CCNPP3COLA NPEmails

From: Arora, Surinder
Sent: Friday, January 22, 2010 3:45 PM
To: 'Poche, Robert'; 'cc3project@constellation.com'
Cc: CCNPP3COL Resource; Honcharik, John; Terao, David; Colaccino, Joseph; Miernicki, Michael; Biggins, James; Vrahoretis, Susan; Hair, Christopher
Subject: DRAFT RAI No. 211 CIB1 4195
Attachments: DRAFT RAI 211 CIB1 4195.doc

Rob,

Attached is DRAFT RAI No. 211 (eRAI No. 4195). You have until February 5, 2010 to review it and decide whether you need a conference call to discuss any questions in the RAI before the final issuance. After the phone call or after February 5, 2009, the RAI will be finalized and sent to you for response. You will then have 30 days to provide a technically complete response or an expected response date for the RAI.

Thanks.

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Sent Date: 1/22/2010 3:44:41 PM
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From: Arora, Surinder

Created By: Surinder.Arora@nrc.gov

Recipients:
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Tracking Status: None
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Request for Additional Information No. 211 (eRAI 4195)
DRAFT
1/22/2010

Calvert Cliffs Unit 3
UniStar
Docket No. 52-016
SRP Section: 03.05.01.03 - Turbine Missiles
Application Section: 3.5.1.3

QUESTIONS for Component Integrity, Performance, and Testing Branch 1 (AP1000/EPR Projects) (CIB1)

03.05.01.03-3

Section 3.5.1.3 of the Calvert Cliffs, Unit 3 COL FSAR, Revision 5 specifies that a turbine missile analysis is available for review. The specific turbine missile analysis, Alstom Report TSDMF 07-018 D, dated May 30, 2007, that was submitted by UniStar letter dated March 2, 2009, to address COL Information Item 3.5-2 in the U.S. EPR FSAR, Tier 2 should be referenced in Section 3.5.1.3 of the COL FSAR.

03.05.01.03-4

Section 3.3 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, states that the NRC regulations specify that the applicant is responsible for demonstrating and maintaining the NRC-specified turbine reliability (along with turbine missile probability analysis) by appropriate in-service inspections, which includes volumetric (ultrasonic) examination and testing throughout the plant's life. This section further states that the manufacturer of the turbine provides applicants and licensees with tables of missile generation probabilities versus time (in-service volumetric disk inspection intervals for the design overspeed and in-service valve testing intervals for destructive overspeed events). However, Section 8.3 of the report does not recommend volumetric inservice-inspections. Therefore, the NRC staff requests the following:

a. Specify volumetric inservice-inspections be performed as stated in the above and in the applicable paragraphs of SRP Sections 10.2.3 and 3.5.1.3, or provide justification for not performing volumetric inservice-inspections that are currently industry practice.

b. Section 4.2 of Alstom Report TSDMF 07-018 D, dated May 30, 2007, provided recommended periodic inspections and tests of the overspeed protection system which are inconsistent with Section 10.2.2.12 of the U.S. EPR FSAR. In addition, there is no analysis to support these recommended inspections and tests.

1. Therefore, discuss the inconsistencies between the U.S. EPR FSAR, which the applicant has incorporated by reference in the COL FSAR, and the Alstom report.

2. Provide an analysis for the valve testing interval as stated in Sections 3.3 and 8.1.4 of the Alstom Report TSDMF 07-018 D,

dated May 30, 2007, and SRP Sections 3.5.1.3 and 10.2.3. This destructive overspeed analysis is used to determine the valve testing interval of the overspeed protection system in preventing the generation of missiles in accordance with GDC 4 of 10 CFR Part 50.

c. Section 7.2 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, states that failure due to cyclic loading and brittle fracture is much more unlikely than failure due to SCC. The staff notes that meeting the guidance in SRP Section 10.2.3 for the ratio between fracture toughness and the maximum circumferential stress at design overspeed exceeding the value of 2 $\sqrt{in}$. only demonstrates that the fracture toughness is acceptable, and not that failure due to cyclic loading (low and high cycle fatigue) and brittle fracture will not occur. The staff requests that the probability of the rotor failing due to these mechanisms be provided to quantify the probability of rotor failure due to these degradation mechanisms. This analysis should meet the guidance of SRP Section 10.2.3, Paragraph II.4.B.

03.05.01.03-5

Section 5.1 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, states that the LP and HIP rotors are small forgings welded together using submerged arc welding procedures to form the complete rotor. Discuss the types of post-weld, heat-treatment performed on these rotors and how the root pass of each weld is performed to ensure complete fusion with no defects, thereby ensuring defects will not propagate and cause generation of a missile. Discuss the type of weld joints used that provide acceptable weld fusion and penetration.

03.05.01.03-6

Section 5.1 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, states that welding procedures provides an inert-gas atmosphere inside the cavities and around the center of the discs, where the net stresses are highest during operation. Discuss how these inner-cavity surface areas, including the inner surfaces of the weld are inspected to ensure and maintain that there are no defects that could propagate and cause a turbine missile. In addition, based on the stresses being highest at the center-cavity surfaces of the rotor, the greatest potential for a crack to grow would appear to be on the interior surface of the rotor and not the outer surface of the rotor. Therefore, provide an evaluation for a crack initiating and growing on the interior surface of the rotor and growing radially outward.

