KHNPTopRptsRAIsPEm Resource

From: Gonzalez, Carlos
Sent: Thursday, May 29, 2014 10:45 AM
To: KHNPTopRptsRAIsPEm Resource
Subject: FW: APR1400 Topical Report RAI 4-7542 (PLUS7 Fuel Design for the APR1400)
Attachments: APR1400 TR RAI 4 SRSP 7542.pdf

From: Ciocco, Jeff
Sent: Tuesday, May 27, 2014 2:47 PM
To: Chang, Harry (hyunseung.chang@gmail.com); Yunho Kim (yshh8226@gmail.com); kimmk89@khnp.co.kr; jylee002@khnp.co.kr; dhsmf@khnp.co.kr; joonseok.kang@khnp.co.kr; KHNPTopRptsRAIsPEm Resource
Cc: VanWert, Christopher; Frankl, Istvan; Olson, Bruce; Lee, Samuel
Subject: APR1400 Topical Report RAI 4-7542 (PLUS7 Fuel Design for the APR1400)

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.

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

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 4-7542

Issue Date: 05/27/2014

Application Title: APR1400 Topical Reports

Operating Company: KHNP

Docket No. PROJ 0782

Review Section: TR PLUS7 Fuel Design for the APR1400
Application Section: PLUS7 Fuel Design for the APR140 (APR1400-F-M-TR-13001-P)

QUESTIONS

TR PLUS7 Fuel Design for the APR1400-1

In Sections 1 and 4, discussions on in-pile tests reference Lead Test Assemblies (LTAs) and Commercial Surveillance Assemblies (CSAs). Staff is seeking clarification on the definitions of LTA and CSA. The following additional information is requested:

- Provide a definition of Lead Test Assembly, including any imposed limitations on location, number of LTAs, etc.
- Provide a definition for Commercial Surveillance Assembly, including any imposed limitations on location, number of CSAs, etc.

TR PLUS7 Fuel Design for the APR1400-2

Section 2.2.2.1 presents the criteria related to the fuel assembly stress limits for normal operation, AOOs, and postulated accidents. Provide additional information regarding the following:

- The minimum ultimate tensile strength at unirradiated conditions (S_u) is listed in the definitions, but is not found in the stress limit equations. How is S_u used in the Plus7 stress limit criteria?
- Is the S_m value, defined by the ASME Section III Stress Intensity for Class 1 Components, for all materials including zirconium alloys? Provide the values used and reference.

TR PLUS7 Fuel Design for the APR1400-3

In Section 2.2.2.2 it is stated that the evaluation of the rod to top nozzle axial clearance is performed by calculation and confirmed by operating experience. The results of this evaluation are provided in Figure 4-6. The lack of a reference has caused staff to question how the calculation was performed. Provide a detailed description of how the rod to top nozzle axial clearance calculation is performed.

REQUEST FOR ADDITIONAL INFORMATION 4-7542

TR PLUS7 Fuel Design for the APR1400-4

In Section 2.2.2.3, hydraulic stability is partially demonstrated through tests performed in the FACTS loop test facility. The range of flows chosen for the tests has caused staff to question the maximum design flow rate for the PLUS7 fuel assembly.

- What is the maximum design flow rate for the PLUS7 fuel assembly?
- Explain what is meant by "equivalent mechanical design flow in the FACTS test", which was used in Section 2.0 of Appendix A.2.1. How does this value differ from in-reactor design flow?

TR PLUS7 Fuel Design for the APR1400-5

The stress analyses for the bottom and top nozzles discussed in Sections 2.3.1.2, and 2.3.2.2 are based on an assumed load, which has caused staff to question the basis for the assumed load. Additionally, staff is seeking clarification of the calculation procedure for the stress analyses. Provide the following:

- Explain how the value for the assumed load during postulated accidents is conservative.
- Provide a summary of the calculation procedure for the stress analyses, including the codes utilized for the calculation, imposition of boundary conditions, and how adequate mesh refinement was determined.

TR PLUS7 Fuel Design for the APR1400-6

The proposed oxide limit in Section 3.2.4 of APR1400-F-M-TR-13001-P is 100 μm. Figure 4-44 indicates that cladding with 100 μm of oxide thickness would exceed the 600 ppm hydrogen content limit, which would lead to a loss of ductility. How does the use of a 100 μm oxide thickness limit support the 1% strain criterion?

TR PLUS7 Fuel Design for the APR1400-7

Section A.2.1 describes the methodology to determine if there are flow induced vibration (FIV) resonances which could lead to fuel failures. It is stated that the vibration spectra is inspected for peaks. What is the criterion for determining if such resonances exist?

TR PLUS7 Fuel Design for the APR1400-8

The FIV tests presented in Appendix A did not result in fretting wear-induced cladding failure caused by cross-flow or natural harmonics through the full range of flow rates. However, it is not stated that there were no indications of fretting wear associated with FIV. How much wall thinning occurred as a result of FIV and how was this incorporated into the stress analysis?

REQUEST FOR ADDITIONAL INFORMATION 4-7542

TR PLUS7 Fuel Design for the APR1400-9

Figure 4-10 presents LTA and CSA predicted oxide thickness versus measured thickness. The staff noted a difference between the prediction accuracy for the LTA data versus the CSA data. While the CSA oxide thickness appears to be typically over predicted, which is conservative, the staff would like to understand the reason for the differences. Please provide a discussion which explains the differences between the CSA and LTA data presented in Figure 4-10 and an explanation of why the CSA oxide thickness appears to be over predicted while the LTA oxide thickness appears to follow a best estimate prediction.

TR PLUS7 Fuel Design for the APR1400-10

Figure 4-44 contains predicted and measured hydrogen content data for the CO3 LTA. Two of the three data points indicate an under prediction of hydrogen content. Provide predicted hydrogen content data for the Kori Unit 2 and Yonggwang Unit 4 data presented in Figure 4-44.

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