JAPAN LESSONS-LEARNED DIVISION

REVISION TO 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

Interim Staff Guidance
Draft Revision 1

October 30, 2015 ML15294A078

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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ADAMS Accession No.: ML15294A078 ***Concurrence via e-mail**

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COMPLIANCE WITH ORDER EA-12-049, ORDER MODIFYING LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS REVISION TO JLD-ISG-2012-01

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC, Commission) staff is providing this Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) to assist nuclear power reactor applicants and licensees with the identification of measures needed to comply with requirements to mitigate challenges to key safety functions. These requirements are contained in Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," [Reference 1] and Virgil C. Summer Nuclear Station, Unit 2 (V.C. Summer) License, License No. NPF-93, Condition 2.D.(13) [Reference 2],), V.C. Summer Nuclear Station Unit 3 License, License No. NPF-94, Condition 2.D.(13) [Reference 3], and Enrico Fermi Nuclear Plant Unit 3 License, License No. NPF-95, Condition 2.D.(12)(g) [Reference 4]. This ISG is applicable to holders of, and applicants for, operating licenses (OLs) for nuclear power reactors issued under Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, "Domestic Licensing of Production and Utilization Facilities," and the holders of, and applicants for, combined licenses (COLs) for nuclear power reactors issued under 10 CFR Part 52, "Licenses, Certifications and Approvals for Nuclear Power Plants." This ISG endorses, with clarifications, the methodologies described in the industry guidance document, Nuclear Energy Institute (NEI) 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," (NEI 12-06), Revision 1A [Reference 5]. This ISG provides one acceptable approach for satisfying those requirements. Holders of OLs or COLs for nuclear power reactors issued under 10 CFR Part 50 or Part 52 may use other methods for satisfying these requirements. The NRC staff will review such methods and determine their acceptability on a case-by-case basis.

BACKGROUND

Following the events at the Fukushima Dai-ichi nuclear power plant on March 11, 2011, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC regulations and processes and determining if the agency should make additional improvements to these programs 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 [Reference 6]. These recommendations were enhanced by the NRC staff following interactions with stakeholders. Documentation of the staff's efforts is contained in SECY-11-0124, "Recommended Actions To Be Taken without Delay from the Near-Term Task Force Report," dated September 9, 2011 [Reference 7], and SECY-11-0137, "Prioritization of

Recommended Actions To Be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 [Reference 8].

As directed by the Commission's staff requirements memorandum (SRM) for SECY-11-0093 [Reference 9], the NRC staff reviewed the NTTF recommendations within the context of the NRC's existing regulatory framework and considered the various regulatory vehicles available to the NRC to implement the recommendations. In SECY-11-0124 and SECY-11-0137 the staff established prioritization of the recommendations.

After receiving the Commission's direction in SRM-SECY-11-0124 [Reference 10], and SRM-SECY-11-0137 [Reference 11], the NRC staff conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities following beyond-design-basis external events. 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 [Reference 12]. FLEX is proposed as a strategy to fulfill the key safety functions of core cooling, containment integrity, and spent fuel cooling. Stakeholder input influenced the staff to pursue a more performance-based approach to improve the safety of operating power reactors 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" [Reference 13] to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 [Reference 14], the NRC staff issued Order EA-12-049 and, in parallel, issued as a Request for Information under 10 CFR 50.54(f) (hereafter referred to as the 50.54(f) letter) for a reevaluation of licensees' flooding and seismic hazards [Reference 15]. On March 30, 2012, the Commission issued Memorandum and Order CLI-12-09, which includes the requirements for mitigation strategies as a license condition for V.C. Summer, Units 2 and 3.

Guidance and strategies required by the order would be available if a loss of power, motive force and normal access to the ultimate heat sink to prevent fuel damage in the reactor and SFP affected all units at a site simultaneously. The order requires a three-phase approach for mitigating beyond-design-basis external events. The initial phase requires using installed equipment and resources to maintain or restore key safety functions including core cooling, containment, and SFP cooling. The transition phase requires 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 requires obtaining sufficient offsite resources to sustain those functions indefinitely.

