Response to

Request for Additional Information No. 18, Revision 0

6/24/2008
U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.05.01.03 - Turbine Missiles
SRP Section: 05.04.01.01 - Pump Flywheel Integrity (PWR)
Application Section: 3.5.1.3 and 5.4.1.6
CIB1 Branch

Question 03.05.01.03-1:

The U.S. EPR FSAR, Tier 2 Section 3.5.1.3 does not provide a turbine missile analysis for either of the two turbine generator designs specified in Section 10.2. In addition, Section 10.2.3.6 of the U.S. EPR FSAR specifies a turbine rotor inservice inspection plan, which specifies that an ASME Code inspection be performed every 10 years, and specifies no volumetric inspections. This contradicts the SRP Section 3.5.1.3, which states that applicants with turbines with no NRC approved reports on turbine missile generation probabilities should commit to the following program (which includes a volumetric inservice inspection with an inspection interval not to exceed 3 years or 2 fuel cycles). Therefore, if no turbine missile analysis is performed, then the 3 year inspection interval (for volumetric inspections) is used. Therefore, the NRC staff requests that a turbine missile analysis for each turbine design be submitted to the staff for review, and provide the corresponding turbine inspection program that follows the guidance of SRP Sections 3.5.1.3 and 10.2.3 in order to meet the requirements of GDC 4, "Environmental and Missile Dynamic Effects Design Bases" of 10 CFR Part 50.

Response to Question 03.05.01.03-1:

The U.S. EPR FSAR provides two alternative turbine generator designs in U.S. EPR FSAR, Tier 2, Section 10.2 and 10.2A. The selection of the desired turbine design technology is at the discretion of the COL applicant. As noted in U.S. EPR FSAR, Tier 2, Section 3.5.1.3, the COL applicant is responsible for providing the associated turbine missile analysis for the selected turbine generator design that demonstrates the probability of turbine missile generation for the selected turbine generator, P1, is less than 1 x 10-4 for turbine-generators favorably oriented with respect to containment. This COL action item is included in Table 1.8-2 of U.S. EPR FSAR, Tier 2 Section 1.8 as Combined License Information Item No. 3.5-2.

With regard to inservice inspections intervals, the text in the 1st paragraph of U.S. EPR FSAR, Tier 2, Section 10.2.3.6 will be changed as noted below:

“The inspections are performed during refueling outages on an interval consistent with the inservice inspection schedules in Reference 3 and the inspection intervals from the turbine manufacturer’s turbine missile analysis provided by the COL applicant as described in U.S. EPR FSAR, Tier 2, Section 3.5.1.3. A COL applicant that references the U.S. EPR design certification will provide the site specific turbine rotor inservice inspection interval consistent with the manufacturer’s turbine missile analysis.”

FSAR Impact:

U.S. EPR FSAR, Tier 2 Section 10.2.3.6 will be revised as described in the response and indicated on the enclosed markup. U.S. EPR FSAR, Tier 2 Table 1.8-2 will be revised as described in the response and indicated on the enclosed markup.

Question 05.04.01.01-1:

The U.S. EPR FSAR, Tier 2 Section 5.4.1.6 does not provide a reactor coolant pump flywheel analysis topical report as recommended by Regulatory Guide (RG) 1.14, paragraph D.3 (which is referenced in SRP Section 5.4.1.1). For example, Section 5.4.1.6 of the U.S. EPR FSAR only provides statements such as "The critical speeds for ductile failure, failure due to excessive deformation and non-ductile failure of the flywheel exceeds two times the nominal speed of the flywheel (where 2 x [nominal speed] = 2400 rpm), in accordance with paragraph 2.f of RG 1.14," without providing the detailed analysis. RG 1.14 states that the recommendations of this regulatory guide will be used in evaluating all topical reports on flywheel integrity after January 1, 1976. In addition, RG 1.14 states that several analysis (critical flywheel speed for ductile fracture, nonductile fracture and excessive deformation) should be submitted in a topical report to the NRC for evaluation. Therefore, the NRC staff requests a detailed technical report concerning the reactor coolant pump flywheel analysis be provided for review in accordance with RG 1.14 and SRP Section 5.4.1.1 in order to meet the requirements of GDC 4, "Environmental and Missile Dynamic Effects Design Bases" of 10 CFR Part 50.

