

## DETAILED STATUS OF ACTIVE GENERIC ISSUES

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## DESCRIPTION OF GENERIC ISSUES PROGRAM

The U.S. Nuclear Regulatory Commission's (NRC's) Generic Issue Management Control System (GIMCS) supplies information relevant to the management and resolution of generic issues (GIs). The resolution of a GI might lead to safety enhancements and the promulgation of new or revised requirements or guidance. The GIMCS is designed to facilitate management of GIs from issue identification through resolution (i.e., development of new criteria, management review and approval, public comments, and incorporation into the regulations as appropriate).

Management Directive (MD) 6.4, "Generic Issues Program," (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14245A048) and the NRC Office of Nuclear Regulatory Research's (RES's) Office Instruction TEC-002, "Procedure for Processing Generic Issues," (ADAMS Accession No. ML102500426) describe the procedures for processing GIs. Other program offices may have instructions for handling GIs specific to their organization.

In accordance with Title 10 of the Code of Federal Regulations (10 CFR) 52.47(a)(21), applications for design certification must contain the following:

Proposed technical resolutions of those Unresolved Safety Issues and medium- and high-priority generic safety issues which are identified in the version of NUREG-0933 current on the date up to 6 months before the docket date of the application and which are technically relevant to the design.

Similarly, in accordance with 10 CFR 52.79(a)(20), applications for combined licenses must contain the following:

Proposed technical resolutions of those Unresolved Safety Issues and medium- and high-priority generic safety issues which are identified in the version of NUREG-0933 current on the date up to 6 months before the docket date of the application and which are technically relevant to the design.

As indicated in MD 6.4, the NRC replaced the prioritization of GIs with the screening process, in which the staff makes a determination to either establish the proposed issue as a GI or not accept the issue into the program. For the purposes of 10 CFR 52.47(a)(21) and 10 CFR 52.79(a)(20), any GI established by the MD 6.4 screening process is considered equivalent to a high-priority GI.

In an effort to increase efficiency in the GI program, the staff revised the GI process in 2014 to incorporate enhancements identified by a tiger team that was implemented as a business process improvement initiative. A revision to MD 6.4, issued on January 2, 2015, documents the revised process. This revision includes the following major changes:

- program simplification by reducing the number of stages from five to three
- increased management involvement and accountability
- new guidance to help licensees identify and act on immediate safety concerns and document the justification for ongoing plant operation to allow them to make progress on the GI without the need to implement remedial actions while the GI is in process.

A near-term result of these changes is that RES and Office of Nuclear Reactor Regulation (NRR) have collaborated to promptly respond to proposed GIs when they are submitted, closely monitor progress of active GIs every quarter, and address any issues that arose in a timely manner. As a result, RES and NRR conducted multiple generic issues review panels which successfully reviewed and closed out four proposed generic issues during FY2016. The staff intends to continue to realize additional efficiencies in the program going forward.

## ACRONYMS

ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
CEUS	central and eastern United States
CFR	Code of Federal Regulations
DSS	Division of Safety Systems
ECCS	emergency core cooling system
EPRI	Electric Power Research Institute
ESEP	expedited seismic evaluation process
ESP	early site permit
GI	generic issue (same meaning as GSI)
GIMCS	Generic Issue Management Control System
GL	generic letter
GSI	generic safety issue
IN	information notice
ISL	Information Systems Laboratories, Inc.
JLD	Japan Lessons-Learned Division
LOCA	loss-of-coolant accident
MD	management directive
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NTTF	Near-Term Task Force
PWR	pressurized-water reactor
PWROG	Pressurized-Water Reactor Owners Group
RES	Office of Nuclear Regulatory Research
RG	regulatory guide
SE	safety evaluation
SPRA	seismic probabilistic risk assessment
SRM	staff requirements memorandum
SSE	safe-shutdown earthquake
SSIB	Safety Issue Resolution Branch
STP	South Texas Project
TI	temporary instruction
TR	topical report
USGS	U.S. Geological Survey
WCAP	Westinghouse Commercial Atomic Power
WUS	western United States

Title: Assessment of Debris Accumulation on PWR Sump Performance

Generic Issue Number: 191

Identification Date: 9/1/1996

Action Level: Regulatory Office Implementation

Office/Division/Branch: NRR/DSS/SSIB

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Technical Assessment: 9/28/2001 (Actual/Complete)

Regulation and Guidance Issuance: 9/30/2004 (Actual/Complete)

Transfer to Regulatory Office for Action: 9/28/2001 (Actual/Complete)

Closure: 12/31/2018 (Estimated)

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#### DESCRIPTION:

This generic issue (GI) concerns the possibility that debris accumulation on the emergency core cooling system (ECCS) sump screens in pressurized-water reactors (PWRs) could result in a loss of net positive suction head (NPSH) margin for the ECCS or containment spray system pumps. Loss of NPSH margin could impede or prevent the flow of water from the sump such that the system would not meet the criteria in Title 10 of the Code of Federal Regulations (10 CFR) 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors." The U.S. Nuclear Regulatory Commission (NRC) staff did not identify any immediate safety concerns during the screening assessment.

#### WORK SCOPE:

The goals of the staff assessment were to (1) determine whether the transport and accumulation of debris in containment after a loss-of-coolant accident (LOCA) could impede the operation of the ECCS in operating PWRs, (2) develop the technical basis for revising NRC regulations or guidance as necessary, (3) provide NRC technical reviewers with sufficient information on the phenomena involved to facilitate the review of plant mechanistic evaluations and any necessary changes to the plants, and (4) issue generic communications and work with industry to resolve GI-191, "Assessment of Debris Accumulation on PWR Sump Performance," for all PWRs.

