U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REGULATORY RESEARCH

November 2015
Division 1

DRAFT REGULATORY GUIDE

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DRAFT REGULATORY GUIDE DG-1301

(Proposed New Regulatory Guide 1.226)

FLEXIBLE MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EVENTS

A. INTRODUCTION

Purpose

This regulatory guide (RG) identifies methods and procedures the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for nuclear power reactor applicants and licensees to demonstrate compliance with NRC regulations covering integrated planning and preparedness for beyond-design-basis events as required by U.S. *Code of Federal Regulations*, Title 10, "Energy," Part 50, "Domestic Licensing of Production and Utilization Facilities," (10 CFR 50) (Ref. 1), Section 50.155, "Mitigation of Beyond-Design-Basis Events," (10 CFR 50.155).

This RG endorses, with clarifications, the methods and procedures promulgated by the Nuclear Energy Institute (NEI) in technical document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 1A (NEI 12-06, Rev. 1A) dated October, 2015 (Ref. 2) as a process the NRC considers acceptable for meeting, in part, the regulations in 10 CFR 50.155. Additionally, this RG provides guidance in areas that are not covered in NEI 12-06, for meeting the regulations in 10 CFR 50.155.

Applicable Orders and Regulations

- NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," was issued March 12, 2012 (Ref. 3). This order requires nuclear power reactor licensees and construction permit holders to develop, implement, and maintain strategies to maintain or restore core cooling, spent fuel pool (SFP) cooling, and containment capabilities following a beyond-design-basis external event (BDBEE).

This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a staff guidance position in this area. It has not received final NRC review or approval and does not represent an official NRC final position. Public comments are being solicited on this draft guide (including any implementation schedule) and its associated regulatory analysis or value/impact statement. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules, Announcements, and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; submitted through the NRC's interactive rulemaking Web page at http://www.nrc.gov; or faxed to (301) 492-3446. Copies of comments received may be examined at the NRC's Public Document Room, 11555 Rockville Pike, Rockville, MD. Comments would be most helpful if received within 90 days after publication of the request for comment in the *Federal Register*.

Electronic copies of this draft regulatory guide are available through the NRC's interactive rulemaking Web page (see above); the NRC's public Web site under Draft Regulatory Guides in the Regulatory Guides document collection of the NRC Library at http://www.nrc.gov/reading-rm/doc-collections/; and the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under Accession No. ML13168A031. The regulatory analysis may be found in ADAMS under Accession No. ML15049A212.

- 10 CFR 50.155, "Mitigation of Beyond-Design-Basis Events," requires nuclear power reactor licensees to develop, implement, and maintain an integrated response capability that includes strategies and guidelines to mitigate a BDBEE.

Related Guidance

- JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Rev. 0, was issued August 29, 2012 (Ref. 4). This interim staff guidance (ISG) endorses, with clarifications, the methodologies described in NEI 12-06, Rev. 0 (Ref. 5) as one acceptable method of demonstrating compliance with NRC Order EA-12-049. JLD-ISG-2012-01 is superseded and replaced by this RG.

Purpose of Regulatory Guides

The NRC issues RGs to describe to the public methods that the NRC considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the NRC uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This RG contains information collection requirements covered by 10 CFR 50 and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," (Ref. 6) that the Office of Management and Budget (OMB) approved under OMB control numbers 3150-0011 and 3150-151 respectively. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

List of Abbreviations

The following abbreviations are used in this RG

ac	alternating current
ADAMS	NRC Agencywide Documents Access and Management System
AFW	auxiliary feedwater
AMS	alternate mitigating strategy
ASCE	American Society of Civil Engineers
BDBEE	beyond-design-basis external event
CFR	U.S. Code of Federal Regulations
DG	draft regulatory guide
EFW	emergency feedwater
ELAP	extended loss of alternating current power
EOP	emergency operating procedure
EPRI	Electric Power Research Institute
ESBWR	economic simplified boiling-water reactor
ESEP	expedited seismic evaluation process

FLEX	diverse and flexible coping strategies
FR	federal register
FSAR	final safety analysis report
FSG	FLEX support guidelines
GL	generic letter
GMRS	ground motion response spectrum
HF	high frequency
HPCI	high pressure core injection
IAEA	International Atomic Energy Agency
IHS	IPEEE high-confidence-of-low-probability-of-failure spectrum
IPEEE	individual plant examination of external events
ISG	interim staff guidance
LLNL	Lawrence Livermore National Laboratory
LUHS	loss of normal access to the ultimate heat sink
NEA	Nuclear Energy Agency
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
NTTF	Near-Term Task Force
OECD	Organization for Economic Co-operation and Development
PGA	peak ground acceleration
RCIC	reactor core isolation cooling
RG	regulatory guide
RLE	review level earthquake
RLGM	review level ground motion
SAMGs	severe accident management guidelines
SEI	Structural Engineering Institute
SEL	seismic equipment list
SFP	spent fuel pool
SMA	seismic margin assessment
SPID	screening, prioritization, and implementation details
SRM	staff requirement memorandum
SPRA	seismic probabilistic risk assessment
SSC	structure, system, and component
THMS	targeted hazard mitigating strategy

B. DISCUSSION

Reason for Issuance

One of the primary lessons learned from the events at Fukushima Dai-ichi was the significance of the challenge presented by a loss of safety-related systems following the occurrence of a BDBEE. In the case of Fukushima Dai-ichi, the extended loss of alternating current power (ELAP) led to loss of core cooling and core damage including a loss of containment integrity. The design basis for U.S. nuclear plants includes bounding analyses with margin for external events expected at each site. Extreme external

events (e.g., seismic events, external flooding, etc.) beyond those accounted for in the design basis are highly unlikely but could present challenges to nuclear power plants.

As one method of addressing these challenges, this RG endorses, with clarifications as detailed in this RG, the principles and processes in NEI 12-06, Rev. 1A, as acceptable for use by applicants and licensees to define and deploy strategies that will enhance their ability to cope with conditions resulting from BDBEEs.

Background

Following the March 11, 2011 events at the Fukushima Dai-ichi nuclear power plant, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF conducted a systematic and methodical review of the NRC regulations and processes and determine if the agency should make additional improvements in NRC regulations or processes in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a comprehensive set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 (Ref. 7). The Commission then directed the NRC staff in staff requirement memorandum (SRM) SRM-SECY-11-0093 (Ref. 8) to identify any actions that could, and in the staff's judgment should, be taken in the near term given consideration to the wide range of regulatory tools available. The staff's response to this Commission direction is contained in SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011(Ref. 9). In SRM-SECY-11-0093, the Commission further directed that all the regulatory actions in the report should be prioritized, and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2012 (Ref. 10) provides the staff's response to this direction.

After receiving the Commission's direction in SRM-SECY-11-0124 (Ref. 11) and SRM-SECY-11-0137 (Ref. 12), the NRC conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and SFP cooling capabilities following a BDBEE. At these meetings, the industry described its proposal for a diverse and flexible mitigation capability (FLEX), as documented in NEI's letter, dated December 16, 2011 (Ref. 13). FLEX was proposed as a strategy to fulfill the key safety functions of core cooling, containment integrity, and spent fuel cooling. Stakeholder input influenced the NRC to pursue a performance-based approach to improve the safety of operating power reactors different than envisioned in NTTF Recommendation 4.2, SECY-11-0124, and SECY-11-0137.

