

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).

The procedures for processing GIs are described in Management Directive (MD) 6.4, "Generic Issues Program," and the Office of Nuclear Regulatory Research (RES), Office Instruction TEC-002, "Procedure for Processing Generic Issues." 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, and
- new guidance to identify and act on immediate safety concerns and to document the justification for ongoing operation, such that progress would be made on the GI without the need to implement remedial actions while the GI is in process.

Although these changes are anticipated to improve the GI program, it will take months to years for several GIs to go through all three stages of the program (screening, assessment, regulatory

office implementation). Therefore, it is still too early to realize the full efficiencies of the process changes. Nonetheless, a near-term result of these changes is that the GI program has placed greater emphasis on reviews of proposed GIs to determine whether the issues constitute an immediate safety concern. Previously, these reviews were done at a very high level, with little or inconsistent documentation. In reviewing the proposed GIs that are currently in the program, RES has collaborated with NRR to develop better documentation of the basis for this determination. As another near-term outcome, the GI program staff is promptly responding to issues when they are submitted, tracking steady progress of active GIs every quarter, and communicating and coordinating with other offices about issues within the GI program so that issues can transition between offices in a smooth manner.

ACRONYMS

ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
CEUS	Central and Eastern United States
CFR	<i>Code of Federal Regulations</i>
DSA	Division of Systems Analysis
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
GR	guidance report
GSI	generic safety issue
IN	information notice
JLD	Japanese Lessons Learned Division
LOCA	loss-of-coolant accident
MD	management directive
NEI	Nuclear Energy Institute
NPSH	net positive suction head
NRC	U.S. Nuclear Regulatory Commission
NRO	Office of New Reactors
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
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
USGS	U.S. Geological Survey
WUS	Western United States

Title: Assessment of Debris Accumulation on PWR Sump Performance

Generic Issue Number: 191

Identification Date: 09/01/1996

Action Level: Regulatory Office Implementation

Office/Division/Branch: NRR/DSS/SSIB

Technical Assessment: 09/15/2001 (Actual/Complete)

Regulation and Guidance Issuance: 09/30/2004 (Actual/Complete)

Transfer to Regulatory Office for Action: 12/31/2007 (Actual/Complete)

Closure: 12/31/2018 (Estimated)

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 of 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 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 U.S. Nuclear Regulatory Commission (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 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:

The NRC issued Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," to PWR licensees on June 9, 2003. The bulletin requested 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 postaccident debris blockage until the required evaluations to determine compliance are completed. 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. Generic closeout of Bulletin 2003-01 was completed in December 2005.

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

The NRC issued Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors," on September 13, 2004. The GL requested 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 required 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 were to be addressed 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 followup 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 other PWR post-LOCA pool environments on January 19, 2006 (ADAMS Accession No. ML060190713). The staff issued Supplement 1 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 that recipients of the notice would 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.

Licensees have completed strainer modifications at all PWRs. These modifications typically increased strainer size by one to two 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 design and administrative changes implemented to address the issues. The staff performed two pilot audits in 2005 (Crystal River Unit 3 and Fort Calhoun) to provide opportunities to exercise and improve the NRC evaluation process. Nine full-scope plant audits were also performed. To support the audits, the NRC staff also visited sump strainer vendor facilities to observe head loss and chemical effects testing. Other limited-scope audits were conducted in 2008 and 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, namely 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 a topical report (TR) Westinghouse Commercial Atomic Power WCAP-16793-NP Rev 1, "Evaluation of Long-Term Cooling

Considering Particulate, Fibrous and Chemical Debris in the Recirculating Fluid," to the NRC in April 2009 (ADAMS Accession No. ML091190484). The staff determined that additional testing was needed to support the TR conclusions. The PWR Owners Group (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 as some of the tests yielded unexpected results. Further evaluation and testing were performed. By letter dated October 12, 2011, the PWROG submitted revision 2 to TR-WCAP-16793-NP-A, (ADAMS Accession No. ML11292A020), 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, the NRC provided a draft safety evaluation (SE) regarding approval of TR WCAP-16793-NP, Revision 2, for review and comment (ADAMS Accession No. ML12115A304). By letter dated March 6, 2013, the PWROG commented on the draft SE, (ADAMS Accession No. ML13093A082). 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. The industry report has not been formally submitted for staff review, but 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 upon individual plant-specific condition.