Preliminary parametric calculations completed in July 2001 indicated the potential for debris accumulation on the ECCS sump strainers at operating PWRs. These calculations were representative of the operating PWR population. The NRC Office of Nuclear Regulatory Research (RES) staff completed a technical assessment, "RES Proposed Recommendation for Resolution of GSI-191, 'Assessment of Debris Accumulation on PWR Sump Performance,'" dated September 28, 2001 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML012750091), that concluded that GI-191 was a credible concern for the population of domestic PWRs and that detailed plant-specific evaluations were needed to determine the susceptibility of each licensed PWR to ECCS sump strainer blockage. After the Advisory Committee on Reactor Safeguards (ACRS) reviewed the staff's technical assessment of the issue, RES transferred the issue to the Office of Nuclear Reactor Regulation (NRR) on

September 28, 2001. NRR has the lead for the regulatory office implementation stage of the GI process for GI-191. NRR evaluated the technical assessment and prepared a task action plan to develop appropriate regulatory guidance and resolve GI-191. NRR is currently working toward closure of the issue with all affected licensees.

#### STATUS:

On June 9, 2003, the NRC issued Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors" (ADAMS Accession No. ML031600259). In the bulletin, the NRC asked licensees to (1) confirm their compliance with 10 CFR 50.46(b)(5) and other existing applicable regulatory requirements or (2) describe compensatory measures taken to reduce the potential risk resulting from post-accident debris blockage until completion of the required evaluations to determine compliance. All PWR licensees responded to the bulletin, describing the interim compensatory measures that they would implement. The NRR Safety Issue Resolution Branch (SSIB) reviewed and evaluated the information and determined that the licensees' actions were responsive and consistent with the guidance of Bulletin 2003-01. The NRR Division of Operating Reactor Licensing issued closeout letters to the PWR licensees as these reviews were completed. The NRC completed the generic closeout of Bulletin 2003-01 in December 2005.

In May 2004, the Nuclear Energy Institute (NEI) provided guidance report NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 2004, to the NRC staff (ADAMS Accession No. ML050550138). The report contains the industry's proposed method for performing plant-specific evaluations. The staff reviewed NEI 04-07 and issued a draft safety evaluation (SE). Subsequently, NEI issued a supplement to NEI 04-07. The NRC staff issued a final SE in December 2004 (ADAMS Accession No. ML050550156), which resulted in an NRC-approved method for evaluating the potential effects of debris on the ECCS strainers.

On September 13, 2004, the NRC issued Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors" (ADAMS Accession No. ML042360586). In GL 2004-02, the NRC asked licensees to perform plant-specific mechanistic evaluations of sump performance following LOCA and high-energy line break events and to implement the corrective actions needed to ensure compliance with regulatory requirements. GL 2004-02 requires licensees to respond with their plans for performing the sump evaluation and their proposed schedule for completion. All PWR licensees responded to the GL by September 2005 with a commitment to perform mechanistic evaluations of the ECCS strainers and modify their plants as necessary to ensure compliance with regulations. The staff evaluated all licensee responses to GL 2004-02 and, in early 2006, issued comments to licensees that they were to address in their final response submittals.

Also requiring resolution was the potential for chemical precipitates and corrosion products to deposit in a fibrous debris bed on a strainer and increase the head loss across the bed. To address these concerns, the NRC started a joint NRC/Industry Integrated Chemical Effects Testing Program in 2004. The program ended in August 2005. During the test program, chemical precipitates were identified and follow up testing and analyses were conducted to determine their effects on head loss. On September 6, 2005, the staff issued Information Notice

(IN) 2005-26, "Results of Chemical Effects Head Loss Tests in a Simulated PWR Sump Pool Environment" (ADAMS Accession No. ML052570220).

The NRC conducted additional research in various technical areas to support staff and industry evaluations and to provide confirmatory information. The research included studies on chemical effects to determine whether the PWR sump pool environment might generate byproducts that could contribute to sump clogging, research on sump screen head losses caused by the accumulation of containment materials and chemical byproducts, and research to predict the chemical species that may form in PWR post-LOCA environments. The staff completed studies on chemical effects for one type of PWR post-LOCA pool chemistry on December 29, 2005 (ADAMS Accession No. ML053550433), and on another type of PWR post-LOCA pool environments on January 19, 2006 (ADAMS Accession No. ML060190713). The staff issued Supplement 1, "Additional Results of Chemical Effects Tests in a Simulated PWR Sump Pool Environment," to IN 2005-26 on January 20, 2006 (ADAMS Accession No. ML060170102), to provide more information on test results related to chemical effects in environments containing dissolved phosphates. NRR expected recipients of the notice to review the information for applicability to their facilities and consider taking actions, as appropriate, to ensure that strainer head loss does not become excessive.

The staff also conducted and documented research on the transportability of coating chips in containment pool environments and on the effect of ingested debris on downstream valve performance.

Between July and September 2006, the staff completed (1) thermodynamic simulations of containment sump pool chemistry to predict the chemical reactions/byproducts in the pools, (2) studies of pressure loss across containment sump screens caused by fibrous insulation debris, chemical precipitates, and coating debris, and (3) a literature survey to determine the potential contribution of material leached from containment coatings to the chemical products formed in the containment sump pool.

Other research activities included development of a revised head loss correlation and completion of a peer review of the NRC's chemical effects research program. All planned NRC-sponsored research activities for GI-191 have been completed and documented. The documents that provided the details of the chemical-effects-related work sponsored by the NRC include the following:

- NUREG/CR-6913, "Chemical Effects Head-Loss Research in Support of Generic Safety Issue 191," issued December 2006 (ADAMS Accession No. ML070090553)
- NUREG/CR-6914, "Integrated Chemical Effects Test Project," Volumes 1–6, issued December 2006 (ADAMS Accession No. ML071800338)
- NUREG/CR-6915, "Aluminum Chemistry in a Prototypical Post-Loss-of-Coolant-Accident, Pressurized-Water-Reactor Containment Environment," issued December 2006 (ADAMS Accession No. ML070160448)
- Argonne National Laboratory technical letter reports (ADAMS Accession Nos. ML080600223, ML082330153, ML081550043, and ML091610696)

The NRC staff also reviewed and issued an SE (ADAMS Accession No. ML073520891) for the Pressurized-Water Reactor Owners Group's (PWROG's) topical report (TR) Westinghouse Commercial Atomic Power (WCAP) -16530-NP-A, "Evaluation of Post-Accident Chemical

Effects in Containment Sump Fluids to Support GSI-191,” dated March 2008 (ADAMS Accession No. ML081150379).

