COMSECY-14-0037

November 21, 2014

MEMORANDUM TO: Chairman Macfarlane
Commissioner Svinicki
Commissioner Ostendorff
Commissioner Baran
Commissioner Burns

FROM: Mark A. Satorius ***/RA/***
Executive Director for Operations

SUBJECT: INTEGRATION OF MITIGATING STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS AND THE REEVALUATON OF FLOODING HAZARDS

This memorandum provides the Commission with information and recommendations for coordinating requirements to implement mitigation strategies for beyond-design-basis external events with actions, if any, necessary to address reevaluated flooding hazards. In response to the March 2011 accident at Fukushima Daiichi, the U. S. Nuclear Regulatory Commission (NRC) issued Order EA-12-049, which 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. In addition, the NRC issued letters to power reactor licensees pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.54(f) (hereafter referred to as the § 50.54(f) letter), which requested that licensees reevaluate the seismic and flooding hazards at their sites using updated hazard information and current regulatory guidance and methodologies. This information was requested to support NRC decisions regarding possible regulatory actions to protect the plants from these reevaluated external hazards.

The mitigating strategies and external hazard reevaluations are not fully independent activities, in that the staff has previously stated that the reevaluated external hazards would inform licensee development of the mitigating strategies, which the staff proposes to reflect in the follow-on rulemaking to Order EA-12-049. Changing the primary focus of the flooding-related response to the § 50.54(f) letters and integrating the decision-making criteria with the development and implementation of mitigating strategies will result in more timely safety enhancements to address reevaluated flooding hazards and improve the effectiveness and efficiency of the regulatory process. The NRC staff is asking the Commission to affirm that licensees for operating nuclear power plants need to address the reevaluated flooding hazards

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within their mitigating strategies, which may include developing targeted or scenario-specific mitigating strategies for some beyond-design-basis events. The staff is also requesting the Commission approve changing the primary focus of the flooding-related response to the § 50.54(f) letters to include ensuring that mitigating strategies capabilities are able to respond to and are protected against the reevaluated flooding hazard.

In response to this proposal, some staff expressed concerns that resulted in two non-concurrences on this memorandum, which are provided as Enclosures 3 and 4. The authors of the first non-concurrence define their concern as follows:

> The fundamental concern with the COMSECY is that it proposes a change that bypasses current plans for a deliberate and systematic process for understanding the potential for flooding events to adversely affect nuclear power plants without sufficient regard for the importance of developing insights about flood risks. The COMSECY describes a significant departure from the current, approved process for implementing NTTF [Near-Term Task Force] Recommendation 2.1….

The authors of the second non-concurrence expressed the following concern:

> We cannot support the full "integration" of Recommendations 2.1 and 4.2 because of the adverse impact on the re-consideration of flooding protection, as intended under Recommendation 2.1….

The staff made improvements to this memorandum in response to the concerns and comments identified in the non-concurrences and related interactions. The NRC staff considered a variety of factors related to potential safety benefits, timeliness of actions, and management of resources. The staff finds that integrating the activities related to flooding reevaluations and mitigating strategies is a more effective regulatory approach to achieve timely safety enhancements than those described in the non-concurrences and related documents such as 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,” and Interim Staff Guidance (ISG) JLD-ISG-2012-05, “Guidance for Performing the Integrated Assessment for External Flooding.” The recommendations in this memorandum reflect the NRC staff’s conclusion that the best overall results involve an appropriate compromise between information gathering and analysis and actual, timely regulatory actions to achieve safety improvements.

BACKGROUND:

The accident at the Fukushima Daiichi nuclear plant in Japan highlighted the possibility that certain external events may simultaneously challenge the prevention, mitigation, and emergency preparedness measures that provide defense in depth protections for nuclear power plants. NRC's assessment of the lessons learned from the experiences at Fukushima Daiichi led to the conclusion that additional requirements were needed to increase the capability of nuclear power plants to address certain beyond-design-basis external events. As a result, the NRC imposed new requirements to enhance safety, while simultaneously asking licensees to reevaluate seismic and flooding hazards using present day standards and guidance and provide that information to the NRC.

