

December 28, 2006

MEMORANDUM TO: Richard P. Croteau, Deputy Director
Engineering Research Applications
Division of Fuel, Engineering and Radiological Research
Office of Nuclear Regulatory Research

THUR: Anthony H. Hsia, Branch Chief **/RA/**
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SUBJECT: SUMMARY OF DECEMBER 14, 2006, CATEGORY 2 PUBLIC MEETING
WITH NUCLEAR ENERGY INSTITUTE (NEI) TO DISCUSS SEISMIC
ISSUES RELATED TO FUTURE REACTOR SITING

On December 14, 2006, a public meeting was held between the U.S. Nuclear Regulatory Commission (NRC) and Nuclear Energy Institute (NEI) at Doubletree Rockville Hotel in Rockville, Maryland. The purpose of this meeting was to discuss (1) NRC and industry's views on the framework for seismic review at the Combined Operating License stage (COL) stage and integration of key technical interfaces of an Early Site Permit (ESP) review and certified design review, (2) NRC staff positions outlined in Draft Regulatory Guide (DG-1146), "A Performance-Based Approach to Define the Safe Shutdown Earthquake Ground Motion," and (3) industry's key comments on DG-1146. A list of meeting attendees is included as Enclosure 1. The meeting agenda is provided as Enclosure 2. The power point presentations provided by NRC staff and NEI representatives are provided as Enclosure 3.

Summary of the Meeting

This meeting was successful in addressing key seismic issues related to new reactor applications and on the integration between DG-1146 and relevant SRP sections, and the meeting was also successful in achieving its objective of establishing a common understand on the integrated seismic review framework. The key issues were summarized as follows:

- Meeting focused on discussion of key technical integration issues expected during ESP, Design Certification (DC) and COL reviews.
- NRC and industry reached common understanding on key technical issues addressed in DG-1146
- NRC and industry agreed that pre-COL interactions are very important in resolving potential seismic issues facing a new reactor application. For example,
 - DG-1146 should end with the site specific response spectrum and the minimum response check should be addressed in the SRP

- Site specific response spectrum should be defined in the free field at the free surface or at the hypothetical outcrop on the top of competent rock
 - The Rock Uniform Hazard Response Spectrum (UHRS) should be scaled to obtain the site specific response spectrum at the surface
 - Consistent terminology should be used in DG-1146 and the SRP
 - The 0.1 g peak ground acceleration (pga) appropriate spectrum at the foundation level requirement of the regulation can be implemented using a RG 1.60 design response spectrum anchored at 0.1g
 - The incoherency issue is important to new reactor applications and the next technical discussion will provide a conclusion on the applicability of the incoherency subject. If it is accepted, incoherent ground motion will be addressed in the corresponding SRP sections
- Industry offered to provide generic studies on understanding site response methods, 3 and 4, proposed in NUREG/CR 6728

Action Items

For NRC

- Check the final conclusion or consensus reached on EPRI report G1.3, "Truncation of the Lognormal Distribution and Value of the Standard Deviation for Ground Motion Models in the Central and Eastern United States," to determine whether a conclusion was reached on the applicability of the sigma reduction and epsilon truncation of CEUS ground motion attenuation relationships
- Inform industry about SRP updates
- Provide clear guidance on reference rock shear wave velocity requirement, i.e., minimum or average

For Industry

- Check with soil amplification experts on how to provide generic studies regarding various soil amplification methods so that those methods addressed in NUREG/CR 6728 can be used in future applications.

Meeting minutes

Anthony Hsia (NRC) opened the meeting by welcoming all and addressing the scope of the meeting agenda (Enclosure 2). He indicated that NRC's desire was to receive industry's key comments on DG-1146, and Industry/NRC plans to integrate the ground motion from DG-1146 with the standard review plan (SRP) sections (3.7.1, 3.7.2, and 3.7.3). NEI representatives expressed that they are generally in agreement with the technical positions of DG-1146.

Topic 1: Integrated seismic review

Nilesh Chokshi (NRC) presented information on the overview and objectives of the integrated seismic review of DG-1146 and the SRP. He indicated that having a common understanding of integrating reviews of early site permit (ESP), certified design (CD), at the combined operating license (COL) applications, would lead to a smooth review process. He also emphasized the importance of pre-COL interactions with the industry to try to minimize potential delays.

Sujit Samaddar (NRC) focused on the technical integration between the DG-1146 and the SRPs. He provided a flow chart illustrating post processes beyond DG-1146 into the SRP (mainly Section 3.7.1-3) review areas, and showed different scenarios between the site-specific response spectra and standard design spectra and potential review steps. He concluded that options for addressing the spectral variance would be to use generic approaches such as the use of advanced techniques, incoherency, to address exceedance; use of generic analyses to bound potential exceedance; and the comparison of key responses from certified design (CD) with new response for site-specific approach.

