

AP1000TopRptsPEm Resource

From: Bavol, Bruce
Sent: Friday, September 09, 2016 9:15 AM
To: AP1000TopRptsPEm Resource
Subject: RAIs Specialized Seismic Option Post Audit-Non Proprietary
Attachments: RAI Response Letter_Non_Proprietary.docx; RAIs_SSO_Post Audit_Non_Proprietary.docx

Bruce Bavol

Project Manager
AP1000, Licensing Projects Branch 4
Office of New Reactors
Nuclear Regulatory Commission
Work Phone: (301) 415-6715
Email: Bruce.Bavol@nrc.gov

Hearing Identifier: AP1000_TR_RAI_Public
Email Number: 7

Mail Envelope Properties (4200ef91ce60433d8e96f157471cf0ed)

Subject: RAIs Specialized Seismic Option Post Audit-Non Proprietary
Sent Date: 9/9/2016 9:15:24 AM
Received Date: 9/9/2016 9:15:26 AM
From: Baval, Bruce

Created By: Bruce.Baval@nrc.gov

Recipients:
"AP1000TopRptsPEm Resource" <AP1000TopRptsPEm.Resource@nrc.gov>
Tracking Status: None

Post Office: HQPWMSMRS06.nrc.gov

Files	Size	Date & Time
MESSAGE	215	9/9/2016 9:15:26 AM
RAI Response Letter_Non_Proprietary.docx	19233	
RAIs_SSO_Post Audit_Non_Proprietary.docx	32086	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

September 08, 2016

Mr. Robert B. Sisk, Director
Specialized Projects Licensing
Westinghouse Electric Company
1000 Westinghouse Drive
Cranberry Township, PA 16066

SUBJECT: SUPPLEMENTAL REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 02 FOR REVIEW OF WESTINGHOUSE ELECTRIC COMPANY'S SUBMITTAL OF HSP-GW-GLR-001, REVISION 0 AND HSP-GW-GLR-002, REVISION 0, "SPECIALIZED SEISMIC OPTION REPORT"

Dear Mr. Sisk:

By letter dated September 28, 2015, Westinghouse Electric Company (WEC) submitted for U.S. Nuclear Regulatory Commission (NRC) staff's review, option report (OR) HSP-GW-GLR-001, Revision 0 and HSP-GW-GLR-002, Revision 0, "The Specialized Seismic Option Report." Following a June 2016 audit, NRC staff identified that additional information is still needed in order to continue portions of the review. The staff's RAIs are contained in the enclosure to this letter.

To support the review schedule, you are requested to respond by November 1, 2016. If RAI clarifications are required, please contact me so that arrangements can be made with the applicable technical staff.

If you have any questions or comments concerning this matter, you may contact me at 301-415-6715 or bruce.bavol@nrc.gov.

Sincerely,

/RA/

Bruce M. Bavol, Project Manager
Licensing Branch 4
Division of New Reactor Licensing
Office of New Reactors

If you have any questions or comments concerning this matter, you may contact me at 301-415-6715 or bruce.bavol@nrc.gov.

Sincerely,

/RA/

Bruce M. Bavol, Project Manager
Licensing Branch 4
Division of New Reactor Licensing
Office of New Reactors

Project No. 0813

Enclosures:
Request for Additional Information (Non-Proprietary)

DISTRIBUTION:

Public	RidsNroDnrLB4	BBavol	CVanWert
RidsAcrsAcnwMailCenter	JNie	TLupold	TLe
RidsOgcMailCenter	JDixon-Herrity	CWu	BJain
RidsRgn2MailCenter	SBurnell	MVera	MPatterson
RidsNroDnr	SSamaddar	RRoche	ANeuhausen

*-concur by email

NRO-002

OFFICE	DEIA/SEB:BC	DEIA/MEB:BC	DSRA/SRSB:BC	DNRL/LB4:PM
NAME	SSamaddar*	TLupold*	RKaras*	BBavol
DATE	09/06/16	08/31/16	09/08/16	09/08/16

