

DRAFT

RECOMMENDATION 2.3: FLOODING

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information request for the following purposes:

- To gather information with respect to Near-Term Task Force (NTTF) Recommendation 2.3, as amended by Staff Requirements Memoranda (SRM) associated with SECY-11-0124 and SECY-11-0137,
- To develop a methodology and acceptance criteria for flooding walkdowns to be endorsed by the staff following interaction with external stakeholder,
- To perform flooding walkdowns using the endorsed walkdown methodology,
- To identify and address plant-specific vulnerabilities¹ or performance deficiencies,
- To verify the adequacy of monitoring and maintenance procedures.

Pursuant to 10 CFR 50.54(f), addressees are required to submit a written response to this information request.

BACKGROUND

Structures, systems, and components (SSCs) important to safety in operating nuclear power plants are designed either in accordance with, or have been revised to meet the intent of Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 2. GDC 2 states that SSCs important to safety at nuclear power plants must be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami, and seiches without loss of capability to perform their intended safety functions. The design bases for these SSCs are to reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. The design bases are also to reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

In response to the accident at the Fukushima Dai-ichi Nuclear Power Plant caused by the March 2011 Tohoku earthquake and subsequent tsunami, the Commission established the Near-Term Task Force (NTTF) to conduct a systematic review of NRC processes and regulations, and to make recommendations to the Commission for its policy direction.

¹ A definition of vulnerability in the context of this enclosure is as follows: Plant-specific vulnerabilities are those features that when subject to **the existing design basis hazard** are unable to perform their intended functions, which may also lead to compromising the overall ability to provide protection or mitigation.

The NTTF developed a set of recommendations that are intended to clarify and strengthen the regulatory framework for protection against natural phenomena. The purpose of this letter is to gather information related to NTTF Recommendation 2.3. Recommendations 2.3, as amended by the SRMs associated with SECY-11-0124 and SECY-11-0137, instructs the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f). This information request is for licensees to develop a methodology and acceptance criteria for flooding walkdowns to be endorsed by the staff following interaction with external stakeholders. Licensees should perform the flood protections walkdowns to identify and address plant-specific vulnerabilities or performance deficiencies and verify the adequacy of monitoring and maintenance procedures.

In developing Recommendation 2.3, the NTTF observed that, “some plants have an overreliance on operator actions and temporary flood mitigation measures such as sandbagging, temporary flood walls and barriers, and portable equipment to perform safety functions” (pg 29). The NTTF Report also states that, “the Task Force has concluded that flooding risks are of concern due to a ‘cliff-edge’ effect, in that the safety consequences of a flooding event may increase sharply with a small increase in the flooding level. Therefore, it would be very beneficial to safety for all licensees to confirm that SSCs important to safety are adequately protected from floods,” (pg 29).

The NRC has developed regulatory programs in the past aimed at identify plant-specific vulnerabilities to external flooding hazards. In June of 1991, the NRC issued Supplement 4 to GL88-20, “Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, 10 CFR 50.54(f)” in 1991. This GL requested that “each licensee perform an individual plant examination of external events to identify vulnerabilities, if any, to severe accidents and report the results together with any licensee determined improvements and corrective actions to the Commission.” Flood-related hazards were considered in the IPEEE Program as one of the HFO (high winds, floods, and other) external initiating-event hazards. Of the 70 IPEEE submittals, most indicated some type of walkdown was performed for the HFO events. However, NUREG-1742 states, “the [HFO walkdown] submittals usually did not provide detailed descriptions of the walkdown procedures and results” (pg xxix). NUREG-1742 also states that, “A few licensees proposed flood-related countermeasures that may be optimistic. For example, one licensee took credit for sandbagging up to a level of 9 feet. In several other submittals, flood barriers made of various construction materials, such as logs or concrete berms, were credited with being effective for preventing flooding, but the submittals did not discuss whether the licensees performed confirmatory testing to verify the effectiveness of certain of these mitigating actions” (pg 4-12).

In late December 1999, a severe storm induced flooding at Le Blayais Nuclear Power Plant Site in France. Lessons-learned from this flooding event are documented in World Association of Nuclear Operators (WANO) Significant Event Report (SER) 2000-3, “Severe Storm Results in Scram of Three Units and Loss of Safety System Functions due to Partial Plant Flooding” and in INPO SER 1-01 with the same title. Both reports list significant aspects and important lessons learned from the flooding event. On March 11, 2010, Électricité de France (EDF) presented lessons learned from the 1999 Blayais Flood at the NRC’s Regulatory Information Conference (<http://www.nrc.gov/public-involve/conference-symposia/ric/past/2010/slides/th35defraguierrepv.pdf>). Lessons-learned discussed in this presentation were: (1) cable openings and trenches were an unrecognized common-mode vulnerability requiring review of existing protective measures, (2) difficulty in detecting water in affective rooms and an inadequate warning system,

and (3) the flood's effects on support functions and surrounding areas were not adequately accounted or were inappropriate for the weather conditions.

