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

DRAFT Interim Staff Guidance

Revision 0

(DRAFT Issue for Public Comment)

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PROPOSED INTERIM STAFF GUIDANCE
JAPAN LESSONS-LEARNED PROJECT DIRECTORATE

DRAFT
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) staff is providing this interim staff guidance (ISG) to assist nuclear power reactors 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," 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)." 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," except those who have permanently ceased operation and have certified that fuel has been removed from the reactor vessel. This draft ISG endorses, with exceptions, 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 B1 [Reference 1]. 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 2]. 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 3] and SECY-11-0137, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 [Reference 4].

As directed by the Commission's Staff Requirement Memorandum (SRM) for SECY-11-0093 [Reference 5], 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 based upon the potential safety enhancements.

After receiving the Commission's direction in SRM-SECY-11-0124 [Reference 6] and SRM-SECY-11-0137 [Reference 7], 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 the Nuclear Energy Institute's (NEI's) letter, dated December 16, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11353A008) [Reference 8]. 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 9] to the Commission, including the proposed order to implement the enhanced mitigation strategies. As directed by SRM-SECY-12-0025 [Reference 10], the NRC staff issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" [Reference 11]. On March 30, 2012, the Commission issued 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 12] 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 the loss of power, motive force and normal access to the ultimate heat sink to prevent fuel damage in the reactor and SFP affected all units at a site simultaneously. The Order requires a three-phase approach for mitigating beyond-design-basis external events. The initial phase requires the use of installed equipment and resources to maintain or restore 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, the Nuclear Energy Institute (NEI) submitted NEI document 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," 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. 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.”

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 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. Licensees’ emergency operating procedures and abnormal operating procedures provide guidance for use during the first phase of response to beyond-design-basis external events. Additional guidance and strategies are necessary for use during the second and third phases of response to such events.

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 14] for holders of and applicants for operating licenses issued under 10 CFR Part 50 and Revision 3 [Reference 15] 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 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

This ISG shall be implemented on the day following its approval. It shall remain in effect until it has been superseded, withdrawn, or incorporated into a regulatory guide and the Standard Review Plan (SRP).

PROPOSED GUIDANCE

As discussed above, this ISG is applicable to holders of power reactor operating licenses and 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, subject to the clarifications and exceptions in Attachment 1 to this ISG is an acceptable means of meeting the requirements of Order EA-12-049.

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

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

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

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

5. 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)

6. 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)

7. 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)

8. 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)

9. 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)

10. 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)

11. Order EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” March 12, 2012 (ADAMS Accession No. ML12054A736)

12. 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)

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

14. Nuclear Energy Institute document 06-12, “B.5.b Phase 2 & 3 Submittal Guideline,” Revision 2, December 2006 (ADAMS Accession No. ML070090060)

15. 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)

16. 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 (ML
May 15, 2012 (ML
May 30, 2012 (ML

GUIDANCE FOR DEVELOPING, IMPLEMENTING AND MAINTAINING MITIGATION STRATEGIES

1.0 Evaluation of External Hazards

Staff Position: Nuclear Energy Institute (NEI) document 12-06, Revision B1, Sections 5.0 through 9.0 and Appendix B provide an acceptable methodology for the evaluation of external hazards with the following clarifications and exceptions:

1. The assessment of external flooding impact in NEI 12-06, Section 6.0 includes considerations that include reference to the design basis flood level. For a multi-unit site or a single unit site in proximity to another licensed site, early site permit, or combined license application, the design basis flood level for storage and deployment of FLEX equipment must include an evaluation of the design basis flood levels established for adjacent licensed sites, early site permits and/or combined license applications.

2.0 Phased Approach

Order EA-12-049 requires a three-phase approach to the problem, 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-events, the damage state could prevent maintenance using the equipment intended for particular phases; in 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 (SAMGs) 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. Guidance and strategies developed using NEI 12-06 must provide a means to monitor for imminent or actual core damage as an input into the decision to manage the response to the event within those guidance and strategies or shift the management to the SAMGs.