OFFICIAL RECORD COPY

**Option report (OR) HSP-GW-GLR-001, Revision 0
"The Specialized Seismic Option Report"**

Request for Additional Information

(DSRA/SRSB)

SSO-007

Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix A, General Design Criterion (GDC) 2, requires that structures, systems, and components (SSCs) important to safety are designed to withstand the effects of earthquakes without the loss of capability to perform their safety functions. The design bases for these SSCs shall reflect: (1) the severity of the historical reports, with sufficient margin to cover the limited accuracy, quantity, and time period for the accumulated data, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed. NUREG-0800 Section 4.2 Appendix A (II)(2) provides review guidance regarding the review of methods used to analyze the design loads and component capacity.

In September 28, 2015, Westinghouse Electric Company (WEC) submitted Option Report HSP-GW-GLR-001, Rev 0, "The Specialized Seismic Option Report" (known from this point forward as Option Report) for review and approval. Section 4.4.1 of the Option Report discusses the [] in relation to the Option response spectrum. The submittal concludes that the Option response spectrum []].

The staff notes that while the Option response spectra []]. Additionally, the Option response spectra becomes [] (see Figure 3-19 of HSP-GW-GLR-001). This has caused the staff to question whether or not the AP1000 fuel assembly []].

Perform an evaluation of the AP1000 fuel assembly structural response for the Option response spectrum and provide justification for []].

(DEIA/MEB)

SSO-008

Westinghouse Option Report, HSP-GW-GLR-001 "The Specialized Seismic Option Report," Revision 0 (Agencywide Documents Access and Management System Accession No. ML15274A048), Section 4.3.3 related to HVAC and Cable Trays.

BACKGROUND

During an audit of the specialized seismic option (SSO or the option), the NRC staff reviewed the adequacy of methods for seismic analysis of heating, ventilating and air-conditioning (HVAC) and Cable Trays in WEC Calculations []

[redacted]. The results for the enhanced seismic spectra (ESS) option for HVAC were obtained by [redacted]. There may be additional areas where the [redacted]. The NRC staff does not agree with the definition of the [redacted]. Section 5.2 of the Option Report defines the [redacted]. The NRC staff notes that the linear static solution can be obtained with the same models [redacted]. The WEC calculations indicate that the [redacted] as part of the Option. However, the input floor response spectra (FRS) was based on the results of the [redacted]. Implementing [redacted]. Therefore, the NRC staff does not believe it to be appropriate to use a [redacted]. Therefore, the additional information identified below is requested.

REQUEST

The applicant is requested to provide (1) a technical basis for using the [redacted], (2) a technical basis for [redacted] for the option, and (3) the scope of structures and components that are analyzed using a [redacted].

(DEIA/SEB)

SSO-009

10 CFR 50 Appendix S requires that the safety functions of SSCs must be assured during and after the vibratory ground motion associated with the SSE ground motion through design, testing, or qualification methods. Ensuring no power deficiency in the acceleration time histories over the frequency range of interest to the SSCs is one of the acceptance criteria used for determining the validity of these time histories used in the seismic analysis and design of SSCs in accordance with 10 CFR 50 Appendix S. The staff reviewed the AP1000 SSO report and the supporting calculations and determined that the information requested below is needed in order to determine the acceptability of the acceleration time histories.

Figure 3-10 of the AP1000 SSO report shows the power spectral density (PSD) of the design time histories up to around [redacted] upper bound frequency as used for the NUREG-0800 Section 3.7.1, Rev. 4 Appendix A target PSD. This upper bound frequency reflects the NRC Regulatory Guide (RG) 1.60 horizontal spectral shape that has a zero period acceleration (ZPA) frequency of 33 Hz. The NUREG-0800 Section 3.7.1 Rev. 4, Appendix A target PSD is compatible with the RG 1.60 horizontal spectral shape. However, compared to the ZPA frequency of [redacted] for the AP1000 SSO ESS, an upper bound frequency of [redacted] appears to be low. NUREG-0800 Section 3.7.1 Rev. 4, Appendix B indicates that for response spectral shapes other than the RG 1.60 horizontal spectral shape, the PSD should be evaluated up to a frequency that is consistent with the design response spectra. Therefore, the staff requests the applicant to provide a PSD assessment of all time histories to cover a [redacted] that is consistent with the AP1000 SSO ESS.

