

## Proposed Resolution Plan for Tier 2 Additional Recommendation

### Evaluation of Other External Natural Hazards

#### Background

As directed by staff requirements memorandum to SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated August 19, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML112310021), the staff sought to identify additional recommendations related to lessons learned from the Fukushima Dai-ichi event, beyond those identified in the Near-Term Task Force report. Many additional recommendations were received from U.S. Nuclear Regulatory Commission (NRC) staff and external stakeholders, including the Office of Science and Technology Policy, Congress, international counterparts, other Federal and State agencies, non-governmental organizations, the public, and the nuclear industry. These issues were raised in a variety of forums, including the staff's August 31, 2011, public meeting and a September 9, 2011, Commission meeting.

As part of that initiative and in response to comments from the Advisory Committee on Reactor Safeguards (ACRS) and specific language included in the Consolidated Appropriations Act, 2012 (Public Law (Pub. L.) 112-74, signed into law on December 23, 2011), the NRC staff identified an action regarding reevaluations of natural external hazards other than seismic and flooding hazards. In SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated March 9, 2012 (ADAMS Accession No. ML12039A103), this action was prioritized as a Tier 2 activity because of the lack of availability of the critical skill sets for both the NRC staff and external stakeholders, and because the NRC staff considered the seismic and flooding reevaluations to be of higher priority.

Enclosure 3 to SECY-12-0025 detailed the initial program plan for this recommendation. That plan called for the staff to follow the same process used for the Tier 1 seismic and flooding reevaluations (i.e., issue a request for information pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54(f)).

Section 402 of Division B of Pub. L. 112-74 requires the NRC to have licensees reevaluate external hazards against applicable NRC requirements and guidance. More specifically, this section provides:

The Nuclear Regulatory Commission shall require reactor licensees to re-evaluate the seismic, tsunami, flooding, and other external hazards at their sites against current applicable Commission requirements and guidance for such licensees as expeditiously as possible, and thereafter when appropriate, as determined by the Commission, and require each licensee to respond to the Commission that the design basis for each reactor meets the requirements of its license, current applicable Commission requirements and guidance for such license. Based upon the evaluations conducted pursuant to this section and other information it deems relevant, the Commission shall require licensees to update the design basis for each reactor, if necessary.

Subsequently, the NRC's Office of Congressional Affairs, during interactions with House and Senate Appropriations staff, clarified that the intent of Pub. L. 112-74 was for the NRC to include natural external hazards in the scope of its review, and exclude man-made hazards. Because man-made hazards do not have a direct nexus to the Fukushima Dai-ichi accident, the NRC staff concluded that they should be treated outside the scope of Fukushima lesson-learned activities. As such, the NRC staff submitted the consideration of man-made hazards to the NRC's Generic Issues (GI) Program by memorandum dated September 9, 2013 (ADAMS Accession No. ML12328A180). By memorandum dated January 17, 2014 (ADAMS Accession No. ML13298A782), the NRC staff concluded that the proposed GI does not satisfy at least three criteria for acceptance as a GI. Therefore, the NRC staff did not undertake possible regulatory requirements or information collection related to man-made hazards and will continue to address issues in that area as they arise on a case-by-case basis, as has been the NRC's historical practice.

### **Current Status**

The NRC staff has reviewed a variety of domestic and international documents related to external hazards. The staff concluded that the most prevalent natural hazards, beyond seismic and flooding, are extreme winds, extreme temperatures, drought and other low-water conditions, and winter precipitation that results in snow and ice loading on structures. These are the hazards the staff has determined should be considered in the Tier 2 activity. The current regulatory framework requires that all U.S. nuclear sites be evaluated for these hazards when initially licensed. As required by 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," licensees shall demonstrate that their safety-related structures, systems, and components are designed to withstand the effects of natural phenomena without loss of capability to perform their safety functions, giving appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

To complete the Tier 2 activity and satisfy the NRC's obligations under Section 402 of Division B of Pub. L. 112-74, the NRC staff is proposing to evaluate the Tier 2 external hazards using existing information and processes, and assess the need for further regulatory actions. This would include consideration of previously submitted licensee information on external hazards, such as: information provided in the licensee's integrated plans required by Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A735); licensee information on the criteria used for their plant's design and licensing basis; information from recent NRC activities related to the prevalent hazards (e.g., Regulatory Issue Summary 15-06, "Tornado Missile Protection," dated June 6, 2015); and recent GI program reviews.