Response to Question 05.04.01.01-1:

AREVA NP will provide to the NRC a technical report concerning the reactor coolant pump flywheel analysis. A complete response to this question, including the technical report and corresponding changes to the U.S. EPR FSAR, will be provided by November 15, 2008.

U.S. EPR Final Safety Analysis Report Markups

Table 1.8-2—U.S. EPR Combined License Information Items
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Item No.	Description	Section	Action Required by COL Applicant	Action Required by COL Holder
10.2-4	A COL applicant that references the U.S. EPR design certification, and selects the alternate turbine, will provide a list of material specifications for the alternate turbine-generator components.	10.2A.2.1.1	Y	
10.2-5	A COL applicant that references the U.S. EPR design certification will provide the site-specific turbine rotor inservice inspection interval consistent with the manufacturer's turbine missile analysis.	10.2.3.6	Y	
10.3-1	A COL applicant that references the U.S. EPR design certification will identify the authority responsible for implementation and management of the secondary side water chemistry program.	10.3.5	Y	
10.3-2	A COL applicant that references the U.S. EPR design certification will develop a FAC condition monitoring program that is consistent with Generic Letter 89-08 and NSAC-202L-R3 for the carbon steel portions of the steam and power conversion systems that contain water or wet steam.	10.3.6.3	Y	
10.4-1	A COL applicant that references the U.S. EPR design certification will describe the site-specific main condenser materials.	10.4.1.2	Y	
10.4-2	A COL applicant that references the U.S. EPR design certification will describe the site-specific design pressure and test pressure for the main condenser.	10.4.1.2	Y	
10.4-3	A COL applicant that references the U.S. EPR design certification will provide the description of the site-specific portions of the CWS.	10.4.5.2.1	Y	
10.4-4	A COL applicant that references the U.S. EPR design certification will provide the specific chemicals used within the chemical treatment system as determined by the site-specific water conditions.	10.4.5.2.2	Y	

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- The combined stresses in the low-pressure turbine rotor at design overspeed due to centrifugal forces and thermal gradients do not exceed 75 percent of the minimum specified yield strength of the material, or 75 percent of the measured yield strength in the weak direction of the materials if tensile tests are performed on the actual rotor material.

- The turbine shaft bearings are able to withstand any combination of the normal operating loads, anticipated transients and accidents resulting in a turbine trip.

- The natural critical frequencies of the turbine shaft assemblies between zero speed and 20 percent overspeed are controlled by design and during operation stages to minimize adverse effects to the unit during operation.

- The turbine rotor design facilitates inservice inspection of high stress regions.

10.2.3.5 Turbine Rotor Preservice Inspections and Testing

The following preservice inspections are performed during manufacture:

- Forged or welded rotors are rough machined prior to heat treatment.

- Each finished forged or welded rotor is subjected to 100 percent volumetric (ultrasonic), surface and visual examinations using procedures and acceptance criteria equivalent to those specified for Class 1 components in the ASME BPV Code, Section III (Reference 7) and Section V (Reference 8). Before welding or brazing, all surfaces prepared for welding or brazing are surface examined. After welding or brazing, all surfaces exposed to steam are surface examined, giving particular attention to stress risers and welds. Welds are ultrasonically examined (100% volumetric examination), equivalent to examinations in Reference 8.

- Each turbine rotor assembly is spin tested at 120 percent of normal operating speed.

10.2.3.6 Turbine Rotor Inservice Inspection Program Plan

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A turbine rotor inservice inspection program detects rotor or disk flaws that can lead to brittle failure at or below design speed in the steam turbine rotor assembly. The turbine rotor inservice inspection program uses visual, surface and volumetric examinations to inspect components in the steam turbine rotor assembly. The inspections are performed during refueling outages on an interval consistent with the inservice inspection schedules in ~~the~~ Reference 3 ~~so that a total inspection has been completed at least once within a 10 year time period~~and the inspection intervals from the turbine manufacturer's turbine missle analysis provided by the COL applicant as derscribed in Section 3.5.1.3. A COL applicant that references the U.S. EPR design certification will provide the site-specific turbine rotor inservice inspection interval consistent with the manufacturer's turbine missle analysis.