NUCLEAR ENERGY INSTITUTE

Adrian P. Heymer
SENIOR DIRECTOR, NEW PLANT DEPLOYMENT
NUCLEAR GENERATION DIVISION

February 2, 2007

Mr. Nilesh C. Chokshi
Office of New Reactors
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: Performance-Based Spectra Definitions and Site Acceptability Standard

PROJECT NUMBER: 689

Dear Mr. Chokshi:

During the NRC public meeting with industry on December 14, 2006, on seismic considerations for new plants, the industry suggested that the performance-based spectra definitions and site acceptability for standard nuclear plants should be consistently applied. Please find attached a white paper providing such definitions and the regulatory background to support them.

The industry believes that these definitions will establish standard terminology and provide a framework for improving consistency of usage in the updated seismic regulatory guidance.

We look forward to discussions with the NRC staff later this month on finalizing the guidance for implementing improved seismic and siting determinations for new nuclear plants.

If you or your staff has any questions please contact Rick Hill at 408-559-4514; rahill@erineng.com or me.

Sincerely,

Adrian P. Heymer

c: Dr. Andrew J. Murphy, NRC
NRC Document Control Desk

Attachment

1776 I Street, NW | Suite 400 | Washington, DC | 20006-3708 | P: 202.739.8094 | F: 202.533.0147 | aph@nei.org | www.nei.org

D8

Performance-Based Spectra Definitions and Site Acceptability for Standard Nuclear Plants

Basic Response Spectra Definitions for Performance-Based Implementation of Part 100.23 and Part 50 Appendix S

The following specific response spectra are defined as part of the revised regulatory guidance for performance-based implementation of the seismic regulations 10 CFR Part 100.23 and 10 CFR Part 50 Appendix S.

1. **Site-Specific Ground Motion Response Spectra (GMRS):** The Site-Specific GMRS are defined as follows:

   The Site-Specific Ground Motion Response Spectra (GMRS) are characterized by site-specific horizontal and vertical response spectra determined as free-field motions on the ground surface or as free-field outcrop motions on the uppermost in-situ competent material defined by shear-wave velocity of 1000 fps or greater, using performance-based procedures described in Draft Regulatory Guide DG-1146. When the Site-Specific GMRS are determined as free-field outcrop motions on the uppermost in-situ competent material, only the effects of the materials below this elevation are included in the site response analysis.

The Site-Specific GMRS are appropriate for performance-based implementation of the requirements of 10 CFR Part 100.23(d)(1) – "Determination of the Safe Shutdown Earthquake Ground Motion". The Site-Specific GMRS are also satisfy the **Safe Shutdown Earthquake Ground Motion** requirement for performance-based implementation of 10 CFR Part 50 Appendix S(IV)(1), "*Application to Engineering Design*", and are the bases for deriving Foundation Input Response Spectra.

2. **Foundation Input Response Spectra (FIRS):** FIRS are defined as follows:

   The Foundation Input Response Spectra (FIRS) are characterized by site-specific horizontal and vertical response spectra derived at the foundation level of safety related structures such that the derived spectra are hazard-consistent with the Site-Specific GMRS. The FIRS are the Site-Specific GMRS transferred to the base elevations of foundations. FIRS are derived as free-field outcrop spectra; that is, only the effects of materials that are below the base elevation of a safety related structure are included in site response analysis.

The FIRS are input for analysis of the soil-structure interaction system meeting the requirements of Part 50 Appendix S(IV).

3. **Certified Seismic Design Response Spectra (CSDRS):** CSDRS are defined as follows:

The Certified Seismic Design Response Spectra (CSDRS) are site independent seismic design horizontal and vertical response spectra that have received Commission approval, issued pursuant to Subpart B of 10 CFR Part 52, as the seismic design response spectra for an approved certified standard design nuclear plant. The input or control location for the CSDRS is specified in the certified standard design.

In order to ensure that CSDRS are suitable for a range of site specific geotechnical conditions CSDRS are evaluated and approved for a specified range of site geotechnical parameters. Standard design nuclear plants that have received Commission design certifications to date have used the Regulatory Guide 1.60 standard site independent spectrum shape or some small modification of that spectrum shape, scaled to 0.3g at 33 Hz to obtain CSDRS.

Minimum Seismic Design Basis Requirement

Part 50 Appendix S(IV)(a)(1)(i) requires that ***"the horizontal component of the Safe Shutdown Earthquake Ground Motion in the free-field at the foundation level of the structures must be an appropriate response spectrum with a peak ground acceleration of at least 0.1g".*** This requirement is satisfied by the approved CSDRS for certified standard plant designs. Comparing the site specific FIRS at the base elevation of the foundations of each safety-related structure with the Regulatory Guide 1.60 horizontal response spectrum scaled to 0.1g can satisfy this requirement for a non-standard design.

Determination of Site Acceptability for a Certified Standard Design Nuclear Plant:

Acceptability of a standard design for a given site is determined by the following steps:

Step 1. Develop the site specific GMRS.

Step 2. When the site-specific GMRS and CSDRS for the proposed certified standard design plant are calculated at the same elevation and: (1) the site-specific soil profile is within the range evaluated for the standard design plant, and (2) the CSDRS envelope the site-specific GMRS, the certified standard design is acceptable for that site and no other seismic analysis is needed to demonstrate the suitability of the site..

Step 3. If the site-specific GMRS and the proposed CSDRS are given at different elevations, calculate FIRS for each safety-related structure. Calculate the free-field response spectra at each foundation level consistent with the CSDRS. If, for each safety-related structure foundation, the envelop of the CSDRS-consistent spectra at the foundation level envelop the FIRS at that foundation level and the site-specific soil profile is bounded by the standard plant analyses, the standard design is acceptable for that site and no other seismic analysis is needed to qualify the site. If not, proceed to Step 4.

Step. 4. Perform a soil-structure interaction analysis using FIRS and including ground motion incoherency effects (where appropriate) and site-specific soil variability (i.e., mean, mean+sigma, and mean-sigma cases), to obtain the in-structure response spectra (ISRS) for each safety-related structure. Compare the ISRS to the spectra consistent with the CSDRS at pre-selected points in the structure. If the CSDRS-consistent spectra envelop the ISRS, the standard design is acceptable and no other seismic analysis is necessary. If not, further analyses are required to demonstrate the accept