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DRAFT REGULATORY GUIDE

Contact: Eric Bowman
(301) 415-2963

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(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 that the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for demonstrating compliance with portions of the NRC regulations to provide additional defense-in-depth measures for the mitigation of beyond-design-basis external events (BDBEEs) as required by Section 50.155, "Mitigation of Beyond-Design-Basis Events," of Title 10 of the *Code of Federal Regulations* (10 CFR 50.155) (Ref. 1).

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 1 (NEI 12-06) dated XXXX (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.

Portions of the RG provide guidance only applicable to certain applicants as defined in 10 CFR 50.155(a)(4) and 10 CFR 50.155(g)(4). Before detailed design or construction, each applicant listed in paragraph (a)(4) may address the elements of 10 CFR 50.155(d) by incorporating into the plant design those design features for mitigating strategies that provide enhanced ability to ensure that core cooling, containment, and spent fuel pool cooling is maintained or restored. Such design features should reduce and simplify the manual actions necessary to maintain these safety functions, and allow more time to properly assess plant conditions and prolong the use of installed equipment, as compared to current operating reactors. This guidance is consistent with the Policy Statement on the Regulation of Advanced Reactors (Ref. 3), in which the Commission previously encouraged vendors to include these design features into the design.

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This regulatory guide is being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. It has not received finalNRC 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 will be most helpful if received by [insert date - 60 days from issuance].

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.

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," issued March 12, 2012 (Ref. 4). 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 BDBEE.

- 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," (Ref. 5). This interim staff guidance (ISG) endorses, with clarifications, the methodologies described in NEI 12-06 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 Part 50 and Part 52 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.

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.

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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, Revision 1, 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. 6). The Commission then directed the NRC staff in staff requirement memorandum (SRM) SRM-SECY-11-0093 (Ref. 7) 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. 8). 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. 9) provides the staff's response to this direction.

After receiving the Commission's direction in SRM-SECY-11-0124 (Ref. 10) and SRM-SECY-11-0137 (Ref. 11), 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. 12). 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. 13) to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 (Ref. 14), the NRC issued Order EA-12-049. On March 30, 2012, the Commission issued Memorandum and Order CLI-12-09 (Ref. 15), 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, Revision B (Ref. 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 (Ref. 17). The strategies and guidance described in NEI 12-06 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."

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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. 18).

On July 3, 2012, NEI submitted Revision C to NEI 12-06 (Ref. 19), incorporating many of the exceptions and clarifications included in the draft version of JDL-ISG-2012-01. On August 3, 2012, NEI submitted Draft Revision 0 to NEI 12-06 incorporating many of the remaining exceptions and clarifications. On August 21, 2012, NEI submitted Revision 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 as a process the NRC considers acceptable for meeting the regulatory requirements with noted clarifications.

Reserved for discussion of interactions on NEI 12-06, Rev. 1 dated XXX .

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, Revision 1 as an acceptable method for applicants and licensees to demonstrate compliance, in part, with the regulatory requirements. NEI 12-06, Revision 1 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 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 beyond-design-basis external event mitigation similar to guidance under revision by the IAEA.

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C. REGULATORY GUIDANCE

This RG endorses, with clarifications in this section, the methods described in NEI report NEI 12-06, Revision 1, dated XXXX. The NRC has determined that the methods described in the NEI report constitute procedures and processes generally acceptable to the NRC for demonstrating compliance with the regulatory requirements in 10 CFR 50.155 with the clarifications listed in these regulatory positions.

10 CFR 50.155(d), "Design Features," requires that each applicant listed in 10 CFR 50.155(a)(4) shall incorporate into the plant design those design features that enhance coping durations and minimize reliance on human actions to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling, during an ELAP concurrent with a LUHS. NEI 12-06 does not provide guidance that addresses 10 CFR 50.155(d). Guidance for nuclear power plants that had been subject to § 50.155(d) in the design phase[1] (referred to in this RG as applicants for new nuclear power plants) is provided in Appendix A of this RG. Appendix A follows the format provided in Section C of this regulatory guide and provides positions for new nuclear power plant applicants to satisfy the NRC regulations discussed in Section C of this regulatory guide and 10 CFR 50.155(d), as appropriate.