The § 50.54(f) letters describe a two phase approach to support NRC decisions on whether to pursue regulatory actions to increase nuclear power plant capabilities to address flooding events. During the first phase, the NRC staff gathers information related to the reevaluation of flooding hazards, as well as assessing each licensee's proposed response(s) to those newly evaluated hazards. The NRC staff recognized that updated standards, models, and data might result in hazard levels for various flooding mechanisms that exceed those considered during the initial siting and licensing of some nuclear power plants.[1] As discussed in SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," the staff identified that certain flooding scenarios are of special concern because of a potential "cliff edge" effect, in that safety consequences of a flooding event may increase sharply with small increases in the flooding level. With this in mind, the NRC issued § 50.54(f) letters to all licensees to reevaluate the flooding hazards at their sites against present-day regulatory guidance and methodologies used for early site permit and combined license reviews under 10 CFR Part 52.

Licensees for operating nuclear reactors are currently submitting their reevaluated flooding hazards. Under existing plans and guidance, licensees would be expected to complete and submit integrated assessments describing the total plant response to the reevaluated hazard. These integrated assessments would include the potential impact of such events on their facilities and describe how a plant's flood protection and mitigation would maintain key safety functions for the various flooding scenarios. Under Phase 2, the staff would determine whether additional regulatory actions are necessary to protect against the updated hazards (e.g., update the design basis for structures, systems, and components (SSCs) important to safety). This paper is responsive to the staff requirements memorandum related to SECY-11-0124, "Recommended Actions to be Taken Without Delay from the Near-Term Task Force Report," in which the staff was directed to provide the Commission with information about the technical bases and acceptance criteria for implementing Recommendation 2.1.

The staff outlined an approach in SECY-12-0025 as follows:

> The NRC staff's goal is to complete Phase 1 and collect sufficient information to make a regulatory decision for most plants within 5 years. It is anticipated that collection of this information for all plants will take no longer than 7 years.
>
> Information collection on hazard protection walkdowns consistent with Recommendation 2.3 will be implemented in a single phase. The results from these walkdowns are expected to capture any degraded, non-conforming conditions, and cliff-edge effects for flooding so that they are addressed by the licensee's corrective action program and will provide input to Recommendation 2.1. It is anticipated that this effort will be completed within approximately 1 year.

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[1] During previous actions by the NRC staff to look back at external hazards after siting and licensing of a plant, the new methods sometimes identified hazard levels and associated effects (for the same or similar flooding events or for newly considered flooding mechanisms) in excess of the design or licensing basis. Examples of such activities discussed in Enclosure 1 include the Systematic Evaluation Program and the Individual Plant Examinations of External Events.

The licensees and staff completed the actions related to the Recommendation 2.3 flooding-related walkdowns in July 2014. The staff's current trajectory, under the existing plans and guidance for Recommendation 2.1, will likewise significantly exceed the projected time and resource estimates in SECY-12-0025 for the flooding-related hazard reevaluations associated with the § 50.54(f) requests for information.

Simultaneously with the reevaluation of flooding hazards, licensees were required to develop and implement improved mitigating strategies in accordance with NRC Order EA-12-049, "Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." Licensees are developing responsive mitigating strategies using guidance prepared by the nuclear industry and endorsed by the NRC. The primary guidance document is Nuclear Energy Institute (NEI) 12-06, "Diverse and Flexible Coping (FLEX) Implementation Guide." The focus of these efforts is to define capabilities to protect against a variety of beyond-design-basis external hazards. The additional capabilities address plant conditions involving an extended loss of all alternating current (ac) power and challenges to the ability to remove heat from the reactor cores and spent fuel pools. As licensees have developed and implemented their mitigating strategies, the NRC has recognized that other Fukushima-related recommendations are being or could be addressed within this activity.[2]

NRC Order EA-12-049 requires nuclear power plant licensees to put in place mitigating strategies for a variety of beyond-design-basis external events, including flooding. The NRC staff plans to incorporate these requirements into NRC regulations through the mitigation of beyond-design-basis events (MBDBE) rulemaking. This approach ensures that licensees implement additional capabilities for dealing with the reevaluated flooding hazards identified from Recommendation 2.1. However, integrating the results of the Recommendation 2.1 activities could lead to some licensees needing to modify their mitigating strategies in response to the reevaluated flooding hazards after they have implemented plant changes and procedures to comply with Order EA-12-049. There is also a possibility that circumstances at some nuclear power plants may warrant consideration of additional measures to protect against or mitigate postulated flooding scenarios. These additional measures (beyond those imposed by Order EA-12-049 and the related MBDBE rulemaking) could be pursued voluntarily by licensees or imposed by the NRC through the process defined in 10 CFR 50.109, "Backfitting."