Licensees have completed strainer modifications at all PWRs. These modifications typically increased strainer size by 1 to 2 orders of magnitude. The NRC has concluded that these modifications have significantly reduced the risk of strainer clogging.

To confirm adequate evaluation of GI-191, the NRC conducted detailed plant audits examining the analyses conducted and the design and administrative changes implemented to address the issues. The staff performed two pilot audits in 2005 (Crystal River Nuclear Generating Station, Unit 3, and Fort Calhoun Station) to provide opportunities to exercise and improve the NRC evaluation process. In addition, the NRC staff performed nine full-scope plant audits. To support the audits, the NRC staff visited sump strainer vendor facilities to observe head loss and chemical effects testing. The agency conducted other limited-scope audits at North Anna Power Station in 2008 and Palisades Nuclear Plant in 2009 to address chemical effects.

In addition to the plant audits, the staff reviewed licensee responses to GL 2004-02 (received in 2008 and 2009) and items identified from NRC regional inspections that were performed using Temporary Instruction (TI) 2515/166, “Pressurized Water Reactor Containment Sump Blockage (NRC Generic Letter 2004-02),” dated March 16, 2006 (ADAMS Accession No. ML060760340). These reviews identified the need for additional information from most licensees to ensure that the licensees fully addressed the sump issues. Licensee responses to these requests for additional information and subsequent NRC staff reviews of the responses are ongoing.

The implementation of GI-191 also revealed an issue involving in-vessel downstream effects (i.e., the potential for debris to bypass the sump strainers and enter the core). In 2008, the NRC staff determined that additional industry-sponsored testing was necessary to support the resolution of this issue. The testing resulted in submittal of TR-WCAP-16793-NP, “Evaluation of Long-Term Cooling Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid,” Revision 1, to the NRC in April 2009 (ADAMS Accession No. ML091190484). The staff determined that additional testing was needed to support the TR conclusions. The PWROG funded the testing and expected it to be completed by the end of 2009. However, the NRC staff identified the need for further testing because some of the tests yielded unexpected results. Further evaluation and testing were performed. By letter dated October 12, 2011 (ADAMS Accession No. ML11292A020), PWROG submitted Revision 2 to TR-WCAP-16793-NP-A to address the effects of debris on the reactor core. The TR guidance and acceptance bases were developed through analyses and flow testing using representative fuel assemblies, debris surrogates, and ECCS flow rates. By letter dated January 29, 2013 (ADAMS Accession No. ML12115A304), the NRC provided a draft SE on approval of TR-WCAP-16793-NP, Revision 2, for review and comment. By letter dated March 6, 2013 (ADAMS Accession No. ML13093A082), the PWROG provided comments on the draft SE. On April 8, 2013, the NRC staff issued an SE on TR-WCAP-16793-NP, Revision 2 (ADAMS Accession No. ML13084A152), finding it an acceptable model for assessing the effect of sump-strainer-bypassed fibrous, particulate, and chemical debris on core cooling in PWRs. Licensees may use the TR and associated staff SE to evaluate the effects of debris that reach the core.

Another issue involved some licensees taking credit for vendor testing as a basis for assuming reduced generation of debris after a LOCA. The NRC staff reviewed the test report and

developed questions about its validity. Despite numerous interactions with the industry on these questions, the NRC staff could not conclude that the reduced debris generation assumptions were valid. The NRC staff informed the industry in March 2010 that it did not accept the testing. The industry responded that it would conduct additional testing to address the staff's concerns and to allow credit for reduced debris generation. The industry completed this testing in 2011. Although the industry has not formally submitted its report for staff review, the staff performed a review of the testing and associated debris generation evaluations. No plant has referenced the industry report. If plants reference the industry report in the future, the NRC staff will determine the acceptability of the report's application based on individual plant-specific conditions.

In April 2010, the staff and industry briefed the Commission on the status of the resolution of GI-191. Representatives from the industry summarized the actions taken to address the issue and suggested that these actions have resolved the GI's safety implications. The industry representatives recommended resolution and closure through the application of General Design Criterion 4, "Environmental and Dynamic Effects Design Bases," in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." This criterion allows crediting (for certain purposes) the high likelihood that a reactor coolant leak would be detected before the occurrence of a major piping rupture. The NRC staff has not allowed this credit for resolving sump performance issues. The staff acknowledged the industry's actions to address this issue. However, the staff stated that its position is that the issue remains of concern for plants that have not demonstrated adequate sump performance using methods acceptable to the NRC. Based on the information presented, the Commission directed the staff to provide information on potential approaches for bringing GI-191 to closure. The staff provided this information in SECY-10-0113, "Closure Options for Generic Safety Issue-191, Assessment of Debris Accumulation on Pressurized Water Reactor Sump Performance," dated August 26, 2010 (ADAMS Accession No. ML101820296). The Commission issued its staff requirements memorandum (SRM) on December 23, 2010 (ADAMS Accession No. ML103570354). The Commission determined that it was prudent to allow the nuclear industry to complete testing on in-vessel effects and zone of influence in 2011 and to develop a path forward by mid-2012. The SRM directed the staff to evaluate alternative approaches, including risk-informed approaches, for resolving GI-191 and to present them to the Commission by mid-2012.

Based on the interactions with stakeholders and the results of industry testing, the NRC staff developed three options to resolve GI-191. The staff documented these options and proposed them to the Commission in SECY-12-0093, "Closure Options for Generic Safety Issue-191, Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," dated July 9, 2012 (ADAMS Accession No. ML121310648). All three options, summarized as follows, required licensees to demonstrate compliance with 10 CFR 50.46:

- (1) Option 1 allows the use of approved models and test methods. Licensees choosing this option will have relatively low fiber plants that can demonstrate that less than 15 grams (0.5 ounces) of fiber per fuel assembly can reach the reactor core.
- (2) Option 2 requires implementation of additional mitigative measures until resolution is completed and allows more time for licensees to resolve issues through further industry testing or use of a risk-informed approach. Licensees choosing this option generally have more problematic materials in containment or desire additional margin for their in-vessel debris limits.



