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Your ref: Docket No. 99900404
Our ref: DCP_NRC_003251

July 15, 2013

Subject: **REPLY TO NOTICE OF NONCONFORMANCE cited in NRC INSPECTION REPORT NO.: *99900404/2013-203* dated June 14, 2013**

Westinghouse received the NRC Inspection Report Number *99900404/2013-203* dated June 14, 2013 including a Notice of Nonconformance (NoN) for two items: *99900404/2013-203-01* and *99900404/2013-203-02*. Westinghouse views any NoN it receives as serious and is committed to be in compliance with the provisions of Title 10, the *Code of Federal Regulations* (CFR), Section 50, Appendix B "Quality Assurance for Nuclear Power Plants and Fuel Reprocessing Plants". Westinghouse also values the results from the NRC's review of the flow induced vibration (FIV) analysis for the reactor vessel internals (RVI) and WEC's corrective actions for closure of the RVI FIV inspection issues, as it validates our overall implementation of applicable industry guidelines and regulations to ensure the robustness of the AP1000 design. In consideration of NRC comments made during the inspection, Westinghouse immediately initiated actions to resolve the specific issues raised by the inspection team prior to completion of the inspection. Details of actions associated with the NRC's issues are described below.

The response for each NoN includes the following items: (1) the reason for the noncompliance, or if contested, the basis for disputing the noncompliance; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid noncompliance; and (4) the date when the corrective action will be completed.

1. NoN 99900404/2013-203-01

The NoN provides the following description:

> *A. Criterion III, "Design Control," of Appendix B, "Quality Assurance Program Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR 50 states, in part, that the design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.*
>
> *Contrary to the above, as of April 5, 2013, Westinghouse failed to sufficiently verify or check the adequacy of the flow-induced vibration analyses to assure that the reactor internals are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. Specifically, Westinghouse failed to adequately address the 15% difference between the core barrel first beam*

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mode frequencies in the reactor coolant pump (RCP) reactor equipment system model (RESM) and the random turbulence RESM, which is greater than the 10% industry accepted standard. The RCP RESM and the random turbulence RESM results are used to predict the high cycle fatigue stress of reactor vessel internal components and to ensure that the high cycle fatigue stress endurance limits in the 1998 Edition of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Mandatory Appendix I, Figure I-9.2.2, "Design Fatigue Curves for Austenitic Steels, Nickel-Chromium-Iron Alloy, Nickel-Iron-Chromium Alloy, and Nickel-Copper Alloy for Sa ≤ 28.2 ksi, for Temperatures Not Exceeding 800°F" are met. In addition, the 10% and 3.5% frequency sweeps applied around the RCP forcing frequencies in the RCP pulsation analysis to account for uncertainties in pump speed, fluid density, and sound speed do not cover the 15% uncertainty core barrel first beam mode frequencies in the two RESMs.

This issue has been identified as Nonconformance 99900404/2013-203-01.

Response:

(1) The reason for the noncompliance, or if contested, the basis for disputing the noncompliance.

Westinghouse understood that a 15% difference existed between the core barrel first beam mode frequencies in the reactor coolant pump (RCP) reactor equipment system model (RESM) and the random turbulence (RT) RESM. However, based on engineering judgment regarding vibration response and Westinghouse historical experience, it was believed that a detailed analysis of the differences between the two models was not needed.

The reactor vessel internals flow-induced vibration (FIV) analyses are performed for both RT and RCP loadings to demonstrate compliance with the ASME Code high cycle fatigue limits. In Westinghouse experience, the core barrel beam mode is critical for the analysis of RT loadings. For analysis of RCP loadings, critical structural responses occur near the RCP forcing frequencies. The 15% difference in the calculated core barrel first beam mode frequency between the RT and RCP models was not considered in a detailed analysis because the first beam mode occurs at a frequency approximately four times lower than the lowest frequency of the RCP loadings. Structural modes which have a much lower frequency than the applied frequency will not respond to the applied frequency. Therefore, the loadings applied at the RCP forcing frequencies would cause a negligible response at the core barrel first beam mode.

The NoN finding discusses a 15% difference in the core barrel beam mode frequencies between the RT and RCP FIV models as not meeting an industry standard. Westinghouse experience is that the guideline typically applied for this type of analysis is a 10% difference between a measured test value and a value predicted by analysis, as opposed to a model-to-model comparison. The actual first core barrel beam mode frequency will be measured as part of the RVI Comprehensive Vibration Assessment Program (CVAP).

