

## KHNPDCDRAIsPEm Resource

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**From:** Ciocco, Jeff  
**Sent:** Thursday, March 31, 2016 6:56 AM  
**To:** KHNPDCDRAIsPEm Resource  
**Subject:** FW: APR1400 Design Certification Application RAI 447-8548 (05.02.03 - Reactor Coolant Pressure Boundary Materials)  
**Attachments:** APR1400 DC RAI 447 MCB 8548.pdf

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**From:** Ciocco, Jeff  
**Sent:** Monday, March 21, 2016 7:37 AM  
**To:** apr1400rai@khnp.co.kr; KHNPDCDRAIsPEm Resource <KHNPDCDRAIsPEm.Resource@nrc.gov>; Jung-ho Kim (jhokim082@gmail.com) <jhokim082@gmail.com>; Andy Jiyong Oh <jiyong.oh5@gmail.com>; James Ross <james.ross@aecom.com>  
**Cc:** Widrevitz, Dan <Dan.Widrevitz@nrc.gov>; Mitchell, Matthew <Matthew.Mitchell@nrc.gov>; Williams, Donna <Donna.Williams@nrc.gov>; Williams, Donna <Donna.Williams@nrc.gov>  
**Subject:** APR1400 Design Certification Application RAI 447-8548 (05.02.03 - Reactor Coolant Pressure Boundary Materials)

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,

Jeff Ciocco  
New Nuclear Reactor Licensing  
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**Hearing Identifier:** KHNP\_APR1400\_DCD\_RAI\_Public  
**Email Number:** 506

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**Subject:** FW: APR1400 Design Certification Application RAI 447-8548 (05.02.03 - Reactor Coolant Pressure Boundary Materials)  
**Sent Date:** 3/31/2016 6:56:23 AM  
**Received Date:** 3/31/2016 6:56:25 AM  
**From:** Ciocco, Jeff

**Created By:** Jeff.Ciocco@nrc.gov

**Recipients:**  
"KHNPDCDRAIsPEm Resource" <KHNPDCDRAIsPEm.Resource@nrc.gov>  
Tracking Status: None

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MESSAGE	1085	3/31/2016 6:56:25 AM
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image001.jpg	5056	

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## REQUEST FOR ADDITIONAL INFORMATION 447-8548

Issue Date: 03/21/2016  
Application Title: APR1400 Design Certification Review – 52-046  
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.  
Docket No. 52-046  
Review Section: 05.02.03 - Reactor Coolant Pressure Boundary Materials  
Application Section:

### QUESTIONS

05.02.03-20

In the Response to RAI No. 335-8351, Question No. 05.02.03-8 (dated January 13, 2016, ML16013A482) it was stated that  $\delta$ -ferrite was limited in accordance with the CASS thermal aging susceptibility screening criteria of the NRC License Renewal Issue No. 98-0030 with the exception that a screening criteria of 500°F (260°C) is acceptable for APR-1400 according to the precedent set in the CESSAR-DC. The staff does not concur that this precedent applies as this precedent has been superseded by License Renewal Issue No. 98-0030.

Additionally the response noted that the applicant considers the use of ASTM A800/A800M to be equivalent to using Hull's method for calculation of  $\delta$ -ferrite and cites the superseded CESSAR-DC precedent. The ASTM A800/800M method is known to under predict  $\delta$ -ferrite, particularly within the range of 12 to 25%  $\delta$ -ferrite where such predictions are needed. The applicant cited the NRC acceptance of the Advanced Light Water Reactor Utility Requirements Document as justification. However, the staff does not concur that this precedent applies as it has been superseded by License Renewal Issue No. 98-0030. The staff notes that detailed information has been submitted to the NRC specifically undermining the use of ASTM A800/A800M for the subject application, for example in NUREG/CR-7185, "Effects of Thermal Aging and Neutron Irradiation on Crack Growth Rate and Fracture Toughness of Cast Stainless Steels and Austenitic Stainless Steel Welds" (ADAMS Accession No. ML15202A007).

License Renewal Issue No. 98-0030 represents the current NRC position and is applied to all applications currently under review. Use of ASTM A800/A800M is not currently accepted by the staff. The staff requests that the applicant either provide revisions to the DCD complying fully with License Renewal Issue No. 98-0030 and the use of Hull's equivalent factors or provide a full and detailed technical evaluation supporting the 500°F criteria and ASTM A800/A800M.

05.02.03-21

In the Response to RAI No. 335-8351, Question No. 05.02.03-12, (dated January 13, 2016, ML16013A482) several proposed revisions and explanations were proffered. The revisions are factually incorrect and the explanations are insufficient. The first revision states that the materials noted do not sensitize; the staff notes that these materials may sensitize but not to a critical extent provided the conditions listed are met. The staff believe that the second revision should become a simple deletion of the original statement.

In addition there appears to be confusion between the term "Type" and "Grades" with regards to the listing "Type 308, 309, 312, 316." Table 5.2-2 does not contain any components having the material of type 308 (UNS S30800), 309 (UNS S30900), or 312 (no UNS code for this non-standard alloy). Type 308 and 309 may be intended to reference ER308 and ER309 which are weld filler materials; however this is otherwise irrelevant as weld materials are not considered susceptible to the subject form of sensitization due to the microstructure of the weldment.

## REQUEST FOR ADDITIONAL INFORMATION 447-8548

It is the understanding of the staff that if both revised statements and the surrounding paragraphs were to be deleted then:

- Welding of cast materials (CF3, CF3M, CF8, and CF8M) would require the same programmatic controls as the wrought austenitic material. Specifically: maximum interpass temperature, heat input, and carbon content. This requirement is already stated in the DCD. This change would reduce the possibility of sensitization of the bulk material and areas of localized low ferrite concentration.
- Furnace or bulk heat treatments would require monitoring to ensure that the material is not exposed to sensitization temperatures.
- The weld materials would be defined as austenitic.

If such a deletion occurred, the following text would remain to be corrected in 5.2.3.4.1.c,

The unstabilized grades of austenitic stainless steels with carbon content of more than 0.03 percent used for components of the RCPB are Type 304 and Type 316. These materials are furnished in the solution-annealed condition. Completed or partially fabricated components are not exposed to temperatures from 427 °C (800 °F) to 816 °C (1,500 °F).

CF8M, CF8 Cast stainless steel: delta ferrite 8 percent to 30 percent, 8 percent to 20 percent for normal operating temperature above 260 °C (500 °F) [The staff disputes this temperature criteria], 14 percent maximum for static cast stainless steel of CF8M

Type 308, 309, 312, 316 Singly and combined stainless steel weld filler metals: delta ferrite controlled to 8FN-15FN (8FN-16FN for Type 309 (L)) with no reading below 5FN as deposited

The staff request that Section 5.2.3.4.1.c be revised to address the noted deficiencies.



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