- Millstone Power Station Units 2 and 3
- North Anna Power Station Units 1 and 2
- Palo Verde Nuclear Generating Station Units 1, 2, and 3
- H.B. Robinson Steam Electric Plant Unit 2
- Surry Power Station Units 1 and 2
- Three Mile Island Nuclear Station Unit 1
- Virgil C. Summer Nuclear Station Unit 1
- Waterford Steam Electric Station Unit 3

With respect to the Option 2A plants, public meetings took place in 2014 and 2015 with the PWROG to discuss the testing and analyses proposed for higher in-vessel debris limits. The PWROG submitted TR-WCAP-17788, "Comprehensive Analysis and Test Program for GSI-191 Closure," on July 17, 2015; the intent of this TR is to justify higher fiber limits than the limits previously approved by the NRC staff. The staff has completed four site visits and three audits at the Westinghouse and AREVA offices. An informational ACRS meeting took place on October 20, 2015, for PWROG to provide an overview of the TR. The PWROG submitted supplemental information in November 2015, allowing the NRC staff to accept the submittal for review in December 2015. Additional ACRS subcommittee meetings and an ACRS full committee meeting are planned before the NRC completes its review of the TR, which the staff anticipates by the end of fall 2017. The Option 2A plants will submit closure letters using the approved TR. Closure of all Option 2A plants is anticipated by the end of 2018.

Option 2B Risk Informed:

- South Texas Project (STP) Units 1 and 2
- Calvert Cliffs Nuclear Power Plant Units 1 and 2
- Diablo Canyon Power Plant Units 1 and 2
- Palisades Nuclear Plant Unit 1
- Seabrook Station Unit 1
- St. Lucie Plant Units 1 and 2
- Turkey Point Nuclear Generating Unit Units 2 and 4
- Vogtle Electric Generating Plant Units 1 and 2
- Callaway Plant Unit 1
- Wolf Creek Generating Station Unit 1

In June 2013, STP submitted a license amendment and exemption requests to implement the pilot risk-informed approach to resolving GSI-191 (Option 2B). The initial submittal was superseded in November 13, 2013. The licensee's methodology evaluated the debris risk associated with the as-built plant compared to the performance of an "ideal plant" without debris risk. The NRC staff and the licensee met with the ACRS Subcommittee on Thermal-Hydraulic Phenomena and Reliability and Probabilistic Risk Assessment in September 2014 and March 2015. STP submitted a simplified methodology (RoverD) on August 20, 2015.

The next ACRS subcommittee meeting is scheduled for March 2017. The NRC expects to complete its review of the application by the end of summer 2017. Other plants using the risk-informed option will submit on a staggered schedule after the STP review is complete. Option 2B plants will use TR-WCAP-17788 for in-vessel debris limits.

## Option 3 Plants:

### Point Beach Nuclear Plant (Point Beach) Units 1 and 2

The staff anticipates to receive the Point Beach application after the staff completes the STP review. However, Point Beach may change from Option 3 to Option 2B because the licensee believes it will be able to treat in-vessel debris deterministically.

The NRC staff has coordinated the development of a risk-informed proposed rulemaking with the review of the Option 2B plants: SECY-12-0034, "Proposed Rulemaking—10 CFR 50.46c: Emergency Core Cooling System Performance during Loss-of-Coolant Accidents (RIN 3150-AH42)," dated March 1, 2012 (ADAMS Accession No. ML112620346). The Commission directed the staff to develop a risk-informed option to the long-term core cooling requirement in 10 CFR 50.46 with respect to the effects of debris on long-term cooling.

The staff has developed guidance for Options 2B and 3 reviews in Regulatory Guide (RG) 1.229, "Risk-Informed Approach for Addressing the Effects of Debris on Post-Accident Long-Term Core Cooling." The staff plans to issue RG 1.229 with the rule package for 10 CFR 50.46c. The staff took its review of the STP risk-informed submittal into account in preparing the guidance.

To provide open communication on NRC activities associated with GI-191 resolution, the agency continues to hold public meetings or conference calls with NEI and industry representatives regularly. ACRS briefings are scheduled periodically to provide opportunities for communication on technical issues and additional public involvement.

## AFFECTED DOCUMENTS:

Affected documents include the following:

- RG 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," Revision 4, issued March 2012 (ADAMS Accession No. ML111330278)
- RG 1.229, "Risk-Informed Approach for Addressing the Effects of Debris on Post-Accident Long-Term Core Cooling." (ADAMS Accession No. ML16125A410)
- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Chapter 6, "Engineered Safety Features," Section 6.2.2, "Containment Heat Removal Systems," Revision 5, and Section 6.3, "Emergency Core Cooling System," Revision 3, both issued March 2007 <<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/>>
- Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors" (ADAMS Accession No. ML031600259)
- GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors" (ADAMS Accession No. ML042360586)
- IN 2005-26 and Supplement 1, "Results of Chemical Effects Head Loss Tests in a Simulated PWR Sump Pool Environment" (ADAMS Accession No. ML060170102)

REASONS FOR SCHEDULE CHANGES:

The NRC plans to close GI-191 when the staff has completed all reviews of responses to GL 2004-02.

RES changed the status of GI-191 to regulatory office implementation (ADAMS Accession No. ML071630094) as part of improvements to the GI program described in SECY-07-0022, "Status Report on Proposed Improvements to the Generic Issues Program," dated January 30, 2007 (ADAMS Accession No. ML063460239). This improvement obviates the need for milestones specifically associated with the GI program after the implementation phase begins. Issue closure will occur in accordance with applicable NRR programs as indicated in the remaining milestones. The table below lists the milestones along with projected and completed dates.

PROBLEM/RESOLUTION:

Licensees submitted supplemental responses to GL 2004-02 starting in 2008 and continuing to the present. The staff has completed its initial review of these responses. However, the reviews completed to date have revealed the need for more information from some licensees. Staff reviews of the additional information will continue.