Under the current approach for handling the requests for information related to reevaluated flooding hazards, progress has been slower than originally estimated in SECY-12-0025 - with the reevaluations and assessments now expected to significantly exceed the original 5 to 7 year goal. There is notable slow progress in resolving the reevaluated flood hazards and a growing trend for more detailed analysis by licensees and NRC staff for various flooding mechanisms. These more complicated analyses will in turn use more licensee and NRC staff resources to

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[2] Previous examples of integrating and consolidating Fukushima activities are described in COMSECY-13-002, "Consolidation of Japan Lessons Learned Near-Term Task Force Recommendations 4 and 7 Regulatory Activities" and SECY-14-0046, "Fifth 6-Month Status Update on Response to Lessons Learned from Japan's March 11, 2011, Great Tōhoku Earthquake And Subsequent Tsunami (Enclosure 6 - Proposal to Consolidate Post-Fukushima Rulemaking Activities)," and the related staff requirements memoranda.

prepare and review responses to the request for information. The inherent complexities of flood modeling and the evolving body of knowledge of flood hazards contribute to this dynamic situation, which is similar to other generic issues when the NRC and industry found themselves developing new analytical tools and models.

The industry's desire for more precise flood hazard estimates stems in part from the uncertainty surrounding the regulatory outcomes (i.e., lack of a well-defined Phase 2 decision-making process for flooding reevaluations). The uncertainties related to regulatory outcomes result in licensees undertaking additional analyses to avoid potentially overly conservative hazard estimates leading to unwarranted plant modifications. The analytical approaches being taken by licensees in turn change the NRC staff's plans for performing reviews. For example, the industry's expected use of more complex analyses techniques for precipitation-related flooding mechanisms is leading the staff to develop a regulatory review process that emulates a process used by the Federal Energy Regulatory Commission (FERC) and other agencies. The established FERC process takes approximately 18 months to complete and involves an independent board of consultants. This new NRC review process has yet not been established. If adopted, the process would be a first-of-a kind approach for the NRC and would involve revising schedules and further delays in achieving a final determination of the reevaluated flood hazards; an essential prerequisite for a plant-level integrated assessment as described in the current guidance. The possible use of immature technologies such as probabilistic flood hazard analysis introduce additional complexities and likely delays, should those tools be necessary to support risk-informed regulatory decisions under the current Recommendation 2.1 approach. The initial estimated schedule for the NRC's Probabilistic Flood Hazard Assessment Research Plan, which is being developed to help resolve some of these issues, extends into 2019.

DISCUSSION:

The Commission determined that reasonable assurance of adequate protection of public health and safety requires that power reactor licensees and construction permit holders develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities in the event of a beyond-design-basis external event. The agency is addressing this through Order EA-12-049 and the related MBDBE rulemaking, which impose additional regulatory requirements on licensees. As a result of the order and the expected rulemaking, licensees have been required to provide capabilities to mitigate extended losses of ac power and challenges to heat removal functions that might be caused by beyond-design-basis external events. Beyond-design-basis events have previously been incorporated into the NRC's regulations as additional risk insights became available from operating experience and analytical studies. Examples of previous instances include regulations for anticipated transients without scram (ATWS), station blackout (SBO), and loss of large areas of the plant due to explosions or fires. The NRC staff intends to use these examples and the associated regulatory processes for developing the requirements for mitigating strategies for beyond-design-basis external events. Enclosure 1 provides background information on how beyond-design-basis issues have been incorporated into the design basis for affected SSCs and treated within the licensing basis of operating nuclear power plants.

The results of the reevaluation of the flooding hazard are important to define the necessary attributes of the mitigating strategies equipment and actions to adequately protect against external events. The NRC staff plans to include this requirement in the pending MBDBE rulemaking. As such, the strategies required by the MBDBE rulemaking cannot be completed without information about the site-specific reevaluated flooding hazards.

