Recommendation 2.2: Evaluation of Periodic Confirmation of Natural Hazards

Contents

1. Background

The U.S. Nuclear Regulatory Commission's post-Fukushima Near-Term Task Force (NTTF) Recommendation 2.2 recommended that the U.S. Nuclear Regulatory Commission (NRC) initiate a rulemaking to require licensees to confirm seismic and flooding hazards every 10 years and address any new and significant information including, if necessary, updating the design basis for structures, systems, and components important to safety to protect against the updated hazards. Other studies conducted after Fukushima included similar recommendations that emphasized the importance of assessing new information. For example, Finding 3.1 of the National Academies of Science report, "Lessons Learned from the Fukushima Nuclear Accident for Improving Safety of U.S. Nuclear Plants," states: "The overarching lesson learned from the Fukushima Dai-ichi accident is that nuclear plant licensees and their regulators must actively seek out and act on new information about hazards that have the potential to affect the safety of nuclear plants."

The NRC staff's subsequent assessment indicated that the intent of Recommendation 2.2 can be met using an alternate approach rather than rulemaking. Specifically, in Enclosure 2 of SECY-15-0137, "Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations," the staff found that current practices to assess new external hazard information are generally effective, but identified a number of ways to enhance existing processes. In addition, the staff recognized that there is no dedicated NRC process that systematically seeks to determine if there is new hazard information available and to comprehensively assess its significance promptly. In SECY-15-0137, staff identified the following potential shortcomings associated with the existing practice:

- There is a potential for delays in the identification and evaluation of new information (e.g., data, models, and methods).

- When new information is identified, there is the potential that the information could be evaluated in isolation, rather than through a methodical evaluation of the cumulative effect of new data, models, and methods that accrue over time.

- Because existing hazard models are not routinely updated with new information, additional resources and time are required to update those methods and models when the agency determines that new information should be evaluated, which leads to decreased predictability and efficiency.

As a result, in SECY-15-0137, staff proposed to enhance existing processes and develop associated staff procedures to ensure that staff proactively and routinely aggregate and assess external hazard information. The staff proposed that the enhanced internal process would leverage and augment existing programs and agreements with domestic and international organizations.

2. Introduction

The purpose of this enclosure is to provide the Commission with additional details regarding the staff's plan to enhance existing processes to ensure ongoing assessment of new information and reconfirmation of external hazards consistent with NTTF Recommendation 2.2. The staff's proposed framework for hazard reevaluation (i.e., Recommendation 2.2 framework) is shown in Figure 1 and consists of three primary components:

1. **Knowledge base activities** include (1) a series of preparatory, near-term activities to develop infrastructure that will gather and preserve, in a retrievable manner, materials that have been docketed by licensees or developed by NRC staff as part of the NTTF Recommendation 2.1 and 2.3 activities, new reactor reviews, and other regulatory activities related to external hazards, and (2) longer-term activities to preserve, maintain, and update the materials.

2. **Active technical engagement and coordination** involves leveraging and enhancing ongoing interactions with internal and external partners (including other Federal agencies; academia; industry; regulators from other countries; and other technical and scientific organizations, such as American National Standards Institute and American Society of Civil Engineers) to ensure that staff routinely and systematically collect new hazard information from a variety of sources.

3. **Assessment activities** include aggregation and evaluation of new information, as well as referral of potentially significant issues to appropriate regulatory programs.

Details of the above components are provided in Section 4.

3. Attributes of Framework

The framework described in this enclosure has the following key attributes:

- ***Enhances safety***: A large cohort of organizations and researchers investigate natural hazards in the United States. The results of these investigations could identify new information that affects a single plant or multiple sites. The proposed Recommendation 2.2 framework enhances the ability of the NRC to (1) identify new information affecting individual sites or larger geographic regions which might otherwise go unrecognized and (2) evaluate whether the information has potential safety significance.