## Discussion

Seismic and flooding hazards were given priority as Tier 1 activities during the NRC's review of Fukushima lessons learned because of the risk these hazards pose to operating plants and due, in part, to significant advancements in the state of knowledge and the state of analysis in these areas since the operating plants were sited and licensed.

The state of knowledge and the state of analysis has also advanced for other natural hazards, such as extreme winds. In some cases improved understanding of the hazard has led the staff to determine the hazard level previously considered was more conservative than that required today. For example, many of the currently operating plants used guidance that relied on the Fujita scale<sup>1</sup> to relate the estimated maximum tornado wind speed to the observed degree of damage. Current guidance relies on the Enhanced Fujita scale, which reduces the estimated maximum tornado wind speed for a given observed damage state, meaning that many currently operating plants used higher tornado wind speeds to design the plant than would be required today. However, improved understanding and enhanced models have also indicated that for some sites, missiles generated from hurricane winds (which are often lower than design basis tornado wind speed) may produce the most intense missiles. Given the information now available to the staff as a result of the ongoing mitigating strategies work, and recognizing that there may be a significant population of plants where the current design basis hazard maybe more conservative than that developed using modern methods, the staff proposes a screening approach that would focus resources on those sites that provide the most opportunity to gain a safety benefit.

As part of its review of this issue, the NRC staff has considered how other natural external hazards are being addressed within the requirements for mitigating strategies for beyond-design-basis external events. Specifically, as part of compliance with Order EA-12-049, the NRC has required licensees to ensure that mitigating strategies can be implemented under a broad array of external hazards, which, in turn, required licensees to evaluate other external hazards applicable to their sites against current NRC requirements and guidance. The guidance in NRC-endorsed Nuclear Energy Institute (NEI) 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," describes a process for licensees to determine which external hazards should be addressed within the mitigating strategies developed for each site. Licensees following this guidance evaluate external hazards on a site-specific basis. The NRC reviews the results of those evaluations during pre-compliance audits. The staff notes that a safety benefit has been achieved in the near term for the Tier 2 hazards, as well as seismic and flooding, because external events associated with these hazards have been considered in the implementation of Order EA-12-049 and are being considered in the proposed rule for Mitigation of Beyond-Design-Basis Events (MBDBE). Nevertheless, consistent with the Consolidated Appropriations Act, 2012, the staff believes that additional review should be performed to

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<sup>1</sup> Since it is difficult to directly measure tornado wind speeds, Dr. T. Theodore Fujita developed the Fujita Tornado Damage Scale (Fujita scale or F-scale) in 1971 to provide an estimate of the tornado wind speed based on the observed damage. The F-scale overestimates the wind speed produced by a tornado to cause the amount of observed damage. In 2007, the Enhanced Fujita scale (EF-scale) was adopted to address limitations in the Fujita scale. The EF-scale lowers the estimated wind speed of a tornado that caused a specific amount of observed damage.

determine if changes in the hazard warrant other actions, beyond those associated with Order EA-12-049 and the MBDBE proposed rule, to ensure public health and safety against external hazards other than seismic and flooding.

The staff notes that the safety benefit achieved through Order EA-12-049 should be factored into an evaluation of potential regulatory requirements to determine whether additional changes could be justified when evaluated against the criteria in 10 CFR 50.109 for the backfitting of operating reactors.

The NRC staff has divided this review into the following four tasks:

1. Define natural hazards other than seismic and flooding to determine those hazards that should be reviewed generically (complete).

Documents reviewed included the following:

- Electric Power Research Institute 1022997, "Identification of External Hazards for Analysis in Probabilistic Risk Assessment"
- American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) RA-Sa-2009 Appendix 6-A, "Addenda to ASME/ANS RA-S-2008 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications"
- International Atomic Energy Agency TECDOC-1341, "Extreme External Events in the Design and Assessment of Nuclear Power Plants"
- NEA/CSNI/R(2009)4, "Probabilistic Safety Analysis (PSA) of Other External Events Than Earthquake"
- NUREG/CR-5042, "Evaluation of External Hazards to Nuclear Power Plants in the United States"
- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light Water Reactor] Edition"
- Other international and domestic references

Using previous analysis and engineering judgment, the other external hazards to be evaluated are wind and missile loads from tornadoes and hurricanes, snow and ice load for roof design, drought and other low-water conditions that may reduce or limit the available safety-related cooling water supply, extreme maximum and minimum ambient temperatures for normal plant heat sink and containment heat removal systems (post-accident), and meteorological conditions related to the maximum evaporation and drift loss (i.e., the loss of entrained water in the discharge vapors from a cooling tower) and minimum water cooling for the ultimate heat sink design.

