UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 16, 2020

MEMORANDUM TO: Raymond V. Furstenau, Director
Office of Nuclear Regulatory Research

FROM: Ho K. Nieh, Director
Office of Nuclear Reactor Regulation

Mirela Gavrilas

Digitally signed by Mirela Gavrilas
Date: 2020.09.16 16:10:52 -04'00'

SUBJECT: CLOSURE RECOMMENDATION FOR GENERIC ISSUE 204, "FLOODING OF NUCLEAR SITES DUE TO UPSTREAM DAM FAILURE"

The Office of Nuclear Reactor Regulation (NRR) recommends closure of Generic Issue 204 (GI-204), "Flooding of Nuclear Sites Due to Upstream Dam Failure." This recommendation is based on the completion of the risk-informed reevaluation of the flooding hazards, including upstream dam failures, for operating power reactor plants in response to the lessons-learned from the reactor accident at the Fukushima Dai-ichi site. In addition, staff from the Office of Nuclear Material Safety and Safeguards (NMSS) and NRR completed an analysis of the applicability of these lessons-learned to facilities other than operating power reactors. The associated facilities included decommissioning reactors with spent fuel stored in spent fuel pools (SFP), and Independent Spent Fuel Storage Installations (ISFSIs). This recommendation is aligned with the U.S. Nuclear Regulatory Commission's (NRC's) Principles of Good Regulation, particularly the principles of Openness, Efficiency, Clarity and Reliability. The associated activities have resulted in voluntary safety enhancements which improved many site's capabilities to protect and mitigate the impacts of all flood hazards, including dam failure events. Moreover, the associated activities have greatly increased the NRC's level of knowledge and risk insights in the area concerning present-day flood hazards. As such, any additional use of NRC resources on GI-204 would only provide marginal benefits to safety.

Enclosure:
Flood Reevaluation Activities –
List of NRC Staff Assessments

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In addition to the hazard reevaluation work completed as noted above, the NRC has implemented a process for the ongoing assessment of natural hazards information (POANHI). The process enhancements are described in SECY-16-0144, dated December 29, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16286A586). Guidance in NRR Office Instruction LIC-208, "Process for the Ongoing Assessment of Natural Hazards Information," institutionalizes a defined structure and procedures to implement this process. Using the enhanced process, the staff can proactively seek out new hazard information and assess its potential impacts on site safety by comparing updated information to existing hazard evaluations for the fleet or individual plants, as appropriate.

The enclosure provides a reference to the ADAMS accession numbers for the applicable staff assessments completed by the NRC staff in response to the licensees' flood hazard reevaluation activities.

Background

Generic issue GI-204 was opened to evaluate the potential safety implications for flooding of nuclear power plant sites due to upstream dam failures. The complete scope of this generic issue includes not only operating nuclear power plants sites, but also sites undergoing decommissioning with spent fuel stored in SFPs and ISFSIs. The issue was officially declared as GI-204 in February 2012. In accordance with Management Directive (MD) 6.4, the staff completed a screening analysis in July 2011 (ADAMS Accession No. ML112430114, non-public version, and ML113500495, publicly available version). The screening analysis did not identify any immediate safety concerns.

No assessment was performed, and the issue was transferred directly to the responsible program office (NRR) for resolution. By letter dated March 6, 2012 (ADAMS Accession No. ML120261155), GI-204 was transferred to NRR for Regulatory Office Implementation. The transfer occurred because of the NRC's parallel activities in response to the Near-Term Task Force[1] (NTTF) recommendations to address flooding at operating reactors, including flooding from postulated upstream dam failures.

Specifically, the NTTF's work incorporated several insights from the GI-204 screening analysis, which contributed to the NTTF's recommendations regarding flooding. The NRC response to these recommendations addressed flooding issues broadly, even beyond the issues represented in the screening analysis for GI-204. As a result (and consistent with MD 6.4), it was determined that GI-204 would be addressed by the NRC's response to the NTTF's recommendations.

The NTTF recommendations were applicable to operating power reactor sites. However, tasking Memorandum COMGBJ-11-0002 (ADAMS Accession No. ML110820875) also directed the staff to assess the applicability of the lessons learned from the accident to non-operating reactors, non-power reactors, and non-reactor facilities. Staff actions in response to this tasking memorandum addressed flooding issues broadly for non-operating reactors and non-reactor facilities, even beyond the issues represented in the screening analysis for GI-204. The staff's assessment can be found in Enclosure 1 of SECY-15-0081 (ADAMS Accession No. ML15050A066). Additional details are described below.