On May 4, 2012, NEI submitted NEI 12-06, Revision B [Reference 16], to provide specifications for an industry-developed methodology 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, Revision B1 [Reference 17]. The strategies and guidance described in NEI 12-06 expand on those that industry developed and implemented to address the limited set of beyond-design-basis external events that involve 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 staff issued a draft version of this ISG [Reference 18], and published a notice of its availability for public comment in the *Federal Register (*77 FR 33779; June 7, 2012), with the comment period running through July 7, 2012, 30 days from its publication. The staff received seven comments during this time, addressing the comments as documented in "NRC Response to Public Comments, JLD-ISG-2012-01 (Docket ID NRC-2012-0068)" [Reference 19].

On July 3, 2012, NEI submitted Revision C to NEI 12-06 [Reference 20], incorporating many of the exceptions and clarifications included in the draft version of this ISG. On August 3, 2012, NEI submitted Draft Revision 0 to NEI 12-06 [Reference 21], incorporating many of the remaining exceptions and clarifications. On August 21, 2012, NEI submitted Revision 0 to NEI 12-06 [Reference 22], making various editorial corrections. The NRC reviewed the August 21, 2012 submittal of Revision 0 of NEI 12-06 and endorsed it as a process the NRC considers acceptable for meeting the regulatory requirements with noted clarifications in Revision 0 of this ISG [Reference 23].

By February 2013, licensees of operating power reactors submitted their overall integrated plans (OIPs) under the mitigating strategies order describing the guidance and strategies to be developed and implemented. Because this development and implementation was to be accomplished in parallel with the reevaluation of the seismic and flooding hazards under the 50.54(f) letter issued subsequent to SECY-12-0025, these included in their key assumptions a statement that typically read, "[f]lood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012, are not completed and therefore not assumed in this submittal. As the reevaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes." (See, e.g., Vermont Yankee Nuclear Power Station's OIP [Reference 24].)

To clarify the relationship between the mitigating strategies order and the hazard reevaluation, the NRC staff provided COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluaton (sic) of Flooding Hazards" [Reference 25] to the Commission on November 21, 2014, requesting that the Commission affirm that "[l]icensees for operating nuclear power plants need to address the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events (Order EA-12-049 and related [mitigation of beyond-design-basis events] MBDBE rulemaking)." In COMSECY-14-0037 the NRC staff further requested affirmation that "[l]icensees for operating nuclear power plants may need to address some specific flooding scenarios that could significantly damage the power plant site by developing targeted or scenario-specific mitigating strategies, possibly including unconventional measures, to prevent fuel damage in reactor cores or spent fuel pools." In SRM-COMSECY-14-0037 [Reference 26], the Commission affirmed these two items and noted that "it is within the staff's authority, and is the staff's responsibility, to determine, on a plant-specific basis, whether targeted or scenario-specific mitigating strategies, possibly including unconventional measures, are acceptable."

On August 25, 2015, NEI submitted Revision 1 to NEI 12-06 [Ref. 27], incorporating lessons learned in the implementation of Order EA-12-049 and alternative approaches taken by

licensees for compliance to that order. After a public webinar discussion of potential exceptions and clarifications on September 21, 2015, NEI submitted Revision 1A to NEI 12-06.

RATIONALE

1. Order EA-12-049 requires that licensees shall develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities following a beyond-design-basis external event. The three-phase approach described in the order is a conceptual framework built upon the need for a licensee to address challenges to the safety functions when they occur using installed structures, systems, and components for a coping period until portable mitigating equipment can be used to address those challenges. The finite level of resources on site makes the arrangement of offsite resources necessary to address potential wide-spread catastrophes, such as the occurrence at Fukushima, where restoration of offsite power is precluded by damage. Licensee's emergency operating procedures will provide command and control in response to beyond-design-basis external events. Additional guidance documents will be developed for deployment of the FLEX strategies in support of the emergency operating procedures.

2. The NRC has previously provided regulatory guidance for the development, implementation, and maintenance of guidance and strategies intended to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under the circumstances associated with loss of large areas of the plant due to explosions or fire through the endorsement of NEI 06-12, "B.5.b Phase 2 & 3 Submittal Guideline," Revision 2 [Reference 28] for holders of and applicants for operating licenses issued under 10 CFR Part 50 and Revision 3 [Reference 29], for holders of and applicants for combined licenses under 10 CFR Part 52. This regulatory guidance continues to provide an acceptable means of meeting the requirement to develop, implement and maintain the necessary guidance and strategies for that subset of beyond-design-basis external events.