2. Determine and apply screening criteria to appropriately exclude certain natural hazards from further generic evaluations, or exclude some licensees from considering certain hazards. Possible screening criteria may include:

- Conservatism of design safety margins.
- Operational limits provided in technical specifications.
- Low frequency of occurrence/low risk.
- Warning time available to allow measures to be taken to prevent an accident from occurring.

This process will consider, among other things, whether external hazards should be eliminated from consideration because they are addressed by existing requirements (e.g., temperatures affecting ultimate heat sinks) or common industry preparations for severe weather such that it is unlikely the hazard will cause an accident. Wind events, and primarily tornados, have been the focus of discussions related to other external hazards because of the limited time available for licensees to prepare for such events. However, as discussed above, some plants may have been designed to winds speeds and missiles that are more severe than would be required today.

3. Perform a technical evaluation to assess the need for additional actions if the hazard or licensee was not screened out generically in Task 2.

If a site-specific evaluation is needed:

- Identify actions that have been taken, or are planned, to address plant-specific issues associated with the updated natural external hazards (including potential changes to the licensing or design basis of a plant or mitigating strategies in place to address the impact of the hazard).
- Request that licensees reevaluate site-specific external natural hazards.

The NRC guidance for determining if requests for information from licensees are warranted is provided in NRC Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection." Regarding the evaluation of other external hazards, the guidance in NEI 12-06 includes a site-specific screening of external events for each site and the NRC staff has reviewed the results of the screenings in overall integrated plans submitted by licensees. The staff's work on Task 2 will consider the work already completed in the development of mitigating strategies, along with previous staff assessments, such as the Individual Plant Evaluation of External Events. The staff notes that some events, such as high temperatures, may already be addressed by specific regulatory requirements (e.g., in a given facility's technical specifications). The staff also will consider this factor in its

assessment. The staff's plans call for considering the results of previous assessments in its evaluation of this issue, preparing more detailed documentation of the technical evaluation, and scheduling additional public interactions for this activity.

4. Determine if additional actions are needed, such as the following:
  - Evaluate the results from Task 3, including actions taken or planned by the licensee, and determine if additional action is needed. Any further regulatory actions will be properly justified and suitably defined as required in 10 CFR 50.109.
  - Issue generic communications per Management Directive 8.18, "NRC Generic Communications Program," dated March 5, 2009.

The NRC guidance for evaluating the possible imposition of additional requirements on licensees for operating nuclear power plants is also provided in NRC Management Directive 8.4. As part of Task 4, the staff would use the information developed to determine if a facility-specific backfit is necessary, based on the guidance in Management Directive 8.4 and the requirements in 10 CFR 50.109. As noted above, the staff would also consider other regulatory options, such as issuance of a generic communication, depending on the results of its assessment.

### **Stakeholder Interactions**

During a meeting held on October 6, 2015, the NRC staff provided the Fukushima subcommittee of the ACRS an overview of the staff's plans to resolve the open Tier 2 and 3 recommendations. A similar meeting is planned with the ACRS full committee on November 5, 2015. In addition, the staff provided an overview of its proposed resolution plans for all the open Tier 2 and 3 recommendations during a Category 2 public meeting held on October 20, 2015.

Prior to completing its review of this recommendation, the NRC staff plans to discuss the results of this review with external stakeholders, including the industry and members of the public. The NRC staff will then conduct a focused briefing on this issue with ACRS, if appropriate, prior to providing its final assessment to the Commission.

### **Conclusion and Recommendation**

The NRC staff proposes to further evaluate the risk to U.S. nuclear sites from other natural external hazards and determine if associated risks warrant regulatory action. The staff would provide the results of this evaluation and the justification supporting resolution of this issue to the Commission by the end of 2016. The final assessment would also consider the outcome of interactions with the ACRS and external stakeholders.

### **Resources**

The resources associated with this effort have not been budgeted for fiscal year (FY) 2016. This shortfall in FY 2016 will be funded by reallocating resources from within the Operating

Reactors Business Line. If the staff identifies the need for additional resources in FY 2017 or beyond as the evaluation is completed, those resource needs will be addressed through the planning, budget, and performance management process.

Office	FY 2016	
	FTE	Dollars, \$K
NRR	0.6	-----
NRO	0.8	-----
RES	0.25	-----
OGC	0.1	-----
TOTAL	1.75	-----