On February 17, 2012, the NRC staff provided SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami" (Ref. 14) to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 (Ref. 15), the NRC issued Order EA-12-049. On March 30, 2012, the Commission issued Memorandum and Order CLI-12-09 (Ref. 16), which included the requirements for mitigation strategies as a license condition for Virgil C. Summer Nuclear Station, Units 2 and 3. These requirements were subsequently included as license condition 2.D.(13) on both combined license NPF-93 and combined license NPF-94 for those units.

On May 4, 2012, NEI submitted NEI 12-06, Rev. B (Ref. 17), to provide specifications for an industry developed method for the development, implementation, and maintenance of guidance and strategies in response to the Mitigating Strategies Order. On May 13, 2012, NEI submitted NEI 12-06, Rev. B1 (Ref. 18). The strategies and guidance described in NEI 12-06, Rev. 1A expand on those developed and implemented by the nuclear industry to address the limited set of BDBEEs involving the

loss of a large area of the plant due to explosions and fire required pursuant to paragraph (hh)(2) of 10 CFR 50.54, "Conditions of licenses."

On May 31, 2012, the NRC issued a draft version of an interim staff guidance, JLD-ISG-2012-01, and published a notice of its availability for public comment in the *Federal Register* (77 FR 33779), with the 30 day comment period running through July 7, 2012. The NRC received seven comments during this time, with the NRC addressing the comments as documented in "NRC Response to Public Comments, JLD-ISG-2012-01 (Docket ID NRC-2012-0068)" (Ref. 19).

On July 3, 2012, NEI submitted Rev. C to NEI 12-06 (Ref. 20), incorporating many of the exceptions and clarifications included in the draft version of JLD-ISG-2012-01. On August 3, 2012, NEI submitted Draft Rev. 0 to NEI 12-06 incorporating many of the remaining exceptions and clarifications. On August 21, 2012, NEI submitted Rev. 0 to NEI 12-06, making various editorial corrections. The NRC reviewed the August 21, 2012 submittal of Rev. 0 of NEI 12-06 dated August 2012 and endorsed it in JLD-ISG-2012-01 as a process the NRC considers acceptable for meeting the regulatory requirements with noted clarifications.

On August 25, 2015, NEI submitted Rev. 1 to NEI 12-06 (Ref. 21), incorporating lessons learned in the implementation of Order EA-12-049 and alternative approaches taken by licensees for compliance to that order. Following a public webinar discussion of potential exceptions and clarifications on September 21, 2015, NEI submitted Rev. 1A to NEI 12-06.

The NRC is issuing 10 CFR 50.155 to, among other things, make the requirements of Order EA-12-049 generically applicable, taking into account lessons learned during the implementation of the orders and input from stakeholders. This RG endorses, with clarifications, NEI 12-06, Rev. 1A as an acceptable method for applicants and licensees to demonstrate compliance, in part, with the regulatory requirements. NEI 12-06, Rev. 1A was developed by NEI to incorporate lessons learned and additional alternative approaches to meet the requirements of Order EA-12-049. The guidelines in NEI 12-06, Rev. 1A recommend a three-phase approach for mitigating BDBEEs. The initial phase makes use of installed equipment and resources to maintain or restore key safety functions including core cooling, containment, and SFP cooling. The transition phase includes providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase includes obtaining sufficient offsite resources to sustain these functions indefinitely.

External Documents Endorsed in This Guide

This RG endorses, in part, the use of one or more codes, standards, or guidance documents developed by external organizations. These codes, standards, and third party guidance documents may contain references to other codes, standards, or third party guidance documents ("secondary references"). If a secondary reference has itself been incorporated by reference into NRC regulations as a requirement, then licensees and applicants must comply with that standard as set forth in the regulation. If the secondary reference has been endorsed in an RG as an acceptable approach for meeting an NRC requirement, then the standard constitutes a method acceptable to the NRC for meeting that regulatory requirement as described in the specific RG. If the secondary reference has neither been incorporated into NRC regulations nor endorsed in an RG, the secondary reference is neither a legally-binding requirement nor a "generic" NRC approved acceptable approach for meeting an NRC requirement. However, licensees and applicants may consider and use the information in the secondary reference, if appropriately justified, consistent with current regulatory practice, and consistent with applicable NRC requirements.

Harmonization with International Standards

The International Atomic Energy Agency (IAEA) has established a series of technical reports, safety guides and standards constituting a high level of safety for protecting people and the environment. IAEA guides present international good practices and identify best practices to help users striving to achieve high levels of safety. This RG and the NEI technical document endorsed by it contain guidance about BDBEE mitigation similar to guidance under revision by the IAEA.

C. STAFF REGULATORY GUIDANCE

This RG endorses, with clarifications, the methods described in NEI 12-06, Rev. 1A, dated October 2015. The NRC staff has determined that the methods described in the NEI 12-06, Rev. 1A constitute procedures and processes generally acceptable to the NRC for demonstrating compliance with the regulatory requirements in 10 CFR 50.155 subject to the following clarifications.

1. Development and Implementation Process

10 CFR 50.155(b) and (b)(1) require that applicants or licensees develop and implement an integrated response capability that includes strategies and guidelines to mitigate beyond-design-basis external events from natural phenomena that result in an ELAP concurrent with either a loss of normal access to the ultimate heat sink (LUHS) or, for nuclear power plants with passive reactor designs, a loss of normal access to the normal heat sink. The strategies and guidelines developed and implemented under those sections must be capable of being implemented site-wide and must include maintaining or restoring core cooling, containment, and spent fuel pool cooling capabilities; and the acquisition and use of offsite assistance and resources to support those functions.

1.1. Establishment of Baseline Coping Capability

Section 1.3 of NEI 12-06, Rev. 1A, discusses the objectives and guiding principles of the FLEX program that are responsive to 10 CFR 50.155(b)(1). These principles retain the three-phase approach that had been required under Order EA-12-049 and provide that plant-specific analyses will determine the duration of each phase.

Section 2 of NEI 12-06, Rev. 1A, provides a high-level discussion of the site-specific nature of the actions required by each licensee to properly implement the performance-based requirements in the regulations. Sections 2.1 through 2.5 of NEI 12-06, Rev. 1A discuss the coping capacities, types of external hazards, strategies, and controls each licensee should implement to meet the requirements in the regulations.

Section 3 of NEI 12-06, Rev. 1A provides performance attributes, general criteria and baseline assumptions for use in the development and implementation of the strategies and guidelines under 10 CFR 50.155(b)(1). NEI 12-06, Rev. 1A further provides that licensees should use these criteria and assumptions for analyses used to establish a baseline coping capability. The assumptions include the initial conditions listed in section 3.2.1.3 that include a loss of offsite power affecting all units at a plant site and the specification that "[a]ll design basis installed sources of emergency on-site ac power and SBO alternate ac power sources [as defined in 10 CFR 50.2] are assumed to be not available and not imminently recoverable."

