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.:	**457-8558**
SRP Section:	**09.01.05 - Overhead Heavy Load Handling Systems**
Application Section:	**DCD Subsection 9.1.5**
Date of RAI Issue:	**04/06/2016**

Question No. 09.01.05-10

Follow up to the response to RAI 124-8071, Question 09.01.05-3.

The staff considered the response incomplete for the following reason.

In the original RAI, the staff raised the following issue (with underlined text for emphasis):

“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.”

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.”

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 9.1.5.3. 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”

In the response the applicant provided the following information to address Item 3 above (with underlined text for emphasis):

"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."

The applicant is requested to identify the crane that is used to handle the spent fuel assembly with its handling tool and a swing gate as discussed in the above response, and revise DCD, Tier 2 Section 9.1.5.3, to reflect that the fuel handling area overhead crane is not "single-failure-proof."

Response

1) Identification of cranes

   The spent fuel handling machine handles the spent fuel assembly with its handling tool. The monorail hoist for the swing gate handles the swing gate. Both cranes are shown in Attachment 2.

2) Single failure proof crane description

   DCD, Tier 2 Section 9.1.5.3, will be revised to state that the fuel area overhead crane is not single failure proof.

Impact on DCD

DCD Tier 2, Subsection 9.1.5.3 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.

located over or close to the safe shutdown system and equipment impacts safe shutdown equipment. However, the safe shutdown equipment or systems are physically separated and redundant so that the consequences of postulated accident load drops do not prevent the capability of their safe shutdown functions. In addition, the safe shutdown equipment or systems will be out of operation when the cranes and hoists are used for handling critical heavy loads over them, and when the safe shutdown equipment or systems are in service, the use of these cranes and hoists is administratively controlled by load handling procedures.

9.1.5.2.4 Load-handling Procedures

Load-handling procedures are established for component handling procedures and plant operating procedures in accordance with ASME B30.2. Component handling procedures include (1) a safe load path for lifting heavy loads to perform special handling component inspections, (2) acceptance criteria prior to lift, and (3) the use of steps and proper sequence in handling the load. Plant operating procedure guidelines include appropriate crane operator training and crane inspections. Load-handling procedures include preparation of operating procedures for preoperational load testing and checkouts of interlocks, brakes, hoisting cables, control circuitry, and lubrication of OHLHS equipment.

The COL applicant is to address the load handling procedures (COL 9.1(3)).