3. The specifications of NEI 12-06, Revision 1A, for development and implementation of mitigating strategies for beyond-design-basis external events provide a framework and methodology for such strategies to address those events that are not covered within the requirements of 10 CFR 50.54(hh)(2).

4. The specifications of NEI 12-06, Revision 1A, for the performance of assessments of the mitigating strategies under the reevaluated flooding hazards under the March 12, 2012, 50.54(f) letter, provides an appropriate methodology for licensees to resolve issues being tracked related to the mitigating strategies and the reevaluated flooding hazards in a manner that aligns with the proposed MBDBE rulemaking.

APPLICABILITY

It shall remain in effect until it has been superseded, withdrawn, or incorporated into a regulatory guide or the Standard Review Plan (SRP).

GUIDANCE

As discussed above, this ISG is applicable to holders of power reactor operating licenses, construction permits or combined licenses.

The NRC staff considers that the development, implementation, and maintenance of strategies and guidance in conformance with the guidelines provided in NEI 12-06, Revision 1A, subject to the clarifications in the enclosure with this ISG, are an acceptable means of meeting the requirements of Order EA-12-049. However, NRC endorsement of NEI 12-06, Revision 1A, does not imply NRC endorsement of references listed in NEI 12-06, Revision 1A.

IMPLEMENTATION

Except in those cases in which a licensee or construction permit (CP) holder proposes an acceptable alternative method for complying with Order EA-12-049, the NRC staff will use the methods described in this ISG to evaluate licensee and CP holder compliance as presented in submittals required in Order EA-12-049.

BACKFITTING DISCUSSION

Licensees and CP holders may use the guidance in this document to demonstrate compliance with Order EA-12-049. Accordingly, the NRC staff issuance of this ISG is not considered backfitting, as defined in 10 CFR 50.109(a)(1), nor is it deemed to be in conflict with any of the issue finality provisions in 10 CFR Part 52.

FINAL RESOLUTION

The contents of this ISG may subsequently be incorporated into the SRP, or other guidance documents, as appropriate.

ENCLOSURE

1. Guidance for Developing, Implementing and Maintaining Mitigation Strategies

REFERENCES

1. NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736).

2. Combined License, Virgil C. Summer Nuclear Station Unit 2, License No. NPF-93, April 10, 2014 (ADAMS Accession No. ML14100A092).

3. Combined License, Virgil C. Summer Nuclear Station Unit 3, License No. NPF-94, April 10, 2014 (ADAMS Accession No. ML14100A101).

4. Combined License, Enrico Fermi Nuclear Plant Unit 3, License No. NPF-95, May 1, 2015 (ADAMS Accession No. ML15084A170).

5. NEI document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 1A, October, 2015 (ADAMS Accession No. ML15279A426).

6. SECY-11-0093, "Recommendations for Enhancing Reactor Safety in the 21st Century, the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011 (ADAMS Accession No. ML11186A950).

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

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

9. SRM-SECY-11-0093, "Staff Requirements – SECY-11-0093 – Near-Term Report and Recommendations for Agency Actions following the Events in Japan," August 19, 2011 (ADAMS Accession No. ML112310021).

10. SRM-SECY-11-0124, "Staff Requirements – SECY-11-0124 – Recommended Actions To Be Taken without Delay from the Near-Term Task Force Report," October 18, 2011 (ADAMS Accession No. ML112911571).

11. SRM-SECY-11-0137, "Staff Requirements – SECY-11-0137- Prioritization of Recommended Actions To Be Taken in Response to Fukushima Lessons Learned," December 15, 2011 (ADAMS Accession No. ML113490055).

12. Letter from Adrian Heymer (NEI) to David L. Skeen (NRC), "An Integrated, Safety-Focused Approach to Expediting Implementation of Fukushima Dai-ichi Lessons Learned," December 16, 2011 (ADAMS Accession No. ML11353A008).

