Attachment
Industry Input to NRC Development of Guidance for Seismic Stability and Tip-Over Analyses Pertaining to Activities Regulated by both 10 CFR Part 50 and 10 CFR Part 72

I. Need for Guidance

NRC guidance on seismic stability evaluations of unrestrained dry storage configurations during loading, unloading and handling activities is needed to improve regulatory clarity. Guidance would provide this clarity by articulating the key aspects that should be included in evaluations, in order for the NRC to review and make a safety determination. Regulatory clarity is desired for future applicants, and existing licensees and CoC holders that do not already have NRC-approved methodologies for evaluating the seismic stability of unrestrained configurations. Currently there are some licensees and CoC holders that already have prior approved NRC methods for conducting these evaluations. Future guidance should recognize the licensees and CoC holders' ability to continue to apply previously approved methodologies by NRC to unrestrained dry storage activities.

As noted in the main body of the letter, these configurations can be governed by 10 CFR Part 50 or 10 CFR Part 72. The majority of dry storage activities are performed under the general license provision of 10 CFR Part 72, inside facilities governed by 10 CFR Part 50. In these cases, most licensees perform analyses under their Part 50 facility license. This is because, consistent with the General License provision, the cask licensing basis leaves most loading, unloading and handling activities conducted using structures licensed under Part 50 to be addressed by the licensee. Although there is a potential option for CoC holders to include a generic evaluation as part of the cask licensing basis under Part 72, this option is normally not pursued because each general license applies at multiple sites and it would be too challenging to envelope the diverse conditions of all the sites with a single evaluation. This avoids excessively conservative results for many sites. Some CoC holders have performed analyses under Part 72 as part of the cask licensing basis for activities that do not rely on Part 50 structures. ISFSIs governed by a Part 72 site-specific license also perform these analyses under Part 72. Therefore, industry desires guidance that is jointly developed and accepted for use under both Part 50 and Part 72.

II. Desired Attributes of Guidance

We propose the following four attributes for NRC developed guidance on seismic stability and tip-over analyses.

1. Guidance should describe the key technical aspects necessary for NRC to complete a review; guidance should not be a detailed methodology

We recommend that guidance focus on the key technical aspects that must be included in license applications or amendments in order for the NRC to review the seismic stability evaluations and make a safety determination. Guidance should not be a specific, detailed and prescriptive methodology. Detailed guidance would result in limiting the ability of applicants, licensees and CoC

holders from proposing alternative methods. Development of generic guidance on the key aspects needed for the NRC to make a safety determination will ensure that guidance works for the many different seismic approaches already approved as part of the Part 50 facility licensing bases, and will preserve the ability for alternative approaches to be proposed. The guidance should also adopt any relevant existing codes and standards that the NRC believes are acceptable, including any exception or augmentations that the NRC may deem appropriate. This approach will also assure applicants, licensees and CoC holders have the ability to propose alternative approaches. We have described, in a later section of this attachment, those key technical aspects and standards that we believe the NRC should consider.

2. Guidance should be consistent with previously established NRC positions

It is essential that guidance be intended for future license applications and not be intended to be applied retroactively to previously approved licensing bases by the NRC. Guidance should also be based upon, and consistent with, approaches previously accepted by the NRC for the same, or technically similar, configurations and conditions. For example, guidance should be consistent with any previously established NRC guidance or prior approved approaches to analyze unrestrained components in the Part 50 plant facility and casks on the storage pad governed exclusively by Part 72. This includes consideration of the difference in commitments made by Part 50 licensees to 10 CFR 100.

3. Guidance should have a defined scope

The predominant desire for regulatory clarity is in the analysis of the "stack-up" configuration, where the transfer cask is placed on top of the storage cask for the operation of transferring the canister into the storage cask. However, there are other configurations of dry storage loading, unloading and handling activities for which guidance could also lead to improved regulatory clarity. Guidance should be developed for other cases of unrestrained non-stacked storage and transfer casks (e.g. transfer cask sitting by itself on the re-fueling floor).

As identified in the NRC's letter (Reference 1), there are two acceptable approaches regarding the analysis of a seismic event with respect to cask tip-over: either 1) demonstration that the cask will not tip over, *or* 2) evaluation of the consequences of tip-over. With respect to demonstrating that the cask will not tip over, the NRC states in their letters (both References 1 and 2) that this demonstration would be through the combination of the design and analysis. It is recommended that the scope of the NRC guidance be focused only on the seismic stability/tip-over analyses, not the evaluation of consequences of a tip-over. Existing NRC guidance (e.g. NUREG-0800 SRP 15.7.4) is adequate in this area.

4. Guidance should be communicated in an appropriate regulatory vehicle, with an opportunity for stakeholder input and comments prior to finalization

The regulatory vehicle for guidance should be consistent with the intended application and use of such guidance. We believe guidance is needed for applicants, licensees and CoC holders. In this case, we believe it appropriate for the NRC to issue a Regulatory Guide, as opposed to an Interim Staff Guidance (ISG). Guidance in the form of an ISG would be temporary and intended for NRC staff, which is not consistent with the industry's need for improved regulatory clarity.

In keeping with the NRC principles of good regulation, we believe that NRC guidance would further benefit from stakeholder input during its development. This should include a comment period for the draft of the guidance along with NRC disposition of stakeholder comments.

III. Key Technical Aspects of Guidance

The following are the five key technical aspects that we believe should be addressed in NRC guidance. It is noted that NRC guidance with respect to these key technical aspects should represent one or more acceptable methods that also allows for alternative approaches. Guidance should also articulate which regulations are applicable to the seismic stability and tip-over analyses, how those regulations are satisfied through the guidance, any technical concerns, and the information needed in order for the NRC to be able to make a safety determination.