During the staff audit in the week of June 6, 2016, the staff raised the above concern to the applicant and subsequently, the applicant showed plots of PSD curves up to [] to address this concern. Those plots showed that the [], contradicting the common expectation of averaging. The frequency window of [] did not appear to explain this observation. Thus, the staff requests the applicant to explain why the [].

During the audit, the staff reviewed WEC Technical Report [] which, in addition to the design acceleration time histories, utilizes another 4 sets of acceleration time histories for the non-linear stability analysis. The PSDs of these 4 sets of acceleration time histories were estimated utilizing their entire duration in the Fourier transform and effective time durations in the denominator of the PSD equation []. The effective time duration of an acceleration time history is defined as the time for its normalized cumulative Arias intensity to rise from 5 percent to 75 percent, adjusted by a factor of 1/0.7. Based on the staff experience, the applicant's method can overestimate the PSD for those frequencies at which the wave components have very low magnitude but span a time longer than the effective time duration. Further, the applicant's method is not consistent with the NUREG-0800 guidance which states that the Fourier transform should be performed over the strong motion portion of the time history, during which the acceleration time history achieves near maximum and nearly stationary power. The applicant indicated during the audit that in contrast to the method described above, the method actually used to estimate the PSD of the design acceleration time histories is consistent with the SRP guidance. Therefore, the staff requests the applicant to provide a technical justification for the adequacy of the method used for estimating the PSDs of the 4 additional sets of time histories or use a method that is consistent with the guidance described in [].

Accordingly, the SSO report should be updated to reflect any necessary changes due to the requested information above for the PSD assessment (for example, update Figure 3-10 of the SSO report).

NOTE: Westinghouse has submitted the 5 sets of time histories to the staff for confirmatory analysis.

SSO-010

Section 4.1.5 in Option Report HSP-GW-GLR-001, Revision 0 describes the design enhancements for the [] that are necessary to accommodate the demand of the ESS. These enhancements modified the structural stiffness and mass of the [], changing its dynamic properties. While the Option Report addresses the dynamic response of the [] for the ESS, the staff review did not find information about the dynamic response of the [] such as those resulting from []. To demonstrate compliance with GDC 2 and consistent with the guidance in NUREG-0800 Section 3.8.3, the staff requests the applicant to provide the technical basis that demonstrate that the dynamic response of the [] due to the aforementioned [] does not adversely affect the structural performance of the [] considering the design enhancements.

SSO-011

Appendix A to 10 CFR Part 50, GDC 2 require SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, without loss of capability to perform their safety functions.

AP1000 DCD Section 3.8.2.1.2, "Containment Vessel Support," describes that the vertical and lateral loads on the containment vessel and internal structures are transferred to the basemat below the vessel by the use of shear studs, and mechanisms of friction, and bearing between the vessel and basemat. The staff review of the Option Report HSP-GW-GLR-001, Revision 0 did not find information demonstrating the adequacy of the shear studs against the seismic demands of the ESS. To demonstrate compliance with GDC 2, the applicant is requested to provide the technical basis demonstrating that the shear studs continue to be adequate for the seismic demands of the ESS.

SSO-012

10 CFR 52.47(a)(27) requires a description of the design-specific probabilistic risk assessment (PRA) and its results. In accordance with this regulation, the applicant provided a description in Section 5.1 of the SSO Report:

"The seismic margin of the Specialized Seismic Option SSCs above the design basis ESS results from the factors as discussed below:

- More robust final design of the certified AP1000 plant SSCs - In the final certified AP1000 plant design, the structural capacities of the certified AP1000 Standard Plant SSCs are improved from those in the certified AP1000 plant DCD Revision 19. The more robust final design of the certified AP1000 Standard Plant SSCs adds extra seismic margin to the SSCs of the Specialized Seismic Option.
- Conservatism in the certified AP1000 plant seismic margin high confidence of low probability of failure (HCLPF) evaluation - The certified AP1000 Standard Plant SSCs seismic margin HCLPF values are evaluated conservatively. [

]

- Conservatism in the structural qualification analysis approach - An accepted but more realistic structural qualification analysis approach than the one used in the certified AP1000 plant DCD Revision 19 (Reference 1) is employed to qualify the component and the structure. [

].