NEI 12-06, Rev. 1A specifies in section 3.2.1.7 that "[s]trategies that have a time constraint to be successful should be identified and a basis provided that the time can reasonably be met." NEI 12-06, Rev. 1A specifies in section 11.4.3 that FLEX support guidelines (FSGs) will be developed to provide guidance that can be employed for a variety of conditions and that the FSGs will be reviewed and validated to ensure they are feasible. NEI 12-06, Rev. 1A, Appendix E provides a method for validation of the FSGs.

NEI 12-06, Rev. 1A, Section 3.2.1.13 specifies that best-estimate analyses are appropriate for the purpose of establishing the baseline coping capabilities.

Staff Position: Sections 1, 2 and 3 and Appendix E of NEI 12-06, Rev. 1A provide an acceptable method for licensees to follow to develop a baseline coping capability for mitigating an ELAP concurrent with either an LUHS or, for nuclear power plants with passive reactor designs, a loss of normal access to the normal heat sink with the following clarifications:

a) It should be noted that the initial and boundary conditions described do not accurately reflect a loss of all ac power condition due to the limitation of initial conditions (1) and (2) of NEI 12-06, Rev. 1A, Section 3.2.1.3. The additional contingencies described in section 1.2 of this document are necessary for compliance with the requirement to mitigate a loss of all ac power.

b) An element of a set of strategies to maintain or restore core and SFP cooling and containment functions includes knowledge of the time a licensee or applicant can withstand challenges to these key safety functions using installed equipment during a BDBEE. This knowledge provides an input to the choice of storage locations and conditions of readiness of the equipment required for the follow-on phase. This duration is related to, but distinct from the specified duration for the requirements of 10 CFR 50.63, "Loss of All Alternating Current Power," paragraph (a), because it represents the current capabilities of the licensee or applicant rather than a required capability and licensees and applicants should 1) account for the SFP cooling function, which is not addressed by 10 CFR 50.63(a), and 2) assume the non-availability of alternate ac sources, which may be included in meeting the specified durations of 10 CFR 50.63(a). This is implicit in the NEI 12-06, Rev. 1A principles described in Section 3.2.1.7, Paragraph (6) and Section 3.2.2, Paragraph (1). However, maintenance of the guidance and strategies requires that the estimate of capability be kept current to reflect plant conditions following facility changes such as modifications or equipment outages. Changes in the facility can impact the duration for which the initial response phase can be accomplished, the required initiation times for the transition phase, and the required delivery and initiating times for the final phase.

c) The use of best-estimate analyses for establishing the baseline coping capabilities is appropriate in the context of the beyond-design-basis external events for 10 CFR 50.155(b)(1). This includes the use of normal fluid levels for tanks that are maintained by procedure or administrative controls rather than the minimum levels allowed by Technical Specifications.

d) Consistent with the goal of mitigation strategies for BDBEE, the validation method documented in Appendix E of NEI 12-06, Rev. 1A is endorsed as a method to (1) assess whether it is feasible, considering design basis, or reevaluated hazard conditions determined under the § 50.54(f) request for information of March 12, 2012 (as applicable), to execute tasks, manual actions and decisions (i.e., human actions) required

by the mitigation strategies described in NEI 12-06, Rev. 1A and (2) support a conclusion that the strategies mitigate, to the extent practical, the adverse effects of BDBEEs on the ability of personnel to perform the required human actions. NEI 12006, Rev. 1A, Appendix E neither proposes nor is endorsed as a method to assess whether required human actions are reliable.

1. The use of Level C validation methods should be limited to those tasks, manual actions and decisions that do not have a time constraint for the strategy to be successful. This is because the Level C validation methods do not result in an estimate of the time necessary to perform the tasks, manual action, or decision and cannot provide a basis that a time constraint can reasonably be met. Tasks, manual actions, or decisions that have time constraints may be validated using a Level A or Level B method that results in an estimate of the time required to complete the task or manual action or to make and communicate the decision in order to confirm that the time constraint can reasonably be met as specified in NEI 12-06, Rev. 1A, Section 3.2.1.7, principle 6, which states that "[s]trategies that have a time constraint to be successful should be identified and a basis provided that the time can reasonably be met."

2. Consistent with NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities" (Ref. 22) as endorsed by NRC letter dated May 15, 2012 (Ref. 23), additional staff and resources may be assumed to be available commencing at the 6 hour point (or less, with justification). As a result, the use of Level B validation techniques, which are less stringent, may typically be substituted for the use of Level A validation techniques at the 6 hour point. However, prior to substituting Level B validation, licensees should confirm that staff augmentation will improve the capability of plant personnel to complete tasks, manual actions, and decisions. Level B validation should not be substituted for tasks, manual actions, and decisions that have time constraints and that cannot performed more effectively or efficiently through addition of personnel. In addition, the results of the integrated review should be used to assess the need to adjust and revalidate tasks, manual actions, or decisions for which the validation did not provide reasonable confidence in the ability of plant personnel to execute a required task, manual action, or decision.

1.1.1. Phased Approach

The regulations in 10 CFR 50.155 do not contain specific requirements for a multiple phase approach to mitigating and recovering from a BDBEE as had been the case under Order EA-12-049. NEI 12-06, Rev. 1A, carries the definitions of the phases from that order forward as a conceptual framework for the development of the FLEX strategies. Maintenance of core and SFP cooling and containment functions requires overlap between the initiating times for the phases with the duration for which each licensee can perform the prior phases. The NRC recognizes that for certain BDBEEs, the damage state could prevent maintenance of key safety functions using the equipment intended for particular phases. Under such circumstances, prompt initiation of the follow-on phases to restore core and SFP cooling and containment functions is appropriate.

Staff Position: NEI 12-06, Rev. 1A provides an acceptable method for developing an approach to mitigate and cope with BDBEEs.

1.1.1.1. Initial Response Phase

The initial response phase will be accomplished using installed equipment. Licensees and applicants should establish and maintain current estimates of their capabilities to maintain core and SFP cooling and containment functions assuming a loss of all alternating current (ac) electric power to the essential and nonessential switchgear buses except for those fed by station batteries through inverters. These estimates provide the time period in which the licensee should be able to initiate the transition phase and maintain or restore the key safety functions using portable on-site equipment. These estimates should be considered in selecting the storage locations for that equipment and the prioritization of resources to initiate their use.

Staff Position: NEI 12-06, Rev. 1A, Section 3.0, provides an acceptable method for determining the baseline coping capabilities for the initial response phase.

1.1.1.2. Transition Phase

The transition phase will be accomplished by supplementing the use of installed equipment with portable equipment stored on-site. The strategies for this phase must be capable of maintaining core cooling, containment, and SFP cooling capabilities (following their restoration, if applicable) from the time they are implemented until they can be supplemented by offsite resources in the final phase. The duration of the transition phase should provide sufficient overlap with both the initial and final phases to account for the time it takes to install equipment and for uncertainties.

Staff Position: NEI 12-06, Rev. 1A, Section 3.0, provides an acceptable method for determining the baseline coping capabilities for the transition phase.

1.1.1.3. Final Phase

The final phase will be accomplished using the portable equipment stored on-site augmented with additional equipment and consumables obtained from off-site until power, water, and coolant injection systems are restored or commissioned.

