NRC STAFF GUIDANCE

REGULATORY DECISIONMAKING FOR REEVALUATED FLOODING AND SEISMIC HAZARDS FOR OPERATING NUCLEAR POWER PLANTS

1. PURPOSE

The purpose of this enclosure is to provide guidance to U.S. Nuclear Regulatory Commission (NRC) staff for making regulatory decisions associated with the information on reevaluated seismic and flooding hazards requested from licensees in a letter issued on March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), pursuant to the Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.54(f). As discussed in this enclosure, the NRC will make regulatory decisions using existing guidance for risk-informed decisionmaking and for evaluating plant-specific backfits.

2. BACKGROUND

In response to the March 2011 accident at the Fukushima Dai-ichi nuclear power plant in Japan, the NRC established a task force of senior agency officials, referred to as the Near-Term Task Force (NTTF), to conduct a systematic and methodical review of NRC regulations and processes. The NTTF developed a number of recommendations to improve the safety of nuclear plants in response to insights from the accident (ADAMS Accession No. ML111861807). This enclosure supports the completion of activities related to NTTF Recommendation 2.1, which involves a reevaluation of seismic and flooding hazards using present-day methodologies and guidance.

In response to NTTF Recommendation 2.1, the NRC issued a letter to power reactor licensees pursuant to 10 CFR Part 50.54(f) (hereafter referred to as the 10 CFR 50.54(f) letter). That letter requested that licensees reevaluate the seismic and flooding hazards at their sites using updated hazard information and current regulatory guidance and methodologies. The request for information and the subsequent NRC evaluations are being implemented in two phases:

> **Phase 1**: Issue 10 CFR 50.54(f) letters to all licensees requesting that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flood hazard information and present-day regulatory guidance and methodologies and, if necessary, requesting they perform a risk evaluation.
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> **Phase 2**: Based upon the results of Phase 1, determine whether additional regulatory actions are necessary (e.g., updating the design basis and structures, systems, and components (SSCs) important to safety) to provide additional protection against the updated hazards.

Along with the 10 CFR 50.54(f) letter, the NRC issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A735), as one of its primary regulatory actions taken in response to lessons learned from the Fukushima accident. This order directed power reactor licensees to develop, implement, and maintain guidance and strategies ("mitigating strategies") to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities following a beyond-design-basis external event. The actions

required by the order provide additional defense in depth and diversity for mitigating beyond-design-basis events. The NRC also initiated the related mitigation of beyond-design-basis events (MBDBE) rulemaking (ADAMS Accession No. ML15049A213).

The agency's response to the Fukushima accident has evolved since the issuance of the NTTF report, which was completed shortly after the accident. Following interactions with external stakeholders and direction from the Commission, the staff modified the Phase 1 implementation process outlined in the 10 CFR 50.54(f) letter for flooding hazards. The staff made less substantial changes were made to the process for the seismic hazard reevaluations. The sections below provide additional details about these modifications.

2.A. Modifications to the Flood Hazard Reevaluation Process

In COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards," dated November 21, 2014, the staff made three recommendations to the Commission associated with the flood hazard reevaluations. The first two recommendations related to mitigation strategies developed and implemented in accordance with Order EA-12-049 and the MBDBE rulemaking. The third recommendation proposed to "revise the Recommendation 2.1 flooding assessments and integrate the Phase 2 decisionmaking into the development and implementation of mitigating strategies in accordance with Order EA-12-049 and the related MBDBE rulemaking." In the staff requirements memorandum (SRM) for COMSECY-14-0037, dated March 30, 2015, the Commission approved the first two recommendations, but disapproved the third. Instead, the Commission directed the staff to do the following:

- reassess the existing Phase 1 guidance to include a graded approach;
- be risk-informed and performance-based;
- reduce unnecessary conservatisms and identify areas with insufficient conservatism;
- evaluate potential changes to introduce realism into assessments;
- focus on areas that could result in cliff-edge effects and where substantial safety benefits can be achieved; and
- consider information related to available physical margin.

In addition, the Commission directed the staff to develop criteria and guidance for Phase 2 regulatory decisionmaking that would do the following:

- add clarity about whether further regulatory actions are necessary;
- allow flexibility in the way in which licensees address vulnerabilities and include the opportunity for licensees to demonstrate that vulnerabilities identified may be less risk significant when more realistic assumptions are applied in the analyses;

- take into account protection of mitigating strategies equipment from the reevaluated flood hazard; and

- consider an appropriate balance between protection and mitigation based on the principle of defense-in-depth.