2.1 Initial Response Phase

2.1.1 Duration

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 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 clarifications and exceptions:

1. An element of a set of strategies to maintain or restore core and SFP cooling and containment functions includes knowledge of the time for which 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 10 CFR 50.63 because it represents the current capabilities of the licensee rather than a required capability. In addition, licensees must 1) account for the SFP cooling function, which is not addressed by 10 CFR 50.63, and 2) assume the non-availability of alternate ac sources, which may be included in meeting the specified durations of 10 CFR 50.63. Maintenance of the guidance and strategies requires that the estimate of capability be kept current to reflect plant conditions following facility changes. 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.

2.1.2 Command, Control and Communications

Following a beyond-design-basis external event, normal plant command and control may be effected. In addition, both on-site and off-site communications may be disrupted. NEI 12-06 provides some guidance on the need for pre-planning of communications systems for ingress and egress to plant areas required for deployment of FLEX strategies in item (8) of Section 3.2.2.

Staff Position: Planning for internal communications as discussed in NEI 12-06, Section 3.2.2, item (8) is a necessary element of an adequate strategy for command, control and communications following a beyond-design-basis external event. In order to address the potential impacts on communications external to the plant, an adequate strategy for mitigation of a beyond-design-basis external event shall include the following:

1. Pre-planned mustering to organize available resources
2. Pre-planned on-site and off-site communication alternatives
3. Identification of available communication resources given the potential for damage beyond the site
4. Definition of the command and control structure taking into account potential casualties affecting its normal state
5. Guidance for notification of off-site responders, to include
    a. Utility emergency response organization (ERO)
    b. Local law enforcement agencies (LLEA)
    c. Local fire departments
    d. Off-site entities supplying equipment and consumables necessary for the indefinite sustainment of key safety functions

2.1.3 Initial Operational Actions

The prevention of core damage will be facilitated by early actions to stabilize the situation and delay event degradation using functional, installed equipment. These actions should include verification that the reactor has been shutdown with adequate shutdown margin in order to minimize the decay heat to be removed and verification that the expected initial means of core cooling have initiated.

Staff Position: NEI 12-06 provides an acceptable method for development of initial operator actions to address a beyond-design-basis external event.

2.1.4 Initial Damage Assessment

Following a beyond-design-basis external event, normal plant instrumentation may not be available. Knowledge of plant and equipment conditions will be necessary in order to support decision making.

Staff Position: The general criteria and baseline assumptions of NEI 12-06 provide an appropriate starting point for the establishment of an adequate set of strategies for mitigating the effects of a beyond-design-basis external event. Due to the fundamentally unbounded nature of such an event, however, it is necessary to verify that the initial conditions of the event conform to these assumptions in order to determine whether to implement these strategies or rely on other guidance such as SAMGs or extensive damage mitigation guidelines. Therefore, an adequate set of strategies will include:

1. Assessment of the reactor and core cooling systems.
2. Assessment of containment and containment cooling and pressure control systems.
3. Assessment of emergency core cooling systems.
4. Assessment of SFP and SFP cooling systems.
5. Assessment of key support systems such as
    a. Electrical power
    b. Cooling water
    c. Control air
6. Assessment of key buildings.

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.

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. An adequate strategy for the

final phase will include an assessment of the time it takes for offsite resources to arrive at the site taking into consideration the evaluation of external hazards described in Section 1.0.

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 with the clarifications provided in Sections 3.1 through 3.4 below.

3.1 Removal of Decay Heat

Core cooling strategies must be capable of removing decay heat that is expected for the conditions when the strategy will be implemented. Temperature of the make-up water for the determination of the required flow rate shall be selected at a conservative value representing the range of expected temperatures for the make-up source. Should the mechanism for removal of decay heat include the removal of water or steam from the reactor coolant system (RCS) or secondary inventory, a conservative value representing its expected temperature and pressure will be used.