Adjusting the primary focus of decision-making to the reliability and performance of the mitigation strategies with respect to the reevaluated flooding hazards would have some practical and positive impacts. It would prioritize developing and implementing robust mitigating strategies capable of responding to the newly identified hazards. Licensees and the NRC staff would be able to leverage their recent experience and lessons learned from implementing Order EA-12-049 in addressing potential changes to the mitigating strategies or developing targeted hazard-specific strategies for specific external events. Licensees and the NRC staff may also be able to avoid more complex flood hazard analyses and assessments because the planned approach establishes clear regulatory criteria involving the ability of mitigating strategies to address identified beyond-design-basis external events. This approach reduces the level of resources necessary to complete this portion of the evaluation, and would allow both the licensees and NRC staff to use their limited resources to resolve other important safety issues. The desire to limit the potential adverse impact on the implementation of mitigating strategies resulting from the delays and uncertainties associated with flooding reevaluations is among the reasons for the integration of activities described in this memorandum.

Focusing the flooding-related Phase 2 decision-making on mitigating strategies means that the integrated (total plant) assessment in Phase 1 is no longer needed in the form described in existing guidance documents. Instead, the mitigating strategies equipment and actions will be confirmed to protect against the reevaluated flooding scenarios. Flood protection features would be verified to provide reasonable confidence that key SSCs (e.g., turbine-driven auxiliary feedwater pumps and direct current power systems) support the ability of mitigating strategies to address the various reevaluated flooding scenarios. There are potential negative aspects to changing the focus of the Phase 1 assessment and Phase 2 decisions for the flooding reevaluations. The planned approach reduces the level of information to be submitted by licensees, and the assessments will focus on mitigating strategies instead of more varied enhancements to protect against a range of flooding conditions. A broader assessment could, for example, identify protective measures for equipment important to safety against some flooding scenarios and thereby reduce the reliance on mitigating strategies to address such events. However, the NRC staff finds that focusing the reevaluated hazards initially on mitigating strategies will produce meaningful and timely safety improvements, while accomplishing the goals of regulatory predictability, stability, and clarity. In addition, the NRC staff will use insights from the flooding reevaluations to assess the possible need to obtain additional information for specific plants and consider flooding protection or mitigation beyond that provided by the requirements for mitigating strategies. The NRC staff provides additional discussion of the integration of activities related to flooding reevaluations and mitigating strategies in Enclosure 2.

Staff's Path Forward on the MBDBE Rulemaking

The NRC staff plans to complete activities currently underway to address lessons learned from the Fukushima accident and describe how the mitigation strategies order, rulemaking, and reevaluated hazards relate to each other now that sufficient information exists to fully describe the process. Primarily, the NRC staff intends to require that licensees' mitigating strategies

address the reevaluated flooding hazards as part of the MBDBE rulemaking. The reevaluation of the flooding hazard will help define the functional requirements and reference bounds of design for the equipment and actions used for the mitigating strategies for beyond-design-basis external events. By focusing the flooding reevaluations on the SSCs serving key safety functions within the mitigating strategies requirements, the need to perform a broader assessment of every plant's flooding response as described in the § 50.54(f) letter and related guidance documents is unnecessary. Instead, the NRC staff would evaluate the need to perform a broader assessment of how beyond-design-basis flooding scenarios might impact plant features beyond mitigating strategies on a case-by-case basis. The staff would determine if additional information and potential plant changes should be sought for each plant or site based on the relevant information from the reevaluated flooding hazard and the plant's capabilities. The NRC staff will also evaluate the implications of this approach for flooding on seismic and other hazard reevaluations, generic issues, and other ongoing NRC activities.

The NRC staff conducted several public meetings with the nuclear industry and members of the public regarding the need to consider the reevaluated flooding hazard and possibly revise equipment or strategies to address conditions different than those considered in the implementation of Order EA-12-049. The industry recognized that the coincident performance of the flooding reevaluations and the implementation of the order would subsequently require assessing the mitigating strategies developed to address a variety of external hazards to ensure they provide capabilities sufficient to address the reevaluated flooding hazards from Recommendation 2.1. These discussions helped identify an approach (subsequently described in a letter from NEI dated November 4, 2014) that initially focuses the flooding reevaluations on the mitigating strategies. Licensees will assess the mitigating strategies developed to address Order EA-12-049 against the site-specific flooding scenarios from their Recommendation 2.1 reevaluations. The mitigating strategies and related equipment will be confirmed to adequately address the postulated scenario, or the licensee will revise the mitigating strategies. Changes to the mitigating strategies could involve modifications to the existing equipment and plans developed for multiple hazards or could involve developing a targeted strategy for a specific flooding scenario. The NRC staff is asking the Commission to support the planned approach by affirming that the MBDBE rulemaking needs to require mitigating strategies that are able to address the reevaluated flooding hazards developed in response to the § 50.54(f) letters in order to ensure reasonable assurance of adequate protection of the public health and safety.