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 a major piping rupture would occur. 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. These options were documented and proposed 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 required licensees to demonstrate compliance with 10 CFR 50.46. The three options are summarized as follows:

- (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.
 - Option 2A Deterministic: Allows industry to perform more testing and analysis to justify higher in-vessel debris limits and to justify debris loads on strainers. The industry submitted TR-WCAP-17788, "Comprehensive Analysis and Test Program for GSI-191 Closure," (ADAMS Accession No. ML15210A668) on July 17, 2015, for NRC review and approval. This TR is intended to increase in-vessel debris limits to values greater than those currently approved.
 - Option 2B Risk Informed: Allows industry to develop a risk-informed approach to quantify the risk associated with GI-191 and submit a license amendment request for NRC review and approval.
- (3) Option 3 involves separating the regulatory treatment of the sump strainer and in-vessel effects. The ECCS strainers will be evaluated using currently approved models while in-vessel effects will be addressed using a risk-informed approach.

The options allowed industry alternative approaches for resolving GI-191. The Commission issued SRM-SECY-12-0093 (ADAMS Accession No. ML12349A378) on December 14, 2012, approving all three options for closure of GI-191.

Current Status of Staff Reviews:

Option 1 Plants:

The staff has issued closeout GL 2004-02 documentation for the following Option 1 plants:

Catawba	Units 1 and 2
McGuire	Units 1 and 2
Oconee	Units 1, 2 and 3
Salem	Units 1 and 2
Sequoyah	Units 1 and 2
Prairie Island	Units 1 and 2
Watts Bar	Units 1 and 2

Byron	Units 1 and 2
Braidwood	Units 1 and 2

Option 2 Plants:

Option 2A Deterministic Plants:

Arkansas Nuclear One	Units 1 and 2
Beaver Valley	Units 1 and 2
Comanche Peak	Units 1 and 2
Davis Besse	Units 1 and 2
D.C. Cook	Units 1 and 2
Farley	Units 1 and 2
Fort Calhoun	Unit 1
Ginna	Unit 1
Harris	Unit 1
Indian Point	Units 2 and 3
Millstone	Units 2 and 3
North Anna	Units 1 and 2
Palo Verde	Units 1, 2, and 3
Robinson	Unit 2
Surry	Units 1 and 2
Three Mile Island	Unit 1
V.C. Summer	Unit 1
Waterford	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, that is intended to justify higher fiber limits than previously approved by the 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 2016. The Option 2A plants will submit closure letters using the approved TR. Closure of all Option 2A plants is anticipated by the end of 2017.

Option 2B Risk Informed:

South Texas Project (STP)	Units 1 and 2
Calvert Cliffs	Units 1 and 2
Diablo Canyon	Units 1 and 2
Palisades	Unit 1
Seabrook	Unit 1
St. Lucie	Units 1 and 2
Turkey Point	Units 2 and 4
Vogtle	Units 1 and 2
Callaway	Unit 1
Wolf Creek	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 October 2016. The NRC expects to complete its review of the application by the end of 2016. 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 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 2A or 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, 10 CFR 50.46c, 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)," (ADAMS Accession No: ML112620346). The Commission directed the staff to develop a risk-informed option to the 10 CFR 50.46 long-term core cooling requirement with respect to the effects of debris on long-term cooling.

The staff has developed guidance for Option 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 the RG 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. Briefings of ACRS are scheduled periodically to provide opportunities for communication on technical issues and additional public involvement.