Staff Position: An adequate core cooling strategy shall be capable of removing decay heat from the core during the time it is expected to be used. For the initial phase, an evaluation should be performed assuming a loss of all ac power occurs while the reactor is operating at 100 percent rated thermal power and has been at this power for at least 100 days. Based upon the capability and duration of the initial phase to maintain or restore core cooling following such an event, the capabilities of the transition phase strategies should be determined.

3.1.1 Engineering Basis for Flow

Core cooling strategies that rely on flow of cooling or make-up water must be capable of providing sufficient flow to remove the decay heat expected.

Staff Position: Licensees shall have an engineering basis that provides reasonable assurance that the intended flow rate is adequate and can be provided. The basis should be auditable, but does not have to be a quality related calculation. However, licensees should ensure that the analytical method used has sufficient justification so as to provide reasonable assurance that all relevant physical phenomena are appropriately modeled. Licensees and applicants should consider the following factors that can affect the ability to provide the specified flow for the required period of time:

- Pump design output performance (flow/pressure) characteristics
- Line losses due to hose size, coupling size, and hose length
- Head losses due to elevation changes, especially for spray strategies

- Back pressure when injecting into closed/pressurized spaces (e.g., containment, steam generators)
- Capacity and availability of the suction sources needs to be considered given the specific external initiating events (condensate storage tank (CST)/refueling water storage tank (RWST)/circulating water basin/fire main/city water supply/lake/river, etc.) to provide an adequate supply for the pumps (fire engines, portable pumps, fire protection system pumps, etc.)
- Potential detrimental impact on water supply source or output pressure when using the same source or permanently installed pump(s) for both makeup and firefighting
- Availability of sufficient supply of fuel onsite to operate diesel powered pumps for the required period of time
- Availability of an adequate and reliable source of electrical power to operate electric powered pumps for the required period of time
- Potential clogging of strainers, pumps, valves or hoses from debris or ice when using rivers, lakes, ocean or cooling tower basins as a water supply

3.1.2 Control of Cool Down/Depressurization Rates

Core cooling strategies must be capable of providing a means to control the cool down/depressurization rates in order to manage appropriate parameters, including RCS inventory or reactor pressure vessel (RPV) level. This may be accomplished by means of portable instrumentation using permanently installed sensors or by the use of operator aids. Such operator aids must take into account appropriate variables such as, for example, the operating history prior to shutdown and the time since shutdown in determining the decay heat rate.

Staff Position: While the strategy must be capable of removing expected decay heat, a means of controlling the degree and rate of cool down/depressurization must be provided. This means must include control of the make-up rate and/or the venting/bleed rate. Control of the degree and rate of cool down/depressurization must be capable of maintaining the system within specified limits and avoiding hazards such as, for example, nitrogen injection from standby (safety) injection tanks that would challenge natural circulation flow within the reactor coolant system for a pressurized-water reactor (PWR).

3.2 Management of Reactor Coolant System Inventory

Core cooling strategies must be capable of providing make-up water as necessary to manage RCS inventory in order to allow continued cooling. This is to account for expected leakage from the reactor coolant system through, for example, reactor coolant pump seals.

Staff Position: Licensees shall be capable of managing RCS inventory through provision of make-up water in addition to control of cool down/depressurization rates. The capability to provide make-up water shall be maintained on-site unless site-specific expected leakage rates demonstrate that management of RCS inventory can be accomplished through management of cool down/depressurization rates until off-site resources can be delivered and installed to provide the necessary RCS make-up water. Management of RCS inventory shall take into account maintenance of subcriticality through the use of borated makeup water if necessary.

3.3 Monitoring of Fuel Condition

Core cooling strategies must provide a means to detect imminent or actual core damage and control venting/bleeding in order to allow appropriate control of radiological releases and initiation of SAMGs.

Staff Position: Monitoring for imminent core damage is necessary in order to allow for control of radiological releases.