APPLICABLE REGULATORY REQUIREMENTS

- 10 CFR 50.34(a)(1), (a)(3), (a)(4), (b)(1), (b)(2), and (b)(4)
Regulations concerning the content of reactor applications and technical information are contained in §50.34.
- 10 CFR 50.54, "Conditions of Licenses"
The licensee shall at any time before expiration of the license, upon request of the Commission, submit, as specified in §50.4, written statements, signed under oath or affirmation, to enable the commission to determine whether or not the license should be modified, suspended, or revoked (§50.54(f)).
- Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, GDC 2, "Design Bases for Protection against Natural Phenomena"
- Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants," to 10 CFR Part 100

The flooding design bases for currently operating nuclear power plants were either developed in accordance with, or have been revised to meet the intent of GDC 2 and 10 CFR Part 100, Appendix A (seismically induced floods and water waves). GDC 2 states that SSCs important to safety at nuclear power plants must be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunami, and seiches without loss of capability to perform their intended safety functions. The design bases for these SSCs are to reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. The design bases are also to reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

DISCUSSION

The NTTF recommended that the Commission direct several actions to ensure adequate protection from natural phenomena. These actions should be taken to prevent fuel damage and to ensure containment and spent fuel integrity. In particular, Recommendation 2.3 states that the Commission should "Order licensees to perform seismic and flood protection walkdowns to identify and address plant-specific vulnerabilities and verify the adequacy of monitoring and maintenance for protection features such as water tight barriers and seals in the interim period until longer term actions are completed to update the design basis for external events."

Staff's assessment of NTTF Recommendation 2.3 is discussed in SECY-11-0124. Staff agreed with the NTTF findings and noted that some plants rely on operator actions and temporary flood mitigation measures such as sandbagging, temporary flood walls and barriers, and portable equipment to perform safety functions. Results of staff's inspections at nuclear power sites in accordance with Temporary Instruction (TI) 2515/183 identified potential issues and observations regarding mitigation measures. Recent flooding at the Fort Calhoun site showed

the importance of temporary flood mitigation measures. The staff also noted that guidance should be developed for both the seismic and flooding walkdowns with external stakeholder involvement to ensure consistency.

In the SRM to SECY-11-0124, the Commission approved the staff's proposed actions to implement without delay the NTTF recommendations as described in the SECY. With regards to Recommendation 2.3, staff's approved actions are to develop and issue a request for information to licensees pursuant to 10 CFR 50.54(f) to develop a methodology and acceptance criteria for flooding walkdowns to be endorsed by the staff following interaction with external stakeholders, perform flood protection walkdowns to identify and address plant-specific vulnerabilities (through corrective action program) and verify the adequacy of monitoring and maintenance for protection features, and inform the NRC of the results of the walkdowns and corrective actions taken or planned. The SRM to SECY-11-0124 also directed the staff to inform the Commission, either through an Information Paper or briefing of the Commissioners' Assistants, when it has developed the technical bases and acceptance criteria for implementing Recommendation 2.3.

TI 2515/183 was issued by the NRC on March 23, 2011. Inspection activities were completed by April 29, 2011, and NRC Inspection Reports were issued by May 13, 2011. The NRC developed a Summary of Observations report to encapsulate the performance of TI 2515/183 (see <http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/follow-up-rpts.html>). The Summary report states that while individually, none of the observations posed a significant safety issue, they indicate a potential industry trend of failure to maintain equipment and strategies required to mitigate some design basis events. Regarding the licensee's capability to mitigate design bases flooding events, the report notes that some equipment (mainly pumps) would not operate when tested or lacked test acceptance criteria and that some discrepancies were identified with barrier and penetration seals.

Additional review of Section 03.03 of the responses to TI2515/183 indicates that several sites were susceptible to water accumulation that submerged safety-related cables. Issues were noted with cracks in penetrations, evidence of water infiltration, and groundwater intrusion. Individual TI Inspection Reports noted that a few licensee-proposed flood-related countermeasures may be optimistic. Flood barriers made of various construction materials were credited with being effective for preventing flooding, but the confirmatory testing to verify the effectiveness of certain of these mitigating actions was found to be lacking. It should be noted that these findings are consistent with findings from the Perspectives Gained from the IPEEE Program Report (NUREG-1742).