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 an LUHS or, for a nuclear power plant for which the Final Safety Analysis Report references Appendix D or E to 10 CFR Part 52, 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 discusses the objectives and guiding principles of the diverse and flexible coping strategies (FLEX) 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 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 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 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 further provides that licensees should use these criteria and assumptions for analyses used to establish a baseline coping capability. The assumptions include the initial

[1] "Nuclear power plants that had been subject to § 50.155(d) in the design phase" are those discussed in § 50.155(a)(4) and those that are the subject of applications for COLs referencing standard design certifications, standard design approvals or manufacturing licenses that are discussed in § 50.155(a)(4).

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conditions listed in section 3.2.1.3 that include a loss of offsite power (LOOP) 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 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, 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, Appendix E provides a method for validation of the FSGs.

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

NRC Position: Sections 1, 2 and 3 and Appendix E of NEI 12-06 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 a nuclear power plant for which the Final Safety Analysis Report references Appendix D or E to 10 CFR Part 52, 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 1, 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 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.

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d) The validation method documented in Appendix E of NEI 12-06 provides an acceptable method of determining the feasibility of the FSGs. Because the severity of a beyond-design-basis external event is not readily definable, it is not practical to fully evaluate the resulting performance shaping factors that underlie the performance attributes discussed in Appendix E. As a result, it is not possible to evaluate the reliability of the FSGs. Further development of the performance shaping factors would be necessary in order to evaluate the FSGs in the context of a defined hazard level.

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 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.

NRC Position: NEI 12-06 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.

NRC Position: NEI 12-06, 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.

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

1.1.1.3. Final Phase

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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.

NRC Position: NEI 12-06, Section 3.0, provides an acceptable method for determining the baseline coping capabilities for the final phase. NEI 12-06, 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, Revision 1, 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 – emergency feedwater (EFW) at some plants] AFW [high pressure core injection] HPCI [reactor core isolation cooling] RCIC [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. AFW/HPCI/RCIC/IC availability 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, which provide a summary of performance attributes for boiling-water and pressurized-water reactors respectively, address guideline (2) of NEI 12-06, section 3.2.2 by specifying that procedures/guidance will include local manual initiation of AFW/EFW/HPCI/RCIC/IC.

NEI 12-06, section 5.3.3, which 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.

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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.

NRC Position: NEI 12-06, section 3.2.2, guideline (2) and the provisions in NEI 12-06, Appendices C and D, for manual initiation of AFW/EFW/HPCI/RCIC/IC coupled with the NEI 12-06, section 5.3.3 provisions for 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, 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, section 5 is applicable to all power reactor licensees, conformance to NEI 12-06, 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 spent fuel pool cooling capabilities for all the power reactor units within the site boundary.

NEI 12-06, 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).

NEI 12-06, 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.

NRC Position: NEI 12-06, 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, 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."

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

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a) Identification of the natural phenomena for which reasonable protection is necessary,

b) Determination of the method of protection to be used,

c) Establishment of controls on unavailability of the equipment, and

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

NRC Position: Sections 5 through 9 and Appendix B of NEI 12-06 provide an acceptable methodology 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 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.

NRC Position: Sections 5 through 9 and Appendix B of NEI 12-06 provide an acceptable methodology 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 discuss methodologies 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.

NRC Position: Sections 5 through 9 and Appendix B of NEI 12-06 provide an acceptable methodology for deployment of the equipment in order to satisfy that element of reasonable protection.

3.4. Programmatic Controls for Unavailability

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Section 11.5.3 of NEI 12-06 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," Revision 4.0, Volume 1, "Specifications," which range from 24 hours to 7 days. [Ref. 25])

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.

