

December 13, 2016

MEMORANDUM TO: Robert K. Caldwell, Acting Director
Division of Engineering Infrastructure
and Advanced Reactors
Office of New Reactors

FROM: Jim Xu, Senior Level Technical Advisor **/RA/**
Division of Engineering Infrastructure
and Advanced Reactors
Office of New Reactors

SUBJECT: TRIP REPORT FOR THE DECEMBER 2016 AMERICAN SOCIETY
OF CIVIL ENGINEERS COMMITTEE MEETING ON STANDARD FOR
SEISMIC DESIGN CRITERIA FOR NUCLEAR FACILITIES

The bi-annual December meeting of the American Society of Civil Engineers (ASCE) Seismic Design Standard for Nuclear Facilities (ASCE43) was held in Walnut Creek, California, during December 1-2, 2016. As the NRC representative on the ASCE Committee, I participated in the meeting and engaged in discussions of various issues affecting the revision of ASCE 43 Standard. The attached trip report contains a summary of the major items discussed at the meeting.

Enclosure:
Trip Report

CONTACTS: Jim Xu, NRO/DEIA
301-415-5793

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ADAMS Accession Number: ML16348A094

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TRIP REPORT
**ASCE Committee Meeting on Standard for Seismic Design Criteria for Structures,
Systems, and Components in Nuclear facilities**
December 1 – 2, 2016

Overview

The American Society of Civil Engineers (ASCE) is currently revising the ASCE/SEI 43-05 Standard - Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities. The last edition of ASCE 43-05 was published in 2005. This standard provides seismic design criteria for safety-related SSCs in nuclear facilities. The term “safety-related” has a much broader meaning than the one codified in NRC regulations to also include activities for the Department of Energy (DOE) facilities. ASCE 43-05 was the first US consensus standard to utilize the performance approach to prescribing seismic design criteria for nuclear facilities. Regulatory Guide (RG) 1.208 endorsed part of provisions of ASCE 43-05 related to the performance goal for nuclear reactors and the approach for the determination of the site-specific ground motion inputs for the seismic design.

The goal of the current ASCE 43 revision is to provide an update to incorporate lessons learned as well as new developments and enhancements in the seismic design criteria. The committee holds bi-annual meetings to provide face-to-face technical discussions and ballots for the standard. The committee is targeting for completing a draft in CY2017 and for submitting a balloted standard to ASCE Nuclear Standard Committee in CY2018.

A brief summary of technical discussions is provided below.

Technical Discussions

- **Seismic Design Category 2 (SDC 2) and associated performance goal**

ASCE 43 refers to ANSI/ANS-2.26 “Categorization of Nuclear Facility Structures, Systems, and Components for Seismic design,” for designating the seismic design categories. The SDC 2 was designated for a facility whose failure will pose no undue risk to public health and safety but may cause injury to facility workers. The DOE has addressed the seismic design for SDC 2 facilities using ASCE 7 and the committee members from the DOE want ASCE 43 also includes seismic design criteria for SDC 2. Some members had tried to compare the performance goals achieved using both standards for SDC 2 seismic design; however, the effort failed because the two standards provide seismic design criteria based on different risk concepts, therefore, a direct comparison is not possible. The committee decided to remove all references to ASCE 7 and develop ASCE 43 seismic design criteria for the SDC 2.

Enclosure

- **Out-of-plane Shear Strength of Unreinforced Concrete Slabs**

The committee members engaged in a productive discussion on the current ACI 349-13 equation for one-way slab plain concrete out-of-plane shear strength. The code equation was expressed as a function of $2*(f_c')^{1/2}$. Studies in recent literature have indicated that the out-of-plane shear strength for concrete one-way slab with little or no reinforcement decreases as the depth of the concrete slab increases. Therefore, the code equation should be modified with a size correction factor as a function of the depth of the slab. An equation for the size correction factor was considered by the ASCE 43 committee which meets the performance criteria established in the ASCE 43 (with 2 percent non-exceedance probability).

However, the proposed size correction factor which reduces the out-of-plane shear strength of concrete slabs should be looked at in the light of the reevaluation effort to determine the seismic capacities of the spent fuel pool structures in the operating plants. We should coordinate with Office of Nuclear Reactor Regulation and Office of Nuclear Regulatory Research (RES) to determine a path forward.

- **Method 3 for Probabilistic Site Response Analysis To Establish Design Basis Ground Motion Spectra**

NUREG/CR-6728 provided a 3 tiered approaches to site response analysis to establish hazard and risk consistent seismic design spectra. RG 1.208 endorsed Methods 2A and 2B which have used in COL applications. Methods 2A and 2B were also incorporated in ASCE 4-17. To further advance the site response analysis methodology, the ASCE 43 committee decided to incorporate Method 3 in the standard. The advantage of the Method 3 is the algorithm which allow propagating the seismic hazard curve from the reference bedrock to surface or appropriate structural foundation levels as opposed to the Method 2 which establishes the design spectra consistent with the uniform hazard spectra at the bedrock. RES is currently performing studies to investigate applicability of Method 3 to various complex site conditions. It is anticipated that the next revision to RG 1.208 will address the use of the Method 3 in the site response analysis.

- **Proposals for Next Revision of ASCE 4**

The ASCE 4-17 is anticipated for publication in spring 2017. Several proposals were also provided to the committee for consideration for the next revision of ASCE 4 which included:

- Feasibility of incorporating the non-linear SSI in Chapter 4 as mandatory. A working group will be set up to perform studies and guide the process forward.

- Remove the design provision for seismic isolation topic from ASCE 4 because it is included in ASCE 43.
- Approach to simplified methods for rocking and sliding of unanchored bodies.

Going Forward

- The ASCE 43 includes 7 Chapters. Updates to the standard are on-going and some chapters have been balloted. The committee is expected to complete the update during CY2017 and send it to ASCE Nuclear Standard Committee in 2018 for approval. The next meeting is scheduled for late April 2017.