- ***Leverages and integrates with existing processes***: The Recommendation 2.2 framework integrates with existing regulatory activities (e.g., collects information from research and oversight activities as well as operating experience), uses the NRC's risk-informed regulatory framework, requires coordination between relevant regulatory offices, and facilitates transfer of issues to the appropriate regulatory program. The Recommendation 2.2 framework also better integrates NRC processes with the broader external hazards technical community.

- ***Efficiencies***: The Recommendation 2.2 framework achieves efficiencies because it focuses solely on issues specific to external hazards rather than more generic topics. The framework also gains efficiencies through maintenance of appropriate infrastructure and use of staff capabilities:

- *Infrastructure*: The proposed framework realizes efficiencies by leveraging the knowledge base that will be initially developed using information from the NTTF Recommendation 2.1 and 2.3 activities and new reactor reviews (including software and models), which will be routinely updated. Availability of the knowledge base ensures the agency continues to benefit from resources expended as part of the Recommendation 2.1 and 2.3 activities. Moreover, development and routine updating of the information maintained by the NRC staff means the staff will be prepared and readily able to efficiently assess the significance of new information when it is identified and supports emergent event response and other regulatory activities.

- *Staff capabilities*: The Recommendation 2.2 program relies primarily on internal NRC resources, particularly the External Hazards Center of Expertise (EHCOE) staff, for implementation. It enhances the technical capabilities of the cohort of subject matter experts in the proposed EHCOE, as well as counterparts from the NRC's Office of Nuclear Regulatory Research (RES), who will remain involved in the broader scientific and technical community through deliberate engagement and periodic coordination with external organizations. This allows staff to proactively seek information rather than relying on passive receipt of information from external parties. By leveraging staff resources, requests for action and information from licensees are limited to situations in which staff has demonstrated the significance of new information through a deliberate and systematic assessment. In addition, partnering with external organizations (including other federal agencies) will increase consistency in the treatment of external hazards and permit overall cost-savings.

- ***Stability and predictability***: Under the proposed framework, stability is ensured by institutionalizing and clearly documenting the systematic framework by management directive and (as appropriate) office instructions or similar documentation. To promote predictability, the process includes an inter-office technical advisory committee, when warranted.

4. Description of Framework

NRC staff has developed details of the proposed framework that expands upon the concepts described in SECY-15-0137 and provides a graded approach that allows NRC to proactively seek, evaluate, and respond to new hazard information. As noted previously, the framework consists of three key components, each of which are described below:

- Knowledge Base Activities (Section 4.1)
- Active Technical Engagement and Coordination (Section 4.2)
- Ongoing Assessment Activities (Section 4.3)

While NTTF Recommendation 2.2 focused on seismic and flooding hazards, the proposed framework is intended to accommodate a range of external hazards (e.g., seismic, flooding, and high winds).

4.1. Knowledge Base Activities

The knowledge base activities provide the foundation for the Recommendations 2.2 framework. Program preparation activities include the development of the knowledge base, which involves infrastructure activities as well as the compilation and organizing of currently available data, models, documentation, and other insights to ensure availability for future staff use. As part of the program implementation, the knowledge base will be maintained and routinely updated to reflect information collected as part of the Recommendations 2.2 activities as well as other regulatory activities and operating experience.

4.1.1. Knowledge Base Development and Organization

Knowledge base development will include a series of near-term activities to gather and preserve relevant existing information related to external hazards that has been submitted by licensees or developed by NRC staff as part of the Recommendation 2.1 and 2.3 activities, new reactor reviews and other regulatory activities (e.g., Generic Issues and Individual Plant Examination of External Events). To populate the knowledge base, staff will organize the existing information gathered through previous work so that staff can readily and easily retrieve it. The knowledge base will preserve critical information that will enable efficient review of new hazards information and supports a variety of agency activities.

