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May 2, 2013

Mr. Cindy K. Bladey
Chief, Rules, Announcements, and Directives Branch (RADB)
Office of Administration, Mail Stop TWB-05-B01M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Industry Comments on Proposed Revision to Design of Structures, Components, Equipment, and Systems (78 FR 19541; Docket: NRC-2013-0041)

Project Number: 689

Dear Ms. Bladey:

On behalf of the nuclear industry, the Nuclear Energy Institute (NEI)[1] appreciates the opportunity to provide industry comments on proposed revisions to the following sections of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition":

- Section 3.7.1, "Seismic Design Parameters"
- Section 3.7.2, "Seismic System Analysis"
- Section 3.7.3, "Seismic Subsystem Analysis"
- Section 3.8.1, "Concrete Containment"
- Section 3.8.3, "Concrete and Steel Internal Structures of Steel or Concrete Containments"
- Section 3.8.4, "Other Seismic Category I Structures"
- Section 3.8.5, "Foundations"

[1] The Nuclear Energy Institute (NEI) is the organization responsible for establishing unified industry policy on matters affecting the nuclear energy industry, including the regulatory aspects of generic operational and technical issues. NEI's members include all entities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel cycle facilities, nuclear materials licensees, and other organizations and entities involved in the nuclear energy industry.

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Add= A. Subbaratnam (1X52)
A. Bradford (ahb1)

In general, we found the April 10 public meeting to be very beneficial in terms of helping us understand the logic behind the more significant changes proposed in these draft revisions. Given the scope and technical complexity of the information in these SRP sections, it may be helpful to have a follow-up meeting to discuss the attached set of comments that have been generated since the April 10 meeting.

We look forward to further discussions on this topic. If you have any questions, please feel free to contact me.

Sincerely,

Kimberly A Keithline

Kimberly A. Keithline

Attachment

c: Ms. Amy E. Cubbage, NRO/DARR/APOB, NRC
Mr. Ramachandran Subbaratnam, NRO/DARR/APOB, NRC
Mr. Nilesh C. Chokshi, NRO/DSEA, NRC

ATTACHMENT

NUREG-0800, Sections 3.7 and 3.8
Industry Comments on Draft Revision (May 2, 2013)