In response to the Commission's direction in the SRM to COMSECY-14-0037, the NRC staff developed an action plan to address revisions to the Phase 1 guidance and offer clarity on Phase 2 decisions. The enclosure to COMSECY-15-0019, "Closure Plan for the Reevaluation of Flooding Hazards for Operating Nuclear Power Plants," dated June 30, 2015, contains the action plan. In that enclosure, the NRC staff described a graded approach to the Phase 1 plant response assessments for external flooding.

Under the graded approach, the majority of sites with reevaluated hazards in excess of the design-basis events would perform focused evaluations. Focused evaluations are used to screen plants out from further evaluation based on factors such as available physical margin (which may include existing or planned design features, equipment, and actions) and, in cases for which local intense precipitation is the only flood mechanism not bounded by the current licensing basis, demonstration of a feasible response to address the hazard. The remaining sites (i.e., sites with flooding hazards that exceed the design-basis flood and where the exceedance could not be addressed through a focused evaluation) would perform more indepth integrated assessments of the risks from and the capabilities to address the beyond-design-basis flooding conditions.

COMSECY-15-0019 also described a high-level framework for Phase 2 decisionmaking. In the SRM for COMSECY-15-0019, dated July 28, 2015, the Commission approved the staff's action plan and required that the staff engage stakeholders, look for opportunities to address overconservatism and streamline processes, and provide the guidance for integrated assessments and associated regulatory decisionmaking to the Commission for information before implementation.

2.B. Modifications to Seismic Hazard Reevaluation Process

For seismic hazards, the overall process for the implementation of Phase 1 remains consistent with that described in the 10 CFR 50.54(f) letter. The 10 CFR 50.54(f) letter originally directed all sites with reevaluated seismic hazards that exceed the plant's design-basis earthquake to perform a seismic probabilistic risk assessment (SPRA). The 10 CFR 50.54(f) letter also allowed for the completion of a seismic margins assessment. However, the staff's discussions with industry indicate that no licensees are expected to complete a seismic margin assessment.

The NRC subsequently changed the portion of the Phase 1 process used to identify plants that would need to perform further assessments of plant response. Specifically, the agency determined that sites with reevaluated hazards that have low to moderate exceedances of the current design-basis do not need to perform an assessment of plant response using an SPRA. This led to a reduction in the number of plants that will need to perform assessments. On October 27, 2015, the NRC issued a final screening letter to inform power reactor licensees of the evaluations and assessments, including SPRAs, that each would need to complete, and to

establish the associated due dates for the seismic evaluations and SPRAs needed to complete the licensees' responses to the 10 CFR 50.54(f) letter (ADAMS Accession No. ML15194A015).

3. PHASE 1 INFORMATION SUPPORTING REGULATORY DECISIONMAKING

3.A. Flooding

The NRC staff has endorsed, with appropriate exceptions and clarifications, industry guidance for licensees to use for performing flood hazard reevaluations. The guidance for flooding focused evaluations and integrated assessments is provided in Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines," issued June 2016 (ADAMS Accession No. ML16165A178) and JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation; Focused Evaluation and Integrated Assessment," dated july 11, 2016 (ADAMS Accession No. ML16162A301). These guidance documents describe acceptable methods for performing the requested integrated assessments for external flooding described in the 10 CFR 50.54(f) letter and the focused evaluations described in COMSECY-15-0019. The NRC staff will review the licensees' integrated assessments and focused evaluations and apply engineering and operational judgement to assess the appropriateness of licensee evaluations and actions. No further regulatory action will be considered for sites that perform a focused evaluation that adequately addresses the reevaluated flooding hazards (including any appropriate regulatory commitments).

Guidance document NEI 16-05 describes five paths for performing integrated assessments and focused evaluations. Path 1 involves refinement to the flooding hazard, Paths 2 and 3 relate to focused evaluations, and Paths 4 and 5 relate to integrated assessments. Path 4 in NEI 16-05 describes how to demonstrate an effective mitigation strategy that uses SSCs, mitigation equipment, and manual actions to maintain or restore key safety functions. Path 5 describes how to define multiple scenarios for the flood mechanisms that are not bounded by the design-basis flood hazard and demonstrate an adequate response strategy for each scenario. The integrated assessment submittals will include evaluations related to various flooding mechanisms, an estimated timeline and associated time sensitive actions, descriptions of existing capabilities to deal with the scenarios, and possible regulatory commitments for new or enhanced capabilities. In addition, a risk insight of particular importance is the frequency of a consequential flooding event. The guidance in NEI 16-05 directs licensees to provide a discussion (quantitative or qualitative) of the likelihood of a flood that could exceed flood protection features and challenge a key safety function. The NRC-endorsed guidance includes a graded approach based on the above factors and includes consideration of effective flood protection and mitigation.

