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.:	**469-8578**
SRP Section:	**09.01.01 – Criticality Safety of Fresh and Spent Fuel Storage and handling**
Application Section:	**09.01.01**
Date of RAI Issue:	**04/22/2016**

Question No. 09.01.01-38

In response to RAI 364-8421, Question 28814 (09.01.01-30) the applicant justified the use of Metamic after the material was exposed to elevated temperatures. The staff reviewed the response and found that the approach was acceptable based upon precedence (SER for Turkey Point Units 3&4, License Amendment Request 178).

In the RAI response the applicant described a mockup used for determining the temperature that the Metamic was exposed to. The staff reviewed the mockup design and the results of the mockup testing and found that the mockup was inadequate. The applicant also described the fabrication of the spent fuel racks which included the use of a gap tool. The staff concludes that the use of a gap tool as described by the applicant is not feasible.

However, the staff also determined that additional information on gap tool and the mockup would involve: 1) such high details of the design that regulating the details would venture into prescriptive regulation rather than performance based regulation and 2) incorporating aspects into the standardized design which have limited safety significance.

The staff has determined that a revision to the FSAR or Technical Report is required for the staff to come to a reasonable assurance finding and to close this RAI.

The FSAR or Technical Report revision shall address the following:

A COL applicant shall create a weld mockup that realistically represents the spent fuel pool racks. During welding of the mockup the applicant shall monitor the temperature of the fuel rack to determine the maximum temperature which the Metamic material is exposed to. The WPS used for the mockup shall be used for fabrication and the fabrication welds shall not exceed the heat input of the mockup welds. If the heat input is exceeded during fabrication the Metamic shall be treated as non-conforming. The non-conformance would be acceptable

following requalification which includes a mockup to determine if the new heat input results in Metamic being eposed to temperatures exceeding 900 F.

This may be implemented as a COL item or a license condition.

For clarity, the staff provides the following comments on the mockup and use of a gap tool. These comments do not need to be addressed in a response to this RAI.

The staff determined that the mockup does not replicate the configuration of the spent fuel racks for the following reasons:

1) The sheath has the wrong thickness (2.5 mm in the mockup vs. 0.6mm in the design)
2) The sheath configuration is not correct (the sheath is perpendicular to the Metamic in the mockup but is surrounding the Metamic plate in the design).
3) The applicant states that a spacer bar will be used during welding of the spent fuel rack; the bar ensures a 5mm gap between the edge of the sheath and the Metamic plate. A spacer bar was not used in the mockup.
4) The applicant places the thermocouple on the opposite side of the “fuel storage cell” plate in relation to the Metamic plate. There is no justification why this location is conservative or representative of the temperatures that the Metamic material will experience.

The staff determined that the use of a gap tool during fabrication may not be feasible for the following reasons:

Figure 1, “Box Assembly,” indicates that the sheath will be attached to the fuel storage cell with 2.5mm fillet welds. Considering that the sheath in the design is 0.6 mm thick, the staff is concerned that the fillet weld will melt through the sheath and weld the 5mm gap tool to the sheath/fuel storage cell.

Additionally, the staff questions the feasibility of using a 5mm gap tool. The applicant states that this tool will be removed after welding. However, austenitic stainless steel contracts significantly after solidification and will probably cause the gap tool to get stuck in the assembled fuel storage cell. Because the gap tool is very thin (assumed 2.5 mm x 5 mm), it is almost certain that a stuck gap tool will break during an attempt to remove the tool.

Response

FSAR 9.1.2.2.2, 9.1.6 and Table 1.8-2 will be revised to include a COL item.

Impact on DCD

FSAR 9.1.2.2.2, 9.1.6 and Table 1.8-2 will be revised as indicated on the attachment.

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 Environment Report.

Spent Fuel Storage Racks

Spent fuel storage racks used for high-density storage are typically stainless steel structures with rectangular fuel storage cells coated with neutron absorbing material (see Figure 9.1.2-2).