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
3.7.1 [ML12352A305]	**3.7.1**	**3.7.1**
General Comment for 3.7.1 and 3.7.2	Site amplification analysis based on Random Vibration Theory (RVT) has widely been used for the past several years (RG 1.208 already permits use of RVT-based site response analysis). This approach provides a significant advantage in that it obviates the need for time-history representation of the design spectrum. This advantage can be further exploited by performing RVT-based SSI analysis, which is significant since it provides a stable mean solution for SSI response, something that has become a concern for time-history based approach (whereby multiple time-histories are warranted). The importance and benefits of RVT-based approach are recognized in the industry, which is reflected by the fact that ASCE 4-13 (due to be issued later this year) permits use of RVT-based approach for both site amplification analysis and SSI analysis.	SRP Sections 3.7.1 and 3.7.2 should include language that recognizes the applicability of RVT-based approach for SSI analysis.
Section 3.7.1.I (Areas of Review, Design Ground Motion), First Paragraph [p. 3.7.1-2]	The revised draft states: *"Both the GMRS and the FIRS are defined as free-field outcrop spectra (not including any soil layers above that elevation)."* This definition is consistent with GMRS definition but it is not consistent with the FIRS definition DC/COL-ISG-017.	Either delete the parenthetical statement or revise it to be consistent with DC/COL-ISG-017.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories), First Paragraph [p. 3.7.1-9]	This paragraph says, "When time histories are used, each of the three ground motion time histories must be shown to be statistically independent from the others." This paragraph should be revised to clarify that the requirement for statistical independence is not needed if in a linear analysis, the maximum response of interest is obtained by taking the square root of the sum of squares (SRSS) of maximum responses from the time history analysis for each of the three earthquake components. See Regulatory Guide 1.92, Rev. 2, Section 2.2(1).	Modify this paragraph to clarify that the requirement for statistical independence is not needed if in a linear analysis, the maximum response of interest is obtained by taking the square root of the sum of squares (SRSS) of maximum responses from the time history analysis for each of the three earthquake components.
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories), First Paragraph [p. 3.7.1-9]	The proposed addition is not practically feasible. Specifically, the new words state that, "phasing characteristics of the real earthquake records should be preserved." However, current methods for spectral matching change the phasing characteristics.	Revise the seventh sentence of this paragraph as follows: "When the seed time histories are selected from real earthquake records...phasing characteristics of the real earthquake records should ~~be preserved~~ not change significantly."
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories), First Paragraph [p. 3.7.1-9]	The proposed addition states that, "If the target spectra include multiple characteristic events...the use of multiple time histories may be appropriate..." This premise appears to assume that the effect of characteristic events (i.e., "controlling earthquakes") is preserved in the target spectra (GMRS or FIRS, as the case may be). However, the methodology for GMRS/FIRS generation is based on a development of a single "broad peak" spectrum whereby the effects of controlling earthquake are embedded in a single spectrum (i.e., low frequency and high frequency content). The suggested approach would require use of multiple time histories all matched to target FIRS that cannot represent the characteristics of the individual events.	Delete the discussion of multiple characteristics events.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories), First Paragraph [p. 3.7.1-9]	The proposed addition suggests that seed time histories should be selected based on how close their spectral shapes are to the target spectral shape. For high frequency CEUS target spectra with limited recorded motion available this approach may result in using vertical seed time history to match the horizontal target spectra. This mismatch should be avoided. In addition, the seismic setting, geologic setting and site conditions of the recorded motion should be considered as basis for selecting seed time history for the plant site. Recent studies of multiple time histories (up to 30) with RVT suggest the proposed refinement does not necessarily resolve issues associated with using limited time histories.	Revise this paragraph to avoid suggesting that spectral shape resemblance to target spectra should be a basis for selecting seed time history. Emphasis should be placed on the power spectral density of the time history.
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories, Option 1, Approach 1), Fourth Paragraph [p. 3.7.1-12]	This section of the SRP suggests using tabulated values in Appendix B as one approach for developing target power spectral density (PSD). Since most soil column analyses start with hard rock high frequency and low frequency spectra (and associated magnitude and distance) as input, it is suggested that the associated hard rock high frequency and low frequency PSD be used and amplified similar to the amplification of the hard rock spectra to GMRS and used as a companion target PSD for the GMRS and time history development for GMRS.	This paragraph should be revised to acknowledge that alternate methods for developing target spectra for GMRS/FIRS are also acceptable and will be reviewed on a case by case basis.
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories, Option 2), First Paragraph [p. 3.7.1-13]	The basis for selecting four time histories for linear analysis is not clear. Recent studies show that obtaining stable mean responses may require either a RVT approach or use of a larger set of time histories.	Add a reference to provide the basis for the selection of four time histories for linear analysis.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.1.II (SRP Acceptance Criteria, Design Ground Motion, Design Time Histories, Option 2), Fourth Paragraph [p. 3.7.1-14]	This paragraph says, "In addition, if the extent of the nonlinear response is found to be significant or if the nonlinear response due to one or several time histories is found to be substantially different from the others results, then additional time histories should be considered." It would be helpful to provide some additional guidance on what would be "substantially different." Otherwise, it becomes difficult to use this part of the SRP since it does not explain what would be acceptable.	Provide additional guidance on what "substantially different" means.
Section 3.7.1.II (SRP Acceptance Criteria, Review Considerations for DC and COL Applications, COL Referencing an ESP and CD), Item vi. [p. 3.7.1-15]	Item vi. states that FIRS are derived as free-field outcrop spectra and that only the effects of materials that are below the base elevation of the seismic category I structure are included in the analysis. This statement is not accurate and inconsistent with DC/COL-ISG-017.	Define FIRS by appropriate reference, (e.g., DC/COL-ISG-017).
Section 3.7.1, Appendix B, Table 1 [p. 3.7.1-27]	The PSD values for CEUS rock sites for Magnitude 6-7 are the same as those for Magnitude 7+. It is not clear if the values are listed accurately.	The PSD values should be checked for accuracy.
Section 3.7.1, Appendix C [p. 3.7.1-31]	Recent PEER report 2012/201 dated July 2012 provides a strong correlation between magnitude and distance and spectra damping amplification. The values listed in Appendix C do not appear to be consistent with the PEER report.	The values in Appendix C should be reviewed and alternative amplification functions considered.