MILESTONE	PROJECTED DATE	COMPLETED DATE
NRR user need request sent to RES	12/1/1995	12/1/1995
User need request assigned to RES	1/1/1996	1/1/1996
Reassessment declared a new generic safety issue (GSI)	9/1/1996	9/1/1996
Issued statement of work for evaluation of GSI A-43	11/1/1996	11/1/1996
Completed evaluation of GSI A-43	4/1/1997	3/1/1997
Issued statement of work for reassessment of debris blockages in PWR containments impact on ECCS performance	9/1/1998	9/1/1998
Completed collection and review of PWR containment and sump design and operation data	12/1/1999	12/1/1999
Completed all debris transport tests	9/1/2000	8/1/2000
Completed parametric evaluation	7/1/2001	7/31/2001
Proposed recommendations to ACRS	8/31/2001	8/31/2001
ACRS review completed	9/30/2001	9/14/2001
Issue transferred from RES to NRR	9/28/2001	9/28/2001
Completed estimate of average core damage frequency reduction, benefits, and costs	4/1/2002	9/28/2001
Prepared memorandum discussing proposed recommendations (end of technical assessment stage of GI process)	4/1/2002	9/28/2001

MILESTONE	PROJECTED DATE	COMPLETED DATE
Issued Bulletin 2003-01	5/1/2003	6/1/2003
Completed development of models and methods for analyzing impact of debris blockages in PWR containments on ECCS performance	4/1/2001	6/9/2003
Discussed RG 1.82, Revision 3, with the ACRS Subcommittee on Thermal-Hydraulic Phenomena	8/20/2003	8/20/2003
Presented final version of RG 1.82, Revision 3, to the ACRS full committee	9/11/2003	9/11/2003
ACRS sent a letter on the final version of RG 1.82, Revision 3	9/30/2003	9/30/2003
Drafted industry guidance for plant-specific analyses	10/30/2003	10/31/2003
Issued RG 1.82, Revision 3	9/30/2003	11/30/2003
Received industry guidance for plant-specific analyses	9/30/2003	5/28/2004
Briefed the ACRS subcommittee on the proposed GL	6/22/2004	6/22/2004
Met with stakeholders	6/29/2004	6/29/2004
Developed the GL for resolution of the GI	7/7/2004	7/7/2004
Briefed the ACRS full committee on the proposed GL	7/7/2004	7/7/2004
Met with the Committee to Review Generic Requirements on the proposed GL	8/10/2004	8/10/2004
Issued GL 2004-02	9/13/2004	9/13/2004
Met with ACRS on the SE of NEI 04-07	10/7/2004	10/7/2004
ACRS responded to the SE of NEI 04-07	10/18/2004	10/18/2004
Executive Director for Operations briefed ACRS on status	9/9/2005	9/9/2005
Received all GL responses addressing plant-specific analyses	5/31/2005	9/15/2005
Issued IN 2005-26	9/16/2005	9/16/2005
Issued Supplement 1 to IN 2005-26	1/20/2006	1/20/2006
Completed review of licensee responses to GL 2004-02	1/20/2006	1/20/2006
Completed research programs evaluating coating transportability and surrogate throttle valve debris ingestion	2/28/2006	2/28/2006
Completed testing and analysis associated with the initial phase of the chemical effects research	5/30/2006	5/30/2006
Completed containment material head loss testing	6/15/2006	6/15/2006
Completed thermodynamic simulation of containment sump chemical constituents	9/30/2006	9/30/2006
Regions completed TI inspections	6/30/2008	6/30/2008

MILESTONE	PROJECTED DATE	COMPLETED DATE
Received last TI verifications from regions	8/11/2008	8/11/2008
Completed the review of TI verifications	8/25/2008	6/30/2009
Issued SECY-12-0093	7/9/2012	7/9/2012
PWROG submitted TR-WCAP-16793-NP-A on in-vessel downstream effects	7/20/2012	7/20/2012
Issued final SE for in-vessel downstream effects on TR-WCAP-16793-NP-A	4/8/2013	4/8/2013
STP submitted pilot application for risk-informed Option 2B for closure of GL 2004-02	11/13/2013	11/13/2013
PWROG submitted TR-WCAP-17788	6/30/2015	7/17/2015
STP submitted supplement to risk-informed Option 2B	8/20/2015	8/20/2015
Issued closures for all Option 1 plants	4/30/2016	5/19/2015
Review and approve STP application	7/28/2017	
Review and issue SE approving TR-WCAP-17788	11/1/2017	
Industry to submit all other Option 2B applications on a staggered basis	2/28/2018	
Review and approve Option 3 plants	5/31/2018	
Review and approve Option 2B plants	11/30/2018	
Review and close all Option 2A plants for GL 2004-02	12/31/2018	
Issue closure memorandum for GSI-191	12/31/2018	

Title: Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants

Generic Issue Number: 199

Identification Date: 5/25/2005

Action Level: Regulatory Office Implementation

Office/Division: NRR/JLD

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Safety Risk Assessment:

6/30/2009 (Actual/Complete)

Transfer to Regulatory Office for Action:

6/30/2009 (Actual/Complete)

Closure Date:

12/31/2020 (Estimated)

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DESCRIPTION:

Newer data and models indicate that estimates of the potential for earthquake hazards for some nuclear power plants in the central and eastern United States (CEUS) could be larger than previous estimates. Although it has been determined that currently operating plants remain safe, the newer seismic data and models warrant further study and analysis. The analysis will allow the NRC to better understand margins at operating plants for earthquakes. The screening assessment did not identify any immediate safety concerns.

WORK SCOPE:

The NRR staff review of the first early site permit (ESP) applications found that the proposed safe-shutdown earthquake (SSE) ground motions for some of the new sites exceeded the SSE ground motion for the co-located operating units. This resulted from the application of more recent seismic hazard models for the ESP applications, which estimated higher seismic hazards for some regions of the CEUS.

Based on the evaluations conducted under the individual plant examination of external events (IPEEE) program in the 1990s, the staff determined that the seismic designs of operating plants in the CEUS provided an adequate level of protection. However, based on the staff's review of the ESP applications and confirmatory analysis using the U.S. Geological Survey (USGS) seismic models, the staff recognized that the probability of exceeding the SSE at some currently operating sites in the CEUS may be higher than previously understood. Therefore, the staff initiated GI-199 to assess the impact of increased seismic hazard estimates on selected nuclear power plants in the CEUS region.