[1] See "Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident" (ADAMS Accession No. ML111861807)

With the completion of these actions, the full scope of GI-204 has been addressed by the NRC's actions in response to the accident at Fukushima Dai-ichi.

NRC's Response to Recommendation 2.1, "Flooding" of the NTTF Task Force Report

By letter dated March 12, 2012 (ADAMS Accession No. ML12053A340), the NRC issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) (hereafter referred to as the "50.54(f) letter"). Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses. Examples of dam-related guidance used by licensee's include Japan Lessons-Learned Project Directorate (JLD) Interim Staff Guidance (ISG) document JLD-ISG-2013-01, Guidance for Assessments of Flooding Hazards Due to Dam Failure (ADAMS Accession No. ML13151A153), and NUREG/CR-7046, "Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America."

A two-phase process was developed to respond to the flood hazard reevaluations requested by the 50.54(f) letter. In Phase 1 (the information gathering phase), licensees submitted flood hazard reevaluation reports (FHRR) evaluating the potential impacts of reevaluated hazards at their sites. The licensees used NRC endorsed, industry developed guidance to complete the evaluations. Each licensee also determined if interim protection measures were needed while a longer-term evaluation of the impacts of the hazard was completed. If interim protection measures were needed, the NRC inspected those actions using Temporary Instruction (TI) 2515/190, "Inspection of Licensee's Proposed Interim Actions as a Result of the Near-Term Task Force Recommendation 2.1 Flooding Evaluation" and documented the results in a quarterly integrated inspection report. The NRC staff reviewed the FHRR and provided an interim hazard letter to provide timely feedback on the staff's review of the flooding hazard reevaluations. The flood hazard information in the interim hazard letter was used by the licensee to complete any additional flood hazard evaluations. Separately, the NRC staff documented the technical bases for its conclusions summarized in the interim hazard letters by issuing a detailed staff assessment of the FHRR. If the reevaluated flood hazard levels were less than or equal to (i.e., bound by) the current licensing basis flood hazard levels, no further evaluations were necessary. If one or more reevaluated flood hazard levels were above the current licensing basis, additional evaluations were necessary.

Using the reevaluated hazard information and a graded approach, the NRC identified the need for, and prioritization and scope of, any needed additional plant specific assessments. On July 18, 2016, the staff issued JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation, Focused Evaluation and Integrated Assessment" (ADAMS Accession No. ML16162A301). The ISG provided the guidance to complete the Phase 1 flooding assessments and endorsed, with appropriate exceptions and clarifications, industry guidance provided in the Nuclear Energy Institute (NEI) guidance document NEI 16-05, "External Flooding Integrated Assessment Guidelines" (ADAMS Accession No. ML16165A178). The NRC staff's graded approach enabled a site with hazard exceedance above its current licensing basis to demonstrate the site's ability, through a Focused Evaluation (FE), to cope with the reevaluated hazard through appropriate protection or mitigation measures which are timely, effective, and reasonable. An Integrated Assessment (IA) would be needed by those sites with the greatest potential for additional safety

enhancements. The IAs are intended for the NRC to assess the site's capability to cope with the reevaluated hazard and to determine if additional regulatory actions are necessary under the backfit regulation.

If a licensee submitted an FE, the NRC staff reviewed the submittal and provided a staff assessment to document the staff's review. If the staff concluded that the FE is the appropriate evaluation mechanism, the site was screened out from any further regulatory actions and no further evaluations were required. Only those plants that met the criteria to perform a flooding IA needed to proceed to Phase 2 (the regulatory decisionmaking phase). This Phase 2 decisionmaking is detailed in letters dated September 21, 2016, and March 2, 2020 (ADAMS Accession Nos. ML16237A103 and ML20043D958, respectively), and describes how the NRC will make any regulatory decisions using existing guidance for risk-informed decisionmaking and for evaluating plant-specific backfits.

These memoranda describe the formation of a Senior Management Review Panel (SMRP) consisting of three division directors from NRR. The SMRP is expected to reach a decision for each plant submitting an IA. The SMRP is supported by NRC technical staff who are responsible for consolidating relevant information and developing recommendations for the consideration of the panel. In presenting recommendations to the SMRP, the supporting technical staff recommended placement of each flooding IA plant into one of three groups:

- Group 1 will include plants for which available information 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.
- Group 2 will include plants for which 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 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.
- 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.

