KHNPDCDRAIsPEm Resource

From: Ciocco, Jeff
Sent: Tuesday, March 01, 2016 9:37 AM
To: apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Andy Jiyong Oh; James Ross
Cc: Van Wert, Christopher; McKirgan, John; Vera, John; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 425-8405 (04.02 - Fuel System Design)
Attachments: APR1400 DC RAI 425 SRSB 8405.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 is planning end of life PLUS7 fuel assembly / spacer grid tests and seismic analyses. KHNP requests, and we grant, the responses to this RAI be submitted after the series of tests by February 28, 2017. We may adjust the schedule accordingly.

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

Thank you,

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Hearing Identifier: KHNP_APR1400_DCD_RAI_Public
Email Number: 475

Mail Envelope Properties (af0cd534d867482eb49c01db979ad5aa)

Subject: APR1400 Design Certification Application RAI 425-8405 (04.02 - Fuel System Design)
Sent Date: 3/1/2016 9:37:15 AM
Received Date: 3/1/2016 9:37:17 AM
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Files	**Size**	**Date & Time**
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APR1400 DC RAI 425 SRSB 8405.pdf	99058	
image001.jpg	5040	

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Priority: Standard
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Expiration Date:
Recipients Received:

REQUEST FOR ADDITIONAL INFORMATION 425-8405

Issue Date: 03/01/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 04.02 - Fuel System Design
Application Section:

QUESTIONS

04.02-9

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2, requires that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. SRP Section 4.2 Appendix A (II)(2) provides review guidance regarding the review of methods used to analyze loads.

Technical Report APR1400-Z-M-NR-14010-P references CENPD-178-P as the methodology used to obtain the transient response. During an audit of the supporting references conducted during October 14-16, 2015, the staff noted that there are differences between the referenced methodology and the methodology actually used to calculate the seismic response for the PLUS7 fuel design and APR1400 plant design. One example of a deviation is the methodology used to determine a conservative natural frequency assumed in the analysis. This has caused the staff question the overall methodology used in the analysis.

A. Identify the complete methodology used to obtain the transient response highlighted in technical report APR1400-Z-M-NR-14010-P. Specifically, identify any deviations from the stated approved methodology and provide justification for the new methodology. If the methodology used differs from what is currently stated in the technical report, update the technical report as necessary.
B. Justify the use of 4.2 Hz as the BOL first mode frequency in the lateral vibration model under air and room temperature conditions instead of the value of 2.7 Hz used in the referenced methodology, which was based on a conservative bounding of test data.

04.02-10

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2, requires that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. SRP Section 4.2 Appendix A (II)(2) provides review guidance regarding the review of methods used to analyze loads.

Technical Report APR1400-Z-M-NR-14010-P references CENPD-178-P as the methodology used to obtain the transient response. During an audit of the supporting references conducted during October 14-16, 2015, the staff reviewed the referenced methodology and noted a section detailing the development of a bounding EOL vibrational model based on extensive testing of fuel that was available at the time. The staff did not see a detailed discussion which would demonstrate the applicability of the results from CENPD-178-P to the PLUS7 fuel design in APR1400 in terms of the vibrational model. This has caused the staff question the applicability of CENPD-178-P for this purpose.

Justify the applicability of the EOL vibrational model from CENPD-178-P to the PLUS7 fuel design for APR1400 with special consideration to the applicability of the test data used in CENPD-178-P to the PLUS7 fuel design.

04.02-11

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2, requires that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. SRP Section 4.2 Appendix A (II)(2) provides review guidance regarding the review of methods used to analyze loads.

During an audit of the supporting references for technical report APR1400-Z-M-NR-14010-P conducted during October 14-16, 2015, the staff reviewed the EOL natural frequency presented in the referenced topical report, CENPD-178 (specifically, in Figure 6-7). Assuming all other model parameters and load inputs remain the same, the limiting grid impact forces and guide tube bending stresses are expected to change with the choice of natural frequency. The proportional relationship between BOL and EOL natural frequencies is derived from this figure and is used to define the EOL natural frequency used in the APR1400 fuel seismic analysis.

A. Identify the bounding range of natural frequencies that encompass the anticipated deflection range of the EOL fuel assembly and justify the choice of representative natural frequency within that range.
B. How does impact force and guide tube stress vary throughout the bounding range of natural frequencies at EOL and how is analytical uncertainty addressed?

04.02-12

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2, requires that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be

performed. SRP Section 4.2 Appendix A (III)(2) provides review guidance regarding the determination of strength for components other than grids.

During an audit of the supporting references for technical report APR1400-Z-M-NR-14010-P conducted during October 14-16, 2015, the staff reviewed the supporting EOL component stress analysis but no similar analysis was available for BOL component stress. Although EOL conditions are often limiting in terms of component stress analyses, BOL conditions must be investigated to ensure that limiting conditions are assumed in the component stress analysis.

Provide a BOL component stress analysis which justifies the assumption from technical report APR1400-Z-M-NR-14010 that EOL conditions are limiting.

04.02-13

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2, requires that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. SRP Section 4.2 Appendix A (III)(1) provides review guidance regarding the determination of grid strength in order to meet Criterion 2.

Technical report APR1400-Z-M-NR-14010-P presents impact forces for APR1400 grids for in-water and in-air conditions. During an audit conducted during October 14-16, 2015, the staff reviewed supporting documentation, but noted that there was no justification presented for the damping values used.

Provide justification for the damping values used to support the structural analysis of the PLUS7 fuel assemblies for seismic and LOCA loading.

04.02-14

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, Criterion 2, requires that SSCs important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. SRP Section 4.2 Appendix A (III)(1) provides review guidance regarding the determination of grid strength in order to meet Criterion 2.

REQUEST FOR ADDITIONAL INFORMATION 425-8405

During an audit of the supporting references conducted during October 14-16, 2015, the staff reviewed the BOL grid test data and methodology used to define the BOL grid critical buckling force, P(crit). The staff noted that the stress-strain curves indicated potential limited plastic deformation which occurred before the onset of a more general plastic deformation state. This point of potential limited plastic deformation occurred below the chosen P(crit). This has caused the staff to question the ability of the chosen P(crit) value to ensure compliance with GDCs 2 and 27.

Justify the chosen grid P(crit) values. If plastic deformation is allowed, then address RCCA insertability to demonstrate compliance with GDC 27.


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