The NRC staff will interact with industry and stakeholders to develop a methodology and acceptance criteria for flooding walkdowns. These walkdowns should integrate the External Flood results in NUREG-1742, common issues and findings discussed in Section 03.03 of the responses to TI 2515/183, and the Significant Aspect findings discussed INPO SER 1-01. It is anticipated that the walkdown procedure will be developed or modified using various existing NRC- and industry-developed procedures. As mentioned in SECY-11-0124, recent flood events at Fort Calhoun should also provide valuable insights. Additional attributes of the walkdown procedure are described in the Requested Action section below. The technical approach used to develop the needed information should be holistic and integrated to account for the site-specific design, physical barriers, procedures, temporary measures, and planned or installed mitigation measures to deal with the potential flooding scenarios.

As stated earlier, the NRC staff will interact with industry and other stakeholders to develop an approach, which can be applied in a uniform and consistent manner across the different sites and plant conditions. An integrated approach will allow the NRC and industry to assess the significance of any new information related to flooding hazards in a systematic manner. During these interactions, the NRC staff will also work with industry and stakeholders to identify efficiencies and strategies to ensure that responses and reviews are timely and support the Commission guidance on the overall schedule.

REQUESTED ACTIONS

To respond to NTTF Recommendation 2.3, as amended by SRMs to SECY-11-0124 and SECY-11-0137, licensees should:

- 1) Develop a methodology and acceptance criteria for flooding walkdowns to be endorsed by the staff following interactions with external stakeholders,
- 2) Perform flood protection walkdowns using the endorsed walkdowns methodology,
- 3) Identify and address plant-specific vulnerabilities or performance deficiencies
- 4) Verify the adequacy of programs, monitoring and maintenance for protection features, and
- 5) Inform the NRC of the results of the walkdowns and corrective actions taken or planned.

Flooding walkdowns should integrate the significant aspects and findings contained in NUREG-1742, Inspection Reports developed in response to TI 2515/183, and INPO SER 1-01. A final report should be submitted to the NRC addressing key findings, all plant-specific vulnerabilities, and mitigating strategies.

The walkdown procedure should verify that passive flood protection systems are available and functional and that active flood protection systems are implementable under a variety of site conditions. In particular, the walkdowns should confirm that: (1) cable and piping trenches and other penetrations to safety-related SSCs, including underground rooms, are protected against external ingress of water, (2) difficulties would not exist in detecting water in affected rooms and an adequate warning system exists, (3) the effects of elevated water levels and severe weather conditions would not impair support functions or would be inappropriate for the weather conditions, and (4) on-site organizational difficulties would not prevent implementation of active flood protection measures at multi-unit sites.

If during the course of the walkdown any performance deficiencies that could result in non-compliance with your licensing basis, identify and address actions planned or taken to bring your deficiency into the compliance through appropriate regulatory programs (e.g. corrective action program). If applicable, also include any measure that you are taking or planning to take, to address deficiencies while the corrective action program is being implemented.

Along with an assessment of reactor integrity, the NTTF recommended an evaluation of spent fuel pool integrity. It is expected that licensees will interact with the staff and other stakeholders to develop an integrated approach to conducting flooding walkdowns to assess spent fuel pool integrity and performance against flooding hazards. The approach should account for the site-specific design, physical barriers, procedures, temporary measures, and planned or existing mitigation measures.

REQUESTED INFORMATION

The NRC requests that each addressee provide a flooding walkdown procedure that will cover the following attributes:

- (1) Address the NTTF Report's observations regarding "overreliance on operator actions and temporary flood mitigation measures" and the 'cliff-edge' effect regarding a sharp increase in flooding risks with a small increase in flooding level.
- (2) Integrate issues discussed in the External Flood Qualitative Results (Section 4.3.3) in NUREG-1742, common issues and findings discussed in Section 03.03 of the responses to TI 2515/183, and the Significant Aspect findings discussed INPO SER 1-01.
- (3) Integrate insights from recent flood-related walkdowns and events at the Fort Calhoun site, as mentioned in SECY-11-0124.
- (4) Integrate the combined effects of flooding along with other adverse conditions, such as high winds, hail, lightning, etc., that could reasonably be expected to simultaneously occur. For example, steps in an active flooding procedure that requires manipulation of systems and components in outside areas of the plant site that could not be safely assessed because of storm conditions.
- (5) Identify pre-walkdown actions, such as the collection of current site topography including any changes since the original licensing (e.g., security improvements and temporary structures), sets of as-built drawings, review of the existing design basis flood level(s), review of any flood protection and pertinent flood mitigation features, such as exterior barriers, incorporated barriers, and temporary flood barriers.
- (6) Identify a list of pertinent elevations of Regulatory Guide 1.29² structures, systems, and components that should be designed to withstand and retain capability for cold shutdown and maintenance thereof (similar to Table 1 for Example 3.1.3 of ANSI/ANS-2.8-1992)
- (7) Identify the team composition (structural engineers, geotechnical engineers, mechanical engineers, electrical engineers, civil engineers, hydraulic engineers, etc.) and qualification criteria for the selection of walkdown team members.
- (8) Verify that passive flood protection systems are available and functional and that active flood protection systems are implementable under a variety of site conditions by reviewing the following:
 - Operator availability, operator training, timeliness of response, equipment maintenance and operability, back-up availability, operator access under adverse site conditions³
 - Methods and acceptance criteria to evaluate exterior barriers⁴

² Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants", and Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants," both recommend the use of Regulatory Guide 1.29, "Seismic Design Classification" for identifying structures, systems, and components, that should be designed to withstand the conditions resulting from the design basis flood and remain functional.

³ This is not necessarily a complete list.

- Methods and acceptance criteria to evaluate incorporated barriers
 - Methods and acceptance criteria to evaluate temporary flood barriers
 - Preparations in advance of adverse weather conditions
- (9) Identify programs in place that periodically verify the status and adequacy of flood mitigation strategies and equipment.
- (10) Develop a documentation template, including peer-review requirements, so that walkdown results can be efficiently and uniformly reviewed and evaluated. The template should also consider the reporting requirement discussed below.

Following NRC's endorsement of the walkdown procedure, conduct the walkdown and submit a final report which includes the following:

- (1) Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.
- (2) Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.
- (3) Describe any warning systems to detect the presence of water in rooms important to safety.
- (4) Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed under Step (8) above.
- (5) Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team, procedures,) using the documentation template discussed in Step (9) above including actions taken in response to the peer review.
- (6) Describe plant-specific vulnerabilities and any actions taken to address these vulnerabilities.
- (7) Describe performance deficiencies, if any, and action taken to address these deficiencies.
- (8) Describe any planned or newly installed flood protection systems or flood mitigation measures including flood barriers.

REQUIRED RESPONSE 2.3

In accordance with 10 CFR 50.54(f), an addressee must respond as described below. The submission of the required information is in stages to allow adequate time for further interactions with the stakeholders to provide clarifications, to develop implementation procedures and processes, and to develop the associated guidance as needed.

- Within XX (e.g. 90) days of the date of this information request, the addressee will submit the walkdown procedure to NRC. This time period will allow time for interactions

⁴ See Regulatory Position 1 of Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants," for definitions acceptable to the NRC staff for exterior barriers, incorporated barriers, and temporary barriers.

with the NRC staff and other stakeholders in the development of the walkdown procedure.

- Within XXX (e.g. 180) days of NRC's endorsement of the walkdown procedure, each addressee will submit its final response for the requested information.

If an addressee cannot meet the requested response date, the addressee must provide a response within 90 days of the date of this information request and describe the alternative course of action that it proposes to take, including the basis of the acceptability of the proposed alternative course of action and estimated completion dates.

The required written response should be addressed to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, 11555 Rockville Pike, Rockville, MD 20852, under oath or affirmation under the provisions of Sections 161.c, 103.b, and 182.a of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f). In addition, addressees should submit a copy of the response to the appropriate Regional Administrator.

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Enclosure 5 References

SECY-11-0124, "Recommended Actions to be taken without Delay from the Near-Term Task Force Report," ML11245A158, dated September 9, 2011.

SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons-Learned," ML11272A111, October 3, 2011.

"Recommendations for Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," ML111861807, DATE.

10 CFR 50.54 – Conditions of Licenses

Appendix A to 10 CFR Part 50, General Design Criteria for Nuclear Power Plants

Appendix A to 10 CFR Part 100, Seismic and Geologic Siting Criteria for Nuclear Power Plants

Temporary Instruction 2515/183, "Follow-up to the Fukushima Dai-ichi Fuel Damage Event," November 2011, ML113220407.

Energy and Water Development and Related Agencies Appropriations Act, 2012

NUREG-0800, SRP 2.4.14

NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," Final Report, ML063550238, June 1991.

ASME/ANS RA-Sa-2009, American Society of Mechanical Engineers/American Nuclear Society standard, RA-Sa-2009, "Standard for Level 1/ Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," 2009.