NRC Position: Section 11.5.3 of NEI 12-06 provides an acceptable methodology 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 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. 26). The EPRI technical report 3002000623 was endorsed by NRC letter dated October 7, 2013 (Ref. 27).

NRC Position: Sections 11.5 and 3.2.1.13 of NEI 12-06 provide an acceptable methodology 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

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from natural phenomena that result in an ELAP concurrent with either an LUHS or, for a nuclear power plant for which the Final Safety Analysis Report references Appendix D or E to 10 CFR Part 52, a loss of normal access to the normal heat sink.

10 CFR 50.155(g) 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 discusses the configuration control of the strategies and guidelines as well as the maintenance of an overall program document and record of changes.

NRC Position: Section 11.8 of NEI 12-06 provides an acceptable methodology for maintaining an integrated response capability under 10 CFR 50.155(b)(1).

6. Treatment of Re-evaluated Hazards under the Requests for Information of March 12, 2012

Reserved.

7. Guidance for AP-1000 Design

Appendix F of NEI 12-06 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.

NRC Position: The guidance of NEI 12-06, 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[2] may use this guide and information regarding the NRC's plans for using this regulatory guide. 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.

Use by Applicants and Licensees

Applicants and licensees may voluntarily[3] use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this regulatory guide 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

2 In this section, "licensees" refers to holders of the following: (1) licenses for nuclear power plants under 10 CFR Parts 50 and 52; and (2) construction permits for nuclear power plants under 10 CFR Part 50. The term "applicants" refers to applicants for the following: (1) licenses for nuclear power plants under 10 CFR Parts 50 and 52 that do not reference a standard design certification, standard design approval, or manufacturing license; (2) construction permits for nuclear power plants under 10 CFR Part 50; (3) standard design approvals and standard design certifications under 10 CFR Part 52; and (4) manufacturing licenses under 10 CFR Part 52 that do not reference a standard design certification or standard design approval.

3 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.

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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 regulatory guide for actions that do not require NRC review and approval. Licensees may use the information in this regulatory guide 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 regulatory guide. The NRC does not expect any existing licensee to use or commit to using the guidance in this regulatory guide, unless the licensee makes a change to its licensing basis. The NRC does not expect or plan to request licensees to voluntarily adopt this regulatory guide 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 regulatory guide. Examples of such unplanned NRC regulatory actions include issuance of an order requiring the use of the regulatory guide, generic communication, or promulgation of a rule requiring the use of this regulatory guide 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 regulatory guide, as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered backfitting. However, unless this regulatory guide 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 regulatory guide 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 regulatory guide and (2) the specific subject matter of this regulatory guide 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 regulatory guide or provide an equivalent alternative process that demonstrates compliance with the underlying NRC regulatory requi**r**ements. 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 regulatory guide or requesting or requiring the licensee to implement the methods or processes in this regulatory guide 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. 28) and the NRC Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection" (Ref. 29).

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REFERENCES[4]

1. U.S. *Code of Federal Regulations* (CFR), *Title 10, Energy*, Part 50.155, "Mitigation Strategies for Beyond-Design-Basis Events."

2. Nuclear Energy Institute (NEI) document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 1, dated XXXX, Washington, DC. (ADAMS Accession No. MLXXXX)[5]

3. U.S. Nuclear Regulatory Commission (NRC), "Policy Statement on the Regulation of Advanced Reactors," *Federal Register*, Volume 73, No. 199, October 14, 2008, pp 60612-60616.

4. 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).

5. 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 29, 2012, NRC, Washington, DC. (ADAMS Accession No. ML12229A174)

6. 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)

7. 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)

8. 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)

9. 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)

10. NRC, SRM-SECY-11-0124, "Staff Requirements - SECY-11-0124 - Recommended Actions to be Take without Delay from the Near-Term Task Force Report," dated October 18, 2011, Washington, DC. (ADAMS Accession No. ML112911571)

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4 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.