13. 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,” February 17, 2012 (ADAMS Accession No. ML12039A103).

14. SRM-SECY-12-0025, “Staff Requirements – 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,” March 9, 2012 (ADAMS Accession No. ML120690347).

15. NRC, Request for Information Pursuant to Title 10 of the *Code of Federal Regulations* 50.54(f) regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, March 12, 2012, (ADAMS Accession No. ML12053A340).

16. NEI document NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” Revision B, May 4, 2012 (ADAMS Accession No. ML12128A124).

17. NEI document NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” Revision B1, May 13, 2012 (ADAMS Accession No. ML12143A232).

18. Draft 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,” May 31, 2012 (ADAMS Accession No. ML12146A014).

19. NRC Response to Public Comments, JLD-ISG-2012-01 (Docket ID NRC-2012-0068), August 29, 2012 (ADAMS Accession No. ML12229A253).

20. NEI document 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” Revision C, July 3, 2012 (ADAMS Accession No. ML121910390).

21. Letter from Scott A. Bauer (NEI) to Steven D. Bloom (NRC), Transmittal of Draft Revision 0) of NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” Draft Revision 0, August 3, 2012 (ADAMS Accession No. ML12221A204).

22. NEI document NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide,” Revision 0, August 21, 2012 (ADAMS Accession No. ML12242A378).

23. 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,” May 31, 2012 (ADAMS Accession No. ML12146A014).

24. Letter from Christopher J. Wamser (Entergy Nuclear Operations), “Vermont Yankee Overall Integrated Plan In Response To March 12, 2012 Commission Order To Modify

Licenses With Regard To Requirements For Mitigation Strategies For Beyond-Design-Basis External Events (Order Number EA-12-049)," February 28, 2013 (ADAMS Accession No. ML13064A300).

25. COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluaton (sic) of Flooding Hazards," November 21, 2014 (ADAMS Accession No. ML14238A616).

26. SRM-COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards," March 30, 2015, (ADAMS Accession No. ML15089A236).

27. NEI document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 1, dated October, 2015, Washington, DC. (ADAMS Accession No. ML15244B006).

28. NEI document NEI 06-12, "B.5.b Phase 2 & 3 Submittal Guideline," Revision 2, December 2006 (ADAMS Accession No. ML070090060).

29. NEI document NEI 06-12, "B.5.b Phase 2 & 3 Submittal Guideline," Revision 3, July 2009 (ADAMS Accession No. ML092120160) (Designated for Official Use Only – Security Related Information).

GUIDANCE FOR DEVELOPING, IMPLEMENTING AND MAINTAINING MITIGATION STRATEGIES

1. Development and Implementation Process

U.S. Nuclear Regulatory Commission (NRC) Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [Reference 1] requires that applicants or licensees develop and implement guidance and to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event (BDBEE). The guidance and strategies developed and implemented under Order EA-12-049 must be capable of being implemented sitewide and must include obtaining sufficient offsite resources to sustain the functions of core cooling, containment and SFP cooling indefinitely.

1.1. Establishment of Baseline Coping Capability

Section 1.3 of Nuclear Energy Institute (NEI) document 12-06, Revision 1A, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," [Reference 2] provides the objectives and guiding principles of the FLEX program that are responsive to Order EA-12-049 and provide that plant-specific analyses will determine the duration of each phase.

Section 2 of NEI 12-06, Revision 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 Order EA-12-049. Sections 2.1 through 2.5 of NEI 12-06, Revision 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, Revision 1A provides performance attributes, general criteria and baseline assumptions for use in the development and implementation of the strategies and guidelines under Order EA-12-049. NEI 12-06, Revision 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 [alternating current] power and SBO [station blackout] alternate ac power sources [as defined in 10 CFR 50.2 [Reference 3]] are assumed to be not available and not imminently recoverable."

In NEI 12-06, Revision 1A it 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." In NEI 12-06, Revision 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, Revision 1A, Appendix E provides a method for validation of the FSGs.