3.B. Seismic

Plants whose reevaluated seismic hazard ground motion response spectra exceed the licensing-basis safe-shutdown earthquake in the 1-10 hertz range and do not meet the criteria for low seismic hazard or narrow band exceedance are expected to perform an SPRA. The SPRA uses SSC fragility calculations integrated with a seismic hazard analysis to quantify risk by calculating the frequencies of core damage and radioactive release based on plant-specific

logic models and accident sequences. An SPRA will provide decisionmakers with quantitative results, such as core damage frequency and large early release frequency, considering a full range of distribution and uncertainties. The SPRA will ultimately lead to the identification of SSCs most likely to contribute to core damage or large early release. Licensees will report the list of significant contributors and any actions planned or taken.

Similar to the flooding hazard reevaluations, the industry has developed, and the NRC has approved, guidance on acceptable methods for satisfying the requested risk evaluation for seismic events described in the 10 CFR 50.54(f) letter. This guidance includes Electric Power Research Institute (EPRI) Report 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," dated November 2012; and EPRI Report 3002004396, "High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation," dated July 29, 2015. In addition, the NRC developed JLD-ISG-2012-04, "Guidance on Performing a Seismic Margin Assessment in Response to the March 2012 Request for Information Letter," dated November 16, 2012. These guidance documents discuss methods for SPRA risk quantification and the identification of significant contributors to risk (i.e., seismic core damage frequency and seismic large early release fraction). The NRC endorsed the guidance in EPRI Reports 1025287 and 3002004396 by letters dated February 15, 2013 (ADAMS Accession No. ML12319A074), and September 17, 2015 (ADAMS Accession No. ML15218A569), respectively.

4. INTEGRATED RISK-INFORMED DECISIONMAKING FRAMEWORK FOR FLOODING AND SEISMIC HAZARD REEVALUATIONS

The NRC staff will assess the information provided for those plants that complete an integrated assessment or SPRA to determine whether: (1) the licensee's response to the 10 CFR 50.54(f) letter demonstrates that no further regulatory actions are necessary, or (2) consideration of the need for additional regulatory actions under the NRC's backfit regulation is warranted. As described below, the staff will complete this assessment in a two-step process involving screening by a Senior Management Review Panel followed by a formal backfit analysis, if necessary.

Step 1. Senior Management Review Panel

The NRC staff plans to use the key principles in Office of Nuclear Reactor Regulation (NRR) Office Instruction (OI) LIC-504, "Integrated Risk-Informed Decisionmaking Process for Emergent Issues" (ADAMS Accession No. ML100541776), to conduct an initial evaluation of the integrated assessment and SPRA submittals. The OI discusses the following key principles:

- compliance with existing regulations
- consistency with the defense-in-depth philosophy
- maintenance of adequate safety margins
- demonstration of acceptable levels of risk
- implementation of defined performance measurement strategies

The consideration of both quantitative and qualitative factors lends itself to the panel-based option described in NRR OI LIC-504. Therefore, to support Phase 2 decisionmaking activities, the NRC staff will establish a temporary Senior Management Review Panel. The Senior Management Review Panel will consist of the directors of NRR's Japan Lessons-Learned Division (or other NRR division with responsibility for Japan lessons-learned activities), Division of Risk Assessment, and Division of Operating Reactor Licensing. Additional support may be solicited from division-level managers in other NRC divisions, as needed to assess specific situations or technical issues. The Senior Management Review Panel will be supported by appropriate technical staff, who will be responsible for consolidating relevant information and developing recommendations for consideration of the panel.

The Senior Management Review Panel is expected to reach a screening decision for each plant submitting an integrated assessment or SPRA. In presenting its recommendations to the Senior Management Review Panel, the supporting technical staff will place each of these plants into one of three groups:

(1) **Group 1** will include plants for which available information clearly indicates that further regulatory action is not warranted. For flooding hazards, Group 1 will include plants that have demonstrated (1) effective protection for severe flood hazards, and (2) that consequential flooding is expected to occur only for hazards with a sufficiently small mean annual frequency of exceedance. For seismic hazards, Group 1 will include plants for which the mean seismic core damage frequency and mean seismic early release frequency clearly demonstrate that a plant-specific backfit would not be warranted. For plants in Group 1, the Senior Management Review Panel will ensure that conclusions based primarily on numerical factors are supported by available qualitative risk insights before deciding that no further regulatory action is required.

(2) **Group 2** will include plants for which it is clear that further regulatory action should be considered under the NRC's backfit provisions. This group may include plants that are unable to protect against relatively frequent flood hazards or plants with relatively large seismic core damage frequency or seismic large early release frequency, such that the event frequency in combination with other factors result in a risk to public health and safety for which a regulatory action is expected to provide a substantial safety enhancement. For these plants, the Senior Management Review Panel may immediately proceed to consideration of the need for further regulatory actions, as described in Step 2 below. The staff expects that few plants will fall into Group 2.