5 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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11. NRC, SRM-SECY-11-0137, "Staff Requirements - SECY-11-0137 - Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated December 15, 2011, Washington, DC. (ADAMS Accession No. ML113490055)

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

13. NRC, 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," dated February 17, 2012, Washington, DC. (ADAMS Accession No. ML12039A103)

14. NRC, 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," dated March 9, 2012, Washington, DC. (ADAMS Accession No. ML120690347)

15. NRC, Commission Memorandum and Order, CLI-12-09, dated March 30, 2112, Washington, DC. (ADAMS Accession No. ML12090A531).

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

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

18. NRC, Response to Public Comments on JLD-ISG-2012-01 (Docket ID NRC-2012-0068), dated August 29, 2012, Washington DC. (ADAMS Accession No. ML12229A253)

19. NEI, document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision C, July 3, 2012, Washington, DC. (ADAMS Accession No. ML121910390)

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APPENDIX A

REGULATORY GUIDANCE FOR APPLICANTS FOR NEW NUCLEAR POWER PLANTS

As discussed in Section C, "Regulatory Guidance," this regulatory guide endorses, with clarifications, the methods described in NEI report NEI 12-06, Revision 1, dated XXXX. The NRC has determined that the methods described in the NEI report are acceptable to the NRC for demonstrating compliance with the NRC's requirements in 10 CFR 50.155(b)(1) and (c)(1)-(c)(3), which are part of the requirements for an applicant or licensee to develop, implement, and maintain an integrated response capability that includes strategies and guidelines to mitigate beyond-design-basis external events and satisfy equipment requirements, respectively, with clarifications provided in the regulatory positions. Additionally, this RG provides guidance in areas that are not covered in NEI 12-06 for meeting the regulations in 10 CFR 50.155.

In addition to 10 CFR 50.155(b)(1) and (c)(1)-(c)(3), applicants for new nuclear power plants are also required under 10 CFR 50.155(d) to incorporate into the plant design those design features that enhance coping durations and minimize reliance on human actions to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities, during an extended loss of alternating current power (ELAP) concurrent with a loss of normal access to the ultimate heat sink (LUHS).

Before detailed design or construction, applicants for new nuclear power plants may address the elements of 10 CFR 50.155(d) by incorporating into the plant design those design features for mitigating strategies that provide enhanced ability to ensure that core cooling, containment, and SFP cooling capabilities is maintained or restored. Such design features should reduce and simplify the manual actions necessary to maintain these safety functions, and allow more time to properly assess plant conditions and prolong the use of installed equipment, as compared to current operating reactors. This guidance is consistent with the Policy Statement on the Regulation of Advanced Reactors, in which the Commission previously encouraged vendors to include these design features into the design.

In this appendix, the ELAP concurrent with a LUHS is referred to as "the event," where appropriate. This appendix follows the format provided in Section C of this regulatory guide and provides positions for applicants for new nuclear power plants to satisfy the NRC regulations discussed in Section C of this regulatory guide and 10 CFR 50.155(d), as appropriate.

As discussed in this regulatory guide, NEI 12-06 (Revision 1) defines FLEX Strategies as the plant-specific functional approaches taken to maintain or restore core cooling, SFP cooling, and containment capabilities. NEI 12-06 defines FLEX equipment as only equipment stored on-site or off-site whose primary function is to support FLEX strategies. NEI 12-06 defines Baseline Coping Capability as a basic set of strategies for providing essentially indefinite coping capability for an extended loss of ac power and loss of the ultimate heat sink scenarios through the use of plant equipment and FLEX equipment. The provisions in this regulatory guide, including this appendix, apply to all SSCs used as part of the FLEX strategies for the plant-specific functional approach taken to maintain or restore core cooling, SFP cooling, and containment capabilities to mitigate an ELAP and LUHS scenarios, regardless of equipment categorization as plant equipment, installed equipment, pre-staged equipment, or portable equipment.