In NEI 12-06, Revision 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 to NEI 12-06, Revision 1A provide an acceptable method for licensees to follow to develop a baseline coping capability for mitigating an extended loss of ac power (ELAP) concurrent with either a loss of ultimate heat sink (LUHS) or, for a nuclear power plant with a passive reactor design, 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, Revision 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,” [Reference 4] 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 Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.63(a), and (2) assume the nonavailability 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, Revision 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 affect 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 BDBEEs for Order EA-12-049. 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, Revision 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 letter issued on March 12, 2012 [Reference 5]) (as applicable), to execute tasks, manual actions and decisions (i.e., human actions) required by the mitigation strategies described in NEI 12-06, Revision 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 12-06, Revision 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, Revision 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" [Reference 6], as endorsed, by NRC letter dated May 15, 2012 [Reference 7], additional staff and resources may be assumed to be available commencing at the 6 hour point (or less, with justification). As a result, using Level B validation techniques, which are less stringent, may typically be substituted for using Level A validation techniques at the 6 hour point. However, before 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 be 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

Order EA-12-049 requires a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment and SFP cooling capabilities. The transition phase requires 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 requires obtaining sufficient offsite resources to sustain those functions indefinitely. 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, Revision 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 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 onsite 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, Revision 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 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 (after 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, Revision 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 to sustain the functions of core cooling, containment and SFP cooling indefinitely.

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

functions indefinitely when coupled with the restoration or commissioning of power, water, and coolant injection systems.

1.2. Contingencies for Loss of All Alternating Current Power

In NEI 12-06, Revision 1A, Section 3.2.2, provides 17 guidelines for use in developing the guidance and strategies under Order EA-12-049. Guideline (2) of this section 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 ELAP event.

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

In NEI 12-06, Revision 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 [beyond-design-basis] 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, Revision 1A, Section 3.2.2, guideline (2) and the provisions in NEI 12-06, Revision 1A, Appendices C and D, for manual initiation of AFW/EFW/HPCI/RCIC/IC; coupled with the NEI 12-06, Revision 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, which are necessary to comply with the Order EA-12-049 requirement to mitigate an extended loss of all ac power. The need for the NEI 12-06, Revision 1A, Section 5.3.3 contingencies to show compliance with the 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, Revision 1A, Section 5 is applicable to all power reactor licensees, conformance to NEI 12-06, Revision 1A, Section 5.3.3 can provide the capabilities necessary to meet that element regardless of the initiating event.

2. Equipment Capacity

Order EA-12-049 requires that the equipment relied upon for the mitigation strategies have sufficient capacity to simultaneously maintain or restore core cooling, containment, and SFP cooling capabilities for all the power reactor units on a site subject to the order.

In NEI 12-06, Revision 1A, Section 3.2.2, Guideline (16), provides guidance for the minimum number of sets of equipment a licensee should have in order to achieve reasonable assurance that the equipment will be available in sufficient quantity to have the capacity necessary to comply with the order. This includes guidance for the provision of spare hoses and cables in a quantity that is either (1) equivalent to 10 percent 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.

In NEI 12-06, Revision 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, Revision 1A, Section 3.2.2, Guideline (16) and Sections 11.1-2, provide an acceptable method to demonstrate compliance with Order EA-12-049.

3. Reasonable Protection

Order EA-12-049 requires that licensees provide reasonable protection for the equipment relied upon for the mitigation strategies required by the order from the external events.

In NEI 12-06, Revision 1A, Appendix A, defines reasonable protection as "[s]toring 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, Revision 1A, provides an acceptable approach for reasonably protecting equipment from the external events. 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, Revision 1A, discusses the overall methodology for identifying external hazards and evaluating their impact. Appendix B to NEI 12-06, Revision 1A discusses the identification of external hazards for which licensees should provide reasonable protection. In NEI 12-06, Revision 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 to NEI 12-06, Revision 1A, provide an acceptable method for the evaluation and equipment considerations to address external events to satisfy that element of reasonable protection.

3.2. Protection from External Hazards

Sections 5 through 9 of NEI 12-06, Revision 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 to NEI 12-06, Revision 1A, provide an acceptable method for protecting the equipment from the external events in order to satisfy that element of reasonable protection.