Staff Position: NEI 12-06, Rev. 1A, Section 3.0, provides an acceptable method for determining the baseline coping capabilities for the final phase. NEI 12-06, Rev. 1A, Section 12.2, provides an acceptable method for establishing the capability to obtain equipment and consumables from off-site until power, water, and coolant injection systems are restored or commissioned.

1.2. Contingencies for Loss of All Alternating Current Power

NEI 12-06, Rev. 1A, Section 3.2.2 provides 17 guidelines for use in the development of the guidance and strategies under 10 CFR 50.155(b)(1). Guideline (2) of this sections states:

> "Plant procedures/guidance should recognize the importance of AFW/HPCI/RCIC/IC during the early stages of the event and direct the operators to invest appropriate attention to assuring its initiation and continued, reliable operation throughout the transient since this ensures decay heat removal."

The risk of core damage due to ELAP can be significantly reduced by assuring the availability of auxiliary feedwater (AFW) (emergency feedwater (EFW) at some plants), high pressure core injection (HPCI), reactor core isolation cooling (RCIC), or isolation condensers (IC), particularly in the first 30 minutes to one hour of the event. Assuring

that one of these systems has been initiated to provide early core heat removal, even if local initiation and control is required is an important initial action. A substantial portion of the decay and sensible reactor heat can be removed during this period. The availability of AFW/HPCI/RCIC/IC can be improved by providing a reliable supply of water, monitoring turbine conditions (particularly lubricating oil flow and temperature), bypassing automatic trips, and maintaining nuclear boiler/steam generator water levels. These actions help ensure that the core remains adequately covered and cooled during an extended loss of ac power event.

Appendices C and D of NEI 12-06, Rev. 1A contain summaries of performance attributes for boiling-water and pressurized-water reactors respectively, address guideline (2) of NEI 12-06, Rev. 1A, Section 3.2.2 by specifying that procedures/guidance will include local manual initiation of AFW/EFW/HPCI/RCIC/IC.

NEI 12-06, Rev. 1A, Section 5.3.3, describes interface considerations for seismic events, expands on this contingency to specify that the strategies and guidelines should include:

> "…a reference source for the plant operators that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy. Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance should include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power."
>
> "This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings using a portable instrument (e.g., a Fluke meter) at a location that does not rely on the functioning of intervening electrical equipment (e.g. I/E convertors, analog to digital converters, relays, etc.) that could be adversely affected by BDB seismic events. An instrument reading should be obtained at the closest accessible termination point to the containment penetration or parameter of measurement, as practical."

Staff Position: NEI 12-06, Rev. 1A, Section 3.2.2, guideline (2) and the provisions in NEI 12-06, Rev. 1A, Appendices C and D, for manual initiation of AFW/EFW/HPCI/RCIC/IC coupled with the NEI 12-06, Rev. 1A, Section 5.3.3 provisions for the development of guidance on obtaining instrument readings and controlling critical equipment without the associated power provide an acceptable method for licensees to develop the contingencies for the loss of all ac power that are necessary to comply with the 10 CFR 50.155(b)(1) requirement to mitigate an extended loss of all ac power. The need for the NEI 12-06, Rev. 1A, Section 5.3.3 contingencies to show compliance with the § 50.155(b)(1) condition of loss of all ac power is not limited to seismically-induced events; it is a necessary element of compliance for that requirement regardless of the initiating event. Because NEI 12-06, Rev. 1A, Section 5 is applicable to all power reactor licensees, conformance to NEI 12-06, Rev. 1A, Section 5.3.3 can provide the capabilities necessary to meet that element regardless of the initiating event.

2. Equipment Capacity and Capability

10 CFR 50.155(c)(1) requires that the equipment relied upon for the mitigation strategies required by § 50.155(b)(1) have sufficient capacity and capability to simultaneously maintain or restore

core cooling, containment, and SFP cooling capabilities for all the power reactor units within the site boundary.

NEI 12-06, Rev. 1A, Section 3.2.2, Guideline (16), provides guidance for the minimum number of sets of equipment a licensee should provide in order to achieve reasonable assurance that the equipment will be available in sufficient quantity to have the capacity and capability necessary to comply with § 50.155(c)(1). This includes guidance for the provision of spare hoses and cables in a quantity that is either (1) equivalent to 10% of the total length of each type of hose or cable necessary; or (2) of sufficient length and sizing to replace the single longest run needed to support any single strategy.

NEI 12-06, Rev. 1A, Sections 11.1 and 11.2 provide guidance on the quality attributes and equipment design a licensee may use to achieve reasonable assurance that the individual pieces of equipment have the capability to perform the functions they are intended for in the FLEX strategies.

Staff Position: NEI 12-06, Rev. 1A, Section 3.2.2, Guideline (16) and Sections 11.1-2, provide an acceptable method to demonstrate compliance with § 50.155(c)(1).

3. Reasonable Protection

10 CFR 50.155(c)(2) requires that the equipment relied upon for the mitigation strategies required by § 50.155(b)(1) be reasonably protected from the effects of natural phenomena.

NEI 12-06, Rev. 1A, Appendix A, defines reasonable protection as… "Storing on-site FLEX equipment in configurations such that no one external event can reasonably fail the site FLEX capability (N) when the required FLEX equipment is available."

Staff Position: NEI 12-06, Rev. 1A, provides an acceptable approach for reasonably protecting equipment from the effects of natural phenomena. This approach includes the following:

- Identification of the natural phenomena for which reasonable protection is necessary,
- Determination of the method of protection to be used,
- Establishment of controls on unavailability of the equipment, and
- Provision of a method of transporting the portable equipment from its storage location to the site in which it will be used.

Individual elements of reasonable protection are discussed below.

3.1. Evaluation of External Hazards

Section 4 of NEI 12-06, Rev. 1A, discusses the overall methodology for identifying external hazards and evaluating their impact. Appendix B of NEI 12-06, Rev. 1A discusses the identification of external hazards for which licensees should provide reasonable protection. NEI 12-06, Rev. 1A, Sections 5 through 9, discuss the evaluation of the effects of natural phenomena to meet the baseline coping capability.

Staff Position: Sections 5 through 9 and Appendix B of NEI 12-06, Rev. 1A, provide an acceptable method for the evaluation and equipment considerations to address the effects of external hazards in order to satisfy that element of reasonable protection.

3.2. Protection from External Hazards

Sections 5 through 9 of NEI 12-06, Rev. 1A discuss methodologies for the protection of the equipment. The methods of protection comprise: 1) physical protection of the equipment; 2) protection by relocation of the equipment from a position in which a licensee may have indication of an impending hazard; and 3) provision of multiple, redundant pieces of equipment or methods to accomplish a function, stored in diverse locations in order to provide assurance that at least one method of accomplishing that function will survive an event of a localized nature such as a tornado missile impact.

Staff Position: Sections 5 through 9 and Appendix B of NEI 12-06, Rev. 1A provide an acceptable method for protecting the equipment from the effects of external hazards in order to satisfy that element of reasonable protection.

3.3. Deployment of Equipment

Sections 5 through 9 of NEI 12-06, Rev. 1A discuss methods for transporting the equipment from the location in which it is stored to the location in which it would be used. These sections additionally discuss the connection of the equipment to structures, systems, and components (SSCs) necessary for completion of the deployment of the equipment from storage to a state in which it can supplement the functions of the installed SSCs.

