KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Monday, January 11, 2016 1:13 PM
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Cc: Yeshnik, Andrew; Mitchell, Matthew; Wunder, George; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 364-8421 (09.01.01 - Criticality Safety of Fresh and Spent Fuel Storage and Handling)
Attachments: APR1400 DC RAI 364 MCB 8421.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, 45 days to respond to this RAI. We may adjust the schedule accordingly.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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United States Nuclear Regulatory Commission
Protecting People and the Environment

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REQUEST FOR ADDITIONAL INFORMATION 364-8421

Issue Date: 01/11/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 09.01.01 - Criticality Safety of Fresh and Spent Fuel Storage and Handling
Application Section: 9.1.1

QUESTIONS

09.01.01-27

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 62 requires preventing criticality in the fuel storage and handling system through the use of physical systems or processes.

Technical Report APR1400-Z-A-NR-14011 "Criticality Analysis of New and Spent Fuel Storage Racks" describes the criticality calculations used to evaluate the adequacy of the new and spent fuel storage racks.

The "Bias and Uncertainty" calculations in this document include a tolerance on the "cell pitch." Confirm whether or not that the cell pitch tolerance includes both positional tolerances and form tolerances (e.g. straightness of the fuel assembly tube/slot).

09.01.01-28

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 62 requires preventing criticality in the fuel storage and handling system through the use of physical systems or processes.

Technical Report APR1400-Z-A-NR-14011 "Criticality Analysis of New and Spent Fuel Storage Racks" describes the criticality calculations used to evaluate the adequacy of the new and spent fuel storage racks.

The "Bias and Uncertainty" calculations in this document includes tolerance for the thickness of several components. The applicant provides the thickness of the materials used in construction in Tables 2.1-1, 3.1-1, and 3.1-2. The majority of material used in the design has been specified as ASTM/ASME SA-240, Type 304 or 304L material.

Material specification (S)A-240 references specification (S)A-480. (S)A-480 contains the material processing requriements that are applicable to a wide range of materials in the Stainless Steel family including Type 304/304L. Annex A2 and A3 contains tables that specify normal tolerances for as purchased material; this includes material thickness tolerances which are specific to the manufacturing method (e.g. hot rolled Quarto Plate, cold rolled material processed from a coil, etc.).

The staff notes that the thickness tolerance stated in APR1400-Z-A-NR-14011 may or may not be in conformance with (S)A-480 based upon the method of manufacturing. In the event that (S)A-480 tolerance on material thickness is greater than the technical report, the applicant can order custom material meeting the thickness requirements in the technical report.

As such, state if any Type 304/304L material in the new or spent fuel racks will have custom requirements on thickness tolerances.

09.01.01-29

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 62 requires preventing criticality in the fuel storage and handling system through the use of physical systems or processes.

In DCD Tier 2, SAR Section 9.1.1.3.3 the applicant states the following:

> c. Credit is taken for the neutron absorption in the rack structural materials and neutron absorbing materials. The steel plate thickness is conservatively set to a minimum, and only 75 percent of B-10 density in the neutron absorbing materials is assumed in order to reflect the deformation of the neutron absorbing material.

Provide additional informaiton the "deformation of the neutron absorbing material."

1. Is this deformation different than the neutron absorber tolerances discussed in technical report APR1400-Z-A-NR-14011-P?
2. Provide that staff with a discussion on how the deformation is related to using 75% of B-10 in the neutron absorbing material.
3. Does the deformation originate during fabrication of the material?

09.01.01-30

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 62 requires preventing criticality in the fuel storage and handling system through the use of physical systems or processes.

This question was provided to the applicant prior to the July 29th, public meeting as Issue #6 (AI 9.24-6). Because no response has been docketed the issue has been turned into an RAI.

In FSAR Section 9.1.2.2.2, on page 9.1-13, the applicant states:

> "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 staff interprets this sentence to specify that the neutron absorber to be installed prior to welding.