3.3. Deployment of Equipment

Sections 5 through 9 of NEI 12-06, Revision 1A discuss methods for transporting the equipment from its storage location to the location in which it would be used. These sections also 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 to NEI 12-06, Revision 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, Revision 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 cannot 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,” Revision 4.0, Volume 1, “Specifications,” which range from 24 hours to 7 days. [Reference 8])

When a licensee can 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 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, Revision 1A provides an acceptable method for controlling unavailability of the equipment to satisfy that element of reasonable protection.

4. Equipment Maintenance

Order EA-12-049 requires that licensees maintain the guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities. This necessitates that the equipment relied on for the mitigation strategies under Order EA-12-049 receive adequate maintenance such that it is capable of fulfilling its intended function.

Section 11.5 of NEI 12-06, Revision 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 Report 3002000623, "Applications Center: Preventive Maintenance Basis for FLEX Equipment – Project Overview Report" [Reference 9]. The EPRI Report 3002000623 was endorsed by NRC letter dated October 7, 2013 [Reference 10].

Staff Position: Sections 11.5 and 3.2.1.13 of NEI 12-06, Revision 1A, provide an acceptable method for maintaining the equipment relied on for the mitigation strategies under Order EA-12-049.

5. Configuration Control

Order EA-12-049 requires licensees maintain the guidance and strategies to maintain or restore core cooling, containment, and SFP cooling capabilities.

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

Staff Position: Section 11.8 of NEI 12-06, Revision 1A provides an acceptable method for maintaining the guidance and strategies required under Order EA-12-049.

6. Treatment of Reevaluated Hazards under the 50.54(f) Requests for Information of March 12, 2012

Order EA-12-049 requires that licensees provide reasonable protection for the equipment relied on for the mitigating strategies from external events. As a result of the reevaluations of flood and seismic hazards under the March 12, 2012, NRC letter issued under 10 CFR 50.54(f), some licensees have identified issues with the level of protection that would be considered reasonable. As affirmed by the Commission in SRM-COMSECY-14-0037 [Reference 11], "[l]icensees for operating nuclear power plants need to address the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events (Order EA-12-049 and related [Mitigation of Beyond-Design-Basis Events] MBDBE rulemaking)." Guidance in this section is intended to align with treatment under the MBDBE rulemaking.

6.1. Treatment of Reevaluated Seismic Hazards

The following guidance establishes considerations to evaluate the equipment used in the guidance and strategies required by EA-12-049 with respect to the reevaluated seismic hazard.

Staff Position: Licensees with reevaluated seismic hazards that exceed the design basis of the facility may resolve issues identified with reasonable protection for the reevaluated seismic hazard of the equipment used in the guidance and strategies required by EA-12-049 as follows. 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 on in mitigating strategies under Order EA-12-049.

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, Revision 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, Revision 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, Revision 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, Revision 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, Revision 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, Revision 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, Revision 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, Revision 1A, Section 5.3.2.2, to confirm they require access only through structures that are seismically robust for the reevaluated seismic hazard.

j. Licensees should evaluate large internal flooding sources considered under NEI 12-06, Revision 1A, Section 5.3.3.2 for robustness as defined in NEI 12-06, Revision 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 Hertz (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 on 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," [Reference 12] consistent with its endorsement by letter dated September 17, 2015, [Reference 13]. Demonstration of reasonable protection for HF exceedances in this manner is an appropriate method to resolve issues identified with the reevaluated seismic hazards.

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 EA-12-049 when the hazard level for the AMS is identified. Development of an AMS is an appropriate method to resolve issues identified with the reevaluated seismic hazard.

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

b. The initial condition of NEI 12-06, Revision 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 offsite power should reflect impact of the flooding mechanism on the delivery of offsite power to the facility.

c. The initial condition of NEI 12-06, Revision 1A, Section 3.2.1.3.2, should be modified to reflect the availability of emergency onsite 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 [Reference 14] and 5 [Reference 15] using the guidance of NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," [Reference 16]. Acceptable approaches to perform the IPEEE included the NRC seismic margin assessment (SMA) method, the EPRI SMA method described in EPRI NP-6041-SL, Revision 1, "A Methodology for Assessment of Nuclear Plant Seismic Margin," [Reference 17]) 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," [Reference 18] 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," [Reference 19], 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" [Reference 20].