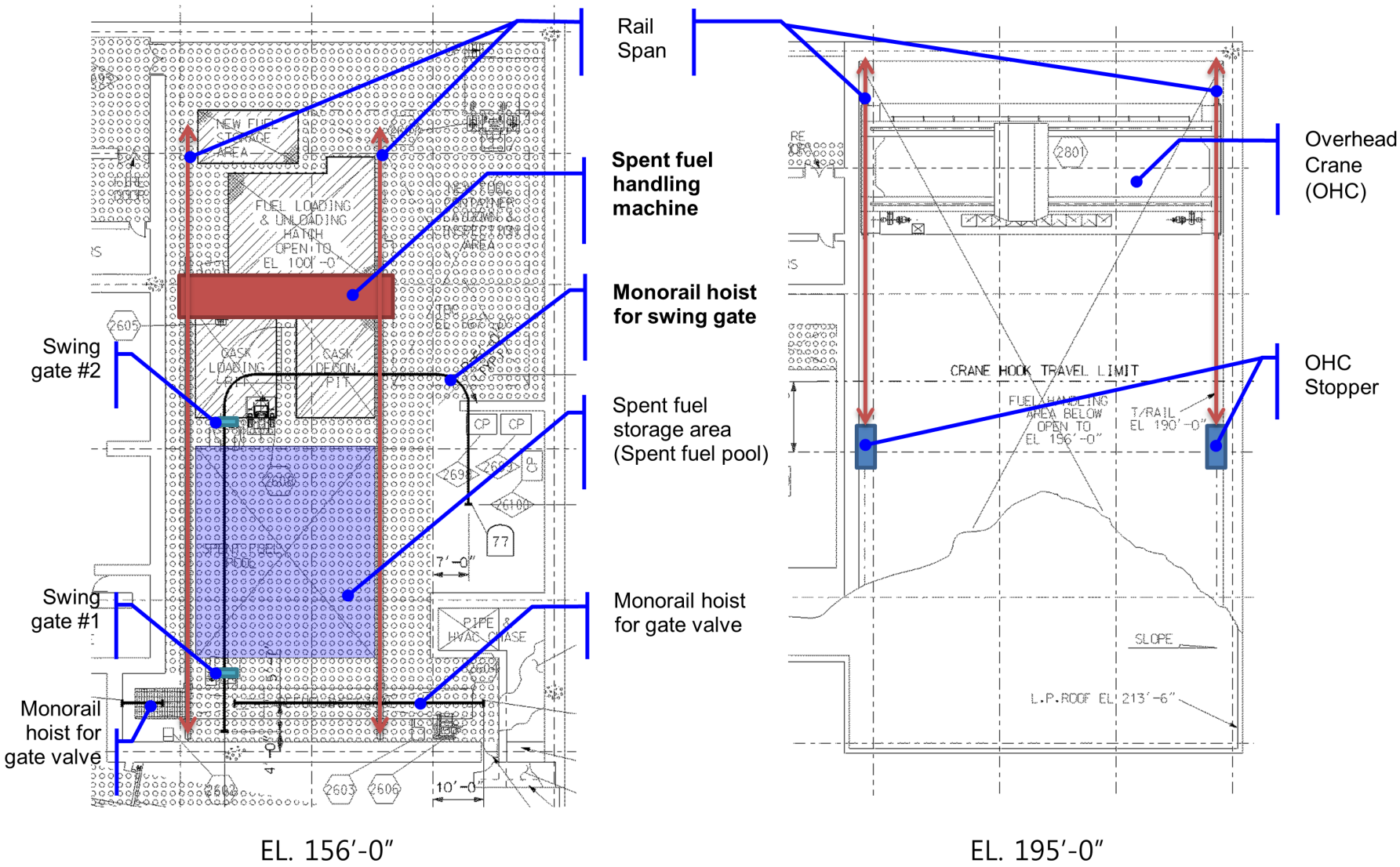
9.1.5.3 Safety Evaluation

The OHLHS is evaluated to provide reasonable assurance that it does not cause a significant release of radioactivity, a loss of margin to criticality, uncovery of irradiated fuel in the reactor vessel or spent fuel pool, or damage to equipment that is essential to achieve or maintain safe shutdown.

The containment polar crane is designed to prevent dropping of the IHA and RV internals by providing single-failure-proof features in accordance with the guidelines of NUREG-0612 and requirements of NUREG-0554.

The fuel handling area overhead crane handles critical heavy loads without single-failure-proof features. The fuel handling area overhead crane is restricted from moving heavy loads over the SFP by the permanent mechanical stops installed on the rails. It is limited to moving in such a manner as to avoid the possibility of falling or tipping into the SFP, in

not single-failure-proof, therefore it is



EL. 156′-0″

EL. 195′-0″

Figure 1. Load Handling Equipments in Fuel Handling Area

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SRP Section:	**09.01.05 – Overhead Heavy Load Handling Systems**
Application Section:	**9.1.5**
Date of RAI Issued:	**04/06/2016**

Question No. 09.01.05-11

Follow up to the response to RAI 124-8071, Question 09.01.05-4.

The staff considered the response incomplete for the following reason.

In the original RAI, the staff raised the following issue (with underlined text for emphasis):

> "DCD Tier 2, Section 9.1.5 classifies the main hoist of the Polar crane as single failure proof. The staff finds it not clear whether the polar crane auxiliary hoist is also single failure proof.
>
> In addition, DCD Tier 2, Section 9.1.5.2.2.1 states that containment polar crane auxiliary hoist has 60-ton load block and Table 9.1.5-1 indicates capacity to be 81.6 metric tons.
>
> The applicant is requested to provide classification of the containment polar crane auxiliary hoist, clarify its capacity, and describe features provided to control travel restrictions."

In the response the applicant provided the following information:

> "The containment polar crane will be used to handle loads including the integrated head assembly, reactor vessel internals, and other necessary equipment or components in the containment during an outage. The main hoist of the polar crane is designed with single-failure proof features so that any credible failure of a single component will not result in the loss of capability to stop and hold the critical load. The auxiliary hoist of the polar crane, which is used for routine maintenance and for inservice inspection, is not designed as single failure proof, and its control restrictions are included in the main hoist path. The DCD will be revised to clarify that the main hoist of the polar crane is designed as a single-failure-proof crane.
>
> The capacity of the containment polar crane main hoist is 475 tons. The capacity of the containment polar crane auxiliary hoist is 90 tons. During construction, the polar crane is

equipped with a special trolley arrangement that increases the load block rated capacity to 950 tons. Therefore, the DCD will be revised to correct the capacity."

