ENCLOSURE 4 to AW-16-4503

Specialized Seismic Option Report Review, Responses to Request for Additional Information (RAI)

(Non-Proprietary)

Specialized Seismic Option Report Review, Responses to Request for Additional Information (RAI)

Please find attached the following request for information (RAI) responses:

RAI-SSO-002 Revision 2

RAI-SSO-011 Revision 0

RAI-SSO-012 Revision 0

RAI-SSO-014 Revision 0

Specialized Seismic Option Report Review

Response to Request for Additional Information (RAI)

Response No. RAI-SSO-002 **Revision** 2

Question:

WEC will need to augment its justification for using the same critical sections that were evaluated in the **AP1000®** Design Control Document (DCD), Revision 19, and demonstrate that these cover an adequate [ ]a,c relative to the ESS.

Supplemental Question:

Staff request Westinghouse to propose mark-ups to the topical report consistent with their response.

Westinghouse Response:

One of the key conclusions of the Option Report (Reference 1) is that the higher Enhanced Seismic Spectra (ESS) generated demands can be accommodated in the Option plant without any plant layout changes. To demonstrate that the design thickness of the nuclear island walls and slabs remained unchanged a number of structural elements of nuclear island building structures have been evaluated. [

]a,c

The seismic forces on any particular critical section are dictated by the overall building response, and its own local modes. In Figures 3-18a and 3-18b of the Option Report mark-up, [

]a,c

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Tables 3-3 and 3-4 of the Option Report markup provide a correlation between the building modes and the critical sections they affect the most. [

]a,c The CIS modes at 11.46 Hz through 14.12 Hz have influence to the critical sections of the CIS. The rest of the CIS modes have less of an overall influence

To identify what range of frequencies affect the critical sections, local modal analyses of each critical section were performed. Figure 3-18c of the Option Report markup identifies [

]a,c

These representative structural elements of the nuclear island (critical sections) encompass a variety of construction design types. The range of building and local frequencies that affect the critical sections is wide, as shown in Tables 3-3 and 3-4 and Figures 3-18a and 3-18b of the Option Report markup. The critical sections represent a sufficient sample size to demonstrate that the nuclear island building structures layout is maintained.

Supplemental Westinghouse Response:

The Westinghouse Response to this RAI has been revised to refer to tables and figures included in the Seismic Option Report (OR) Text Revision section of this RAI Response.

Reference(s):

1. HSP-GW-GLR-001, Revision 0, "The Specialized Seismic Option Report," September 2015 (Proprietary) and HSP-GW-GLR-002, Revision 0, "The Specialized Seismic Option Report," September 2015 (Non-Proprietary)

2. HSP_NRC_000025, Revision 0, "Westinghouse Specialized Seismic Option Report – Action Items from June 2016 NRC Audit - Updated", November 22, 2016.

Specialized Seismic Option Report (OR) Text Revision:

Revisions to 3.5 text are provided. It is noted that changes previously provided to address audit action item 4 (Reference 2) are included in the revisions below.

3.5 UNDERSTANDING THE ESS IMPACT ON THE AP1000 PLANT DESIGN

[

]a,c

[

]a,c

One of the key objectives of this Option Report is to demonstrate that the higher ESS generated demands can be accommodated in the Option plant [

]a,c

[

]a,c

[

]a,c

The seismic forces on any particular critical section are dictated by the overall building response, and its own local modes. In Figures 3-18a and 3-18b, [

]a,c

Tables 3-3 and 3-4 provide a correlation between the building modes and the critical sections they affect the most. [

]a,c

To identify what range of frequencies affect the critical sections, local modal analyses of each critical section were performed. Figure 3-18c identifies [

]a,c

[

]a,c

[

]a,c

Table 3-3. Correlation between the NI Building Dominant Excitation Modes and the Affected Critical Sections

a,c

Table 3-4. Correlation Between the CIS Dominant Excitation Modes and the Affected Critical Sections

a,c

a,c

Figure 3-18a. Auxiliary Building and Shield Building Modes

a,c

Figure 3-18b. Containment Internal Structures Modes

a,c

Figure 3-18c. Building and Critical Section Local Modes

Specialized Seismic Option Report Appendix A (DCD Mark-up) Revision:

None

Technical Report (TR) Revision:

None

Specialized Seismic Option Report Review

Response to Request for Additional Information (RAI)

Response No. RAI-SSO-011 **Revision** 0

Question:

(DEIA/SEB)

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.

