



**JAPAN LESSONS-LEARNED PROJECT DIRECTORATE**

**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**

*Revision 0*



# U.S. NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

*Protecting People and the Environment*

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**INTERIM STAFF GUIDANCE (ISG)  
JAPAN LESSONS-LEARNED PROJECT DIRECTORATE (JLD)**

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

**PURPOSE**

The U.S. Nuclear Regulatory Commission (NRC, or Commission) staff is providing this 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 Memorandum and Order CLI-12-09, "In the Matter of South Carolina Electric & Gas Co. and South Carolina Public Service Authority (Also Referred to as Santee Cooper; Virgil C. Summer Nuclear Station, Units 2 and 3)" [Reference 2]. 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 0 [Reference 3]. 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 4]. 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 5], and SECY-11-0137, "Prioritization of

Recommended Actions to be Taken in Response to Fukushima Lessons Learned,” dated October 3, 2011 [Reference 6].

As directed by the Commission’s staff requirement memorandum (SRM) for SECY-11-0093 [Reference 7], 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. SECY-11-0124 and SECY-11-0137 established the staff’s prioritization of the recommendations.

After receiving the Commission’s direction in SRM-SECY-11-0124 [Reference 8], and SRM-SECY-11-0137 [Reference 9], the NRC staff conducted public meetings to discuss enhanced mitigation strategies intended to maintain or restore core cooling, containment, and 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 10]. 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 11] to the Commission, including the proposed Order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 [Reference 12], the NRC staff issued Order EA-12-049. 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 Virgil C. Summer Nuclear Station, 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 spent fuel pool (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 the use of 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 13], 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 14]. 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 15], and published a notice of its availability for public comment in the *Federal Register* (77 FR 33779, dated 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 16].

On July 3, 2012, NEI submitted Revision C to NEI 12-06 [Reference 17], 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 18], incorporating many of the remaining exceptions and clarifications. On August 21, 2012, NEI submitted Revision 0 to NEI 12-06, making various editorial corrections.

## **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 off-site resources necessary to address potential wide-spread catastrophes such as the occurrence at Fukushima, where restoration of off-site 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 19] for holders of and applicants for operating licenses issued under 10 CFR Part 50 and Revision 3 [Reference 20], 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 0, 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).

## **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 0, subject to the clarifications in Attachment 1 to this ISG are an acceptable means of meeting the requirements of Order EA-12-049. However, NRC endorsement of NEI 12-06 does not imply NRC endorsement of references listed in NEI 12-06.

## **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, and/or other guidance documents, as appropriate.

## **ATTACHMENT**

1. Guidance for Developing, Implementing and Maintaining Mitigation Strategies

## **REFERENCES**

1. 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. Memorandum and Order CLI-12-09, "In the Matter of South Carolina Electric & Gas Co. and South Carolina Public Service Authority (Also Referred to as Santee Cooper; Virgil C. Summer Nuclear Station, Units 2 and 3)," March 30, 2012 (ADAMS Accession No. ML12090A531)
3. Nuclear Energy Institute document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, August 21, 2012 (ADAMS Accession No. ML12242A378)

4. SECY-11-0093, "Recommendations for Enhancing Reactor Safety in the 21<sup>st</sup> Century, the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011 (ADAMS Accession No. ML11186A950)
5. SECY-11-0124, "Recommended Actions to be Taken without Delay from the Near-Term Task Force Report," September 9, 2011 (ADAMS Accession No. ML11245A158)
6. SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," October 3, 2011 (ADAMS Accession No. ML11272A111)
7. 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)
8. SRM-SECY-11-0124, "Staff Requirements – SECY-11-0124 – Recommended Actions to be Take without Delay from the Near-Term Task Force Report," October 18, 2011 (ADAMS Accession No. ML112911571)
9. 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)
10. 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)
11. 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)
12. 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)
13. Nuclear Energy Institute document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision B, May 4, 2012 (ADAMS Accession No. ML12128A124)
14. Nuclear Energy Institute document NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision B1, May 13, 2012 (ADAMS Accession No. ML12143A232)
15. 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)
16. NRC Response to Public Comments, JLD-ISG-2012-01 (Docket ID NRC-2012-0068), August 29, 2012 (ADAMS Accession No. ML12229A253)

17. Nuclear Energy Institute document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision C, July 3, 2012 (ADAMS Accession No. ML121910390)
18. Nuclear Energy Institute document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Draft Revision 0, August 3, 2012 (ADAMS Accession No. ML12221A204)
19. Nuclear Energy Institute document 06-12, "B.5.b Phase 2 & 3 Submittal Guideline," Revision 2, December 2006 (ADAMS Accession No. ML070090060)
20. Nuclear Energy Institute document 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)

Public Meetings:

December 1, 2011 (ML11341A160)  
December 8, 2011 (ML11348A098)  
January 13, 2012 (ML11362A202)  
January 18, 2012 (ML12032A044)  
March 28, 2012 (ML12104A019)  
April 10, 2012 (ML12082A028)  
April 24, 2012 (ML12123A162)  
May 9, 2012 (ML12159A072)  
May 15, 2012 (ML12159A106)  
May 30, 2012 (ML12159A188)  
June 13, 2012 (ML12174A328)  
July 26, 2012 (ML12229A135)



# **GUIDANCE FOR DEVELOPING, IMPLEMENTING AND MAINTAINING MITIGATION STRATEGIES**

## **1.0 Evaluation of External Hazards**

NEI 12-06, Section 4 discusses the overall methodology for evaluating the impact of the hazards, discussed in Section 5.0 through 9.0, on the deployment of the strategies to meet the baseline coping capability.