Staff Position: Sections 5 through 9 and Appendix B of NEI 12-06, Rev. 1A provide an acceptable method for deployment of the equipment in order to satisfy that element of reasonable protection.

3.4. Programmatic Controls for Unavailability

Section 11.5.3 of NEI 12-06, Rev. 1A discusses the programmatic controls for equipment and connections between that equipment and permanently installed SSCs. These controls include limited time periods in which the equipment and connection points may be unavailable for any reason, with the duration of the acceptable time period being based on the ability of the licensee to accomplish the intended function of the equipment by other means.

When a licensee is unable to accomplish the intended function of the equipment by other means, unavailability durations are limited to periods comparable to those allowed by Technical Specifications for safety-related SSCs with similar functions. (See, e.g., the completion times allowed for restoration of turbine-driven auxiliary feedwater trains in limiting condition for operation 3.7.5, "Auxiliary Feedwater (AFW) System," of NUREG-1431, "Standard Technical Specifications – Westinghouse Plants," Rev. 4.0, Volume 1, "Specifications," which range from 24 hours to 7 days. [Ref. 24])

When a licensee is able to accomplish the intended function of the equipment by other means (i.e., the equipment is spare equipment beyond the minimum necessary to accomplish the intended function), unavailability of the equipment is limited to 90 days based on a normal plant work cycle of 12 weeks in order to avoid displacing maintenance actions for other safety-significant equipment or SSCs.

When a licensee is able to accomplish the intended function of the equipment by other means, but that means is not protected from all possible effects of natural phenomena, unavailability of the equipment is limited to 45 days based on a short-cycle work period of 6 weeks in order to avoid displacing maintenance actions for other safety-significant equipment or SSCs.

Similar controls are applied to connection points for the equipment to installed SSCs.

Staff Position: Section 11.5.3 of NEI 12-06, Rev. 1A provides an acceptable method for controlling unavailability of the equipment in order to satisfy that element of reasonable protection.

4. Equipment Maintenance

10 CFR 50.155(c)(3) requires that the equipment relied on for the mitigation strategies under § 50.155(b)(1) receive adequate maintenance such that it is capable of fulfilling its intended function.

Section 11.5 of NEI 12-06, Rev. 1A discusses the maintenance and testing of the equipment. Section 3.2.1.13 discusses the Electric Power Research Institute (EPRI) program developed for maintenance of the equipment, which is documented in the EPRI technical report 3002000623, "Applications Center: Preventive Maintenance Basis for FLEX Equipment – Project Overview Report" (Ref. 25). The EPRI technical report 3002000623 was endorsed by NRC letter dated October 7, 2013 (Ref. 26).

Staff Position: Sections 11.5 and 3.2.1.13 of NEI 12-06, Rev. 1A, provide an acceptable method for maintaining the equipment relied on for the mitigation strategies under § 50.155(b)(1).

5. Configuration Control

10 CFR 50.155(b) and (b)(1) require that applicants or licensees maintain an integrated response capability that includes strategies and guidelines to mitigate beyond-design-basis external events from natural phenomena that result in an ELAP concurrent with either an LUHS or, for nuclear power plants with passive reactor designs, a loss of normal access to the normal heat sink.

10 CFR 50.155(f) allows licensees to make changes to the implementation of the requirements of 10 CFR 50.155 without NRC approval provided that the licensee performs an evaluation demonstrating that 10 CFR 50.155 continues to be met prior to making the change.

Section 11.8 of NEI 12-06, Rev 1A discusses the configuration control of the strategies and guidelines as well as the maintenance of an overall program document and record of changes.

Staff Position: Section 11.8 of NEI 12-06, Rev. 1A provides an acceptable method for maintaining configuration control of an integrated response capability under 10 CFR 50.155(b)(1) and (f).

6. Treatment of Reevaluated Hazards under the Requests for Information of March 12, 2012

10 CFR 50.155(c)(2)(i) requires that each licensee that received the March 12, 2012, NRC letter issued under § 50.54(f) concerning reevaluations of seismic and flooding hazard levels provide

reasonable protection against that reevaluated seismic or flooding hazard(s) if it exceeds the design basis of its facility.

6.1. Treatment of Reevaluated Seismic Hazards

The following guidance establishes the necessary considerations to evaluate the equipment used in the guidance and strategies required by 10 CFR 50.155(b)(1) with respect to the reevaluated hazard as required under 10 CFR 50.155(c)(2)(i). Detailed implementation methods will be developed as necessary.

Staff Position: Licensees with reevaluated seismic hazards that exceed the design basis of the facility should demonstrate reasonable protection for the reevaluated seismic hazard of the equipment used in the guidance and strategies required by 10 CFR 50.155(b)(1) as required under 10 CFR 50.155(c)(2)(i). Past seismic reevaluations, to the extent they meet the standards of reasonable protection described here, can be used to meet the requirements.

a. The demonstration of reasonable protection should address all phases of mitigation and consider FLEX equipment as well as installed equipment or structures, systems, and components of the facility relied upon in mitigating strategies under 10 CFR 50.155(b)(1).

b. Licensees should evaluate the equipment and SSCs within the scope of the demonstration considering all pertinent failure modes (both the individual and system level failure modes) that could prevent the functional performance needed for the mitigating strategies as discussed in provisions c through k below. This should include consideration of seismic interactions, evaluation of soil related failure modes, and consequential failures.

c. Licensees should evaluate structures containing cooling and makeup water, fuel, and equipment relied on for the mitigating strategies under NEI 12-06, Rev. 1A, Sections 3.2.1.3.3 through 3.2.1.3.7, 3.2.2.5, and footnote 4 to Section 3.2.3 for robustness as defined in NEI 12-06, Rev. 1A, Appendix A using the reevaluated seismic hazard rather than the design basis seismic hazard. Deformation of the structures is acceptable so long as they will remain functional (i.e., retain the fluids and allow access for deployment and use of the equipment as well as support equipment functionality).

d. Licensees should evaluate delivery systems for cooling and makeup water and fuel relied on for the mitigating strategies under NEI 12-06, Rev. 1A, Sections 3.2.1.3.4, 3.2.1.3.10, 3.2.2.5 and 3.2.2.13 for robustness as defined in NEI 12-06, Rev. 1A, Appendix A using the reevaluated seismic hazard rather than the design basis seismic hazard. Deformation of the systems is acceptable so long as they will remain functional (i.e., retain the fluids and allow their flow).

e. Licensees should evaluate portable equipment and the means to move that equipment that is stored as described in NEI 12-06, Rev. 1A, Section 5.3.1.1.a to confirm that securing and protection from seismic interactions at the new seismic hazard level remains acceptable. The structure housing the equipment should be evaluated to confirm it has adequate seismic margin to protect the equipment at the reevaluated seismic hazard.

f. Licensees should evaluate portable equipment and the means to move that equipment that is stored as described in NEI 12-06, Rev. 1A, Section 5.3.1.1.b to confirm that securing and protection from seismic interactions at the new seismic hazard level remains

acceptable. The structure housing the equipment should be evaluated to confirm that, while deformation of the structure is possible, it will protect the equipment at the reevaluated seismic hazard so as to allow deployment of the equipment.

g. Licensees should evaluate portable equipment and the means to move that equipment that is stored as described in NEI 12-06, Rev. 1A, Section 5.3.1.1.c to confirm that securing and protection from seismic interactions at the reevaluated seismic hazard level remains acceptable.

h. Licensees should review routes for the deployment of equipment from a storage location to its usage location to ensure no adverse impact is created by a seismic event at the reevaluated hazard level, such as potential soil liquefaction.

i. Licensees should evaluate locations for connection points described in NEI 12-06, Rev. 1A, Section 5.3.2.2 to confirm they only require access through structures that are seismically robust for the reevaluated seismic hazard.

j. Licensees should evaluate large internal flooding sources considered under NEI 12-06, Rev 1A, Section 5.3.3.2 for robustness as defined in NEI 12-06, Rev 1A, Appendix A using the reevaluated seismic hazard rather than the design basis seismic hazard.

k. Licensees may consider equipment from off-site in diverse, redundant locations to be protected from the reevaluated seismic hazard.