Westinghouse Response:

The shear studs are not required for design basis loads. The shear studs provide additional margin for earthquakes beyond the safe shutdown earthquake. The Option Report (Reference 1) does not include the evaluation of embedded items, since they can relatively easily be upsized without affecting layout or safety analyses. In the detailed design phase, the shear studs will be evaluated to assure they can carry the loads generated by the Option Review Level Earthquake (RLE=1.67*ESS). It is noted that the stud size in the **AP1000** plant is [ ]^{a,c}. So, it is likely that the stud size will remain unchanged once the Option detailed design calculation is complete.

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Westinghouse does not propose revised text to the Specialized Seismic Option (Reference 1) in response to this RAI.

Reference(s):

1. HSP-GW-GLR-001, Rev. 0, "The Specialized Seismic Option Report," September 2015 (Proprietary) and HSP-GW-GLR-002, Rev. 0, "The Specialized Seismic Option Report," September 2015 (Non-Proprietary).

Specialized Seismic Option Report (OR) Revision:

None

Specialized Seismic Option Report Appendix A (DCD Mark-up) Revision:

None

Technical Report (TR) Revision:

None

Specialized Seismic Option Report Review

Response to Request for Additional Information (RAI)

Response No. RAI-SSO-012 **Revision** 0

Question:

(DEIA/SEB)

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. **[**

][a,c]

- 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

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the structure. [

]a,c

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.

Westinghouse Response:

In the response that follows, the phrase "more robust final design" used in the Option Report has been replaced with the phrase "increased structural capacities in the final design".

Section 5.1 of the Specialized Seismic Option Report (Reference 1), lists the factors that contributed to the seismic margin of the Option SSCs. These are repeated below:

- [ ]a,c
- Increased structural capacities in the final design of the certified **AP1000** plant SSCs
- [ ]a,c
- Conservatism in the certified **AP1000** plant seismic margin HCLPF evaluation
- Conservatism in the structural qualification analysis approach

The seismic margin HCLPF values of all SSCs listed in Table 5-1 of the Option Report benefit from the factors of " [ ]a,c " and " [ ]a,c ". More specifically, the use of [ ]a,c categorized into " [ ]a,c " is beneficial to all

SSCs seismic margin HCLPF values. The other three factors contribute to the HCLPF value of the individual SSCs as listed in Table 5-1. In the following, examples are provided to explain the contribution of each of the three factors.

- Increased structural capacities in the final design of the certified **AP1000** plant SSCs

  The example is the final design of the certified **AP1000** plant [ ]a,c which has greater structural capacities than the design used to calculate the HCLPF value of [ ]a,c in the certified **AP1000** plant DCD Revision 19.

- Conservatism in the certified **AP1000** plant seismic margin HCLPF evaluation

  The example is the evaluation of the HCLPF value of the [ ]a,c for the SSO. The ESS-induced seismic loads on the [ ]a,c were calculated by the seismic analysis and then combined with other normal operating loads to determine the seismic margin HCLPF value. The design specification loads are the loads used to design the [ ]a,c which are defined in the design specification. [

  ]a,c

- Conservatism in the structural qualification analysis approach

  The example is the evaluation of the [ ]a,c. In the SSO, the [ ]a,c was analyzed with a more realistic shell model instead of the lumped-mass-stick model to predict the stress value on the [ ]a,c more accurately.