The heat produced by welding the sides of the sheath may affect the Metamic material. Provide the staff with a discussion on how the heat from welding will impact the neutron attenuation uniformity, mechanical properties, thermal properties, and possible production of reactive products.

09.01.01-31

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 62 requires preventing criticality in the fuel storage and handling system through the use of physical systems or processes.

These topics were provided to the applicant prior to the July 29th, public meeting in Issue #9 (AI 9.24-9). Because no responses have been docketed the issues have been turned into an RAI.

Issue 9

In FSAR Section 9.1.2.4, on page 9.1-18, the applicant states:

> "Qualification Program for the METAMIC Neutron Absorbing Material
>
> The potential environmental deterioration mechanism is corrosion. Corrosion testing is performed, and the results are evaluated. The neutron absorbing material has sufficient strength and ductility for handling and fabrication and supporting its own weight in the rack."

The staff seeks further information on the qualification program for Metamic:

1. Reynolds Metal Company in cooperation with EPRI has conducted accelerated corrosion testing as part of the qualification program of Metamic ("Qualification of METAMIC for Spent-Fuel Storage Application," EPRI 1003137, available on EPRI's website and "Use of Metamic in Fuel Pool Applications," ML022280353). Is the proposed corrosion testing different than the EPRI and Holtec qualification tests? If so, provide a description of tests to be performed and the acceptance criteria.

2. The applicant does not describe the qualification program for the manufacturing of the Metamic material. Will critical characteristics (such as areal density, dimensions, thermal conductivity) be verified? Revise FSAR Section 9.1.2.4 to list all characteristics to be verified and the acceptance criteria.

3. Metamic is not a standardized material. Revise FSAR Section 9.1.2.4 to describe the quality assurance program that will be used to manufacture the material. The program should be sufficient to give confidence that the Metamic product will meet all the design functions.

09.01.01-32

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria 62 requires preventing criticality in the fuel storage and handling system through the use of physical systems or processes.

Technical report APR1400-Z-A-NR-14011-P, Section 5.3 has a requirement for the areal density of the neutron in the "Spent Fuel Pool Limitations" section. The areal density requirement is not consistent with the Tables 3.1-1 and 3.1-2 in the same technical report.

Correct or clarify the information in the technical report.

09.01.01-33

On November 13th 2015 the applicant provided docketed responses to eight of the ten items of concern that were sent as part of a request for a July 29th, 2015 public meeting on DCD Tier 2, FSAR Section 9.1.1 (ML15317A525).

The response to Issue #8 (AI 9.24-8) the applicant provided the staff with acceptance criteria for the coupon monitoring program:

> Acceptance criteria for these measurements are as follows:
> - A decrease of no more than 5% in Boron-10 content, as determined by neutron attenuation, is acceptable.
>
> - An increase in thickness at any point should not exceed 25% of the initial thickness at that point.
>
> Changes in excess of either of these two criteria requires investigation and engineering evaluation which may include early retrieval and measurement of one or more of the remaining coupons to provide corroborative evidence that the indicated change(s) is real. If the deviation is determined to be real, an engineering evaluation shall be performed to identify further testing or any corrective action that may be necessary.
>
> The remaining measurement parameters serve a supporting role and should be examined for early indications of the potential onset of neutron absorbing material degradation, if any, that would suggest a need for further attention and possibly a change in the measurement schedule. These include (1) visual or photographic evidence of unusual surface pitting, corrosion or edge deterioration, or (2) unaccountable weight loss in excess of the measurement accuracy."

Part 1:
Provide additional clarification:

The Metamic product has a requirement of "decrease of no more than 5%" of B-10."

What will the measured neutron attenuation of the coupon be compared to? Will it be compared to the 95% probability 95% confidence minimum areal density of the heat of the Metamic material? Or compared to a pre-operation neutron attenuation measurement done on each coupon? Or something else?

Part 2:
Provide additional clarification:

The Metamic product has a requirement of "not exceed 25% of the initial thickness at that point."