6.1.1. Case 1: Demonstration of Reasonable Protection for Exceedances Limited to High Frequency

Staff Position: If the ground motion response spectrum (GMRS) for a licensee's reevaluated seismic hazard is fully bounded by the licensee's design basis seismic hazard from 1 Hz to 10 Hz, but exceeds the design basis seismic hazard above 10 Hz, the licensee should evaluate high frequency (HF) sensitive in-plant SSCs relied upon for execution of the mitigating strategies using the methodologies of the EPRI Report 3002004396, "High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation," (Ref. 27) consistent with its endorsement by letter dated September 17, 2015, (Ref. 28).

6.1.2. Alternate Mitigating Strategies

Staff Position: Development of an Alternate Mitigating Strategy (AMS) that provides a capability to mitigate the BDBEE by mitigating or preventing an ELAP that would occur as a result of the BDBEE through exhaustion of fuel for operating emergency power sources is an acceptable method of compliance with 10 CFR 50.155(b)(1) when the hazard level for the AMS is identified.

a. Reevaluated seismic hazard should be used in place of the safe shutdown earthquake (SSE) as described in Section 6.1 of this RG.

b. The initial condition of NEI 12-06, Rev. 1A, Section 3.2.1.3.1 should be modified to reflect the reevaluated seismic hazard as the initiating event for the associated AMS. Timing of the loss of off-site power should reflect impact of the flooding mechanism on the delivery of off-site power to the facility.

c. The initial condition of NEI 12-06, Rev. 1A, Section 3.2.1.3.2 should be modified to reflect the availability of emergency on-site ac power sources and station blackout alternate ac power sources unless and until they are rendered unavailable by the reevaluated seismic hazard.

6.1.2.1. Case 1: Demonstration of Reasonable Protection Based upon the Individual Plant Examination of External Events

Licensees completed the Individual Plant Examination of External Events (IPEEE) in the 1990s under Generic Letter (GL) 88-20 Supplements 4 (Ref. 29) and 5 (Ref. 30) using the guidance of NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," (Ref. 31). Acceptable approaches to perform the IPEEE included the NRC seismic margin assessment (SMA) method, the EPRI SMA method described in EPRI NP-6041-SL, Rev. 1, "A Methodology for Assessment of Nuclear Plant Seismic Margin," (Ref. 32) or a seismic probabilistic risk assessment (SPRA). For each approach, a seismic equipment list (SEL) was developed that included multiple redundant safe shutdown success paths and/or accident sequences. Under NUREG-1407, plants performed the seismic portion of the IPEEE in three categories, reduced scope, focused scope and full scope. The seismic IPEEEs were generally performed using input motions based on the following:

a. Median-centered response spectrum using the shape from NUREG/CR-0098, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," (Ref. 33) anchored to 0.3g peak ground acceleration (PGA).

b. For SPRAs, plants generally used the mean uniform hazard response spectra and hazard curves developed by Lawrence Livermore National Laboratory (LLNL) in NUREG-1488, "Revised Livermore Seismic Hazard Estimates for Sixty-Nine Nuclear Power Plant Sites East of the Rocky Mountains," (Ref. 34), and/or the EPRI in the EPRI NP-6395-D, "Probabilistic Seismic Hazard Evaluations at Nuclear Plant Sites in the Central and Eastern US: Resolution of the Charleston Earthquake Issue" (Ref. 35).

c. In some cases, past SPRAs were submitted for IPEEE closure that used input motions and hazard curves that preceded the LLNL and EPRI hazard curves of NUREG-1488 and EPRI NP-6395-D respectively.

Consistent with the input spectrum shape used in an IPEEE, a licensee can develop an IPEEE high-confidence-of-low-probability-of-failure spectrum (IHS).

Staff Position: The evaluation of redundant safe shutdown success paths under the IPEEE demonstrates the reasonable protection of equipment necessary to maintain or restore core cooling and containment capabilities for licensees provided that:

a. The IHS envelopes the GMRS for the reevaluated seismic hazard from 1 to 10 Hz, with the exception of small narrowband exceedances that meet the criteria of the EPRI 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" (Ref. 36); and

b. The previous seismic evaluation was accepted by the NRC in the letter dated May 9, 2014, (Ref. 37), or is subsequently accepted by the NRC to screen out of conducting a seismic risk evaluation based on the IHS; and

c. If the licensee performed an EPRI SMA, a plant-specific evaluation shows that SSCs that limit the coping duration to 72 hours are available for an indefinite period to support continued maintenance of the safe shutdown conditions.

Licensees relying on the IHS to demonstrate reasonable protection of equipment necessary to maintain or restore core cooling and containment capabilities should:

a. Evaluate the seismic capacity of equipment necessary to maintain or restore SFP cooling capabilities to the GMRS for the reevaluated seismic hazard; and

b. Evaluate HF sensitive in-plant SSCs relied upon to maintain or restore core cooling, containment and SFP cooling capabilities using the methods of the EPRI Report 3002004396, "High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation," if the GMRS from the reevaluated seismic hazard exceeds the design basis seismic hazard above 10 Hz.

6.1.2.2. Case 2: Demonstration of Reasonable Protection Based upon the Expedited Seismic Evaluation Process

The EPRI report 3002000704, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," (Ref. 38), described an expedited seismic evaluation process (ESEP) to evaluate the seismic ruggedness of SSCs for a review level ground motion (RLGM) derived by linearly scaling the design basis seismic hazard by the maximum ratio of it to the GMRS for the reevaluated seismic hazard in the 1 to 10 Hz range, with this ratio limited to a maximum of two times the design basis seismic hazard. Alternatively, licensees conducted the ESEP using the GMRS itself. The ESEP evaluated seismic adequacy of components in a single success path for core cooling, reactor coolant system makeup and containment capabilities for the RLGM or the GMRS resulting from the reevaluated seismic hazard. This process was endorsed by the NRC by letter dated May 7, 2013 (Ref. 39).

Staff Position: The ESEP demonstrates reasonable protection of evaluated SSCs necessary for the maintenance or restoration of core cooling and containment capabilities for those licensees having reevaluated seismic hazards less than twice the design basis seismic hazard.