1. Development and Implementation Process

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REGULATORY GUIDANCE FOR APPLICANTS FOR NEW NUCLEAR POWER PLANTS

The discussion provided in C.1 is applicable to applicants for new nuclear power plants.

1.1. Establishment of Baseline Coping Capability

The position provided in C.1.1 is applicable to applicants for new nuclear power plants.

1.1.1. Phased Approach

The position provided in C.1.1.1 is applicable to applicants for new nuclear power plants.

1.1.1.1. Initial Response Phase (Phase 1)

The position provided in C.1.1.1.1 is applicable to applicants for new nuclear power plants with the following clarification and addition:

To satisfy the NRC's requirements in 10 CFR 50.155(d) to enhance coping durations, the applicant should provide reasonable assurance that mitigation during the initial response phase can be accomplished using only installed plant equipment for at least 24 hours following an ELAP and LUHS. This extended response phase allows for increased flexibility in onsite response to the event and reduced burden on plant operators, without the need to access and operate portable equipment. For applicants for new nuclear power plants proposing to rely on a supplemental ac power source (SAC) power source, defined in Section 7 of this appendix, the NRC separates this initial phase into Sub-Phases 1a and 1b.

Sub-Phase 1a should last a minimum of 8 hours after the event and assumes no SAC is available. Definition and attributes of a SAC system are described in Section 7 of this appendix. Sub-Phase 1a should be accomplished using installed plant equipment, with no resupply (e.g., through use of portable equipment) of necessary consumables (such as water, fuel, or air).

Sub-Phase 1b extends from the end of Sub-Phase 1a to at least 24 hours after the event. Sub-Phase 1b should be accomplished using installed plant equipment, with no resupply (e.g., through use of portable equipment) of necessary consumables (such as water, fuel, or air). Sub-Phase 1b is similar to Sub-Phase 1a but the applicant may rely on a SAC system.

For applicants for new nuclear power plants, 10 CFR 50.155(d) also requires that plant design features minimize reliance on human (e.g., operator) actions. As such, during Phase 1, plant design features shall minimize reliance on human actions necessary to perform the key safety functions. Operator actions, to the extent practical for command and control, should be predominately performed from the main control room or a location that is designed to handle all ELAP safety functions (core, containment, and SFP cooling), habitable under a loss of ac power and contain the necessary communication equipment. Operator actions should be performed from protected buildings, as described in Section 3.2 of this appendix, without exposure to the elements (i.e., from within connected, reasonably protected buildings). Operator actions in

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Sub-Phase 1b may be more numerous and complex than Sub-Phase 1a, if justified as reliable through analyses of personnel availability in conjunction with analyses of the time available, relative to the time required, to perform the actions. Operator action is further discussed in Section 9, "Operator Action," of this appendix. Additionally, see Section 8, "Shutdown and Refueling Modes," of this appendix for the NRC position related to shutdown and refueling modes for new nuclear power plants.

1.1.1.2. Transition Phase (Phase 2)

The position provided in C.1.1.1.2 is applicable to applicants for new nuclear power plants with the following clarification and addition:

To satisfy the NRC's requirements in 10 CFR 50.155(d) to enhance coping durations, the applicant should provide reasonable assurance that mitigation during the transition response phase extends from the end of Phase 1, which is at least 24 hours, to 3 days (72 hours) and should be accomplished using on-site equipment (e.g., augmenting installed plant equipment with sufficient on-site equipment). Re-supply of consumables is from sources located onsite. Phase 2 equipment, consumables, and any connections should be protected as defined in Section 3.2 of this appendix. Depending upon the plant design, a transition phase using on-site equipment may not be needed if the initial phase is of sufficient duration (e.g., 72 hours or greater) to transition directly to the final phase.

The operator actions needed to place on-site equipment in service should be justified assuming site-wide damage (e.g., the analysis determines the availability and evaluates the use of alternate ingress/egress paths or assumes delays to contend with debris removal and adverse environmental conditions). Applicants should demonstrate that these actions can be completed prior to the end of Phase 1 (at least 24 hours) and before the plant exhausts its capability to maintain the core and SFP cooling and containment functions. The difference between the time available and the time required to complete each action should include sufficient margin such that it can be deemed reliable.