It is the staff's understanding that not all of these factors apply to all of the SSCs for which a seismic margin is calculated. The staff requests the applicant to clearly describe in this section of the report that each factor may apply individually or with other factors to contribute to the seismic margin, as applicable. The staff also requests the applicant to provide examples that

further clarify the contribution of the individual factors to the seismic margin, as described in more detail below:

a. For the bullet, “more robust final design of the certified AP1000 plant SSCs,” the staff requests the applicant to clarify how this factor contributes to the seismic margin, specifically with respect to the use of the terms “robust” and “improved”, and describe an example SSC to demonstrate the meaning of the statement. The staff interprets the existing statement to imply that the seismic margin for the SSO is greater than for the AP1000 plant design, which is not necessarily the case.

b. For the bullet, “conservatism in the certified AP1000 plant seismic margin HCLPF evaluation,” the staff requests the applicant to supplement their description of the use of plant actual loads vs. design specification loads with an example to clarify the difference between the plant actual loads associated with the ESS and the design specification loads. The applicant should also discuss how these loads are determined.

c. For the bullet, “conservatism in the structural qualification analysis approach,” the staff requests the applicant supplement their description with an example.

SSO-013

10 CFR 52.47(a)(27) requires a description of the design-specific PRA and its results. During the audit of June 7-9, 2016, the evaluation supporting the conclusion in Section 5.2, of the SSO Report, which states, “The seismic margin assessment (SMA) evaluation considers the effect of uplift and sliding of the nuclear island (NI) basement foundation. The NI seismic response has been evaluated at 1.1 times the review level ESS (1.67xESS), and it is concluded that the NI basemat retains its stability against sliding and overturning,” was not available for staff review. The staff requests the applicant to provide a description of the evaluation to support the conclusion that the NI basemat retains its stability against sliding and overturning.

The staff in addition requests the applicant to revise the proposed markups for DCD Chapter 19 to clarify that the review level ESS is 1.67 x ESS.

SSO-014

10 CFR 52.47(a)(27) requires a description of the design-specific PRA and its results.

The SSO Report, in Section 5.2, describes the application of the [] for seismic demands of some SSCs. The SSO Report states, “For the single-mode-dominated component with a HCLPF value greater []” During the staff’s audit of calculations from June 7 – 9, 2016, the applicant identified the following components for which the [] was used: []

Since the AP1000 DCD Rev. 19 Table 19.55-1 HCLPF values provided for the [], the staff requests the applicant to explain the use of the [] for these primary components. The staff also requests the applicant to confirm that these six components [] are the only SSCs for which the [] was applied.

SSO-015

The staff reviewed Option Report HSP-GW-GLR-001, Revision 0 and identified areas in need of clarification. The applicant is requested to address the following:

- a) Section 2.2.1 in the Option Report states that in general, the SSO ESS imparts higher seismic demands on the certified AP1000 NI critical sections. Further, this section indicates that while modeling refinements have been made, the dynamic response and overall behavior of the refined models (e.g. ISRS, base shears, story forces, etc.) remain consistent with that described in the certified AP1000 plant DCD Rev. 19. Given that in general the ESS imparts higher seismic demands, the staff requests the applicant to clarify what is meant by the indication that the ISRS, base shears, story forces, etc. remain consistent with the descriptions in AP1000 DCD Rev. 19.

- b) Appendix A to the Option Report includes markups for Table 3H.5-13, "Design Summary of Floor at Elevation 135'-3" Area 1 (Main Control Room Ceiling)." In the design evaluation results the markups show that [

] the values in AP1000 DCD Rev. 19. The applicant is requested to clarify the reason for the [

] relative to the AP1000 DCD Rev. 19.