The staff reviewed the proposed change to DCD Tier 2, Section 9.1.5.2.2.1 and Table 9.1.5, and noted that classification of the containment polar crane auxiliary hoist is not clearly identified.

The applicant is requested to revise the DCD Tier 2, section 9.1.5 to incorporate the correct classification of the containment polar crane auxiliary hoist as discussed in the response.

Response

The DCD Tier 2, section 9.1.5.2.2 will be revised to incorporate the correct classification of the containment polar crane auxiliary hoist.

Impact on DCD

DCD Tier 2, Subsection 9.1.5.2.2 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.

RAI 124-8071 Question 09.01.05-4

RAI 457-8558 Question 09.01.05-11

The design of the containment polar crane conforms to the requirements of ASME NOG-1, Type 1 cranes; NUREG-0612; and Section 2-1 of ASME B30.2. ~~The~~ containment polar crane is designed as a single-failure-proof crane, so that a single failure will not result in the crane losing the capability to perform its safety function with the hoisting system and braking system on the drum for trolley and bridge through redundancy or duality in braking components, and through two independent reeving systems. The containment polar crane is also designed as seismic Category II in accordance with NRC RG 1.29. The dynamic behaviors according to the seismic event are restricted by the seismic restraints, which prevent the bridge or trolley from jumping the rails during an earthquake.

The main hoist of the

475

90

The containment polar crane is used to handle the IHA and RV internals. The containment polar crane, which has a ~~450~~-ton-rated capacity for normal operation, is used with various lifting rigs to remove the IHA with the RV closure head and RV upper and lower internals, as described in Subsections 9.1.5.2.2.1 and 9.1.5.2.2.2. A ~~60~~-ton auxiliary load block is used for routine maintenance and for inservice inspection (ISI). During construction, the polar crane is equipped with a special trolley arrangement that increases the load block rated capacity to ~~900~~ tons. The crane is controlled from its bridge-mounted cab or a festooned pendant control. The polar crane is designed to maintain its integrity without dropping its load during an SSE. The main hoist of the polar crane has an inching feature that enables the crane to be properly positioned.

950

The normal parking position of the polar crane is based on a location that does not interface with the post-accident radiation monitoring functions.

The auxiliary hoist of the containment polar crane, which is used for routine maintenance and for inservice inspection, is designed as non-single-failure-proof.

9.1.5.2.2.1 Integrated Head Assembly

The IHA is shown in Figure 9.1.5-1. The IHA is composed of the cooling shroud assembly, lifting frame assembly, control element drive mechanism (CEDM) cooling system, missile shield, head area cable system, and seismic support system. The lifting frame assembly, including the main columns attached to the RV closure head, lifts the IHA with the RV closure head for the refueling operation. The lifting system of the IHA is designed, tested, and inspected to meet the design criteria of NUREG-0612 (Reference 22) and ANSI N14.6 (Reference 27). When the lifting system is designed, the maximum lifting crane acceleration/ deceleration dynamic load factor of 0.15 g is applied. The IHA is lifted using the main hoist of the containment polar crane.

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Application Section:	**9.1.5**
Date of RAI Issued:	**04/06/2016**

Question No. 09.01.05-12

Follow up to the response to RAI 124-8071, Question 09.01.05-8.

The staff found the response unacceptable for the following reason.

In the original RAI, the staff raised the following issue:

> "DCD Tier 1, Section 2.7.4.5 specifies "OHLHS prevents the uncontrolled lowering of a heavy load." Similarly, ITAAC Design Commitment for Item 5 of DCD Tier 1, Table 2.7.4.5-1 specifies OHLHS prevents the uncontrolled lowering of a heavy load." The staff finds that the testing and acceptance criteria of the ITAAC are requesting NOG-1 load tests to verify lifting capacity.
>
> The applicant is requested to justify how lift capacity testing is sufficient to assure uncontrolled lowering of a heavy load will not occur."

In the response the applicant provided the following information:

> "Both the containment polar crane and the fuel handling area overhead crane are designed to prevent a fuel handling equipment or fuel cask drop by providing special devices that are locked in a manner that will not allow the release of the fuel handling equipment or the fuel cask. Also, the overspeed switch is attached on the cranes to prevent uncontrolled lowering of a heavy load. NOG-1 load tests include the proper function testing of devices. However, the overspeed switch function test will be performed at the manufacturing shop, and it is impossible to test the overspeed switch function during power plant operation. Therefore, the testing and acceptance criteria of the ITAAC will be deleted."