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 Report 1025287, "Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" [Reference 21]; and

b. The previous seismic evaluation was accepted by the NRC in the letter dated May 9, 2014, [Reference 22], 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," consistent with its endorsement by letter dated September 17, 2015, 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 on 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," [Reference 23], 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. The NRC endorsed this process by letter dated May 7, 2013 [Reference 24].

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," [Reference 25] 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 nonseismic Category 1 structures

3. operator pathways – interaction pathway review (use the beyond-design-basis seismic evaluation criteria described in Section 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

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" [Reference 26] related to beyond-design-basis seismic evaluation for purposes of defining an appropriately low probability of failure. In ASCE/SEI 43-05 defines a 10 percent probability of unacceptable performance ($C_{10\%}$), which is reviewed against the beyond-design-basis seismic event (150 percent 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 Report 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 [Reference 27], and on average area biased slightly conservative (i.e., slightly low β_C on average). Because random variability β_R is primarily because of 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 percent 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 Report 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 perform the following:

    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 on 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,” consistent with its endorsement by letter dated September 17, 2015, 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 to NEI 12-06, Revision 1A discusses a method to assess the results of the flooding hazard reevaluations with respect to the guidance and strategies required by EA-12-049.

6.2.1. (Modified) Mitigating Strategies

Sections G.4.1 and G.4.2 of Appendix G to NEI 12-06, Revision 1A discuss a method to assess or modify the mitigating strategies to show they provide reasonable protection from 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 to NEI 12-06, Revision 1A provide appropriate methods to resolve issues regarding the reevaluated flooding hazards and show that the existing strategies and guidelines provide reasonable protection 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 to NEI 12-06, Revision 1A discusses a method to develop AMS to provide reasonable protection for the reevaluated flooding hazards.

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 providing reasonable protection when the hazard level for the AMS is identified.

6.2.3. Targeted Hazard Mitigating Strategies

Section G.4.4 of Appendix G to NEI 12-06, Revision 1A discusses a method to develop targeted hazard mitigating strategies (THMS) to address the reevaluated flooding hazards.

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 providing reasonable protection for the reevaluated flooding hazard when the hazard level for the THMS is identified. Section G.4.4 of Appendix G of NEI 12-06, Revision 1A provides an acceptable method to develop THMS to resolve issues identified with the reevaluated flooding hazards.

7.0 Guidance for AP1000 Design

Appendix F of NEI 12-06 provides specific guidance for licensees with reactors of the AP1000 design on how to satisfy provisions of Order EA-12-049, Attachment 3, for the final phase (for sufficient offsite resources to sustain functions indefinitely).

Staff Position: The guidance of NEI 12-06, Appendix F, provides an acceptable means to meet the requirements of Order EA-12-049 or license conditions imposing similar requirements.

REFERENCES

1. NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A736).

2. NEI document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 1A, October, 2015 (ADAMS Accession No. ML15279A426).

3. *U.S. Code of Federal Regulations*, "Domestic Licensing of Production and Utilization Facilities," part 50, Section 50.2, "Definitions," Chapter 1, Title 10, "Energy" (10 CFR 50.2).

4. *U.S. Code of Federal Regulations*, "Domestic Licensing of Production and Utilization Facilities," part 50, Section 50.63, "Loss of All Alternating Current Power," Chapter 1, Title 10, "Energy" (10 CFR 50.63).

5. NRC, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, March 12, 2012, (ADAMS Accession No. ML12053A340).

6. NEI document NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communication Capabilities," Revision 0, dated May 2012 (ADAMS Accession No. ML12125A412).

7. Letter from David L. Skeen (NRC) to Susan Perkins-Grew (NEI), "U.S. Nuclear Regulatory Commission Review of NEI 12-01, 'Guidelines for Assessing Beyond-Design-Basis Accident Response Staffing and Communication Capabilities,' Revision 0, dated May 2012" (ADAMS Accession No. ML12131A043).

8. NRC, NUREG-1431, Volume 1, Revision 4 “Standard Technical Specifications:Westinghouse Plants- Specifications” (ADAMS Accession No. ML12100A222).

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