03.05.01.03-7

Section 5.2 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, states that the minimum fracture toughness K_{IC} at 20 C (68 ºF) equals K_{IC} at the 5% Fracture Appearance Transition Temperature (FATT 5) (i.e., 160 ksi $\sqrt{in}$ for the LP rotors and 155 ksi $\sqrt{in}$ for the HIP rotors). However, SRP Section 10.2.3, Paragraph II.1.b specifies the use of FATT 50.

a. Since FATT 50 would have a lower K_{IC}, explain why K_{IC} at FATT 5 is used in lieu of FATT 50.
b. Provide the K_{IC} at FATT 50 for the rotor material as stated in SRP Section 10.2.3, and provide an analysis using this K_{IC} value.
c. The report uses terminology "$Rp_{0.2}$ (68ºF) = 102 ksi for LP rotors and 107 ksi for HIP rotor." Please clarify the terminology and how it is applied to the turbine missile analysis.

03.05.01.03-8

Discuss how the cracks in the scenarios stated in Section 7.1.4 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, can be detected by visual and surface examinations performed during the inservice inspections proposed by the U.S. EPR FSAR, and Section 8.3 of this report before they reach the critical-crack size.

03.05.01.03-9

Section 7.1.1 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, provides an illustration in Figure 6 regarding the propagation rate of stress-corrosion cracks for a material (ASTM A471, Type 26NiCrMoV 12 7) that is similar to the Alstom material specification B65A-S. In addition, Section 7.1.1 states that the stress corrosion crack growth rate increases until a plateau is reached over a wide range of stress intensity, and that this plateau range extends to at least K_I = 100ksi √in.

a. Discuss why the materials are similar and equivalent so that the stress corrosion cracking growth rates for ASTM A471 can be used for the B65A-S material, and/or provide a similar figure for the actual material specification to be used for the rotors.

b. Based on Figure 6, the plateau range seems to end at approximately 80 ksi √in, and not 100 ksi √in. It should also be noted that Table 3 uses a crack growth rate based on 80 ksi √in. Explain why 80 ksi √in is not used as the limit for the plateau range.

03.05.01.03-10

Discuss how the last bullet in Section 7.1.4 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, is a conservative assumption and provide a sketch of the rotor with the pins securing the blades to the disc fingers.

03.05.01.03-11

Specify the initial existing crack size (inches/millimeters) that was used in the analysis in Section 8.1.2.5 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007.

03.05.01.03-12

Clarify whether the turbine missile probabilities in Figures 15 through 17 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, are based on the stresses due normal-operating speed or design overspeed. If these figures are not based on design overspeed stresses, then provide similar figures based on design overspeed (120% of normal operating speed as stated in SRP Section 3.5.1.3, Paragraph II.2).

03.05.01.03-13

Appendices 1 and 2 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, specify the use of referenced documents (Section 4) for the material specifications, ordering requirements and technical specification for the turbine rotors. Please submit these references.

03.05.01.03-14

Provide the locations where the mechanical test specified in Appendices 1 and 2 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, will be performed on the rotor to ensure the large forgings have homogeneous properties.

03.05.01.03-15

Section 2.2 of Appendix 1 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, should specify that the impact test will be performed after heat treatment, and test specimens will be taken in the transverse direction from the forging direction to ensure that the appropriate testing is performed to produce accurate material properties of the actual turbine rotor. Explain why this information is not specified.

03.05.01.03-16

Section 2.3.2 of Appendices 1 and 2 of the Alstom Report TSDMF 07-018 D, dated May 30, 2007, states that the K_{IC} values of the actual rotor material are for information only. SRP Section 10.2.3, Paragraph II.4 uses the fracture toughness K_{IC} to ensure that the ratio of K_{IC} of the rotor material to the maximum tangential stress at speeds from normal to design overspeed is at least 10 $\sqrt{}$mm (2 $\sqrt{}$in) at the minimum operating temperature. This ensures the rotor material has sufficient toughness to minimize brittle fracture and the generation of a missile. Therefore, Section 2.3.2 of Appendices 1 and 2 should be modified accordingly.

03.05.01.03-17

Appendix 4 to the Alstom Report TSDMF 07-018 D, dated May 30, 2007, specifies that the entire volume of the part shall be ultrasonically examined (preservice inspection) with longitudinal waves and provides Table No. 1 with various acceptance criteria for different sections of the turbine rotor. However, it is not clear if the weld-preparation surfaces and welds are examined, and whether the inspection and the acceptance criteria meet the ASME Code, Sections III and V. Discuss how this ultrasonic inspection meets the guidance in SRP Section 10.2.3, paragraph II.3, which states that each welded rotor should be subjected to ultrasonic, surface and visual examinations using procedures and acceptance criteria for Class 1 components in the ASME Code, Section III and V. This includes ultrasonically examining the welds in the radial and radial-tangential sound-beam directions, and performing surface examinations of all weld-prepared surfaces prior to welding and that all surfaces exposed to steam should be surface-examined. It should be noted that SRP Section 10.2.3, Paragraph III.3 provides the acceptance criteria for ultrasonic examinations.

03.05.01.03-18

Discuss why Figures 4 and 12 in the Alstom Report TSDMF 07-018 D, dated May 30, 2007, are different, and why the stresses in Figure 12 at the 4LP location are not used in the analysis in Section 9 since this location seems to have higher stresses.