KHNPDCDRAIsPEm Resource

From:	Ciocco, Jeff
Sent:	Wednesday, July 06, 2016 8:24 AM
To:	apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource; Jungho Kim (jhokim082 @gmail.com); Andy Jiyong Oh; James Ross
Cc:	Honcharik, John; Mitchell, Matthew; Umana, Jessica; Williams, Donna
Subject:	APR1400 Design Certification Application RAI 503-8641 (05.04.01.01 - Pump Flywheel Integrity (PWR))
Attachments:	APR1400 DC RAI 503 MCB 8641.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, 60 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

Hearing Identifier: KHNP_APR1400_DCD_RAI_Public
Email Number: 558

Mail Envelope Properties (d3a151a0fcd5415191ac66ad4bbd58f6)

Subject: APR1400 Design Certification Application RAI 503-8641 (05.04.01.01 - Pump Flywheel Integrity (PWR))
Sent Date: 7/6/2016 8:24:00 AM
Received Date: 7/6/2016 8:24:02 AM
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Files	**Size**	**Date & Time**
MESSAGE	603	7/6/2016 8:24:02 AM
APR1400 DC RAI 503 MCB 8641.pdf	103031	
image001.jpg	5040	

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Priority: Standard
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Recipients Received:

REQUEST FOR ADDITIONAL INFORMATION 503-8641

Issue Date: 07/06/2016
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 05.04.01.01 - Pump Flywheel Integrity (PWR)
Application Section: 5.4.1.1

QUESTIONS

05.04.01.01-7

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criterion (GDC) 4, “Environmental and dynamic effects design bases,” states in part that structures, systems, and components important to safety shall be protected against environmental and dynamic effects, including the effects of missiles, that may result from equipment failure. Reactor coolant pump (RCP) flywheels have large masses and rotate at 1200 revolutions per minute (rpm) during normal reactor operation. A loss of flywheel integrity could result in high energy missiles and the safety consequences could be significant because of possible damage to the reactor coolant system, the containment, or the engineered safety features. Also, to meet GDC 1, “Quality Standards and Records,” and 10 CFR Part 50.55a(a)(1), the adequacy of the RCP flywheel design, materials selection, fracture toughness, preservice and inservice inspection programs, and overspeed test procedures are reviewed to assure a quality product commensurate with the importance of the safety function to be performed.

In order for the staff to determine whether the APR1400 design meets these criteria with regard to RCP flywheel integrity to minimize the effects of missiles on components important to safety, the staff is requesting the following information.

In response to RAI 341-8410, question 05.04.01.01-1, your letter dated April 29, 2016, did not provide adequate justification that the flywheel material, 26NiCrMoV14-5, is equivalent to the steels specified in APR1400 FSAR Section 5.4.1.1.2 and NUREG 0800, Section 5.4.1.1, “Pump Flywheel Integrity (PWR)” in order to use an indirect method of determining the fracture toughness. Your response stated that the justification to use an indirect method of determining fracture toughness would be the use of American Society of Mechanical Engineers (ASME) Code Case N-631, “Use of Fracture Toughness Test Data to Establish Reference Temperature for Pressure Retaining Materials Other Than Bolting for Class 1 Vessels Section III, Division 1.” This is unacceptable as ASME Code Case N-631 is applicable to the ferritic steels currently specified in the ASME Code. The flywheel material, 26NiCrMoV14-5, is not specified as an acceptable material in the ASME Code.

Revise the information in the APR1400 Design Certification Document to document an acceptable approach for determining the fracture toughness of the RCP flywheel materials used in the APR1400 design.