STATUS:

In August 2005, RES issued a task order for a contractor (Information Systems Laboratories, Inc. (ISL)) to develop a probabilistic screening analysis for exceedance of the SSE ground motion on nuclear power plants in the CEUS. The contractor was to use information provided by the NRC to perform this task in accordance with the guidelines in Section 3.3 and Appendix B.3.2 to NUREG-1489, "A Review of NRC Staff Uses of Probabilistic Risk

Assessment,” issued March 1994. The information to be provided by the NRC included Electric Power Research Institute (EPRI) Report NP-6395-D, “Probabilistic Seismic Hazard Evaluations at Nuclear Power Plant Sites in the Central and Eastern United States: Resolution of the Charleston Earthquake Issue,” issued April 1989. In May 2007, the NRC directed the contractor to stop work on this task order because the NRC and EPRI had not resolved issues with releasing the copyrighted EPRI Report NP-6395-D to the NRC contractor for performing this task.

In April 2007, RES decided to complete the USGS update of the seismic hazard assessment of CEUS plants and use this information to perform the screening analysis for this GI. In May 2007, the staff developed a plan to complete the screening analysis for GI-199 by February 2008 and began work on initial tasks described in this plan. In June 2007, the staff decided to focus the screening analysis efforts on using existing USGS seismic hazard information to address the seven criteria for screening GIs described in SECY-07-0022, “Status Report on Proposed Improvements to the Generic Issues Program,” dated January 30, 2007 (ADAMS Accession No. ML063460239). In July 2007, the staff completed its preliminary screening analysis and gave it to the screening analysis review panel in August 2007.

In October 2007, the staff determined that the screening analysis should consider seismic hazard data and models besides those available from USGS. It made this determination based on its ongoing interactions with stakeholders to develop a new performance-based approach for assessing seismic hazards for new reactors as described in a memorandum to the Commission, “A Performance-Based Approach To Define the Safe Shutdown Earthquake Ground Motion,” dated July 26, 2006 (ADAMS Accession No. ML052360044).

The staff completed the screening analysis using guidance in Management Directive (MD) 6.4, “Generic Issues Program,” and SECY-07-0022 in December 2007 and reconvened the screening panel in January 2008. On February 1, 2008, the RES Director approved the screening panel recommendation (ADAMS Accession No. ML073400477) to begin the safety/risk assessment stage of the GI process. On February 6, 2008, the staff met with the public and stakeholders at NRC Headquarters to discuss the results of the screening stage of GI-199.

EPRI performed an independent evaluation of the implications of changes in seismic hazard estimates. The staff interacted with EPRI (under a memorandum of understanding) to discuss data, methodology, and its conclusions.

In June 2009, the staff completed the review and analysis of seismic data in support of the safety/risk assessment. Several meetings of the safety/risk assessment panel took place in July and August 2009. From November 2009 through March 2010, the RES staff held internal briefings with NRR, the Office of New Reactors, and NRC regional offices. The safety/risk assessment panel reconvened in March 2010 and June 2010 to review its recommendations. The safety/risk assessment panel issued its report on September 2, 2010 (ADAMS Accession No. ML100270582). The panel recommended that lead responsibility for subsequent GI-199 actions be transferred to NRR for regulatory office implementation and that further actions be taken to address GI-199 outside the GI program (i.e., obtain information and develop methods, as needed, to complete plant-specific value impact analyses of potential back fits to reduce seismic risk). The issue was transferred to NRR on September 2, 2010, for regulatory office implementation.

The staff issued INs to inform stakeholders of the GI-199 safety/risk assessment report and results. It issued IN 2010-18, "Generic Issue 199, 'Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants,'" (ADAMS Accession No.ML101970221), on September 2, 2010, to nuclear power plants and independent fuel storage installations. It issued IN 2010-19, "Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States," (ADAMS Accession No.ML102160735), on September 16, 2010, to fuel cycle facilities. A public meeting took place on October 6, 2010, and a presentation to the ACRS Siting Subcommittee occurred on November 30, 2010. NRR issued a draft GL, "NRC Generic Letter 2011-XX: Seismic Risk Evaluations for Operating Reactors" (ADAMS Accession No. ML111710783), on September 15, 2011, for public comment. The public comment period ended on December 15, 2011. The agency incorporated GI-199 into the work being done by the Japan Lessons-Learned Division (JLD) in response to the March 2011 Japan nuclear event at Fukushima Dai-ichi.

NRR's GI-199 request for information was addressed in the 10 CFR 50.54(f) letters to all licensees for Recommendations 2.1 and 2.3 of the Near-Term Task Force (NTTF) report (ADAMS Accession No. ML12053A340). The NRC has requested that all nuclear power plants reevaluate seismic hazards using present-day guidance and methods. Licensees for plants in the CEUS submitted their seismic hazard reevaluations in March 2014, and those for plants in the western United States (WUS) submitted their seismic hazard reevaluations in March 2015. Depending on the comparison between the reevaluated seismic hazard and the design basis, the resulting outcome is either no further risk evaluation for the plant (screened out) or performance of a plant risk assessment if the reevaluated hazard exceeds the plant's design basis (screened in). For those plants that screen in, if the reevaluated hazard show that the ground motion response spectrum exceeds the plant's design-basis safe shutdown earthquake (SSE) only in the above 10 hertz, then the license needs to assess the potential impact of high frequency ground motion on plant equipment. If the reevaluated hazard exceeds the design basis below 2.5 Hz, then the licensee must perform a low frequency limited scope evaluation. In addition, if any plant whose reevaluated hazard exceeds the design basis in the 1-10 Hz range, then the licensee must perform a low hazard spent fuel pool evaluation; and if the reevaluated hazard exceeds a peak spectral acceleration of 0.8g, a high hazard spent fuel evaluation is required.

The NRC staff has finished reviewing the reports and issued a final determination letter for seismic risk evaluations on October 27, 2015 (ADAMS Accession No. ML15194A015). The final determination letter updates the preliminary screening letters that the NRC issued on May 9, 2014 (for CEUS plants) and May 13, 2015 (for WUS plants). The final determination letter includes a staggered schedule for licensees to submit their seismic risk evaluations to the NRC for those sites that screen in, with the earliest in March 2017 and the latest in December 2019.