It should be noted that in some limited cases, the newly estimated flooding hazards could result in significant damage to a nuclear power plant site and licensees may need to develop scenario-specific strategies. However, even in such extreme cases, licensees will be required by the planned MBDBE regulation to have appropriate mitigating strategies that provide capabilities that can be deployed to prevent fuel damage in reactor cores or spent fuel pools. These scenario-specific strategies may involve an orderly plant shutdown followed by unconventional measures, such as a rapid entry to refueling modes of operation, allowing flood waters into buildings, and pre-staging equipment and personnel to higher elevations. The NRC staff would review any such proposals to ensure the licensee's analyses, assumptions, and planned actions appropriately address the risk from such flooding scenarios. The NRC staff is also seeking Commission affirmation on this general approach for licensees developing mitigating strategies for floods that might result in significant damage to a nuclear power plant site.

Staff's Evaluation of Requirements Beyond Order EA-12-049 and the MBDBE Rulemaking

The NRC staff will use insights from the flooding reevaluations to assess for each operating plant the possible need for additional flooding protection or mitigation beyond that provided by the requirements for mitigating strategies. The staff will review licensees' responses to the flooding-related § 50.54(f) letters, overall integrated plans for mitigating strategies, and other available and relevant information as part of an appropriate assessment of each plant's capabilities to address reevaluated flooding hazards. These assessments will consider information about revised flooding conditions, estimated event frequencies, available response times for identified scenarios, plant-specific configurations and licensing histories, and any other factors relevant to the staff's evaluation of potential regulatory actions. The NRC will address, as a separate matter from mitigating strategies, whether the existing design basis and licensing basis for flooding of any nuclear power plant continues to be acceptable if the re-evaluated flood hazard at any plant is greater than the plant's design basis and licensing basis. The NRC staff will follow the established processes for imposing additional requirements on licenses including Management Directive 8.4, "Management of Facility-specific Backfitting and Information Collection," which describe how to initiate, review, and disposition these types of safety concerns. The evaluation of plant-specific backfits and their potential to improve overall plant safety will, if the Commission affirms the recommendations in this memorandum, consider the benefits from requiring licensees to have mitigating strategies to address the reevaluated flooding hazards. The staff will document the disposition of the flooding reevaluations and inform licensees and other stakeholders about the results, including the possible need for more information or consideration of plant-specific actions.

The current efforts to integrate activities related to mitigating strategies and flooding reevaluations reflect the NRC staff's conclusion that the best overall results involve an appropriate compromise between information gathering and analysis and actual, timely regulatory actions to achieve safety improvements. The NRC staff is requesting that the Commission approve the changes to the Recommendation 2.1 flooding assessments and integration of the Phase 2 decision-making into the development and implementation of mitigating strategies in accordance with Order EA-12-049 and the related MBDBE rulemaking.

Staff Recommendation

The staff recommends that the Commission affirm the following:

1. Licensees for operating nuclear power plants need to address the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events (Order EA-12-049 and related MBDBE rulemaking),

2. Licensees for operating nuclear power plants may need to address some specific flooding scenarios that could significantly damage the power plant site by developing targeted or scenario-specific mitigating strategies, possibly including unconventional measures, to prevent fuel damage in reactor cores or spent fuel pools, and

3. The staff should revise the Recommendation 2.1 flooding assessments and integrate the Phase 2 decision-making into the development and implementation of mitigating strategies in accordance with Order EA-12-049 and the related MBDBE rulemaking.

SECY, please track.

Enclosures:
1. Background - Design-basis Events, Design-basis Information, and External Events
2. Coordination and Clarification
3. Non-Concurrence Package 2014-010
4. Non-Concurrence Package 2014-011

3. The staff should revise the Recommendation 2.1 flooding assessments and integrate the Phase 2 decision-making into the development and implementation of mitigating strategies in accordance with Order EA-12-0049 and the related MBDBE rulemaking.

SECY, please track.

Enclosures:
1. Background - Design-basis Events, Design-basis Information, and External Events
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4. Non-Concurrence Package 2014-011

ADAMS Package No:ML14309A256; ML14238A616 (SECY) *via email **Non-Concurrence

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Non-Concurrence NCP-2014-010; Non-Concurring Employees

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