Goutam Bagchi (NRC) continued with the concepts to implement the integrated review framework. He elaborated on some preliminary ideas on review attributes for assessing adequacy of certified design and provided key review attributes for section 3.7.1, 3.7.2, and 3.7.3 of the SRP:

- Site-specific response spectrum in a free field
- Review attributes for minimum design check
 - RG 1.60 anchored @ 0.1g at the foundation level
 - Site soil profile – best estimate, upper and lower bound properties
 - Spectrum at free surface is then the minimum design check
- For standard design that use 0.3g RG 1.60 or greater design spectra, the minimum check is likely to be met
- Subsystem modeling attributes to capture peripheral responses: vertical, torsion, and lateral rocking
- Utilize modeling and analyses techniques to capture high frequency responses.

Topic 2: Industry presentation of integration approach

Carl Stepp, consultant for Electric Power Research Institute (EPRI), presented industry's key technical points for integrating DG-1146 and the SRP. He stated that the wording on location of the safe shutdown earthquake (SSE) ground motion in Section 5.3 of DG-1146 is acceptable; however, the industry prefers to have DG-1146 ending at the development of site specific ground motion and prefers to have the 0.1g (pga) check at the foundation level be included in the corresponding SRP sections. He indicated that industry would prefer to use the foundation excitation motion at the foundation level from the site response analyses and that the soil properties used for the SSI analyses should be the same as those used for the site response analyses. He also indicated that incoherence effects should be incorporated into the SSI analyses and that the coherency function would be the one proposed by EPRI and could be implemented in CLASSI and SASSI codes. Industry also recommends that the 0.1 g check should not change the site specific SSE, because it is a site specific criterion. The NRC did not provide staff's positions on the above comments, but would discuss the comments internally to reach a consensus.

Topic 3: Overview of staff positions in DG-1146

Annie Kammerer (NRC) summarized the staff's positions described in DG-1146. She highlighted the items that were implemented in the draft regulatory guide: the use of epsilon (the number of standard deviations for the curves in your analyses); cumulative absolute velocity (CAV) filtering (a way of characterizing the damage potential of small magnitude earthquakes); and the performance-based approach defined in American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI 43-05) standard, "Seismic Design Criteria for Structures,

Systems, and Components in Nuclear Facilities,” where the final surface uniform hazard response spectrum (UHRS) is scaled by frequency dependent design factors to develop the safe shutdown earthquake (SSE) ground motion

Topic 4: Key industry comments on DG-1146

Robert Kennedy (NEI) presented industry comments on DG-1146. The industry recommended that the NRC should make it clear in DG 1146 that the CEUS ground motion sigma reduction developed in Task G1.3, “Truncation of the Lognormal Distribution and Value of the Standard Deviation for Ground Motion Models in the Central and Eastern United States,” is acceptable to be used in applications. The NRC staff agreed to check the final conclusion or consensus reached on G1.3 report.

Robert Kennedy also stated that industry is in general agreement with the guidance related to the use of the CAV-based lower magnitude cut off, the control location of SSE as described, site response estimate, and using the ASCE 43-05 performance-based approach. He also noted that industry would like incoherency explicitly mentioned in an appropriate NRC document(s). During the discussion, the NRC indicated that the appropriate document to address this issue would not be DG-1146, but rather (if a coherency function is accepted) the appropriate SRP section. Industry emphasized that the timeline for industry to incorporate incoherency into their analyses is critically short.

Industry noted that DG-1146 should address dynamic site response analysis approaches to (1) develop site response function and (2) to obtain UHRS at surface/control locations. In particular, it should accept approaches 2A, 2B, 2A/3, and 4 from NUREG/CR-6728 and 6729 explicitly. Industry asked the NRC if there is anything that they (industry) could do to provide a complete development for approaches 3 and 4. Kennedy stated that DG-1146 should provide more guidance for ground motion in Western United States (WUS) sites. Some specific topics include the reference rock, which is more appropriate for CEUS than for WUS, and the discussion of WUS attenuation relationship.

Industry noted that DG-1146 should clearly state that seismic source characterizations that have been accepted by the NRC generically or as part of an ESP or COL application should be used as starting bases for subsequent site-specific PSHAs. The NRC staff expressed a general agreement with this concept as long as it is clear that the source characterization is only a starting point and more recent work on seismic sources should be reviewed. The NRC will address this issue in DG-1146.

Kennedy concluded that the methods used in development of the surface UHRS needs to ensure that the exceedance frequencies of the UHRS are maintained over all structural frequencies of interest. Industry further explained their position through examples provided by Robin McGuire. Through discussion it was clarified that the proposed industry approach (i.e. multiplying the site amplification factors by the UHRS--not the individual controlling earthquakes) was what the NRC had intended to convey. The NRC will review the language in DG 1146 to make this point clearer.

Unless noted above, the NRC did not express specific opinions regarding the industry comments. Instead the NRC staff will discuss the comments internally to reach a consensus. It was noted that the use of the term "database" as used in DG-1146 can be confusing because the definition, when one considers the EPRI and LLNL studies, differs from the more general

usage. It was suggested that the intended meaning be included in the glossary (Note: this comment was later officially forwarded in a second set of post-meeting comments from NEI).

After asking for public comments or questions, the meeting was adjourned.

Enclosures:

1. List of Attendees
2. Agenda
3. Presentation Materials

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