The evaluation process that was performed to provide the basis for the staff's grouping recommendation to the SMRP for each site is described in the staff assessment issued for each IA. Six operating reactor sites met the criteria for the performance of an IA. Based on its evaluation, the staff recommended to the SMRP that each site be classified as a Group 1 plant and therefore, no further regulatory action was warranted. As documented in the staff assessments, the SMRP approved the staff's recommendations that the applicable hazard(s) for each site should be classified as Group 1, meaning that no further response or regulatory action is required.

NRC's Response to Tasking Memorandum COMGBJ-11-0002

The NTTF recommendations were applicable to operating power reactor sites. As one of the longer-term activities, COMGBJ-11-0002 also directed the staff, in part, to assess the applicability of the lessons learned from the accident to non-operating reactors, including those with spent fuel in SFPs, and ISFSIs. Very shortly after the accident, NRC staff from NMSS and

NRR performed limited assessments to ensure that no immediate safety concerns existed at these facilities.

In 2015, with insights gained from NRC activities related to operating power reactors and from the results of inspections at fuel cycle facilities, NRC staff more fully evaluated issues and possible actions related to non-operating reactors and other NRC-licensed materials, devices, and non-reactor facilities. The NRC staff's detailed evaluation can be found in Enclosure 1 of SECY-15-0081. The assessments specific to ISFSIs is included in Section 1 of the enclosure. The assessments specific to decommissioning reactors is included as Section 7 of the enclosure.

The types of events that NRC staff assessed for these facilities included postulated external events, seismic hazards, external flooding hazards, internal flooding hazards, wind and tornado loading, extended loss of alternating current or emergency power, and fires, to determine if existing regulatory requirements appropriately address such hazards. In addition to the evaluation of initiating events and external hazards, NRC staff assessed these licensees qualitatively in terms of (1) policy issues related to Fukushima, (2) the NTTF's findings and recommendations, and (3) other domestic and international studies and evaluations. The NRC staff's review was broad in scope and was not limited to specific recommendations and considerations provided by the NTTF, which tend to be discussed in the context of operating power reactors.

In each case, the NRC staff's analysis determined that no further study or regulatory action is recommended for decommissioning power reactor sites nor ISFSIs. Specifically concerning GI-204, the staff assessed the risk of external events for the decommissioned power reactors that have fuel stored in their spent fuel pools, including five recently shutdown sites. Previous studies and analyses (e.g., NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants" and NUREG-2161, "Consequence Study of a Beyond-Design-Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark I Boiling Water Reactor," (ADAMS Accession Nos. ML010430066 and ML14255A365, respectively)) have shown that the spent fuel pool structure is extremely robust and capable of withstanding the external events addressed in the SECY paper. In addition, based on the decay heat levels of recently permanently shutdown reactors and the time available to take mitigating actions, there are no identified safety concerns that need further analysis.

Conclusions

Since March 2012, all operating power reactor licensees have reevaluated the flood hazards applicable to their sites, including the effects of postulated upstream dam failure. These reevaluations used present-day, modern techniques and information to determine the flood hazards applicable to each site. The NRC staff reviewed each licensees' submittals and evaluations. Using a graded, risk-informed approach, the NRC staff used that information to determine if any further regulatory actions would be warranted under the NRC's backfit rule. Based on the completion of flood reevaluation activities related to the lessons-learned from the Fukushima Dai-ichi accident, the staff has determined that there are no additional regulatory actions that are needed to address flood hazards at operating power reactor sites. This includes flood hazards associated with upstream dam failures.

In addition to flood hazards applicable to operating power reactor sites, the NRC staff performed a detailed evaluation of the need to apply any of the NTTF recommendations to non-operating power reactors, non-power reactors, and non-reactor facilities. The NRC staff concluded that,

except for some additional follow-up activities for fuel cycle facilities and higher-power research reactors, the NRC staff has determined that further assessments are not needed based on Fukushima lessons learned and that the existing regulatory requirements and processes ensure adequate protection of public health and safety. The limited follow up actions have been completed. Therefore, no additional regulatory actions were needed to address non-operating power reactors (i.e., decommissioning facilities and ISFSIs).