Of the 61 sites (58 CEUS and 3 WUS), 18 operating reactor sites (16 CEUS and 2 WUS) have screened in thus far, requiring licensees to complete a seismic probabilistic risk assessment (SPRA). Two CEUS sites were screened out late, based on additional information provided by the licensee, by letter dated December 22, 2016 (ADAMS Accession No. ML16344A313). Of the remaining 43 sites, 9 sites have screened out of any further evaluations, and the remaining 34 sites are required to perform limited-scope evaluations (i.e., high-frequency evaluations, low-frequency evaluations, or spent fuel pool evaluations).

In addition to the SPRAs, 34 sites (33 CEUS and 1 WUS) were required to complete near-term expedited seismic evaluation process (ESEP) reports of key equipment needed to protect the reactor core following a beyond-design-basis seismic event. The staff received all ESEP reports for CEUS plants by December 2014, and it received the ESEP report for the one WUS plant during the second quarter of 2016. The staff completed its evaluation of all 33 CEUS expedited seismic evaluation reports during the second quarter of 2016 and the one WUS site in May 2016. Some plant modifications are required as a result of the ESEP reports. Licensees have notified the NRC of 15 modifications that have been completed. Plant upgrades not requiring an outage will be completed by June 2018 for WUS plants.

The NRC received a number of limited-scope evaluation submittals. The table below summarizes the status and expected due dates.

EVALUATION	DUE DATE	RECEIVED	STAFF ASSESSMENT COMPLETED
Low-Frequency Plant	December 2016	1 of 1	1 of 1
High-Frequency Plant	August 2017	21 of 32	13 of 32
Spent Fuel Pool Low	December 2016	29 of 30	20 of 30
Spent Fuel Pool High	December 2017	0 of 10	0 of 10

#### AFFECTED DOCUMENTS:

The affected documents include the following:

- IN 2010-18, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," dated September 2, 2010 (ADAMS Accession No.ML101970221)
- IN 2010-19, "Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States," dated September 16, 2010 (ADAMS Accession No.ML102160735)

#### PROBLEM/RESOLUTION:

The screening analysis was delayed when EPRI would not release its copyrighted report NP-6395-D to the NRC contractor. RES considered alternatives for proceeding with the screening assessment of GI-199 in accordance with MD 6.4 and SECY-07-0022. From April 2007 through September 2007, the staff performed the initial screening analysis of GI-199 using currently available seismic hazard information from USGS. In October 2007, the staff determined that the screening analysis should consider seismic hazard data and models besides those available from USGS. The RES staff worked with technical experts from NRR and the Office of New Reactors to complete a screening analysis and develop an approach for the safety/risk assessment stage. The NRC staff considers the previous problems to be resolved.

REASONS FOR SCHEDULE CHANGES:

The inability to identify an amenable solution for EPRI's release of NP-6395-D to the NRC contractor for performing the screening analysis task resulted in schedule delays involving the initial screening analysis. Based on discussions with USGS, the staff determined that the timeframe for obtaining current seismic hazard update information for CEUS plant sites would be mid-2008 instead of October 2007. Accordingly, the staff changed the projected date for the milestone listed as "Receive seismic hazard update results for selected CEUS plants from USGS" in the table below from October 30, 2007, to June 30, 2008. To support completion of the screening analysis, consistent with the timeliness targets described in SECY-07-0022, the staff decided to base the screening analysis on seismic hazard information available from USGS at that time. Following this approach, the staff completed the milestone listed as "Generated screening analysis" on July 27, 2007, and then completed the milestone listed as "Screening panel met" on September 12, 2007.

In October 2007, the staff determined that the screening analysis should consider seismic hazard data and models other than those available from USGS. Based this determination and ongoing interactions with stakeholders, the staff developed a new performance-based approach for assessing seismic hazards for new reactors as described in a memorandum to the Commission, "A Performance-Based Approach To Define the Safe Shutdown Earthquake Ground Motion," dated July 26, 2006 (ADAMS Accession No. ML052360044). The staff's ongoing work on this performance-based approach resulted in issuance of RG 1.208, "A Performance-Based Approach To Define the Site-Specific Earthquake Ground Motion," issued March 2007, that endorses the performance-based approach. After the RES Director approved the screening panel's recommendation (ADAMS Accession No. ML073400477) to conduct a safety/risk assessment stage, a milestone was added for completion of this stage.

The safety/risk assessment panel was extended because of the complexity of additional evaluations and the desire for internal and external stakeholder agreement. The RES Director approved the safety/risk assessment and panel recommendation on September 2, 2010.

The table below lists the milestones along with projected and completed dates.

MILESTONE	PROJECTED DATE	COMPLETED DATE
Issued request for proposal to the NRC contractor (ISL) for technical assistance	7/7/2005	7/7/2005
Received proposal from ISL	8/11/2005	8/11/2005
Generated screening analysis	10/31/2006	7/27/2007
Screening panel met	11/30/2006	9/12/2007
Prepared screening analysis applying criteria from MD 6.4 and SECY-07-0022	12/15/2007	12/31/2007
Reconvened screening panel	12/15/2007	1/11/2008
Provided screening panel recommendation memorandum for RES Director approval	1/31/2007	1/25/2008