AFFECTED DOCUMENTS:

- RG 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident"
- RG 1.229, "Risk-Informed Approach for Addressing the Effects of Debris on Post-Accident Long-Term Core Cooling."
- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (Section 6.2.2, "Containment Heat Removal Systems," and Section 6.3, "Emergency Core Cooling System")

- Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors"
- GL 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors"
- IN 2005-26 and Supplement 1, "Results of Chemical Effects Head Loss Tests in a Simulated PWR Sump Pool Environment"

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.

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	12/01/1995	12/01/1995
User need request assigned to RES	01/01/1996	01/01/1996
Reassessment declared a new generic safety issue (GSI)	09/01/1996	09/01/1996
Issued statement of work for evaluation of GSI A-43	11/01/1996	11/01/1996
Completed evaluation of GSI A-43	04/01/1997	03/01/1997
Issued statement of work for reassessment of debris blockages in PWR containments impact on ECCS performance	09/01/1998	09/01/1998
Completed collection and review of PWR containment and sump design and operation data	12/01/1999	12/01/1999
Completed all debris transport tests	09/01/2000	08/01/2000
Complete parametric evaluation	07/01/2001	07/31/2001
Proposed recommendations to ACRS	08/31/2001	08/31/2001
ACRS review completed	09/30/2001	09/14/2001
Issue transferred from RES to NRR	09/28/2001	09/28/2001

Milestone	Projected Date	Completed Date
Completed estimate of average core damage frequency reduction, benefits, and costs	04/01/2002	09/28/2001
Prepared memorandum discussing proposed recommendations (end of technical assessment stage of GI process)	04/01/2002	09/28/2001
Issued Bulletin 2003-01	05/01/2003	06/01/2003
Completed development of models and methods for analyzing impact of debris blockages in PWR containments on ECCS performance	04/01/2001	06/09/2003
Discussed RG 1.82, Revision 3, with ACRS Subcommittee on Thermal-Hydraulic Phenomena	08/20/2003	08/20/2003
Presented final version of RG 1.82, Revision 3, to ACRS full committee	09/11/2003	09/11/2003
ACRS sent letter on final version of RG 1.82, Revision 3	09/30/2003	09/30/2003
Drafted industry guidance for plant-specific analyses	10/30/2003	10/31/2003
Issued RG 1.82, Revision 3	09/30/2003	11/30/2003
Received industry guidance for plant-specific analyses	09/30/2003	05/28/2004
Briefed ACRS subcommittee on proposed GL	06/22/2004	06/22/2004
Met with stakeholders	06/29/2004	06/29/2004
Developed GL for resolution of GI	07/07/2004	07/07/2004
Briefed ACRS full committee on proposed GL	07/07/2004	07/07/2004
Met with the Committee to Review Generic Requirements on proposed GL	08/10/2004	08/10/2004
Issued GL 2004-02	09/13/2004	09/13/2004
Met with ACRS on SE of NEI 04-07	10/07/2004	10/07/2004
ACRS responds to SE of NEI 04-07	10/18/2004	10/18/2004
Executive Director for Operations briefed ACRS on status	09/09/2005	09/09/2005
Received all GL responses addressing plant-specific analyses	05/31/2005	09/15/2005
Issued IN 2005-26	09/16/2005	09/16/2005
Issued Supplement 1 to IN 2005-26	01/20/2006	01/20/2006
Completed review of licensee responses to GL 2004-02	01/20/2006	01/20/2006
Completed research programs evaluating coating transportability and surrogate throttle valve debris ingestion	02/28/2006	02/28/2006
Completed testing and analysis associated with initial phase of chemical effects research	05/30/2006	05/30/2006
Completed containment material head loss testing	06/15/2006	06/15/2006
Completed thermodynamic simulation of containment sump chemical constituents	09/30/2006	09/30/2006