Although not directly related to the resolution of GI-204, POANHI has enhanced the existing NRC processes such that the staff proactively and systematically reviews new natural hazard information and assess its impact on site safety by comparing updated information to existing hazard evaluations for the fleet or individual plants, as appropriate. Any future issues that may be similar in nature to GI-204 would be assessed by this new, improved, and enhanced process.

The full scope of GI-204 has been addressed through the NRC response to the Fukushima Lessons-Learned. All agency actions associated with GI-204 are complete, including implementation and verification activities by the regulatory office. No additional evaluations or regulatory activities are necessary. Therefore, NRR recommends that GI-204 be closed.

Flood Reevaluation Activities – List of NRC Staff Assessments

SUMMARY OF NRC RESPONSES FOR EACH SITE Agencywide Documents Access and Management System (ADAMS) Accession Numbers							
Site	*Interim Staff Response*	*Flood Hazard Reevaluation Report (FHRR) Staff Assessment*	*Bounded - No further assessment needed*	*Focused Evaluation (FE) Staff Assessment*	*Integrated Assessment (IA) Staff Assessment*	*Deferred or not completed*	*Remarks*
ANO	ML16327A482	ML17230A261		ML17214A029			
Beaver Valley	ML17040A011	ML18158A484		ML18067A112			
Braidwood	ML15230A523	ML16308A161		ML16265A214			Limited IA in FHRR.
Browns Ferry	ML15240A189	ML16196A088		ML20112F485			
Brunswick	ML17072A364	ML18089A055		ML18348B185			
Byron	ML15243A462	ML16214A297	x				
Callaway	ML15314A108	ML14290A532	x				
Calvert Cliffs	ML15281A218	ML15077A103		ML17338A356			
Catawba	ML15352A192	ML16251A281		ML19115A267			
Clinton	ML15230A012	ML15279A134	x				
Columbia	ML16337A109	ML18051A401		ML18079A226			
Comanche Peak	ML16041A228	ML17067A166		ML19206A073			
Cooper	ML15355A416	ML18054B428			ML19262G904		
Davis-Besse	ML15239B210	ML16323A236		ML19255H099			
DC Cook	ML15334A413	ML17164A308		ML18026A882			
Diablo Canyon	ML16083A551	ML17024A207		ML17328A249			
Dresden	ML15307A056	ML15072A007			ML18138A385		
Duane Arnold	ML16084A767	ML17076A193		ML18101B405			
Farley	ML15343A418	ML16288A167		ML17331A410			
Fermi	ML15313A470	ML14351A438	x				
FitzPatrick	ML15238B537	ML17067A469		ML18075A432			
Fort Calhoun	ML15355A087	See Remarks		See Remarks		ML16326A046	Fort Calhoun did not complete all flood evaluation activities prior to final shutdown. NRC staff did not complete the FHRR staff assessment.
Ginna	ML15334A453	ML16295A334		ML18025B757			
Grand Gulf	ML15329A043	ML14323A019		ML18123A314			
Hatch	ML15321A156	ML16237A095		ML18030B076			
Hope Creek	ML15238B655	ML16266A281		ML17275A945			
Indian Point	ML16112A172	ML18136A831		See Remarks		ML17222A239	FE/IA submittal is deferred until August 2021, past the expected shutdown date.
LaSalle	ML15232A190	ML16350A219		ML17191A323			
Limerick	ML15357A517	ML16280A382		ML16265A152			Limited IA in FHRR.
McGuire	ML15230A161	ML16293A666		ML18031A564			
Millstone	ML16308A226 ML19070A217	ML18256A200 ML19246A116			ML20171A534		
Monticello	ML16248A004	ML17104A310		ML18081A948			
Nine Mile Point	ML15306A502	ML14153A410		ML17251A045			
North Anna	ML15238A844	ML15238A844		ML17325B644			Interim staff response was included in FHRR SA
Oconee	ML15239B261	ML15352A207		ML18141A755			
Oyster Creek	ML16035A265	ML18033B744		ML18038B252			
Palisades	ML15356A765 ML18086A218	ML18037A625		ML18354B133			
Palo Verde	ML15268A413	ML16306A444		ML17299A041			
Peach Bottom	ML16091A136	ML17284A035		ML17292B763			
Perry	ML16202A348	ML18002A555		ML20115E243			
Pilgrim	ML16215A086	See Remarks		See Remarks		ML16278A313 ML19168A231	Pilgrim did not complete all flood evaluation activities prior to final shutdown. NRC staff did not complete the FHRR staff assessment.
Point Beach	ML15321A063	ML17136A322		ML18136A700			
Prairie Island	ML16248A005 ML16286A161	ML17144A154		ML17228A032			
Quad Cities	ML15238B691	ML16323A343			ML19168A196		
River Bend	ML15230A010	ML16204A207		ML17220A113			
Robinson	ML15357A064	ML16350A205			ML19186A290		
Salem	ML15238B704	ML16265A085		ML17257A279			