Reference(s):

1. HSP-GW-GLR-001, Rev. 0, "The Specialized Seismic Option Report," September 2015 (Proprietary) and HSP-GW-GLR-002, Rev. 0, "The Specialized Seismic Option Report," September 2015 (Non-Proprietary).

Specialized Seismic Option Report (OR) Revision:

Revise Section 5.1 (page 5-4) as follows:

- ~~More robust~~Increased structural capacities in the 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~~increased structural capacities in the final design of the certified **AP1000** plant SSCs adds extra seismic margin to the SSCs of the Specialized Seismic Option. For example the final design of the [ ]^{a,c} has greater structural capacities than the design used in the certified **AP1000** plant DCD Revision 19.

- [

  ]^{a,c}

- Conservatism in the certified **AP1000** plant seismic margin HCLPF evaluation

  The certified **AP1000** plant SSCs seismic margin HCLPF values are evaluated conservatively. [

  ]^{a,c}

- Conservatism in the structural qualification analysis approach

  An accepted ~~but~~and 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. [

  ]^{a,c}

Specialized Seismic Option Report Appendix A (DCD Mark-up) Revision:

None

Technical Report (TR) Revision:

None

Specialized Seismic Option Report Review

Response to Request for Additional Information (RAI)

Response No. RAI-SSO-014 **Revision** 0

Question:

(DEIA/SEB)

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

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

Westinghouse Response:

In Section 5 of the Specialized Seismic Option Report (OR) (Reference 1), the [ ]a,c was used for [ ]a,c. Since the HCLPF values of the **AP1000** plant [ ]a,c given in the **AP1000** plant DCD

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Revision 19 Table 19.55-1 do not exceed [ ]^{a,c}, the use of the [ ]^{a,c} for the [ ]^{a,c} in the SSO SMA is explained below.

The **AP1000** plant [ ]^{a,c} HCLPF value was re-evaluated based on the review of the **AP1000** plant [ ]^{a,c} detailed structural qualification analysis results. A HCLPF value equal to [ ]^{a,c} was established for the **AP1000** plant [ ]^{a,c} when subjected to the **AP1000** plant Certified Seismic Design Response Spectra (CSDRS) anchored to [ ]^{a,c}. This HCLPF value was the starting point for the evaluation of the [ ]^{a,c} HCLPF value for the Option. Therefore, the **AP1000** plant [ ]^{a,c} HCLPF value is higher than [ ]^{a,c} and meets the application criteria of the [ ]^{a,c} as described in Section 5.2 of the OR and the [ ]^{a,c} was appropriate to apply to the [ ]^{a,c}.

The **AP1000** plant [ ]^{a,c} HCLPF value was re-evaluated based on the review of the **AP1000** plant [ ]^{a,c} detailed structural qualification analysis results. A HCLPF value equal to [ ]^{a,c} was established for the **AP1000** plant [ ]^{a,c} when subjected to the **AP1000** plant CSDRS anchored to [ ]^{a,c}. This HCLPF value was the starting point for the evaluation of the [ ]^{a,c} HCLPF value for the Option. Therefore, the **AP1000** plant [ ]^{a,c} HCLPF value is higher than [ ]^{a,c} and meets the application criteria of the [ ]^{a,c} as described in Section 5.2 of the OR and the [ ]^{a,c} was appropriate to apply to the [ ]^{a,c}.

Reference(s):

1. HSP-GW-GLR-001, Rev. 0, "The Specialized Seismic Option Report," September 2015 (Proprietary) and HSP-GW-GLR-002, Rev. 0, "The Specialized Seismic Option Report," September 2015 (Non-Proprietary).

Specialized Seismic Option Report (OR) Revision:

5.2 RESULTS

[

]a,c

Specialized Seismic Option Report Appendix A (DCD Mark-up) Revision:

None

Technical Report (TR) Revision:

None