1. SSCs not within the scope of the ESEP should be evaluated for reasonable protection as follows:

    a. Qualitatively based on Seismic Experience. EPRI NP-6041-SL and EPRI TR-104871, "Generic Seismic Technical Evaluations of Replacement Items for Nuclear Power Plants," (Ref. 40) provide guidance on rugged SSCs. Such equipment that was not included within the ESEP review and that have high seismic capacities would require no further actions to demonstrate reasonable assurance to withstand the new seismic hazard. These SSCs include:

        1. Piping, cabling, conduit, and their supports

        2. Manual valves, check valves, and rupture disks

3. Power operated valves not required to change state as part of the FLEX mitigation strategies

4. Nuclear steam supply system components (e.g. reactor pressure vessel and internals, control rod drive mechanisms (CRDMs), fuel rods, reactor coolant pumps and seals, etc.)

5. Portable FLEX equipment (tie downs and seismic interactions should be addressed using the approach 3 below)

6. Safety-related buildings

b. Quantitatively as described in item c below for SSCs and seismic interactions that were not included in the ESEP review and cannot be justified to be inherently rugged for seismic accelerations and displacements. Examples of these SSCs and seismic interactions include:

1. Haul Path – including liquefaction, slope stability and interactions

2. FLEX Equipment Storage Building and Non-Seismic Category 1 Structures

3. Operator Pathways – interaction pathway review, use the beyond-design-basis seismic evaluation criteria described in § 6.1.2.2.1.c, below, if calculation is required

4. Tie down of FLEX portable equipment that are required to be restrained during the earthquake

c. Beyond-Design-Basis Seismic Evaluation Criteria

In order to demonstrate reasonable protection of equipment that was not included in the ESEP review and is not inherently rugged for seismic accelerations, a licensee should demonstrate that the GMRS level of seismic hazard at the site results in an acceptably low probability of failure. Licensees may rely on the guidance in the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) Standard 43-05, "Seismic Design Criteria for Structures, Systems and Components in Nuclear Facilities" (Ref. 41) related to beyond-design-basis seismic evaluation for purposes of defining an appropriately low probability of failure. ASCE/SEI 43-05 defines a 10% probability of unacceptable performance ($C_{10\%}$) which is reviewed against the beyond-design-basis seismic event (150% of the design-basis event (DBE) ground motion for the ASCE/SEI 43-05 case).

The process for calculating the $C_{10\%}$ values is defined in this section. Table 1 provides recommended values for β_C, β_R, β_U, and the ratio of the median capacity $C_{50\%}$ to the $C_{1\%}$ capacity taken from the SPID determined in the EPRI 1025287. The recommended β_C values are based on Kennedy's recommendations in "*Overview of Methods for Seismic PRA and Margin Analysis Including Recent Innovations*," Proceedings of the Organization for Economic Co-operation and Development (OECD)-Nuclear Energy Agency (NEA) Workshop on Seismic

Risk, Tokyo, Japan, August, 1999 (Ref. 42), and on average area biased slightly conservative (i.e., slightly low β_C on average). Because random variability β_R is primarily due to ground motion variability, a constant β_R value of 0.24 is recommended regardless of the SSC being considered. The recommended uncertainty β_U values are back-computed from the recommended composite β_C and β_R values. The β values for Table 1 apply to fragilities tied to ground motion parameters (e.g., PGA or Peak Spectral Acceleration at 5 Hz). The ratios of the 10% failure probability capacity $C_{10\%}$ to the $C_{1\%}$ capacity have been calculated and are shown in the last column of Table 1. The method for demonstrating the adequate seismic ruggedness for mitigation systems would follow the approach for an SMA wherein a defined capacity is shown to exceed the defined demand. In the case of an SMA the demand for the assessment is referred to as the review level earthquake (RLE). The following steps would be undertaken for SSCs within the mitigation systems that undertake the $C_{10\%}$ review:

- The GMRS will be the RLE for the beyond-design-basis seismic review of the mitigation strategies
- The seismic capacity aligned with reasonable protection will be the $C_{10\%}$ value. The $C_{10\%}$ can be calculated by:
    - Calculate the $C_{1\%}$ capacity using the methods documented in past SPRA and seismic margin documentation and as summarized in the SPID defined in EPRI 1025287.
    - Multiply the $C_{1\%}$ capacity by the $C_{10\%}/C_{1\%}$ ratio from Table 1 based on the type of SSC being evaluated
- Verify that the $C_{10\%}$ capacity exceeds the RLE demand

Table 1: β_C, β_R, β_U, and $C_{50\%}/C_{1\%}$ Values for Hybrid Method for Various Types of SSCs

Type SSC	Composite β_C	Random β_R	Uncertainty β_U	$C_{50\%}/C_{1\%}$	$C_{10\%}/C_{1\%}$
Structures & Major Passive Mechanical Components Mounted on Ground or at Low Elevation Within Structures	0.35	0.24	0.26	2.26	1.44
Active Components Mounted at High Elevation in Structures	0.45	0.24	0.38	2.85	1.60
Other SSCs	0.40	0.24	0.32	2.54	1.52

2. Licensees relying on the ESEP to demonstrate reasonable protection of equipment necessary to maintain or restore core cooling and containment capabilities should:

   a. Evaluate the seismic capacity of equipment necessary to maintain or restore SFP cooling capabilities to the GMRS for the reevaluated seismic hazard; and

   b. Evaluate HF sensitive in-plant SSCs relied upon to maintain or restore core cooling, containment and SFP cooling capabilities using the methods in the EPRI Report 3002004396, "High Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation," ADAMS Accession No. ML15223A095, consistent with its endorsement by letter dated September 17, 2015, ADAMS Accession No. ML15218A569, if the GMRS from the reevaluated seismic hazard exceeds the design basis seismic hazard above 10 Hz.

6.2. Treatment of Reevaluated Flooding Hazards

Appendix G of NEI 12-06, Rev. 1A discusses a method to assess the results of the flooding hazard reevaluations with respect to the guidance and strategies required by 10 CFR 50.155(b)(1).

6.2.1. (Modified) Mitigating Strategies

Sections G.4.1 and G.4.2 of Appendix G of NEI 12-06, Rev. 1A discuss a method to assess or modify the mitigating strategies to show they comply with the requirements of 10 CFR 50.155(b)(1) and 10 CFR 50.155(c)(2)(i) by using the new flooding hazard information, referred to as mitigating strategies flood hazard information.

Staff Position: Sections G.4.1 and G.4.2 of Appendix G of NEI 12-06, Rev. 1A provide acceptable methods to show that the existing strategies and guidelines comply with the requirements of 10 CFR 50.155(b)(1) and 10 CFR 50.155(c)(2)(i) for the new flooding hazard information or for developing modified strategies and guidelines.

6.2.2. Alternate Mitigating Strategies

Section G.4.3 of Appendix G of NEI 12-06, Rev. 1A discusses a method to develop AMS to meet the requirements of 10 CFR 50.155(b)(1) and 10 CFR 50.155(c)(2)(i).

Staff Position: Development of an AMS that provides a capability to mitigate the BDBEE by mitigating or preventing an ELAP that would occur as a result of the BDBEE through exhaustion of fuel for operating emergency power sources is an acceptable method of compliance with 10 CFR 50.155(b)(1) when the hazard level for the AMS is identified. Section G.4.3 of Appendix G of NEI 12-06, Rev. 1A provides an acceptable method to develop AMS to meet the requirements of 10 CFR 50.155(b)(1) and 10 CFR 50.155(c)(2)(i).