The staff disagreed with the applicant's decision to delete this ITAAC because it will be performed by the vendor at the factory test shop. The applicant is requested to retain this ITACC with different test description to reflect testing of the applicable overspeed switches. In addition,

the applicant is requested to add an ITAAC to test other design features to meet NOG-1 requirements (e.g., no-load, full-load and rated-load tests).

Response

The ITACC will not be deleted for a field acceptance test being performed. And since the ITACC will be added again, the design features to meet ASME NOG-1 requirements (e.g., no-load, full-load and rated-load tests) will be performed for the inspection and tests, analyses.

Tests for the overspeed switches or limit switches are included in the full-load test and no-load test as per ASME NOG-1. The description from ASME NOG-1 is provided below.

"**6440 Limit Switches**

6441 General (Types I, II, and III Cranes). A

limit switch is defined as a switch that is operated by some part or motion of a power driven machine or equipment to alter the electric circuit associated with the machine or equipment. This Section includes the following limit switch requirements for nuclear power plant cranes:

(a) hoist overtravel,

(b) hoist overspeed,

(c) hoist overload,

(d) hoist drum rope mis-spooling, and

(e) bridge and trolley overtravel limits.

7421 No-Load Test. A no-load test will be performed on cranes, after the power supply has been verified to be in conformance with the crane specifications, to verify the following:

c) **limit switches**, interlocks, and stops are properly adjusted and set;"

"**7422 Full-Load Test**.

With this load, the crane shall be operated through all drives for hoist, trolley, and bridge, and through all speed ranges to demonstrate **speed controls** and **proper function of limit switches**, locking, and safety devices."

Therefore, the test description to reflect testing of the applicable overspeed switches will not be separately added or described in the ITACC for Overhead Heavy Load Handling System.

Impact on DCD

DCD Tier 1, Table 2.7.4.5-1 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.

RAI 124-8071 Question 09.01.05-8

RAI 457-8558 Question 09.01.05-12

Restore

Delete

Table 2.7.4.5-1 (3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
~~5. OHLHS prevents the uncontrolled lowering of a heavy load.~~	~~5. The following tests for the OHLHS will be performed in accordance with ASME NOG-1:~~ ~~• full-load test with a minimum of 100% of rated load in accordance with ASME NOG-1.~~ ~~• rated load test with a minimum of 125 % of rated load in accordance with ASME NOG-1.~~ ~~• no-load test in accordance with ASME NOG-1.~~	~~5. A report exist and concludes tha the as-built OHLHS operate with 100% of rated load and lower, stop and hold 125% of rated load.~~
6. The hoists of containment polar crane and the fuel handling area overhead crane are provided with two limit switches to prevent the hoisting system from two-blocking.	~~6.~~ Tests of the fuel handling area overhead crane and containment polar crane hoists will be performed to confirm limit switches de-energize the hoist drive motor and the motor power supply.	~~6.~~ The fuel handling area overhead crane and containment building polar crane hoists are equipped with the protective control system to de-energize th hoist drive motor and the motor power supply.
~~7.~~ The fuel handling hoist of fuel handling area overhead crane is interlocked to prevent moving new fuel over the spent fuel storage racks.	~~7.~~ Tests of fuel handling hoist of fuel handling area overhead crane will be performed to confirm the interlock function to limit travel.	~~7.~~ The fuel handling hoist of fuel handling area overhead crane is limited by the interlock to travel over the spent fuel storage racks.
~~8.~~ The cask handling hoist of fuel handling area overhead crane is interlocked and equipped with mechanical stops to prevent moving a cask over the spent fuel storage racks and the new fuel storage racks.	~~8.~~ Tests of cask handling hoist of fuel handling area overhead crane will be performed to confirm the interlock function and mechanical stop to limit travel.	~~8.~~ The cask handling hoist travel of fuel handling area overhead crane is limited by the interlock and the mechanical stops.
~~9.~~ OHLHS has a control system to return to or maintain a secure holding position of critical loads in the event of a system fault.	~~9.~~ Tests of the as-built OHLHS control system will be performed to assure that the as-built OHLHS returns to or maintains a secure holding position of critical loads in the event of a system.	~~9.~~ The as-built control system includes safety devices which assure that the as-built OHLHS returns to and/or maintains a secure holding position of critical loads in the event of a system fault.

Delete

~~5.~~ 6.

~~6.~~ 7.

~~7.~~ 8.

~~8.~~ 9.

Restore