Staff Position: NEI 12-06, Sections 5.0 through 9.0 and Appendix B provide an acceptable methodology for the evaluation of external hazards, recognizing that it does not purport to compute beyond-design-basis hazard levels.

## **2.0 Phased Approach**

Order EA-12-049 requires a three-phase approach to mitigating beyond-design-basis events, with an initial response phase using installed equipment, a transition phase using portable equipment and consumables to provide core and spent fuel pool (SFP) cooling and maintain the containment functions, and a third phase of indefinite sustainment of these functions using off-site resources. 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 staff recognizes that for certain beyond-design-basis external events, 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. If fuel damage occurs, the Severe Accident Management Guidelines should be used as guidance.

Staff Position: NEI 12-06 provides an acceptable method for developing the phased approach required by Order EA-12-049.

### **2.1 Initial Response Phase**

The initial response phase will be accomplished using installed equipment. Licensees should establish and maintain current estimates of their capabilities to maintain core and SFP cooling and containment functions assuming a loss of alternate current (ac) electric power to the essential and nonessential switchgear buses except for those fed by station batteries through inverters. This estimate provides 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. This estimate 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, Section 3.0, provides an acceptable method for determining the baseline coping capabilities, which will determine the duration of the initial response phase, with the following clarification:

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 can withstand challenges to these key safety functions using installed equipment during a beyond-design-basis external event. This knowledge provides an input to the choice of storage locations and conditions of readiness of

the equipment required for the follow-on phases. This duration is related to, but distinct from the specified duration for the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.63, "Loss of all alternating current power," paragraph (a), because it represents the current capabilities of the licensee rather than a required capability and licensees must 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 FLEX principles described in Section 3.2.1.7, Paragraph 6) and Section 3.2.2, Paragraph (1) of NEI 12-06; 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.

## **2.2 Transition Phase**

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

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

## **2.3 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.

Staff Position: NEI 12-06 provides an acceptable method for determining the baseline coping capabilities for the final phase.

## **3.0 Core Cooling Strategies**

The first set of strategies necessary to meet the requirements of Order EA-12-049 addresses challenges to core cooling. Core cooling must be accomplished in all three phases described in the Order. The purpose of these strategies is to provide a means of cooling the core in order to prevent fuel damage.

Staff Position: NEI 12-06 provides an acceptable method of developing strategies to maintain or restore core cooling capabilities.

## **4.0 Spent Fuel Pool Cooling Strategies**

The second set of strategies necessary to meet the requirements of Order EA-12-049 addresses challenges to SFP cooling. SFP cooling must be accomplished in all three phases described in the Order. The purpose of these strategies is to provide alternative means of cooling the spent fuel in order to prevent fuel damage. Licensees must consider all loading conditions relevant to their SFP, including a maximum core offload.

Staff Position: NEI 12-06 provides an acceptable method to develop strategies and guidance for SFP cooling.

## **5.0 Containment Functions Strategies**

The third group of strategies and guidance necessary to meet the requirements of Order EA-12-049 addresses challenges to the containment functions. Containment functions must be accomplished in all three phases described in the Order.

### **5.1 Removal of Heat from Containment (Pressure Control)**

Beyond-design-basis external events such as a prolonged SBO or loss of normal access to the ultimate heat sink could result in a long-term loss of containment heat removal. The goal of this strategy is to relieve pressure from the containment in such an event.

Staff Position: NEI 12-06 provides an acceptable method to develop strategies and guidance for removal of heat from containment.

## **6.0 Programmatic Controls**

### **6.1 Equipment Protection, Storage, and Deployment**

Storage locations chosen for the equipment must provide protection from external events as necessary to allow the equipment to perform its function without loss of capability. In addition, the licensee must provide a means to bring the equipment to the connection point under those conditions in time to initiate the strategy prior to expiration of the estimated capability to maintain core and spent fuel pool cooling and containment functions in the initial response phase.

Staff Position: NEI 12-06 provides an acceptable method to provide reasonable protection, storage, and deployment of the equipment associated with Order EA-12-049.

### **6.2 Equipment Quality**

Staff Position: NEI 12-06 provides an acceptable method to control the quality of equipment associated with Order EA-12-049 with the following clarifications.

1. Installed structures, systems and components pursuant to 10 CFR 50.63(a) should continue to meet the augmented quality guidelines of Regulatory Guide 1.155, "Station Blackout."
2. Development of maintenance and testing programs for the portable equipment responsive to Order EA-12-049, following the guidelines of NEI 12-06 and standard industry processes for ensuring equipment reliability, provides an acceptable method to reasonably assure the equipment will be functional.
3. In the absence of consensus standards specifically developed for these mitigating strategies, a licensee's conformance to consensus standards developed for similar emergency uses, such as those of the National Fire Protection Association for fire protection equipment, provides an acceptable method to reasonably assure the equipment will be functional.

## **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.