

February 5, 2014

MEMORANDUM TO: Anthony J. Mendiola, Chief  
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Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

FROM: Joseph J. Holonich, Sr. Project Manager /RA/  
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Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF OCTOBER 31, 2013, MEETING ON NEI 12-16,  
"GUIDANCE FOR PERFORMING CRITICALITY ANALYSES OF  
FUEL STORAGE AT LIGHT-WATER REACTOR POWER PLANTS"

On October 31, 2013, staff from the U.S. Nuclear Regulatory Commission (NRC) held a second meeting with representatives from the Nuclear Energy Institute (NEI) and industry. The purpose of the meeting was to discuss revisions to NEI 12-16, "Guidance for Performing Criticality Analyses of Fuel Storage at Light-Water Reactor Power Plants." The meeting presentations can be found in the Agencywide Documents Access and Management System (ADAMS) package for the meeting at Accession No. ML13262A135). A copy of the notice and agenda can be found in ADAMS at Accession No. ML13262A132. A list of attendees is enclosed.

In its opening remarks, the NRC staff stated that the meetings being held to discuss NEI 12-16 were beneficial in helping to ensure the revision aligned with the NRC focus on this issue. The NEI representatives identified the following three purposes in its opening remarks: 1) reach resolution on methods to be used in spent fuel pool criticality analysis; 2) focus on issues around modeling of the fuel storage rack and neutron absorbers; and 3) identify areas needing additional description, justification, or explanation in NEI 12-16.

The first industry presentation provided information on sensitivity studies that the Electric Power Research Institute (EPRI) will be performing. The sensitivity studies were intended to determine the impact of certain parameters on the spent-fuel pool (SFP) criticality analysis. In the presentation, the EPRI representative provided information to show why two prototype fuel assemblies, a Westinghouse 17X17 and Combustion Engineering 16X16 assembly for pressurized water reactors could be used to cover all types of fuel assemblies in the sensitivity analysis.

During the discussion of fuel manufacturing tolerances, the NRC staff raised a question of whether fuel-rod pitch tolerances were considered in the assessment. The EPRI representative responded that the individual fuel-rod pitch was not considered but the overall fuel-assembly pitch was considered.

Further in the presentation, it was stated that the borated case in the sensitivity analysis was being done to try and create a basis for the analysis. The EPRI presenter clarified that some licensees could have unborated cases in their assessments.

A question raised by the NRC staff during the presentation was why the use of uniform axial burnup was representative of burnup. In answer to the question, NEI and EPRI representatives reported that removing axial burnup from the sensitivity calculations did not alter the results. Thus, the sensitivity calculations were intended to look at what was important for the calculations and axial burnup was not. The NRC staff agreed with the answer.

In summary, the industry reported that the sensitivity analysis will be performed to determine the impact of certain parameters on criticality, including: 1) manufacturing tolerances, borated vs. non-borated; 2) in-core detectors in instrument tube; and 3) burnable absorbers. Also, the industry committed to increase the sensitivity analysis based on information at subsequent meetings.

The next presentation covered new-fuel vault and SFP storage rack models. The presentation provided information on axial and lateral geometric modeling. It also covered simplifications used in the model and it was noted that the guidance for SFP criticality would include the need to confirm the simplifications applied to individual modeling. Small changes from the simplifications would be acceptable but large changes would have to be justified.

Closing the presentation were the topics of fuel location and convergence in the rack model. In the question-and-answer portion of the presentation, a question arose about how accident conditions were considered. The NEI representative responded that accident conditions would be in the guidance but that that topic would be covered in a future meeting.

Storage rack manufacturing tolerances was the next presentation. The presentation covered the important parameters in the calculations for moderator density calculations and loading configurations in each rack design.

Modeling of fuel assemblies in the storage rack was presented. Discussions dealt with part-length absorber panels, eccentric positioning of assemblies, credit for guide tube inserts, static/dynamic conditions, and channels in the boiling water reactor analysis. During the discussion of eccentric positioning, a question arose about using just a 2X2 array in the calculation. The NEI representative committed to look at 6X6 and 7X7 arrays and the effects. If there was a small impact to the results, then the 2x2 array was sufficient for the calculation.

A presentation on operating conditions was then made. The topics in this presentation covered new fuel vault analysis, SFP temperatures, and SFP soluble boron credit. This was followed by a presentation on scenario and storage configuration. Some background on the need to consider the configuration in modeling was given. It was presented that higher enrichment and BORAFLEX degradation led to more complex controls on configurations.

The discussion of neutron absorbers, the next presentation, began with some background information on the different types of neutron absorbers. Then for each type of absorber the material, degradation mechanism, observations, and other relevant information were given. The conclusions given were that a majority of neutron absorber material have not seen

degradation/corrosion effects. However, industry will continue to monitor and test neutron absorbers to assess long-term performance.

In the next presentation, the Boron-10 Areal Density Gauge for Evaluating Racks (BADGER) system was discussed. Topics included an overview of the system, incentives for change, and system design. Additional information on the system tests and operation was also provided. It was noted that this information could form the basis for a topical report on BADGER. The presentation closed with a discussion of 2014 BADGER activities.

The NEI representative then gave a presentation on a survey done with all US nuclear utilities/plants on neutron absorber. The goal of the survey was to gain an understanding of industry actions on neutron absorbers in SFPs. The questions and responses and the conclusions made were then covered in the presentation.

A presentation on the neutron absorber testing program was made next. Items covered included absorber testing, regulatory analysis, and conclusions. Storage rack interfaces were addressed in the following presentation. The presentation started with a discussion of definitions, and continued with a talk on existing guidance and concluded with acceptable interfaces.

With the completion of the presentations, a list of action items were identified and agreed upon. The items follow. Unless otherwise noted, the action item will be completed by NEI.

#### Action Items

- Investigate sources of previous work performed on axial modeling of reflectors (pure water versus other reflectors) – NRC and NEI
- Investigate the number of storage rows or mean free path length that is equivalent to an infinite array
- Evaluate whether there is benefit in determining a concrete composition for use in NFV calculations
- Reactivity effect of the neutron absorber sheathing tolerance
- Justification for application of eccentric positioning as an uncertainty
- Provide examples of Boral blistering causing fuel assembly movement issues – NRC
- Justification of continued functionality of neutron absorber under accident conditions
- Define “loss of function” in the NEI guidance document.
- White paper on 50.36 analysis and precedent
- Explain/justify basis of 6 inches as neutronically decoupled
- Justify the method for addressing storage rack interfaces

Project No. 689

Enclosure:  
List of Attendees

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**ADAMS Accession Nos.: Package (ML13262A135); Summary (ML13309B558); Notice (ML13262A132) NRC-001**

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**U.S. NUCLEAR REGULATORY COMMISSION (NRC) AND NUCLEAR ENERGY INSTITUTE MEETING ON  
SPENT FUEL POOL CRITICALITY ANALYSIS**

**October 31, 2013**

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ENCLOSURE

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