1.1.1.3. Final Phase (Phase 3)

The position provided in C.1.1.1.3 is applicable to applicants for new nuclear power plants.

1.2. Contingencies for Loss of All Alternating Current Power

The position provided in C.1.2 is applicable to applicants for new nuclear power plants.

2. Equipment Capacity and Capability

The position provided in C.2 is applicable to applicants for new nuclear power plants with the following clarifications and addition provided in Sections 2.1 - 2.2 below.

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REGULATORY GUIDANCE FOR APPLICANTS FOR NEW NUCLEAR POWER PLANTS

2.1. Plant Equipment (Systems, Structures, and Components)

2.1.1 Phase 1

The applicant may rely on equipment designed and qualified to safety-related criteria to perform their intended safety functions throughout (i.e., during and following) the external event (such as Seismic Category I qualification, 10 CFR 50.49 environmental qualification, and Regulatory Guide 1.100 (Rev. 3) functional qualification in accordance with 10 CFR Part 50, Appendix B to justify capability to operate during and following the external event). The performance requirements for equipment should be evaluated to identify instances for which the original design and procurement specifications do not satisfy the mitigation strategies functional requirements for that equipment. For those instances, the applicant should justify performance capabilities of equipment used for mitigation strategies functional requirements where the performance requirements extend beyond the original design and procurement specifications.

For SSCs that do not satisfy the safety-related criteria, the applicant may rely on equipment not designed to safety-related criteria where this approach provides a similar level of qualification, reliability, and quality assurance to ensure that the installed equipment will perform its mitigation functions. For example, an applicant could describe the design capability of the equipment to perform their intended functions during and following the external event with respect to their seismic capability, environmental capability, and functional capability in accordance with acceptable design, maintenance, testing, and configuration control with auditable documentation that provides reasonable assurance that the equipment will perform its intended mitigation functions. For these SSCs, the applicant should establish programmatic controls for procurement, installation, testing, surveillance, and maintenance.

2.1.2 Phase 2 and Phase 3

Phase 2 and Phase 3 plant equipment and their connections to other mitigation equipment (e.g., installed or portable) are not required to be capable of performing their mitigation function during the external event. Phase 2 and Phase 3 plant equipment may be classified as safety-related or as nonsafety-related with augmented capacity and capability demonstration (such as demonstration of seismic capability, environmental capability, and functional capability to perform the intended mitigation functions with auditable documentation). For these plant equipment and connections, the applicant should establish programmatic controls for procurement, installation, testing, surveillance, and maintenance.

2.2 Equipment Stored On-Site

The position provided in C.2 is applicable to applicants for new nuclear power plants.

3. Reasonable Protection

The position provided in C.3 is applicable to applicants for new nuclear power plants.

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3.1. Evaluation of External Hazards

The position provided in C.3.1 is applicable to applicants for new nuclear power plants with the following clarification:

Evaluation of external hazards will differ between standard design certifications and other license (e.g., COLs, operating license) applications. For standard design certifications, site-specific external hazard information is not available. Instead, standard design certifications include an evaluation of beyond-design-basis seismic hazards (i.e., the seismic margin assessment) and specify criteria that assures design margin for flooding hazards (e.g., specification of siting the design at least one foot above the site-specific design basis flood level at the location that a plant will be built). Therefore, the design features or other components associated with mitigation strategies specified as part of a standard design should consider external hazards consistent with the external hazard criteria associated with the standard design (e.g., the beyond-design-basis seismic hazards and criteria that assures margin for flooding). Other license applicants should evaluate applicable external hazards on a site specific-basis in accordance with hazards defined in the Final Safety Analysis Report (FSAR).