Monitoring for actual core damage is necessary in order to determine whether exit criteria for the core cooling strategies and entrance criteria for the SAMGs have been met. If these criteria have been met, licensees shall manage the accident response following the SAMGs.

3.4 Human Factors

Licensees must be capable of executing the core cooling strategies in the context of a prolonged station blackout (SBO). This includes operation beyond the battery life for installed emergency lighting.

Staff Position: Licensees shall ensure that component accessibility and marking supports timely and reliable operation given the potential unavailability of installed plant lighting and potentially high ambient temperatures and humidity.

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. 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 with the following exceptions:

1. Use of the fire protection system ring header as a water source is acceptable only if the header meets the criteria to be considered “robust” as defined in NEI 12-06.

2. The minimum SFP make-up capacity must be capable of compensating for boil off due to the design basis heat load for the SFP.

3. The minimum SFP spray capacity is 200 gallons per minute per unit for shared SFPs.

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.

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: For boiling-water reactors (BWRs) with Mark I and Mark II containments only; licensees shall provide a power-independent means to remove heat from containment by locally opening containment vent pathways using criteria developed in response to Order EA-12-050.

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

5.2 Hydrogen Control for Protection of Containment Integrity Function

BWR facilities with Mark I and Mark II containment structures are required to maintain an inert containment atmosphere during plant operation at power to protect against hydrogen detonation. PWR facilities with large dry containments are not required to control hydrogen buildup inside the containment structure because the containment volume is sufficient to keep the pressure spike of potential hydrogen deflagrations within the design pressure of the structure. However, BWR facilities with Mark III containments and PWR facilities with ice condenser containments are required to have hydrogen igniters inside containment to control the buildup of hydrogen gas. These igniters are operated in two redundant trains, with each train powered by one of the redundant safety-grade ac electrical power systems. The igniters must be powered prior to the onset of fuel damage to ensure hydrogen concentrations remain within acceptable limits for maintenance of containment integrity.

Generic safety issue (GSI)189, “Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion during a Severe Accident,” raised questions about the effectiveness of these igniter systems during a prolonged SBO scenario. In response to the issues raised in GSI-189, licensees operating BWRs with Mark III containments voluntarily developed equipment, procedures, and training to support provision of nonsafety-grade backup electrical power from portable generators to one train of the igniters that is independent of much of the safety-grade ac and dc onsite power systems. Licensees operating PWRs with ice condenser containments voluntarily developed similar capabilities, but with less independence from the on-site ac and dc power distribution systems.

Staff Position: Licensees with installed hydrogen igniters shall develop and maintain strategies to provide alternative power from generating equipment independent of the safety-related on-site power sources to supply electricity to one train of hydrogen igniter equipment. Independent alternative power generating equipment shall be accessible and capable of installation in the transition phase.

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. For example, if the evaluation of external hazards shows that it is appropriate to install connections for the equipment at a specific height above the design flood level for the plant, then the equipment should be stored in locations that are at or above that level. 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 subject to Staff Position 1 of Section 1.0, "Evaluation of External Hazards," above.

6.2 Equipment Quality

Equipment associated with the strategies developed to meet the requirements of Order EA-12-049 need not be treated as safety-related equipment or subject to special treatment requirements under 10 CFR such as Part 50 Appendix B quality assurance (QA), seismic, or Environmental Qualification.

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. Licensees must maintain a program that provides assurance that the equipment used to meet the requirements of Order EA-12-049 and not already covered by existing QA requirements in Appendix B or R of 10 CFR Part 50 is tested, maintained and operated so that they will function as intended. This equipment must be implemented so that it does not degrade the existing safety-related systems. This is accomplished by making the non-safety equipment as independent as practicable from existing safety-related systems. The guidance provided in this section outlines an acceptable QA program for non-safety equipment used for Order EA-12-049 and not already covered by existing QA requirements. Activities should be implemented from this section as appropriate, depending on whether the equipment is being added (new) or is existing.