05.04.01.01-8

In response to RAI 341-8410, question 05.04.01.01-1, your letter dated April 29, 2016, provided operating experience of the proposed flywheel material. However, it is unclear whether the operating experience cited is directly applicable to the flywheel material proposed in the

APR1400 design, with a yield strength of 92,825 lbs/in^2. Therefore, the NRC staff needs the following clarifications:

- The operating experience cited for the material includes spare flywheels that have not seen service or plants that have not been operated. It is unclear how this information is relevant to demonstrating the performance of the proposed flywheel material under APR1400 operating conditions. Please clarify.
- The operating experience cited to justify the use of the specific material cited in the APR1400 design (26NiCrMoV14-5, that has a yield strength of 92,825 lbs/in^2) should be specific to flywheels manufactured from that particular material. If operating experience is cited for a flywheel of similar design but different material (or this material in a different flywheel design), provide justification as to why that operating experience is relevant to the review of the ARP1400 flywheel design.

05.04.01.01-9

In response to RAI 341-8410, question 05.04.01.01-3, your letter dated April 29, 2016, did not provide a sufficient basis for using the design acceptance criteria of one-third ultimate strength in lieu of one-third yield strength for the flywheel design stress limit. The use of one-third of the yield strength as a design acceptance criteria has been documented by the NRC in SRP 5.4.1.1 and RG 1.14 as providing an acceptable level of safety for this component. The use of one-third of the ultimate strength of the material as the basis for the flywheel design stress limit is unacceptable absent a technical basis demonstrating why the use of such a criteria will provide for an acceptable level of safety against flywheel failure. Revise the APR1400 Design Certification to apply a RCP flywheel stress limit of one-third of the yield strength of the material, or provide a technical justification regarding why the use of one-third of the ultimate strength as the design stress limit will provide an acceptable level of safety against potential failure of the flywheels.

Your response also stated that the “NRC staff used an approximate conversion factor of 1 MPa = 145 psi to arrive at the value of 800/3 MPa = 38,667 psi.” The NRC did not convert the units from metric to standard, but simply used the flywheel material ultimate strength (standard units) specified in the flywheel analysis report of 116,000 psi, and divided it by three to obtain 38,667 psi. Therefore, if the use of the one-third ultimate strength criteria is to be justified as noted above, the acceptance criteria should be revised to specify 38,667 psi in the technical report APR1400-A-M-NR-14001-P, “KHNP APR 1400 Flywheel Integrity Report,” Revision 0, dated November 24, 2014.

REQUEST FOR ADDITIONAL INFORMATION 503-8641

05.04.01.01-10

In response to RAI 341-8410, question 05.04.01.01-3, your letter dated April 29, 2016, did not provide an analysis of the hub nor an acceptable justification for the fatigue crack growth rates used for the flywheel as was previously requested in RAI 341-8410, question 05.05.01.01-3. The use of fatigue crack growth rates from ASME Code, Section XI, Appendix A, Paragraph A-4300 for the proposed flywheel material is unacceptable, as those fatigue crack growth rates are for SA-533 Grade B, Class 1 and SA-508, Class 3 steels, and no justification has been provided for using them for high alloy 26NiCrMoV14-5 material.

Revise the technical report to include an appropriate analysis of the hub, including an appropriate fatigue evaluation for the applicable hub material, and revise the technical report to use appropriate fatigue crack growth rates for the proposed flywheel material.

05.04.01.01-11

In response to RAI 341-8410, question 05.04.01.01-4, your letter dated April 29, 2016, did not revise the APR1400 FSAR to specify the maximum flaw size used as the acceptance criteria for the preservice inspection and that it is bounded by the flaw size used in determining the critical flaw size in Technical Report APR1400-A-M-NR-14001-P as was previously requested in RAI 341-8410, question 05.04.01.01-4. Revise the APR1400 FSAR to include this information.

05.04.01.01-12

In response to RAI 341-8410, question 05.04.01.01-5, your letter dated April 29, 2016, did not revise the APR1400 FSAR to include that the hub will be inspected for both pre-service inspection (PSI) and in-service inspection (ISI) in the same manner as the flywheel. In addition, the applicant's response also stated that the hub has oil channels that would make it difficult to perform UT inspection.

Revise APR1400 FSAR Section 5.1.1.1.4 to state that the hub will be inspected for both PSI and ISI in the same manner. In addition, provide a discussion on the extent and acceptance criteria of UT inspections that could be performed or other alternatives of performing in-service inspections given these geometric interferences (oil channels).


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