(3) **Group 3** will include plants for which further regulatory action may be needed, but for which more thorough consideration of both qualitative and quantitative risk insights is needed before determining whether a formal backfit analysis is warranted. For Group 3 plants, the Senior Management Review Panel will consider quantitative risk information (if available), as well as qualitative risk insights and other factors. Quantitative risk information will be considered in conjunction with an understanding of the uncertainty in the associated analysis, assumptions, and interpretation of findings.

The Senior Management Review Panel's primary decision is whether the licensee has provided sufficient information and rationale for closing out the 10 CFR 50.54(f) letter, or whether safety concerns remain that necessitate the need for consideration of additional regulatory actions under the NRC's backfit process. Because of the inherent uncertainties associated with evaluation of natural hazards, it is not appropriate to apply strict numerical screening values as part of the initial assessment performed by the Senior Management Review Panel. If a submittal includes quantitative information, the panel will ensure that such uncertainties are considered. The panel will also ensure that the Commission's direction on the use of qualitative factors in regulatory decisionmaking is implemented. Some examples of qualitative factors that should be considered by the Senior Management Review Panel include the following:

- available warning time (in the case of flooding hazards);
- defense-in-depth, including the balance between protection and mitigation;
- reliability of flood and seismic protection and mitigation features;
- actions taken by the licensee to address vulnerabilities identified in the integrated assessment or SPRA, including any new regulatory commitments; and
- protective actions (e.g., evacuations) that could be taken to limit possible health consequences of the identified flooding and seismic hazards at a given site.

In addition, as discussed above, the frequency of the hazard is also an important factor for panel consideration. The panel may conclude that additional regulatory actions should be considered under the backfit process in cases for which it determines that a relatively frequent hazard poses an undue risk to public health and safety.

If the panel concludes that the information provided in response to the 10 CFR 50.54(f) letter demonstrates that additional regulatory actions are not warranted, the basis for the decision will be documented as described in Section 5. In other cases, the panel will direct the NRC staff to undertake further evaluation of potential regulatory actions, as described below, to determine whether a plant-specific backfit is warranted.

The panel will assess the above guidance and process after making decisions on the first several flooding integrated assessments and SPRAs. Lessons learned from those first several panel deliberations and decisions will determine if changes to the guidance and process are appropriate.

Step 2. Backfitting

If the Senior Management Review Panel determines that the information provided by a licensee in response to the 10 CFR 50.54(f) letter indicates that additional regulatory action may result in a substantial increase in safety, the NRC staff will identify and assess the potential change using the NRC's backfit process. The staff will follow the guidance for conducting backfit assessments in Management Directive (MD) 8.4, "Management of Facility-Specific Backfitting and Information Collection," and NRR OI LIC-202, "Procedures for Managing Plant-Specific

Backfits and 50.54(f) Information Requests;" (ADAMS Accession No. ML092010045), as well as related references, such as NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," issued September 2004. Potential additional regulatory actions could involve changes to procedures, operations, SSCs, or other actions to improve the protection from or mitigation of beyond-design-basis external events. The staff may also consider requiring the escalation of the regulatory treatment of an issue from one tier of the licensing basis (e.g., regulatory commitment) to another tier (e.g., regulatory requirement).

If the backfit analysis demonstrates a cost-justified substantial enhancement and no clearly preferable alternative to the proposed action is available, the staff will initiate the management approval process for a plant-specific backfit. The backfit analysis must be approved by the appropriate managers in NRR and copies provided to the Office Director and the Executive Director for Operations before the analysis is transmitted to the licensee. If the backfit analysis shows that a backfit identified by the staff is not justified because of the lack of substantial additional overall protection or justification of the direct and indirect costs of implementation, the issue may be closed. In that case, the staff will inform management of the finding and proceed with the closure of the related 10 CFR 50.54(f) letter for the subject plant.

5. DOCUMENTATION

For issues evaluated and dispositioned by the Senior Management Review Panel, the panel will ensure that the bases for its decisions are appropriately documented, consistent with the guidance in NRR OI LIC-504. The staff will issue a closeout letter to the licensee if the panel decides that the licensee has provided the information required by the 10 CFR 50.54(f) letter and that additional regulatory actions are not justified.

Similarly, for issues evaluated under the backfit process for which the backfit analysis demonstrates that a backfit is not justified, the staff will issue a closeout letter to the licensee providing the results of the staff's assessment. The staff will use the documentation guidance in NRR OI LIC-202 for any cases in which the staff concludes that a plant-specific backfit is warranted.