Staff will compile information (e.g., data, models, and methods), insights, and lessons-learned from the Recommendation 2.1 and 2.3 activities, new reactor review activities and other regulatory actions into an organized knowledge base. The compilation will include currently available information that licensees have already docketed (or will docket) or made available as part of the Recommendation 2.1 and 2.3 and new reactor review activities. Staff will also compile information and associated documentation developed by NRC staff and contractors to support Recommendations 2.1 and 2.3, new reactor review activities, and other regulatory activities, including staff calculation packages and use of software. Examples of available seismic hazard resources include: data, models, and methods used to estimate site-specific hazards (e.g., seismic source characterization, ground motion prediction equations, and site characterization); results of assessments (e.g., ground motion response spectra and site-specific hazard curves); and tools used to perform assessments (e.g., hazard and site-response software). Examples of available flood hazard resources include: climatologic and meteorological assessments (e.g., site-specific probable maximum precipitation assessments); hydrologic and hydraulic models, including input/output files; and results of assessments (e.g., flood heights, associated effects, and flood event duration).

Staff will also identify information and analyses that provide insights on plant margins that are relevant to demands from external hazards. This detailed information is needed so that the appropriate technical basis is available to conduct an efficient evaluation of new hazard information. Examples of plant-specific information related to seismic hazards include: plant fragility information; results of high-frequency analyses; and results and insights from seismic probabilistic risk assessments (e.g., high-confidence of low probability of failure values, seismic core damage frequencies, and seismic large early release frequencies). Examples of plant specific information related to flooding hazards include: descriptions of plant protection; available physical margin and cliff-edge effects; frequency of consequential flooding; and results of focused evaluations and integrated assessments. Staff will also identify and compile relevant information regarding mitigating strategies for beyond design basis external events (e.g., post-Fukushima migrating strategies, as well as alternate and targeted hazard mitigating strategies).

Information related to hazards and plant margins will include a wide range of disparate information and files types as well as potentially large file sizes. This information may include text documents as well as geographic information system data, software, input/output files, and data that is updated periodically by external organizations. To ensure the knowledge base is readily accessible and can be updated in response to new information, staff will develop infrastructure that is capable of preserving and cataloguing diverse and dynamic information types. This infrastructure will include digital archives containing the aforementioned existing licensee- or staff-generated information.

A portion of the knowledge base development work is already underway. For example, EHCOE staff has developed a relational database that contains site-specific information related to flooding design bases and reevaluated flooding hazards. In addition, RES (with support from the EHCOE) is developing a flood hazard information resource (often referred to as the "flood information digest") as part of the flooding research activities, which will be leveraged in the knowledge base development.

4.1.2. Knowledge Base Maintenance and Update

Staff will maintain and routinely update the knowledge base to reflect the information collected, aggregated, and assessed as part of the Recommendation 2.2 activities, as well as from other regulatory programs and operating experience. The maintenance of the knowledge base will include updating of site-specific information and hazard models, as well as relevant plant-specific information, as needed. In addition, staff will maintain cumulative information records for potentially significant topics, which document the accumulation of new external hazard information over time (i.e., changes to the state of practice, including new data, models, and methods). The cumulative information records will facilitate the aggregation of information and allow staff to identify when further assessments are warranted.

In addition to supporting the Recommendation 2.2 activities, the knowledge base will also ensure information is available and can be used to support other agency activities, including:

- Assisting the agency in responding to events associated with external hazards by promptly providing relevant information
- Responding to emergent issues, such as the 2011 Great Tohoku earthquake in Japan
- Engaging with external stakeholders (e.g., through allegations and petitions)
- Evaluating inspection findings related to external hazard under the NRC's Significance Determination Process
- Implementing research plans associated with external hazards
- Updating of regulatory guidance

4.2. Active Technical Engagement and Coordination

The active technical engagement and coordination component of the Recommendation 2.2 framework involves interactions with internal and external organizations (e.g., federal agencies, industry, and international counterparts) as well as academia and other technical and scientific organizations. These activities will augment staff activities and facilitate identification of new data, models, and methods. As part of program preparation activities, staff will augment existing technical coordination activities and establish new agreements or leverage existing partnerships to ensure ongoing and periodic interactions between NRC staff and the following groups:

- Federal partner agencies (e.g., Department of Energy; United States Geological Survey for seismic hazards; National Oceanic and Atmospheric Administration (NOAA); United States Army Corps of Engineers; Federal Energy Regulatory Commission; United States Bureau of Reclamation; Department of Homeland Security/Federal Emergency Management Agency for flooding hazards; and NOAA and National Institute of Standards and Technology for wind hazards)

- Industry stakeholders (e.g., Electrical Power Research Institute)

- International counterparts (e.g., Canadian Nuclear Safety Commission; Organisation for Economic Co-operation and Development/Nuclear Energy Agency, International Atomic Energy Agency)

To ensure NRC staff maintains awareness of new developments for an appropriate range of external hazards to support program implementation, staff will coordinate periodic interactions with organizations that develop external hazards data and models. Specifically, NRC staff will periodically coordinate and document the outcomes of meetings during which NRC and the aforementioned groups will review and discuss the evolution in knowledge (e.g., changes in data, models, and methods). In addition, staff will remain engaged in the broader technical and scientific community, which will ensure staff are aware of, and contributors to, advances in data, models, and methods (including opportunities for leveraging more sophisticated models and refinements). This systematic engagement effort also ensures staff has the appropriate knowledge and capabilities to assess the significance of new information. In general, this external engagement enhances staff capabilities, which will allow significant portions of the Recommendation 2.2 framework to proceed using staff resources and minimize the burden placed on licensees and applicants. Focus areas for technical engagement and coordination, including identification of key partner organizations, will be identified in hazard-specific research plans.

4.3. Ongoing Assessment Activities

As part of the program implementation, staff will collect information from the ongoing technical coordination and engagement activities, as well as other NRC sources (e.g., operating experience, licensing experience, and long-term research). When new hazard information is identified, the staff will promptly aggregate the information with previously collected information. Thus, the new information will be assessed for potential significance in the context of accumulated hazards information, rather than in isolation. This assessment will evaluate the change in the hazard represented by the aggregated information, and consider available risk insights, to determine whether the change in the hazard has a potentially significant effect on plant safety.

The assessment of hazard significance initially involves determination of whether the new information indicates that the hazard is more severe than considered in previous evaluations. To assess the significance of an increase in hazard severity, staff will use available information and risk insights. For example, additional information may be available based on the outcomes of activities associated with Recommendation 2.1, such as seismic capacities, available physical margin for flooding, and cliff-edge effects. As another example, to inform the assessment of hazard significance, staff can consider the characteristics of the increased hazard severity (e.g., screening criteria used in Recommendation 2.1 seismic reevaluations). These insights will help determine whether the new information has a potentially significant effect on plant safety and, thus, warrants further consideration or assessment.

Depending on the nature of the new information, the assessment of hazard significance may be based on site-specific assessments, consider groups of representative sites (e.g., based on geographic location), or use generic assessments. The assessment will be performed by subject matter experts in the EHCOE, augmented, as needed, by staff from other NRC organizations. Assessment activities are intended to require limited resources and use information contained within the knowledge base to determine if the change in hazard is potentially significant.

The director of the EHCOE can convene a technical advisory committee to assess the hazard significance and recommend appropriate next steps to address the issue. The technical advisory committee will be comprised of senior technical staff with expertise in relevant technical fields (e.g., external hazards assessments) and will be expanded, as needed, to include other program offices and relevant personnel to address site-specific issues and ensure assessment results are presented in a manner that supports next steps to be taken by relevant program offices.

If the significance assessment indicates that new hazard information does not significantly affect plant safety, the staff will document the results of the assessment in updates to the cumulative information records. These updates will include a short summary of the new hazard information and the information used to reach a determination of non-significance.