Milestone	Projected Date	Completed Date
Regions completed TI inspections	06/30/2008	06/30/2008
Received last TI verifications from regions	08/11/2008	08/11/2008
Completed review of TI verifications	08/25/2008	06/30/2009
Issued SECY-12-0093	07/09/2012	07/09/2012
PWROG submitted TR-WCAP-16793-NP-A on in-vessel downstream effects	07/20/2012	07/20/2012
Issued final SE for in-vessel downstream effects on TR-WCAP-16793-NP-A	04/08/2013	04/08/2013
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	06/30/2015	07/17/2015
STP submitted supplement to risk-informed Option 2B	08/20/2015	08/20/2015
Issued closures for all Option 1 plants	04/30/2016	05/19/2015
Review and approve STP application	12/30/2016	
Review and issue SE approving TR-WCAP-17788	12/30/2016	
Review and close all Option 2A plants for GL 2004-02	12/30/2017	
Industry to submit all other Option 2B applications on a staggered basis	05/31/2017	
Review and approve Option 2B plants	10/31/2018	
Review and approve Option 3 plants	05/31/2018	
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: 05/25/2005

Action Level: Regulatory Office Implementation

Office/Division/Branch: NRR/JLD

Safety Risk Assessment: 09/02/2010 (Actual/Complete)

Transfer to Regulatory Office for Action: 09/02/2010 (Actual/Complete)

Closure Date: 12/31/2020 (Estimated)

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, in light of 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 this GI 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 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 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, in August 2007, gave it to the screening analysis review panel.

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 contained in MD 6.4 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 Safety/Risk Assessment Panel meetings took place in July and August 2009. From November 2009 through March 2010, RES staff held internal briefings with NRR, the Office of New Reactors (NRO), 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. The panel recommended transferring lead responsibility for subsequent GI-199 actions 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 backfits 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,'" 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," 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 was held on

November 30, 2010. NRR developed a draft generic letter, "NRC Generic Letter 2011-XX: Seismic Risk Evaluations for Operating Reactors" (ADAMS Accession No. ML111710783) that was issued on September 15, 2011, for public comment. The public comment period ended on December 15, 2011. The agency incorporated GI-199 into the work done by the Japan Lessons-Learned Project Division in response to the March 2011 Japan nuclear event. NRR's GI-199 activities are being addressed in the 10 CFR 50.54(f) letters on Recommendations 2.1 and 2.3 of the Near-Term Task Force (NTTF).

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). If the reevaluated hazard only exceeds the design basis above 10 hertz, then the licensee needs to perform a high-frequency confirmation.

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 the CEUS plants) and May 13, 2015 (for WUS plants). The final determination letter includes a staggered schedule for licensees to submit the 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), 20 operating reactor sites (18 CEUS and 2 WUS) have screened in thus far, requiring licensees to complete seismic probabilistic risk assessment (SPRAs). Of the remaining 41 sites, nine sites have screened out of any further evaluations, and the remaining 32 sites are required to perform limited-scope evaluations (i.e., high-frequency evaluation, low-frequency evaluation, or spent fuel pool evaluation).

In addition to the SPRAs, out of the 61 sites, 48 original sites (later reduced to 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 expedited seismic evaluation process 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, and 15 plants have identified potential plant upgrades. Plant upgrades not requiring an outage will be completed by December 2016 for CEUS plants and by June 2018 for WUS plants.

AFFECTED DOCUMENTS:

- IN 2010-18, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants"
- IN 2010-19, "Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States"

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 NRO 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 the EPRI 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 time frame for obtaining current seismic hazard update information for CEUS plant sites would be mid-2008 instead of October 2007. Accordingly, the staff changed the date for the milestone, "Receive Seismic Hazard Update Results for Selected CEUS Plants from USGS," 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 currently available from USGS. Following this approach, the staff completed the milestone, "Generate Screening Analysis," on July 27, 2007, and then completed the milestone, "Screening Panel Meeting," 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.