SRP 3.7.2	**SRP 3.7.2**	**SRP 3.7.2**
Section 3.7.2.I (Areas of Review), First Paragraph [p. 3.7.2-1]	Title is missing	"1. Seismic Analysis Methods" should be added to the beginning of the paragraph that starts on this page.
Section 3.7.2.I (Areas of Review, Development of In-structure Response Spectra) [p. 3.7.2-3]	Recent studies have shown that RVT can provide a very stable in-structure response spectra by avoiding issues related to the adequacy of the time histories.	Add a statement that RVT approach will be reviewed on a case by case basis.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Seismic Analysis Methods, Dynamic Analysis Methods), Item i. [p. 3.7.2-8]	This paragraph lists acceptable methods of analysis but does not include RVT.	Include RVT as an alternate method.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Procedures Used for Analytical Modeling, Decoupling Criteria for Subsystems) [p. 3.7.2-10]	There appears to be a typo in criterion ii. ("0.8 $\geq$ Rf $\geq$ 1.25" should be "0.8 $\leq$ Rf $\leq$ 1.25").	Change "0.8 $\geq$ Rf $\geq$ 1.25" to "0.8 $\leq$ Rf $\leq$ 1.25"
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction) [p. 3.7.2-15]	At the top of p. 3.7.2-15, it says, "If the ratio is less than 80%, then the effect of the nonlinearity due to the foundation uplift should be assessed, and if found to be important, then it should be accounted for in the seismic design, which is reviewed on a case-by-case basis." The SRP should be expanded to describe in more detail what is considered "important." Otherwise, it becomes difficult to use this part of the SRP since it is not clear what would be acceptable to the NRC.	The SRP should be expanded to describe in more detail what is considered "important."
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion), Item ii. [p. 3.7.2-16]	It is not clear why site specific design motion should be developed only for the ground surface level. The concept of FIRS was developed to have design motion at the foundation level. See DC/COL-ISG-017.	Add the option to develop the site-specific motion either at the surface or foundation level and emphasize the consistency of design motion generation with its application to SSI analysis.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis), Fourth Bullet [p. 3.7.2-17]	FIRS is more appropriate than GMRS for the comparison discussed in this bullet.	Change GMRS to FIRS in this bullet.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis), Eighth Bullet [p. 3.7.2-19]	The direct approach requires input motion in the form of displacement, velocities, or acceleration at the boundary of the model.	Revise this bullet to acknowledge that it may be demonstrated that the foundation level motion, far from the structure, as calculated by the direct approach envelops the FIRS typically obtained from 1D site response analysis.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis) [pp. 3.7.2-20 and 3.7.2-21]	The recommendations for checking the frequencies of the excavated soil volume are not necessary. Please note the excavated soil volume under fixed boundary condition is not relevant to the excavated soil volume in the SSI model. The frequencies under fixed base condition may be totally absent in the SSI solution, making such a test much less relevant. The checking should be limited to careful inspection of transfer functions for the responses of interest supplemented by SSI analysis using a half or quarter model with the direct method or independent verification. These two measures will be adequate to prevent spurious peaks from the use of the SM. Furthermore, the effect of spurious peaks on design quantities must be assessed. Transfer function is a very sensitive measure of response but it is never used for design. ISRS and seismic member forces are used for design.	Revise these pages to allow use of the design quantities to justify the accuracy of the solution and avoid unnecessary frequency calculation of the excavated soil.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis) [p. 3.7.2-20]	The results of subtraction method or extended subtraction method can be independently verified per the direct approach by using alternate computer programs with identical soil, motion, and structural model parameters in lieu of using smaller scale representative models. The direct approach is a more complete and independent method of verification, since the alternate computer program can solve the SSI problem directly, without using a sub-structuring approach. Use of the SASSI sub-structuring direct method to verify SASSI subtraction method is computationally exhaustive and provides for a less accurate verification compared with using a true direct solution approach to perform verification.	Acknowledge in this Section that independent verification using a direct approach provides a more accurate benchmark for verification of the sub-structuring subtraction solution approach.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis) [p. 3.7.2-21, Last Paragraph]	The limits on maximum reductions allowed due to incoherency are specified without explaining how these values were established. As discussed in DC/COL-ISG-01, two separate computer programs with entirely different formulations have used the same verified ground motion incoherency model resulting in very close SSI responses for the same SSI model that shows the reduction may be much more than 30% due to incoherency effects.	Please provide the basis for limiting the reductions allowed due to incoherency or cite a reference.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis) [p. 3.7.2-21]	Performance of an incoherency SSI analysis should be optional rather than required.	Include a statement to make it clear that an incoherency analysis is optional rather than required.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Soil-Structure Interaction, Input Ground Motion, Specific Guidelines for SSI Analysis) [p. 3.7.2-21, Second Paragraph]	This paragraph states that a larger reduction due to incoherency may be acceptable if justified. It would be helpful for this Section to include a reference to one or more examples of acceptable justification for larger reductions.	Please provide a reference for one or more example cases that includes the justification.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Development of In-Structure Response Spectra) [p. 3.7.2-23]	The use of RVT should be allowed for generation of ISRS.	Expand the discussion to allow RVT to be used for generating ISRS.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Interaction of Non-Category I Structures with Category I SSCs) [p. 3.7.2-24]	Item C should be expanded to clearly specify that for II/I evaluations, the design of non-Category I structures can use site-specific SSE loads.	Revise Item C to clearly specify that for II/I evaluations, the design of non-Category I structures can use site-specific SSE loads.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Methods Used to Account for Torsional Effects) [p. 3.7.2-26]	It is not clear why accidental torsion is required for cases where an adequate structural model is developed that accounts for stiffness and mass distribution in the structure.	Cite a reference for the basis of requiring accidental torsion if the dynamic model is capable of capturing the torsional response.
Section 3.7.2.II (Acceptance Criteria, SRP Acceptance Criteria, Analysis Procedure for Damping) [pp. 3.7.2-26 and 3.7.2-27]	The definitions for K and M should use symbols consistent with those in the equations.	Use K and M with bars over the top of the letters, not underlined.
SRP 3.7.3 [ML12353A357]	**SRP 3.7.3**	**SRP 3.7.3**
Section 3.7.3.II (Acceptance Criteria, SRP Acceptance Criteria, Basis for Selection of Frequencies) [Page 3.7.3-5]	In the draft Revision 4, the first sentence has been changed from "...less than ½ or more than twice..." to "...less than two or more than twice..." This appears to be a typo that should be corrected.	Change "two" back to "½."