If the new hazard information is found to have a potentially significant effect on plant safety, the issue will be referred to appropriate regulatory programs for further action. Regulatory programs for these referrals include:

- Transfer of an issue to the relevant program office for resolution (e.g., via plant-specific regulatory action),

- Transfer of the issue to the Generic Issues Program, if the new information could potentially affect safety at multiple plants and meets other Generic Issues Program screening criteria, or

- Identification of the need for further research if a better understanding of the new information could improve staff's understanding of the hazard and the resulting potential effects on plant safety.

The relevant program office will decide if requests for additional information should be issued to a licensee and whether they are issued generically or on a site-specific basis. The program office will decide whether and how regulatory analysis and decision-making should proceed, consistent with existing regulatory processes (e.g., backfit).

5. Infrastructure, Roles, and Responsibilities

The majority of information needed to initially develop the knowledge base will be gathered by technical staff responsible for the execution of the Recommendation 2.1 and 2.3 activities and new reactors reviews (i.e., staff in the EHCOE, with support from RES). Support from staff in RES and the NRC's Office of the Chief Information Officer will be required to support development of the infrastructure associated with the knowledge base.

Consistent with current functions, RES will have the primary responsibility for facilitating the technical coordination and engagement between NRC and partner organizations and other external stakeholders. The EHCOE and RES staff will jointly participate in the periodic information exchange meetings and other activities to remain engaged in the broader technical and scientific communities. Technical coordination and engagement activities will be included within the research plans for the relevant external hazards.

Information collection and aggregation will be the joint responsibility of EHCOE and RES staff, and will likely include input and participation from other program offices and the NRC's regional offices. The assessment of hazard significance will utilize subject matter experts from the EHCOE, augmented (as needed) by representatives from other offices and external organizations. Regulatory decisions will be made by the appropriate regulatory office in conjunction with the regions and other stakeholders, as appropriate. Procedures, roles, and responsibilities associated with the Recommendation 2.2 framework will be institutionalized through an office instruction developed and maintained by the EHCOE.