Milestone	Projected Date	Completed Date
Issued request for proposal to contractor (ISL) for technical assistance	07/07/2005	07/07/2005
Received proposal from ISL	08/11/2005	08/11/2005
Generated screening analysis	10/31/2006	07/27/2007
Screening panel met	11/30/2006	09/12/2007

Milestone	Projected Date	Completed Date
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	01/11/2008
Provided screening panel recommendation memo for RES Director approval	01/31/2007	01/25/2008
Issued screening analysis and panel recommendation approved by RES Director	12/31/2006	02/01/2008
Received seismic hazard update results for selected CEUS plants from USGS	10/30/2007	10/15/2008
Received information from EPRI	05/30/2008	12/03/2008
Scheduled and conducted safety/risk assessment panel	09/30/2008	08/31/2009
GI-199 transferred to NRR for regulatory office implementation	06/30/2009	09/02/2010
Issued RES Director-approved safety/risk assessment and panel recommendation	01/31/2010	09/02/2010
Issued IN 2010-18	09/02/2010	09/02/2010
Issued IN 2010-19	09/16/2010	09/16/2010
Conducted public meeting	06/30/2009	10/06/2010
Presented to ACRS subcommittee	11/05/2009	11/30/2010
Presented to Committee to Review Generic Requirements	06/30/2011	08/02/2011
Issued draft GL for public comment	07/31/2011	09/01/2011
Presented to ACRS subcommittee	10/13/2011	10/13/2011
Presented to ACRS subcommittee	10/31/2011	11/08/2011
Transferred activities to the Japanese Lessons Learned Project Directorate (JLD)	03/08/2012	03/08/2012
CEUS plants submitted seismic hazard reevaluations	03/31/2014	03/31/2014
WUS plants submitted seismic hazard reevaluations	03/12/2015	03/12/2015
CEUS plants completed expedited seismic evaluations	12/31/2014	12/31/2014
WUS plant completed expedited seismic evaluations	01/31/2016	01/31/2016
CEUS plants install upgrades (not requiring outage)	12/30/2016	
WUS plants install plant upgrades (not requiring outage)	06/30/2018	
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: 07/19/2010

Action Level: Regulatory Office Implementation

Office/Division/Branch: NRR/JLD

Transfer to Regulatory Office for Action:

03/06/2012 (Actual/Complete)

Closure Date:

12/30/2021 (Estimated)

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 the GI 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 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. This information includes 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, suggesting that flooding effects in some cases may be greater than previously expected.

The NTTF review of the Fukushima 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 May 2012 (ADAMS Accession No. ML12097A509). This letter describes the criteria used to place each site into one of three completion date categories. As of August 2015, most sites have completed flood hazard reevaluations in response to the March 2012 request. Some sites have requested and been granted extensions, as appropriate. The staff expects to complete the technical staff assessments documenting the Flood Hazard Reevaluation Report (FHRR) review by 2016.

The staff issued COMSECY-15-0019, "Closure Plan for the Reevaluation of Flooding Hazards for Operating Nuclear Power Plants," on July 28, 2015, providing 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 in mid-2017 and the integrated assessments are due by the end of 2018.

Milestone	Projected Date	Completed Date
Issue declared a GI	02/29/2012	02/29/2012
Transferred activities to JLD	03/06/2012	03/06/2012
Received flooding hazard reevaluations for Category 1 sites	03/12/2013	03/12/2013
Received flooding hazard reevaluations for Category 2 sites	03/12/2014	03/12/2014
Received flooding hazard reevaluations for Category 3 sites	03/12/2015	03/12/2015
Granted extension to licensees needing additional research to complete flooding hazard reevaluations	03/12/2015	03/12/2015
Issued COMSECY-15-0019, providing the Commission with a plan for closing NTTF Recommendation 2.1 on the reevaluation of flooding hazards for operating nuclear power plants	06/30/2015	06/30/2015
Complete review of the technical staff assessments documenting the Flood Hazard Reevaluation Report	12/30/2016	
Those sites that had flood-causing mechanisms that exceeded the current design basis are required to perform <u>focused evaluation</u> to evaluate the site response to the updated flood hazard	06/30/2017	
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	