Will all points of the Metamic coupons be measured prior to installation in the spent fuel racks? Or will the "initial thickness" be the thickness of the Metamic coupons on the periphery of the coupon where blistering is unlikely to occur?

Part 3:

The second to last paragraph is not sufficient. If the coupon monitoring program determines that Boron-10 is being lost or blistering of the material is occurring, a licensee must immediately evaluate implications to GDC 62. Revise the last paragraph as follows:

> "Changes in excess of either of these two criteria requires investigation and engineering evaluation which may include early retrieval and measurement of one or more of the remaining coupons to provide corroborative evidence that the indicated change(s) is real. If the deviation is determined to be real, **an evaluation shall be performed to determine if the spent fuel system complies with the licensing basis.**"

Part 4:

The final paragraph (which relates to visual examination and weighing of coupons) states that if signs of degradation are found, then a licensee, "would suggest a need for further attention and possibly a change in the measurement schedule."

This requirement is insufficient. Corrosion of the neutron absorber could be initiated by several different events (e.g. foreign material introduced to the pool, failure of the spent fuel pool cleanup system, contamination of the neutron absorber during fabrication, etc.) which could impact the safety of the spent fuel pool or other shared systems.

If indications of material degradation are found, then the degradation should be evaluated, the causes should be identified, and the necessary corrective actions should be implemented.

Revise the acceptance criteria. An acceptable change would be:

> The remaining measurement parameters serve a supporting role and should be examined for early indications of the potential onset of neutron absorbing material degradation. These include: (1) visual or photographic evidence of unusual surface pitting, corrosion, or edge deterioration; or (2) unaccountable weight loss in excess of the measurement accuracy. **If indications of material degradation are found (other than normally expected oxidation), then the degradation shall be evaluated, causes shall be identified, and corrective actions, as necessary, shall be implemented.**

09.01.01-34

On November 13th 2015 the applicant provided docketed responses to eight of the ten items of concern that were sent as part of a request for a July 29th, 2015 public meeting on DCD Tier 2, FSAR Section 9.1.1 (ML15317A525).

The response to Issue #4 (AI 9.24-4) the applicant provided the staff with the following fabrication sequence:

> (2) General fabrication sequence for spent fuel rack
>
> - Step 1: Fabricating the box.
> - Step 2: Fabricating the sheathing plate for fastening the location of neutron absorbing material and protecting the neutron absorbing material.
> - Step 3: Assembling the box with neutron absorbing material and sheathing plate. (called box assembly) Location of neutron absorbing material is between box and sheathing plate. Welding among each item is as follows;
>   - Box and sheathing plate : Resistance weld (Spot weld)/Intermittent fillet weld
>   - Box and neutron absorbing material : No weld
>   - Sheathing plate and neutron absorbing material : No weld
> - Step 4: Fabricating the base plate for assembling with box assembly.
> - Step 5: Fabricating the support for shoring up the fuel rack weight.

- Step 6: Assembling the base plate with support. (called support assembly)
- Step 7: Assembling the box assembly with support assembly.

In DCD Tier 2, SAR Chapter 9, the applicant provides the an image of the Region I racks in Figure 9.1.2-2A. Based upon the information provided, the staff believes that the Region I spent fuel racks has type 304L stainless steel "spacer bars" between the “box assemblies.”

The staff cannot determine the point where this assembly is done; this operation does not appear to correspond to Step 5, Step 6, or Step 7. The support for the "fuel rack weight" is assembled to the base plate of the rack in Step 6. The "spacer bars" do not appear to be part of the fabrication sequence because they are assembled to the "box assembly" but there is no desciption of this step.

Provide further information on the assembly of the Region I rack.

This information is requested because it appears that the spacing bar is attached to the outside of the box assembly. The staff is not sure if the spacing bar is free floating, welded to the fuel assembly tube, or welded to the sheath.

If the bar is welded to the sheath, the staff would be concerned about:

1) The effect of welding heat on the neutron absorbing material
2) The strength of the sheath as it relates to the structural adequacy of the Region I spent fuel rack design


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