6. Stakeholder Interactions

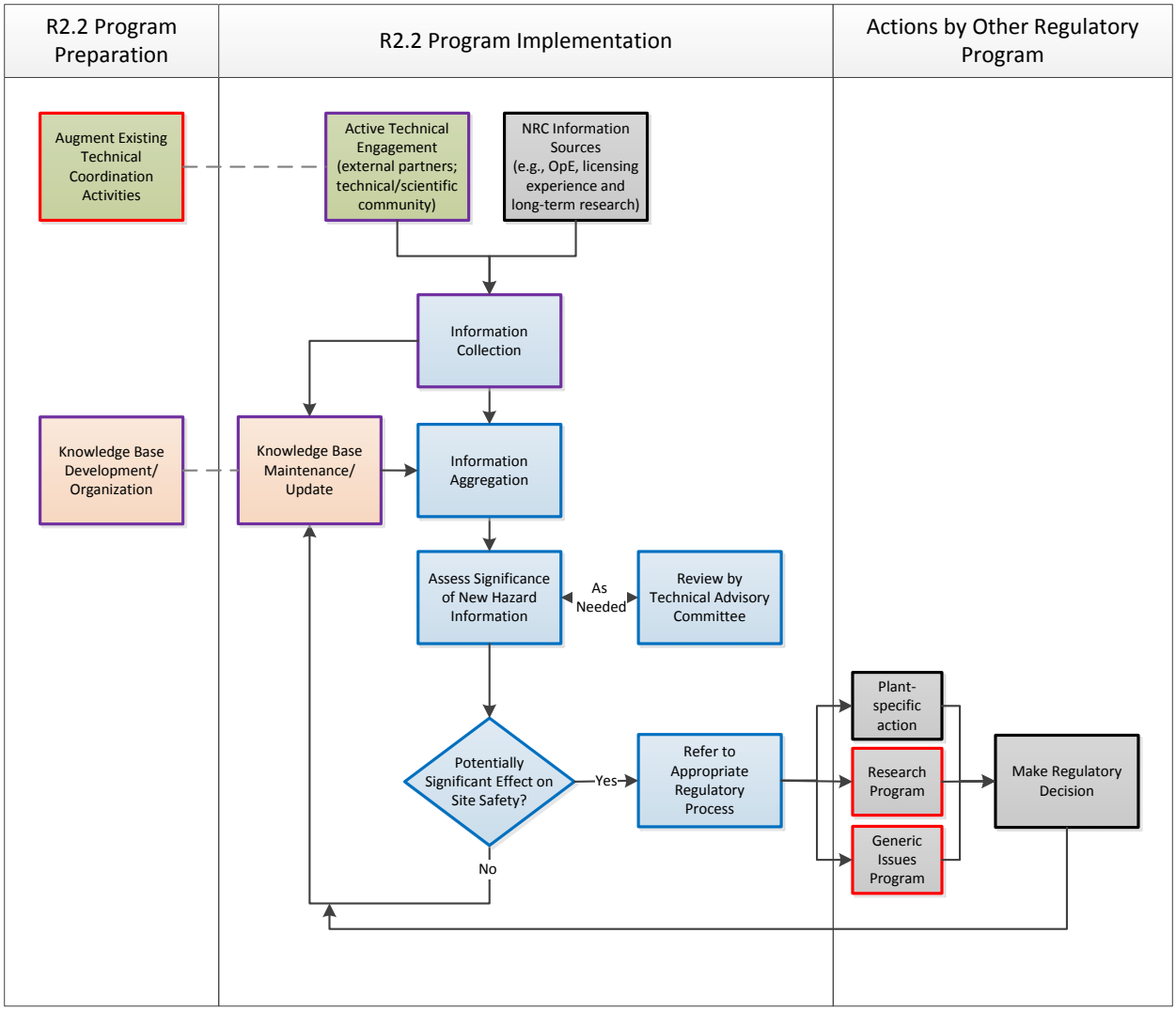
Staff discussed the framework described in this enclosure with external stakeholders during a Fukushima Joint Steering Committee meeting held on August 25, 2016. The staff intends to discuss the framework during an additional public meeting scheduled for September 28, 2016 (see Agencywide Documents Access and Management System Accession No. ML16245A004), and with the Advisory Committee on Reactor Safeguards (ACRS) Fukushima Subcommittee and ACRS's Full Committee during meetings in October 2016 and December 2016, respectively.

7. Resource Timelines and Estimates

While the framework described above leverages existing processes and activities, it is recognized that a commitment of a limited amount of resources is needed to support implementation. It is noted that full-time equivalent (FTE) allocations will come from prioritizing work activities rather than adding new FTE. The following table provides estimated timelines and resources required for the Recommendation 2.2 activities:

	Timelines		Resources	
	Near-Term	**Longer-Term**	**Near-Term**	**Longer-Term for Program Maintenance***
Knowledge Base Development and Activities	End 2017	Ongoing	[information withhed]	EHCOE: [information withheld] RES: [information withheld]
Active Technical Engagement and Coordination	End 2017	Ongoing (periodic)	[information withheld]	Continuous RES: [information withheld] EHCOE: [information withheld]
Assessment Activities	N/A	Ongoing	N/A	RES: [information withheld] EHCOE: [information withheld]

***** Resource needs for program-specific maintenance requirements.
▫ Contract resources made be needed if internal capabilities not available.



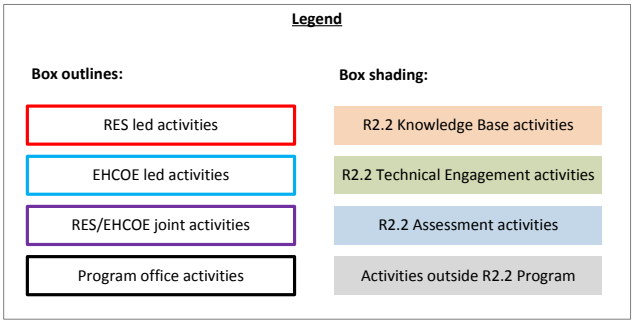


Figure 1: Key elements of proposed R2.2 Program