MILESTONE	PROJECTED DATE	COMPLETED DATE
Issued screening analysis and panel recommendation approved by RES Director	12/31/2006	2/1/2008
Received seismic hazard update results for selected CEUS plants from USGS	6/30/2008	10/15/2008
Received information from EPRI	5/30/2008	12/3/2008
Scheduled and conducted safety/risk assessment panel	9/30/2008	8/31/2009
GI-199 transferred to NRR for regulatory office implementation	6/30/2009	9/2/2010
Issued RES Director-approved safety/risk assessment and panel recommendation	1/31/2010	9/2/2010
Issued IN 2010-18	9/2/2010	9/2/2010
Issued IN 2010-19	9/16/2010	9/16/2010
Conducted public meeting	6/30/2009	10/6/2010
Presented to the ACRS subcommittee	11/5/2009	11/30/2010
Presented to the Committee to Review Generic Requirements	6/30/2011	8/2/2011
Issued draft GL for public comment	7/31/2011	9/1/2011
Presented to the ACRS subcommittee	10/13/2011	10/13/2011
Presented to the ACRS subcommittee	10/31/2011	11/8/2011
Transferred activities to the Japanese Lessons Learned Project Directorate (now the Japan Lessons-Learned Division) (JLD)	3/8/2012	3/8/2012
CEUS plants submitted seismic hazard reevaluations	3/31/2014	3/31/2014
WUS plants submitted seismic hazard reevaluations	3/12/2015	3/12/2015
CEUS plants completed expedited seismic evaluations	12/31/2014	12/31/2014
WUS plant completed expedited seismic evaluations	1/31/2016	1/31/2016
CEUS plants install upgrades (not requiring outage)	12/30/2016	12/30/2016
WUS plants install plant upgrades (not requiring outage)	6/30/2018	
Receive responses from licensees performing SPRAs	12/31/2019	

Title: Flooding of Nuclear Power Plant Sites Following Upstream Dam Failure

Generic Issue Number: 204

Identification Date: 7/19/2010

Action Level: Regulatory Office Implementation

Office/Division: NRR/JLD

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Transfer to Regulatory Office for Action:

3/6/2012 (Actual/Complete)

Closure Date:

12/30/2021 (Estimated)

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#### DESCRIPTION:

The NRC has started a formal evaluation of potential generic safety implications for dam failures upstream of U.S. commercial nuclear power plants. The complete scope of GI-204 includes the effects of flooding from upstream dam failures on nuclear power plants sites, spent fuel pools, and sites undergoing decommissioning with spent fuel stored in spent fuel pools. The NRC began examining this issue after inspection findings at two plants. The staff completed a draft of the screening analysis in July 2011 (ADAMS Accession No. ML113500495). The issue was officially declared as GI-204 in February 2012.

#### STATUS:

Nuclear power plant designs include protection against serious but very rare flooding events, including flooding from dam failure scenarios. Dam failures can occur as a consequence of earthquakes, overtopping, and other mechanisms such as internal erosion and operational failures. A dam failure could potentially cause flooding at a nuclear power plant site depending on a number of factors, including the location of the dam, reservoir volume, dam properties, flood routing, and site characteristics.

Although the screening analysis did not identify any immediate safety concerns, inspections or other reviews at individual plants have led to those plants taking actions regarding flooding scenarios on a site-specific basis. GI-204 has been subsumed as part of the implementation of the NTTF recommendations in response to the earthquake/tsunami and reactor accident at the Fukushima Dai-ichi site.

Although the NTTF used preliminary information from the GI screening analysis and discussed flooding in its July 2011 report (ADAMS Accession No. ML111861807), the issue related to flooding from the upstream dam failure came to the staff's attention long before the earthquake/tsunami and reactor accident at the Fukushima Dai-ichi site. New sources of information on this issue have accumulated over the past few years. These sources include inspections of flood protection and related procedures, as well as recent reevaluations of dam failure frequencies and possible flood heights at some U.S. nuclear power plants. These reevaluations suggest that flooding effects in some cases may be greater than previously expected.

The NTTF review of the Fukushima Dai-ichi accident led to recommendations related to the potential for flooding from all hazard mechanisms at operating reactors. On March 6, 2012, RES transferred the GI to NRR for regulatory office implementation (ADAMS Accession No. ML120261155). On March 12, 2012, the holders of operating licenses and construction permits received letters from the NRC that requested the reevaluation of all flood hazards (including dam failures) using present-day guidance and methodologies (ADAMS Accession No. ML12053A340). (Sites undergoing decommissioning, which are part of the GI, are not included in the NRC's activities related to reevaluation of flood hazards.)

The staff prioritized due dates related to the reevaluation of flood hazards in a letter dated May 11, 2012 (ADAMS Accession No. ML12097A509). This letter describes the criteria used to place each site into one of three completion date categories. As of September 2016, all sites have completed flood hazard reevaluations in response to the March 2012 request. The staff expects to complete the technical staff assessments documenting the Flood Hazard Reevaluation Report (FHRR) review by 2017.

The staff issued COMSECY-15-0019, "Closure Plan for the Reevaluation of Flooding Hazards for Operating Nuclear Power Plants," on July 28, 2015, which provides the Commission with a plan for closing NTTF Recommendation 2.1 (ADAMS Accession No. ML15153A104). Those sites that had flood-causing mechanisms that exceeded the current design basis are required to perform additional analysis (e.g., focused evaluation or integrated assessment, depending on the hazard) to evaluate the site response to the updated flood hazard. This graded approach will focus on the areas with the most potential safety benefit. The focused evaluations are due to the NRC by mid-2017 and the integrated assessments are due by the end of 2018.

The table below lists the milestones along with projected and completed dates.

MILESTONE	PROJECTED DATE	COMPLETED DATE
Issue declared a GI	2/29/2012	2/29/2012
Transferred activities to JLD	3/6/2012	3/6/2012
Received flooding hazard reevaluations for Category 1 sites	3/12/2013	3/12/2013
Received flooding hazard reevaluations for Category 2 sites	3/12/2014	3/12/2014
Received flooding hazard reevaluations for Category 3 sites	3/12/2015	3/12/2015
Granted extension to licensees needing additional research to complete flooding hazard reevaluations	3/12/2015	3/12/2015
Issued COMSECY-15-0019, which provides the Commission with a plan for closing NTTF Recommendation 2.1 on the reevaluation of flooding hazards for operating nuclear power plants	6/30/2015	6/30/2015
Those sites that had flood-causing mechanisms that exceeded the current design basis are required to perform a	6/30/2017	

MILESTONE	PROJECTED DATE	COMPLETED DATE
<u>focused evaluation</u> to evaluate the site response to the updated flood hazard		
Complete review of the technical staff assessments documenting the flood hazard reevaluation report	12/30/2017	
Those sites that had flood-causing mechanisms that exceeded the current design basis are required to perform an <u>integrated assessment</u> to evaluate the site response to the updated flood hazard	12/30/2018	