Spent fuel storage rack modules are free standing on embedments in the pool floor. Sufficient space is provided between adjacent modules and between modules and other obstructions in the SFP to allow the modules to slide without contacting each other or other obstructions during a seismic event. The modules are equipped with stable, adjustable feet that rest on the embedments. The adjustable feet and lifting lugs permit the modules to be installed in the pool. The stainless steel used for the fabrication of the racks is compatible with fuel assembly materials and the spent fuel borated water environment.

Neutron absorbing material is used for reactivity control in spent fuel storage rack. Neutron absorbing material is inserted between the fuel storage cell and the cover plate. Stainless steel plate for cover plate is welded to each side of the fuel storage cell with the neutron absorbing material installed in the cover plate cavity. The objective of cover plate design is to secure the neutron absorbing material to be installed safety. The cover plate serves to locate and position the neutron absorbing material accurately and to preclude its movement under seismic conditions. The cover plate also isolates the neutron absorbing material from the fuel. The neutron absorbing material covers the full length of the active fuel. Provisions are made for installing surveillance specimens of the neutron absorbing material to the rack modules in an accessible location. The surveillance specimens are removed in accordance with a preplanned schedule using remotely operated tools.

The COL applicant shall create a weld mockup that realistically represents the spent fuel storage racks in case of the neutron absorbing material to be installed in the sheath cavity prior to sheath welding. During welding of the mockup the applicant shall monitor the temperature of the fuel rack to determine the maximum temperature which the neutron absorbing material is exposed to. The WPS used for the mockup shall be used for fabrication and the fabrication welds shall not exceed the heat input of the mockup welds. If the heat input is exceeded during fabrication the neutron absorbing material shall be treated as non-conforming. The non-conformance would be acceptable following requalification which includes a mockup to determine if the new heat input results in neutron absorbing material being exposed to temperatures exceeding 900°F. (COL 9.1 (6)).

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.

COL 9.1(6) The COL applicant shall create a weld mockup that realistically represents the spent fuel storage racks in case of the neutron absorbing material to be installed in the sheath cavity prior to sheath welding. During welding of the mockup the applicant shall monitor the temperature of the fuel rack to determine the maximum temperature which the neutron absorbing material is exposed to. The WPS used for the mockup shall be used for fabrication and the fabrication welds shall not exceed the heat input of the mockup welds. If the heat input is exceeded during fabrication the neutron absorbing material shall be treated as non-conforming. The non-conformance would be acceptable following requalification which includes a mockup to determine if the new heat input results in neutron absorbing material being exposed to temperatures exceeding 900°F.

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.

Table 1.8-2 (10 of 22)

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 chekouts 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 filing, 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 water hammer potential 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 standard plant system design pressure, and (3) evaluate potential for vortex formation 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 and vent line and their discharge locations in the ESWS.
COL 9.2(5)	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(6)	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(7)	The COL applicant is to evaluate the need and design and install freeze protection in the ESWS if required.

COL 9.1(6) The COL applicant shall create a weld mockup that realistically represents the spent fuel storage racks in case of the neutron absorbing material to be installed in the sheath cavity prior to sheath welding. During welding of the mockup the applicant shall monitor the temperature of the fuel rack to determine the maximum temperature which the neutron absorbing material is exposed to. The WPS used for the mockup shall be used for fabrication and the fabrication welds shall not exceed the heat input of the mockup welds. If the heat input is exceeded during fabrication the neutron absorbing material shall be treated as non-conforming. The non-conformance would be acceptable following requalification which includes a mockup to determine if the new heat input results in neutron absorbing material being exposed to temperatures exceeding 900°F.

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Question No. 09.01.01-39

In response to RAI 364-8421, Question 28814 (09.01.01-30) the applicant justified the use of Metamic after the material was exposed to elevated temperatures.

The KHNP proposed coupon monitoring program utilizes as-fabricated coupons. The as-fabricated condition is no longer the only condition of the Metamic material (i.e. Metamic exposed to elevated temperatures during welding). There is insufficient operating experience on Metamic material exposed to elevated temperatures after fabrication to conclude that an additional degradation mechanism is not introduced.

The applicant must revise the coupon monitoring program include coupons that are exposed elevated temperatures.

Response

Metamic coupons utilized in the coupon monitoring program are an as-manufactured condition from Holtec, not an as-fabricated condition exposed to elevated temperatures like welding.

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 Environment Report.