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
SRP 3.8.1 [ML12353A365]	**SRP 3.8.1**	**SRP 3.8.1**
Section 3.8.1.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures) Subsection E [p. 3.8.1-14]	Please refer to our comments related to SRP Section 3.8.4.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures), Subsection H below.	Please refer to our comments related to SRP Section 3.8.4.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures), Subsection H below.
SRP 3.8.3 [ML12353A377]	**SRP 3.8.3**	**SRP 3.8.3**
Section 3.8.3.II (Areas of Review, Loads and Loading Combinations) [p. 3.8.3-8]	Loads induced by the proposed construction sequence and differential settlements may not be applicable to small modular reactors where the containment and its internal structures are fabricated in factory-controlled conditions offsite and the containment is not placed in the building until the foundation and walls are in place.	Applicability of this section for small modular reactors should be clarified.
SRP 3.8.4 [ML12353A382]	**SRP 3.8.4**	**SRP 3.8.4**

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.8.4.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures) Subsection H [p. 3.8.4-12]	The second method involves direct determination of dynamic soil pressure from SSI/FEM analysis. This approach is more accurate than the Wood method when adequately detailed SSI finite element model is used (the results from SSI/FEM analysis are more realistic since they account for the timing effect and spatial variation). Since the main purpose of seismic earth pressure determination is to use it as a load to calculate the design forces and moments on embedded walls, an even better advantage of the SSI/FEM analysis can be realized by directly harvesting the seismic-induced forces in the walls from the SSI analysis. This avoids two-step analysis approach of computing maximum seismic soil pressure and the follow up structural analysis. Also, the results from SSI/FEM analysis are more realistic since they account for the timing effect. The member forces should be computed for the range of soil profiles used in the SSI analysis with proper consideration of soil-wall separation.	Rather than using SSI/FEM analysis to just determine the dynamic soil pressure, please consider acknowledging that such analysis can directly provide the wall member forces considering the range of SSI soil profiles for design of the walls.
Section 3.8.4.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures) Subsection H [p. 3.8.4-12]	It is not clear why the third method for passive pressure should be used. It is understood that if passive pressure is used for stability analysis, part of the passive pressure mobilized must be calculated and used for design of the wall. However, for cases where stability does not require mobilizing the passive soil pressure, the calculation and use of passive pressure is not clear.	Expand the discussion to include the circumstances under which calculation of relative displacement dependent passive soil pressure should be performed for wall design.

AFFECTED SECTION(S) (or "GENERAL")	COMMENT/BASIS	RECOMMENDATION
Section 3.8.4.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures) Subsection H [p. 3.8.4-12]	The revised SRP on the subject of seismic soil pressure is too complex and the road map for the designer is confusing. The need for use of three methods has not been clearly explained.	Please consider revising this section to clearly explain the requirements if calculation of seismic soil pressure is needed and how it should be obtained in the following situations: (1) when an adequate SSI/FEM model is used, (2) when the SSI model is not refined enough such that the applicable method needs to be used, and (3) when the soil's (relative displacement dependent) passive resistance is relied upon for stability against seismic loads.
SRP 3.8.5 [ML12353A388]	**SRP 3.8.5**	**SRP 3.8.5**
Section 3.8.5.II (Acceptance Criteria, SRP Acceptance Criteria, Design and Analysis Procedures) [p. 3.8.5-10]	Item B was enhanced guidance to evaluate sliding and overturning. However, foundation overturning may not be possible for structures in some small modular reactor designs.	This section should be revised to clarify the applicability of the criteria for small modular reactor designs.