SUMMARY OF NRC RESPONSES FOR EACH SITE Agencywide Documents Access and Management System (ADAMS) Accession Numbers							
Site	*Interim Staff Response*	*Flood Hazard Reevaluation Report (FHRR) Staff Assessment*	*Bounded - No further assessment needed*	*Focused Evaluation (FE) Staff Assessment*	*Integrated Assessment (IA) Staff Assessment*	*Deferred or not completed*	*Remarks*
Seabrook	ML16356A479	ML17354B172		ML18039A920			
Sequoyah	ML15240A134	ML16194A115		ML20036F064			
Shearon Harris	ML15301A557	ML15104A370		ML17335A121			
St. Lucie	ML15224B449	ML17286A084		ML17325B630			
STP	ML15314A061	ML14259A195	x				
Surry	ML16041A332	ML16323A185			ML20076A576		
Susquehanna	ML15314A747	ML16231A517	x				
TMI	ML16091A084	ML17276B218		ML17254A424			
Turkey Point	ML15301A200	ML14324A816		ML19204A179			
Vermont Yankee	See Remarks	See Remarks		See Remarks		ML15135A046	Vermont Yankee did not complete all flood evaluation activities prior to final shutdown. NRC staff did not complete the FHRR staff assessment.
VC Summer	ML15296A377	ML14356A002		ML17272A929			
Vogtle 1 & 2	ML15300A140	ML14279A352		ML17242A050			
Waterford	ML16090A327	ML17311B351		ML17171A128			
Watts Bar	ML15239B287	ML15310A085		ML20087M008			
Wolf Creek	ML15357A179	ML17174B243		ML17241A251			
62 sites total[1,2]		Totals for each	6	46	6	4	
			62				

For additional information, please see the plant specific pages under the "Safety Enhancements After Fukushima" public web page (https://www.nrc.gov/reactors/operating/ops-experience/post-fukushima-safety-enhancements.html)

1 Previously Operating Power Reactor Units Subject to the March 12, 2012 50.54(f) letter that Shutdown without completing any flood reevaluation activities

Crystal River	Crystal River Unit 3 shutdown prior to completing any flood reevaluation activities. In a letter dated January 22, 2014 (ML13325A847), the NRC agreed that no further responses or actions associated with the 50.54(f) letter are necessary.
Kewaunee	Kewaunee shutdown prior to completing any flood reevaluation activities. In a letter dated January 22, 2014 (ML13322B255), the NRC agreed that no further responses or actions associated with the 50.54(f) letter are necessary.
San Onofre	San Onofre Units 2 and 3 shutdown prior to completing any flood reevaluation activities. In a letter dated January 22, 2014 (ML13329A826), the NRC agreed that no further responses or actions associated with the 50.54(f) letter are necessary.

2 Sites Under Active Construction or Deferred Policy Subject to the March 12, 2012 50.54(f) letter

Bellefonte	TVA will submit a schedule under Section III.A.6 of the Commission Policy Statement on Deferred Plants, by the respective date that TVA submits the letters to reactivate construction at Bellefonte Units 1 and 2. NRC approved the proposed schedule changes in a letter dated February 26, 2015 (ML15023A259)
Vogtle 3 and 4	For combined license (COL) holders under 10 CFR Part 52, the issues in NTTF Recommendation 2.1 regarding flooding reevaluations are resolved. Therefore, COL holders are not required to respond to Enclosures 1 through 4 of this letter.

SUBJECT: CLOSURE RECOMMENDATION FOR GENERIC ISSUE 204, "FLOODING OF NUCLEAR SITES DUE TO UPSTREAM DAM FAILURE" DATED SEPTEMBER 16, 2020

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ADAMS Accession No.: ML20230A216 ***via email** **NRR-106**

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