conditions, and the bridge and trolley remain in place on their respective runways with their wheels prevented from leaving the tracks. The crane is not required to be functional during and after the SSE, but structural integrity is preserved.

~~The design of the fuel handling area overhead crane limits the impact energy of postulated dropped loads on the new fuel storage racks, spent fuel storage racks, fuel transfer system fuel carrier, and SFP. The shipping cask is prevented from traveling over the new fuel storage racks and the spent fuel storage racks by mechanical stops and electrical interlocks.~~

4.5 m (15 ft)

The defined load path prevents the shipping cask from traveling within ~~4 m (13 ft)~~ of the edge of the SFP and provides reasonable assurance that the shipping cask is ~~not~~ lifted above the operating floor elevation. ~~This restriction on the lift height also precludes passage of the shipping cask over the new fuel racks.~~

no more than 6 inches

Deleted

~~All loads that are handled over the new fuel storage racks, spent fuel storage racks, SFP, and fuel transfer system fuel carrier are limited in weight and lift height so that, if they fall, the resultant impact will not exceed the design impact energy of the fuel storage racks and SFP.~~

~~The design impact energy is equal to the postulated drop of a fuel assembly, its handling tool or a combination of both the tool and the fuel assembly, and any other fuel handling component attached to the hoisting cable during fuel assembly handling, from their maximum lifted elevation above the fuel racks during normal handling. The elevation to which the fuel assembly is lifted is limited by interlocks on the fuel handling hoist and the design of the handling tools. The weight that is lifted is limited by load interlocks and/or hoist motor stall torque.~~

9.1.5.2.2 Containment Polar Crane

The containment polar crane is mounted on a circular rail along the containment inside wall and travels the entire circumference of the containment. The containment polar crane has a main hoist and an auxiliary hoist to handle the various loads during refueling. Provisions are made to provide reasonable assurance of safe heavy load handling in the containment. These provisions include automatic control of the bridge and hoist, automatic control of heavy load limits and lifting height, and a load handling path to prevent any fuel damage from a heavy load drop. The safe load handling paths of the containment polar crane are shown in Figure 9.1.4-9.

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RAI No.:	**124-8071**
SRP Section:	**09.01.05 - Overhead Heavy Load Handling Systems Application Section: 9.1.5**
Application Section:	**9.1.5**
Date of RAI Issue:	**08/04/2015**

Question No. 09.01.05-3

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

DCD Tier 2, Section 9.1.5.2.1 states “[a]ll loads that are handled over the new fuel storage racks, spent fuel storage racks, SFP, and fuel transfer system fuel carrier are limited in weight and lift height so that, if they fall, the resultant impact will not exceed the design impact energy of the fuel storage racks and SFP.”

The staff finds it not clear what loads this statement is referring to, since the fuel handling area overhead crane has travel restrictions to avoid carrying loads over these components. The staff is also unable to locate any load drop analysis to verify the resultant impact will not exceed the design impact energy, as indicated in this statement.

DCD Tier 2, Section 9.1.5.3 states “[t]he effects of a heavy load drop are analyzed. The results provide reasonable assurance that it does not damage stored fuel and preclude the operation of equipment required to achieve safe shutdown.” As noted above, Section 9.1.5.2.1 indicates the design of the fuel handling area overhead crane limits the impact energy of postulated dropped loads on the new fuel storage racks, spent fuel storage racks, fuel transfer system fuel carrier, and SFP.

The staff finds it not clear what analyses have been performed and referred to in DCD, Tier 2 Sections 9.1.5.2.1 and 9.1.3. The applicant is requested to:

1. Specify what loads will be handled over the safe shutdown equipment, new fuel storage racks, spent fuel storage racks, spent fuel pool, and fuel transfer system fuel

carrier by the fuel handling hoist and cask handling hoist of the non-single failure proof Fuel Building Area Overhead Crane

2. Provide description of analyses completed for heavy load handling system.

3. Clarify what load drop analyses were completed and which cranes were evaluated for impact energy of postulated dropped loads and what assumptions were included

Response

1. There is no load handled by the Fuel Handling Area Overhead Crane (FHA OHC) over the spent fuel storage racks, spent fuel pool, and fuel transfer system fuel carrier. The FHA OHC is prevented from travelling over the spent fuel pool area by mechanical stops and electrical interlocks as described in the DCD Tier 2 Section 9.1.5.2.1.

   The shipping cask, the new fuel assembly and the transport container are handled by the FHA OHC in the vicinity of FHA OHC operating area, except the new fuel storage area. For the new fuel storage area, fuel assemblies with a handling tool are handled by the fuel handling hoist of the FHA OHC. Other heavy loads are prohibited from travelling over the new fuel storage area by electrical interlocks when new fuel is stored in the area.

   There is no safe shutdown equipment in the vicinity of the FHA OHC.

Table Summary Table for Loads handled by FHA OHC

Over Area/Item	Fuel handling area overhead crane	
	Fuel handling hoist	Cask handling hoist
Safe shutdown equipment	None(1)	None(1)
New fuel storage racks	New fuel assembly with handling tool	None(2)
Spent fuel storage racks	None(2)	None(2)
Spent fuel pool	None(2)	None(2)
Fuel transfer system fuel carrier	None(2)	None(2)
Other areas	New fuel assembly with handling tool	Shipping cask, new fuel transfer container

Note (1) There is no safe shutdown equipment in the vicinity of the FHA OHC.
(2) The heavy load handling hoist is restricted from travel over the area by interlock(s).

2. For the heavy loads drop analysis, the design information has been reviewed (1) to identify all overhead handling systems from which a load drop may result in damage to any structures, systems, and components required for plant shutdown or decay heat

removal and (2) to identify the travelling paths of the loads, locations of the spent fuel storage racks, and the equipment important to safety. The compliance with NUREG-0612 has been evaluated. SSCs important to safety are not located under the travelling paths of non-single failure proof cranes.

The statement, “[a]ll loads that are handled over the new fuel storage racks, spent fuel storage racks, SFP, and fuel transfer system fuel carrier are limited in weight and lift height so that, if they fall, the resultant impact will not exceed the design impact energy of the fuel storage racks and SFP.”, will be removed as the markup of the answer to the RAI Question No. 09.01.05-2 because this is not related to the FHA OHC and is related to the spent fuel handling machine of the light load handling system(LLHS) in the DCD Tier 2, Section 9.1.4. The safety analysis of the load drop event from LLHS over the spent fuel pool is performed to evaluate the structural integrity of the racks and stored spent fuel considering impact energy load. The LLHS is has interlocks to restrict the lift height and weight of the loads to meet the impact energy requirement considered in the structural design and safety evaluation.

3. There is no load drop from FHA OHC that will affect the spent fuel storage racks, the spent fuel pool, or the fuel transfer system fuel carrier, except the new fuel storage racks. The FHA OHC is restricted from travelling over the new fuel storage racks by the electrical interlock when new fuel is stored in this area. The FHA OHC is excluded in the load drop analysis.

   The drops of a spent fuel assembly with its handling tool and a swing gate of the spent fuel pool have been analyzed to evaluate the structural integrity of the spent fuel storage rack and the liner. Impact energies due to the drop scenarios are considered in the analyses. The integrity of spent fuel assemblies stored in the racks is assured for both drop accidents. The structural integrity of the pool is also ensured.

   The assumption included in the heavy load analysis is that the operator and the administrative controls follow the procedures based on NUREG-0612.

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.