- c) Appendix A to the Option Report includes markups for Table 3H.5-14, "Design Summary of Enhanced Shield Building Comparison to Acceptance Criteria (sheet 1, 2 and 3)." In general, the markups show that the [

] than AP1000 DCD Rev. 19 required values. The applicant is requested to explain what is causing the [

].

SSO-016

The staff reviewed Option Report HSP-GW-GLR-001, Revision 0 and identified areas in need of editorial corrections and/or revisions to avoid inconsistencies in the Option Report descriptions. The applicant is requested to address the following:

- a) In the executive summary of the AP1000 SSO Report the figures of the comparison of the ESS and the certified AP1000 plant CSDRS, as well as the Example Spectrum (Figure 3 and 4 page vi) should include the damping value.

- b) First paragraph in Section 2.1. "Application of the specialized seismic option ESS," states, "This design change affects DCD Revision 19 Tier 1 Chapters 1.2 and 5.0 and Tier 2 Chapters 2.5, 3.7, 3.10, 19, and Appendix 3I." The staff reviewed Table 9-2 "DCD Change road map for Appendix A changes" and Appendix A "Markups of the certified AP1000 DCD Revision 19 to support the Specialized Seismic Option" and found that some sections are missing in the statement, therefore the applicant is requested to revise that statement and include the sections missing to be consistent with the information in Table 9-2 in the SSO Report. This also applies to the last paragraph in Section 2.1.

- c) In the Option Report, the first paragraph in Section 4.1 seems to limit the scope of the design calculation performed for the Option to the []. However, the last paragraph in Section 4.1 along with the subsequent 4.1 subsections describe design calculations performed for critical sections for steel containment and containment internal structures. To avoid inconsistencies in the description regarding the scope of the design calculations performed, the staff requests the applicant augment the description in the first paragraph in Section 4.1, similar to the 2nd sentence in the last paragraph in Section 4.1, to include the other structures for which design calculations are performed for the SSO Report.
- d) In the Option Report, Section 4.1.2 “Auxiliary Building,” the applicant states “The auxiliary building critical sections, shown in this report in []. However, [] could not be located in SSO Report. The staff requests the applicant to add [] to the report.
- e) In the Option Report, Section 5.1 describes the use of the strength factor and ductility factor with the conservative deterministic failure margin (CDFM) method for the Option Report. Further, in its response to RAI SSO-004, the applicant confirmed these factors to be the only factors used in the CDFM calculations for the Option Report. To avoid inconsistencies regarding the factors used for the CDFM calculations for the Option Report, the applicant is requested to provide markups for DCD Section 19.55.2.2.3 (under CDFM method) to remove the description of damping factor.
- f) In the Option Report, Table 6-1 summarizes the design enhancements for building structures. Regarding the design enhancements for the [], Option Report, Table 6-1 (and respective information in Table 7-2) described the [] but did not describe the [], described in Section 4.1.5 and Table 4-9. Additionally, the description in Table 6-1, references the []; however, the [] are the same as given in AP1000 DCD Rev. 19. The staff requests the applicant to revise the description in Table 6-1 (and respective information in Table 7-2) to be consistent with the description in Section 4.1.5 and Table 4-9.
- g) Appendix A to the Option Report includes markups to DCD Tier 1 Table 5.0-1 removing the information related to the []. However, based on the markups to Option Report, Section 3.8, such information continues to be applicable for the SSO Option Report (i.e. the information remains in DCD Section 3.8.5.5.3). The staff agrees with the applicability of such information to the Option Report, and therefore, requests the applicant to keep the information related to the minimum required angle of internal friction in DCD Tier 1 Table 5.0-1.
- h) Figure 3H.5-11 in Appendix A to the Option Report is missing certain details and lines, therefore, the applicant is requested to provide a better figure with necessary details, such as missing structural details and dimension lines and also explain why some information has been deleted.