It is noted that the frequency sweeps referred to in the NoN are typically intended to cover uncertainties near the forcing frequencies and are not associated with the core barrel beam mode frequencies, which are on the order of four times less.

(2) The corrective steps that have been taken and the results achieved.

Following the NRC inspection, a technical peer review of the current FIV analysis program including both RT and RCP RESM models was performed. The peer review identified several actions and recommendations to improve the modelling techniques and address potential differences between the models.

(3) The corrective steps that will be taken to avoid noncompliance.

Westinghouse will complete additional analyses to address core barrel first beam mode differences between the RCP and RT RESM models. In addition, Westinghouse will address the actions and recommendations identified in the above mentioned technical peer review. These analyses will confirm the ASME Code high cycle fatigue limits referenced in the NoN continue to be satisfied.

These actions are being tracked to closure in the Westinghouse Corrective Action System.

(4) The date when the corrective action will be completed.

Westinghouse expects the corrective actions concerning the analysis and fatigue margins to be complete by March 31, 2014

2. NoN 99900404/2013-203-02

Description:

The NoN provides the following description:

B. Criterion XVI, "Corrective Action," of Appendix B, to 10 CFR 50 states, in part, that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected.

Contrary to the above, as of April 5, 2013, Westinghouse failed to correct a condition adverse to quality. Specifically, Westinghouse used incorrect engineering judgment to close Corrective Action Process (CAPs) Issue Report (IR) 12-286-W001, which addressed not applying random turbulence loads to the base plate in the random turbulence RESM. Westinghouse closed CAPs IR 12-286-W001 and revised the calculation note in APPMI01-S3C-331, Rev. 3, "Flow-Induced Vibration (FIV) of the AP1000 Vortex Suppression Plate and Secondary Core Support Structures," based on engineering judgment that assumed additional conservatism in the analysis that did not exist. Westinghouse asserted that applying the random turbulence pressure load in the upwards and downwards direction to the vortex suppression plate would effectively double the applied load, which it did not.

This issue has been identified as Nonconformance 99900404/2013-203-02.

Response:

(1) The reason for the noncompliance, or if contested, the basis for disputing the noncompliance.

As noted in the NoN, calculation APP-MI01-S3C-331 Rev. 3, "Flow-Induced Vibration (FIV) of the AP1000 Vortex Suppression Plate and Secondary Core Support Structures," included justification for simplified loadings that was inaccurate. This inaccurate statement originated in the calc note and was then carried over into the CAP closure statement. Given the fact that the calculation was final approved (including verification) and used as the basis for the CAP IR justification for closure, the event focused herein is the inaccuracy in calculation APP-MI01-S3C-331 Rev. 3.

An apparent cause analysis (ACA) for this inaccuracy was completed and concluded the following:

- The author/verifier did not understand an element of the assumptions that had been established in the earlier revisions of the document, and thus did not recognize the inaccuracy of their description of the analysis performed,

- Inadequate documentation (per WEC procedures) of the assumptions with justification by the authors of the previous revisions of the document. Adequate documentation in earlier revisions may have mitigated the inaccuracy.

Note, to clarify the NoN description, the phrase "...to the base plate in the random turbulence RESM." should state "...to the base plate in the secondary core support structure dynamic analysis (APP-MI01-S3C-331 Rev. 3)."

(2) The corrective steps that have been taken and the results achieved.

- The original CAP IR (12-286-W001) that was found to have been improperly closed was reopened and the basis for closure was corrected. It was confirmed that the technical content of the analysis (and ultimately, the resulting ASME Code margin) is unaffected by the inaccurate statement in the documentation.
- The improper closure of 12-286-W001 is being addressed in the Westinghouse Corrective Action System.
- An ACA was conducted as part of CAP, which resulted in the following corrective actions:
  1. Individuals involved were coached on the importance of technical rigor and attention to detail.
  2. Additional focused training on the implementation of the Westinghouse verification process was conducted for the affected organization.

(3) The corrective steps that will be taken to avoid noncompliance.

Calculation APP-MI01-S3C-331 Rev. 3 will be updated to address concerns included in this NoN. This action is being tracked to closure in the Westinghouse Corrective Action System.

(4) The date when the corrective action will be completed.

Westinghouse expects the corrective action to update calculation APP-M101-S3C-331, Rev 3 to be complete by March 31, 2014.

Conclusion

Westinghouse believes that the information presented in this response resolves the issues identified by the subject NRC Inspection Report.

Questions or requests for additional information related to this response to the NRC Inspection Report should be directed to the undersigned.

Very truly yours,

Paul A. Russ
Director, US Licensing

/Enclosures

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