6.2.3. Targeted Hazard Mitigating Strategies

Section G.4.4 of Appendix G of NEI 12-06, Rev. 1A discusses a method to develop targeted hazard mitigating strategies (THMS) to meet the requirements of 10 CFR 50.155(b)(1) and 10 CFR 50.155(c)(2)(i).

Staff Position: Development of a THMS that provides a capability to mitigate the BDBEE by mitigating or preventing an ELAP that would occur as a result of the BDBEE through exhaustion

of fuel for operating emergency power sources is an acceptable method of compliance with 10 CFR 50.155(b)(1) when the hazard level for the THMS is identified. Section G.4.4 of Appendix G of NEI 12-06, Rev. 1A provides an acceptable method to develop THMS to meet the requirements of 10 CFR 50.155(b)(1) and 10 CFR 50.155(c)(2)(i).

7. Coordination with Severe Accident Management Guidelines

In SRM-COMSECY-15-0065, (Ref. 43) the Commission directed the NRC staff to "…ensure that any NRC-endorsed guidance for the proposed rule will provide for appropriate coordination of the FLEX support guidelines, extreme damage mitigating guidelines, and voluntarily maintained SAMGs with the existing emergency operating procedures (EOPs) at each plant…."

Section 3.2.1.10 of NEI 12-06, Rev. 1A provides criteria for the selection of parameters to be monitored as part of the minimum set of parameters necessary to support strategy implementation. These criteria include the ability to demonstrate the success of the strategies at maintaining the key safety functions as well as indicating imminent or actual core damage to facilitate a decision to manage the response to the event within the EOPs and FSGs or within the Severe Accident Management Guidelines (SAMGs).

Section 11.4 of NEI 12-06, Rev. 1A provides that FSGs will be used to supplement (not replace) the existing procedure that establishes the command and control for the event. This section further provides that the existing command and control procedure structure will be used to transition to SAMGs if FLEX mitigation strategies are not successful.

Staff Position: Sections 3.2.1.10 and 11.4 provide appropriate coordination between the FSGs and voluntarily maintained SAMGs, retaining command and control direction as defined within the EOPs unless and until a licensee transitions to the use of SAMGs.

8. Guidance for AP-1000 Design

Appendix F of NEI 12-06, Rev. 1A provides specific guidance for licensees with reactors of the AP-1000 design on how to satisfy provisions of the aforementioned regulations for sufficient offsite resources to sustain functions indefinitely.

Staff Position: The guidance of NEI 12-06, Rev. 1A, Appendix F, provides an acceptable means to meet the requirements of the regulations or license conditions imposing similar requirements.

D. IMPLEMENTATION.

The purpose of this section is to provide information on how applicants and licensees[1] may use this guide and information regarding the NRC's plans for using this RG. In addition, it describes how the NRC complies with the Backfit Rule found in 10 CFR 50.109(a)(1) or any applicable finality provisions in 10 CFR Part 52.

1 In this section, "licensees" refers to holders of, and "applicants" refers to applicants for, licenses for nuclear power plants under 10 CFR Parts 50 and 52.

Use by Applicants and Licensees

Applicants and licensees may voluntarily[2] use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this RG may be deemed acceptable if they provide sufficient basis and information for the NRC to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. Current licensees may continue to use guidance the NRC found acceptable for complying with the identified requirements as long as their current licensing basis remains unchanged.

Licensees may use the information in this RG for actions that do not require NRC review and approval. Licensees may use the information in this RG or applicable parts to resolve regulatory or inspection issues.

Use by NRC

The NRC does not intend or approve any imposition or backfitting of the guidance in this RG. The NRC does not expect any existing licensee to use or commit to using the guidance in this RG, unless the licensee makes a change to its licensing basis. The NRC does not expect or plan to request licensees to voluntarily adopt this RG to resolve a generic regulatory issue. The NRC does not expect or plan to initiate NRC regulatory action that would require the use of this RG. Examples of such unplanned NRC regulatory actions include issuance of an order requiring the use of the RG, generic communication, or promulgation of a rule requiring the use of this RG without further backfit consideration.

During regulatory discussions on plant specific operational issues, the NRC staff may discuss with licensees various actions consistent with NRC positions in this RG, as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered backfitting. However, unless this RG is part of the licensing basis for a facility, the NRC may not represent to the licensee that the licensee's failure to comply with the positions in this RG constitutes a violation.

If an existing licensee voluntarily seeks a license amendment or change and (1) the NRC's consideration of the request involves a regulatory issue directly relevant to this RG and (2) the specific subject matter of this RG is an essential consideration in the NRC's determination of the acceptability of the licensee's request, then the NRC may request that the licensee either follow the guidance in this RG or provide an equivalent alternative process that demonstrates compliance with the underlying NRC regulatory requirements. This is not considered backfitting as defined in 10 CFR 50.109(a)(1) or a violation of any applicable finality provisions in 10 CFR Part 52.

If a licensee believes that the NRC is either using this RG or requesting or requiring the licensee to implement the methods or processes in this RG in a manner inconsistent with the discussion in this Implementation section, then the licensee may file a backfit appeal with the NRC in accordance with the guidance in NUREG-1409, "Backfitting Guidelines," (Ref. 44) and the NRC Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection" (Ref. 45).

2 In this section, "voluntary" and "voluntarily" means that the licensee is seeking the action of its own accord, without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

REFERENCES[3]

1. *U.S. Code of Federal Regulations*, *Title* 10, "*Energy*," Chapter 1, "Nuclear Regulatory Commission," Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. Nuclear Energy Institute (NEI) document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 1A, dated October 2015, Washington, DC. (ADAMS Accession No. ML15279A426)[4]

3. NRC, Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012, Washington, DC. (ADAMS Accession No. ML12054A736).

4. NRC, JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events," Revision 0, Issued August 2012, NRC, Washington, DC. (ADAMS Accession No. ML12229A174)

5. NEI, document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 21, 2012, Washington, DC. (ADAMS Accession No. ML12242A378)

6. *CFR*, *Title 10, Energy*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

7. NRC, SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011, Washington, DC. (ADAMS Accession No. ML11186A950)

8. NRC, SRM-SECY-11-0093, "Staff Requirements – SECY-11-0093 – Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated August 19, 2011, Washington, D.C. (ADAMS Accession No. ML112310021)

9. NRC, SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011, Washington, DC. (ADAMS Accession No. ML11245A158)

10. NRC, SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011, Washington, DC. (ADAMS Accession No. ML11272A111)

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3 Publicly available documents from the U.S. Nuclear Regulatory Commission (NRC) are available electronically through the NRC Library on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/. The documents can also be viewed on-line for free or printed for a fee in the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415 3548; and e-mail pdr.resource@nrc.gov.

4 Publications from the Nuclear Energy Institute (NEI) are available at their Web site: http://www.nei.org/ or by contacting the headquarters at Nuclear Energy Institute, 1776 I Street NW, Washington DC 20006-3708, Phone: 202-739-800, Fax 202-785-4019.

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