1. **Sliding and Rocking** – Guidance should recognize that sliding and rocking are permissible as long as 1) the cask does not tip over *or* a consequence analysis is performed, and 2) any impact with other structures or components is either precluded or evaluated as an accident.

2. **Use of Design Features –** Guidance should articulate the elements of analysis which may be simplified if certain design features are incorporated. Examples of design features are use of physical seismic restraint systems, or constant support of the fuel container by a lifting device.

3. **Use of Codes and Standards** – Guidance should address the acceptability of established codes and standards related to seismic stability analyses of freestanding objects. For example ASCE 43-05 Appendix A (Reference 3) might be one method the NRC finds acceptable. Guidance should also address the applicability of existing guidance, such as NUREG-0800 Section 3.7.1 and various Regulatory Guides (e.g. RG 1.61). We recommend that the guidance articulate how and when these codes, standards and regulatory guides are applicable, including any exceptions or augmentations to their use.

4. **Use of Computational Codes** – Guidance should address the use of computer codes for the seismic stability analysis by indicating which codes the NRC finds acceptable for use in

the seismic stability analysis. LS-DYNA and ANSYS are two examples of the several codes that the NRC might find acceptable.

5. **Interface with Plant's Seismic Method** – Guidance should include discussions on when and how specific elements of the guidance are applicable depending on the type of seismic analysis already approved as part of the facility's licensing basis (e.g. time history, response spectra, equivalent static, and non-linear methods). It is recommended that guidance be constructed to accommodate all of the facility methods previously approved by the NRC, but also provide meaningful insight into the NRC's technical position. For example, if a non-linear analysis is necessary in order to take credit for the coefficient of restitution and behavior of gaps under the components, then this should be articulated in the guidance.

IV. Technical Details that might be Appropriate for Inclusion in Guidance

The following technical details should be included in future NRC guidance if it is essential information needed by the NRC to be able to make a safety determination *and* it does not already exist in codes, standards or other NRC guidance. If guidance includes technical details in these areas, it should be developed such that it is not prescriptive and preserves the ability for alternative approaches to be proposed.

Rigid Body – Discussion of the key aspects to demonstrate that a multi-body system can be modeled as a single rigid body. In the case of a stack-up configuration, a rigid connection would ensure that the combined stack-up configuration can be modeled as a single rigid body in the seismic stability/tip-over analysis. One approach might be to assume multi-body systems are essentially a single rigid body if they have a rigid connection, which can be ensured through various techniques, including the bolting of the two bodies together, that are made in accordance with the Codes and Standards of the licensing basis (e.g. Part 72 cask licensing basis for rigid connection of the transfer cask and storage cask).

Canister Movement – Discussion of the conditions for which it is acceptable to ignore the relative movement of the canister inside the transfer cask and consider them both acting together as a single rigid body. This may include identifying the maximum gap between the canister and transfer cask for which canister movement can be ignored.

Use of Friction – Discussion of the use of friction, including how and when friction can be credited. For example, a reasonable amount of friction could be permitted for the cases where the mating of the transfer cask and storage casks is not demonstrated to be a rigid connection, and between freestanding components and solid surfaces.

Coefficient of Restitution – Discussion of the staff's position on the use of the coefficient of restitution.

Material Modeling – Discussion of the key aspects that need to be included in material modeling, including material damping. Guidance might also establish the specific acceptance criteria.

Rigidity of Supporting Structure – Discussion of the key aspects for demonstrating when a surface can be treated as essentially rigid (e.g. thick concrete slab). For supporting structures which are flexible (e.g. rail cart), guidance could accept methods to model surface flexibility.

Time History Ensembles – Discussion of analytical approaches that use multiple time-history ensembles, including the number of time histories that should be used and whether the mean response or the bounding response should be used for subsequent demand-to-capacity checks. Guidance could recognize that methods in NUREG-0800 SRP 3.7.1, and ASCE 43-05 Appendix A are acceptable. If bounding responses are to be used, then guidance might find acceptable the use of probability and confidence interval prediction of the bounding responses equal to those used to define the basic ground motion.

Safety Factors – Discussion of appropriate safety factors and under what conditions they are applicable. Guidance could express the appropriateness of using smaller safety factors for analyses with greater confidence.

References

1. Letter from A. Howe (NRC) to M. Ajluni (Southern Nuclear) on June 15, 2011, *Joseph M. Farley Nuclear Plant Units 1 and 2 – Position on Spent Fuel Cask Handling*
2. Letter from V. Ordaz (NRC) to R. McCullum (NEI) on June 30, 2011, *NEI Position Regarding the Stack-up Configuration for Dry Storage Casks*
3. *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*, ASCE/SEI 43-05, Appendix A - *Approximate Methods for Sliding and Rocking of an Unanchored Rigid Body*.
4. *Evaluation of the Seismic Design Criteria in ASCE/SEI Standard 43-05 for Application to Nuclear Power Plants*, U.S. Nuclear Regulatory Commission NUREG/CR-6926, March 2007.
5. *Response to Region III Technical Assistance Request for First Energy Operating Company Perry Nuclear Power Plant, Unit 1, Evaluation of Freestanding Stack-up Configuration (ML103010389), Dated 10-29-2010,* NRC Memorandum from Vonna Ordaz to Anne Boland DSST Ticket No. 2011000002, ML110200478, February 25, 2011.