In developing mitigating strategies, susceptibility to external flooding and flood hazard characterization should consider all flooding mechanisms defined in the FSAR that may adversely affect the plant site, including the effects of local intense precipitation. Because all sites are subject to local intense precipitation, no site may be considered "dry" with respect to flooding hazards. Flood hazard characterization should include flood height, associated effects (e.g., wind waves, run-up, sedimentation, erosion, and debris) and flood event duration (e.g., warning time and period of inundation), as defined in the FSAR. The determination of "limiting" flood scenarios should consider the full hazard characterization and should not be limited to only those scenarios yielding the highest flood level. This may result in the need to consider multiple limiting scenarios (e.g., limiting scenarios may include those scenarios associated with highest flood height, shortest warning time, longest duration, or most severe associated effects).

3.2. Protection from External Hazards

The position provided in C.3.2 is applicable to applicants for new nuclear power plants with the following clarification and addition:

For the protection of equipment from high wind hazards, new reactor applicants should use the guidance in NEI 12-06, section 7.3.1.1.a (i.e., storage within a safety-related structure or located within a structure designed to the design-basis extreme winds and associated missiles).

SSCs relied on during Phase 1 should be protected to safety-related criteria (e.g., Seismic Category I and flood protection in accordance with Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants") to be capable of performing the intended safety functions during and

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following the external event. SSCs and equipment relied upon during Phase 1 should be protected from all external hazards, regardless of warning time.

For seismic events, the applicant may propose an alternative approach to ensuring a level of protection consistent with the site hazard, including a safety margin, and demonstrate that the overall high confidence of low probability of failure is equal to or less than 1% at the site specific hazard times a margin factor (e.g., GMRS * 1.67) which is consistent with that used in the plant design assessment.

Phase 2 and Phase 3 plant equipment and associated connections should be designed to survive the external event, but would not be required to perform during the initiating event. Structures used to house Phase 2 and Phase 3 plant equipment and associated connections should be capable of protecting the plant equipment and associated connections during the external event such that they are available to perform their mitigation functions. Phase 2 and Phase 3 plant equipment should be protected from equipment or structures whose failure during the event could damage or prevent the satisfactory accomplishment of the Phase 2 and Phase 3 functions.

3.3. Deployment of Equipment

The position provided in C.3.3 is applicable to applicants for new nuclear power plants.

3.4. Programmatic Controls for Unavailability

The position provided in C.3.4 is applicable to applicants for new nuclear power plants.

4. Equipment Maintenance

The position provided in C.4 is applicable to applicants for new nuclear power plants. Guidance for equipment maintenance and other programmatic controls is discussed in Appendix A, Section 2 of this regulatory guide.

5. Configuration Control

The position provided in C.5 is applicable to applicants for new nuclear power plants.

6. Guidance for the AP1000 Design

The position provided in C.7 is applicable to applicants that reference the AP1000 certified design.

7. Supplemental AC (SAC) Power Source

NEI 12-06 Section 2.1, "Establish Baseline Coping Capability," states the following:

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While initial approaches to FLEX strategies will take no credit for installed ac power supplies, longer term strategies may be developed to prolong Phase 1 coping that will allow greater reliance on permanently installed, bunkered or hardened ac power supplies that are adequately protected from external events.

Section 1.1.1.1, "Initial Response Phase (Phase 1)," of this appendix identifies that applicants for new reactor power plants may elect to use a supplemental ac power source to satisfy enhanced coping durations required by 10 CFR 50.155(d).

The following guidelines apply when an applicant credits the use of a supplemental ac power source in Phase 1:

- The system should be permanently installed and normally disconnected from the bus.
- The system should be designed such that only minimal operator action (limited in number and complexity to the extent practical) is needed to put the system in service.
- The system is a diverse and independent ac source (from the emergency ac generator source).
- The ac source, distribution system, and necessary loads should meet equipment quality conditions per Section 2.1 of this appendix.
- The ac source, distribution system, and necessary loads should be protected per Section 3.2 of this appendix.
- The system should be minimally dependent on auxiliary systems (e.g., air cooled). Any needed auxiliary systems should be protected per Section 3.2 of this appendix.
- The engineered SAC final electrical design will have the necessary equipment isolations such that non-safety-related equipment failure would not prevent any safety-related equipment from performing its nuclear safety-related function. (Isolation between Class 1E power supplies and non-Class 1E loads is discussed in Subsection 8.3.1.1.1 of Regulatory Guide 1.75, "Physical Independence of Electric Systems").
- Periodic testing of engineered SAC will be in accordance with Regulatory Guide 1.118 and or mitigation equipment testing requirements.
- The engineered SAC should have adequate instrumentation to monitor electrical power equipment including measurement tolerance/accuracy and protection.

8. Shutdown and Refueling Modes

The NRC position for applicants for new nuclear power plants regarding shutdown and refueling modes is an enhancement to the guidance contained in NEI 12-06 Section 3.2.3, "Shutdown Modes."

Before detailed design or construction, applicants for new nuclear power plants may address the elements of 10 CFR 50.155(d) by incorporating into the plant design those design features for mitigating strategies that provide enhanced ability to ensure that core cooling and containment capabilities are maintained or restored. Such design features should reduce and simplify the

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manual actions necessary to maintain these safety functions, and allow more time to properly assess plant conditions and prolong the use of installed equipment, as compared to current operating reactors. This guidance is consistent with the Policy Statement on the Regulation of Advanced Reactors, in which the Commission previously encouraged vendors to include certain design features into the plant design.

The probability of an ELAP concurrent with a LUHS occurring during any specific outage configuration is expected to be small. However, as seen in shutdown and full power probabilistic risk assessment for new nuclear power plants, the shutdown core damage frequencies and the large release frequencies are comparable to full power core damage frequencies and large release frequencies. These shutdown frequencies are annualized and take into account the frequency and duration that a licensee enters a shutdown condition, which is approximately five percent of a calendar year. This effect is caused by reduced defense-in-depth, loss of multiple barriers (such as an open reactor coolant system and an open containment), and the increased reliance on operator actions.

The regulatory positions in this guide are intended to enhance margins of safety for new reactors through the use of design features that enhance the initial phase capabilities and transition phase capabilities until equipment and resources are brought from offsite. Therefore, the positions outlined in this appendix apply to all modes, including shutdown and refueling modes, and applicants for new nuclear power plants should address shutdown modes at the design stage. The strategies should provide for core cooling in all modes of plant operation including when the reactor coolant system is breached. The strategies should address any challenges to the containment function in all modes of plant operation in which containment is required to be maintained.

9. Operator Action

Applicants for new reactor power plants are required to incorporate into the plant design those design features that enhance coping durations and minimize reliance on human actions to maintain or restore core cooling, containment, and SFP cooling capabilities.

For the purpose of evaluating operator action, applicants for new nuclear power plants should assure, to the extent practical, that: (1) all necessary actions to monitor and coordinate control of the nuclear facility can be performed in the control room, or at an alternate station containing equipment specifically designed for control purposes; and (2) a reduced amount of active operator intervention, if any, is required.

Reduction in the use of operator action is measured relative to the actions required to address mitigating strategies already in place (e.g., actions contained in operational programs at current operating reactor sites). Each design feature and functional capability incorporated into the design does not have to involve reduced use of operator actions. The overall reduction in use of operator actions should be judged for the complete set of design features and functional capabilities identified by the applicant to show that the acceptance criteria have been met. In this

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context, "operator action" includes actions of operators in the control room or at alternate control panels or control areas to control the reactor and the nuclear facility, as well as other manual actions associated with implementation of the mitigation strategies and the design features (e.g., connection of equipment). This means that active operator intervention and initiation of responsive action to maintain core cooling, containment and SFP cooling capabilities should be reduced. Fundamental considerations should be reducing operator workload so that time and attention can be directed toward managing critical safety functions. In some cases, there may be countervailing considerations that weigh against reducing the use of operator action to the absolute minimum.

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