1. Licensees shall control those commercial items that are commonly procured for use in the fire protection, such as fire hoses, spray nozzles, fire pumper trucks, and temporary fire pumps, using the fire protection QA program. Quality of the equipment being maintained shall be understood to be with respect to the associated strategies, rather than with respect to fire protection, as would be required by Regulatory Guide 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, Section C.4 of Branch Technical Position (BTP) CMEB 9.5-1, Revision 2, in the review and acceptance of approved Fire Protection Plans for plants licensed after January 1, 1979, or BTP APCSB 9.5-1, its Appendix A, and Generic Letter 77-02 for plants licensed before January 1, 1979.

2. Licensees may include other equipment used to meet the requirements of Order EA-12-049 in the Appendix B or fire protection QA programs or in a separate program implementing the following activities as appropriate.

    a. Design Control and Procurement Document Control. Measures should be established to ensure that all design related guidelines used in complying with Order EA-12-049 are included in design and procurement documents, and that deviations therefore are controlled.

    b. Instructions, Procedures, and Drawings. Inspections, tests, administrative controls, and training necessary for compliance with Order EA-12-049 should be prescribed by documented instructions, procedures, and drawings and should be accomplished in accordance with these documents.

    c. Control of Purchased Material, Equipment, and Services. Measures should be established to ensure that purchased material, equipment, and services conform to the procurement documents.

    d. Inspection. A program for independent inspection of activities required to comply with Order EA-12-049 should be established and executed by (or for) the organization performing the activity to verify conformance with documented installation drawings and test procedures for accomplishing the activities.

    e. Testing and Test Control. A test program should be established and implemented to ensure that testing is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. The tests should be performed in accordance with written test procedures; test results should be properly evaluated and acted on.

    f. Inspection, Test, and Operating Status. Measures should be established to identify items that have satisfactorily passed required tests and inspections.

    g. Nonconforming Items. Measures should be established to control items that do not conform to specified requirements to prevent inadvertent use or installation.

    h. Corrective Action. Measures should be established to ensure that failures, malfunctions, deficiencies, deviations, defective components, and nonconformances are promptly identified, reported, and corrected.

    i. Records. Records should be prepared and maintained to furnish evidence that the criteria enumerated above are being met for activities required to comply with Order EA-12-049.

j. Audits. Audits should be conducted and documented to verify compliance with design and procurement documents, instructions, procedures, drawings, and inspection and test activities developed to comply with Order EA-12-049.

7.0 Off-site Resources

The Final Phase of the guidance and strategies required by Order EA-12-049 requires use of off-site resources to sustain the strategies indefinitely.

Staff Position: NEI 12-06 provides an acceptable means to meet the requirements of Order EA-12-049 subject to the following clarification:

1. Licensees shall establish an oversight mechanism to provide reasonable assurance that portable equipment necessary to sustain indefinite operation of the mitigating strategies can be deployed to the site, installed in sufficient time to allow overlap between the transition and final phases and capable of performing their intended functions.

8.0 Strategy Maintenance

Order EA-12-049 requires maintenance of the guidance and strategies licensees develop. This maintenance is part of the implementation and has the purpose of assuring the continued viability of the strategies feasibility.

Staff Position: NEI 12-06 provides an acceptable method for maintenance of the guidance and strategies.

9.0 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 with the exceptions and clarifications provided below.

Table F.3.2-1 lists the equipment to be provided.

Staff position: FLEX equipment for RCS, Containment, and SFP instruments must include portable instrumentation and control measurement equipment and power supplies. This is necessary, if the 480V distribution equipment is not available as a backup strategy in order to avoid a single-point of failure.

Section F.4 Step 2: Determine Applicable Extreme External Hazards

Staff position: NEI 12-06, Section F.4, Step 2, paragraph 2 in not endorsed. All AP1000 plants should provide a mitigating strategy since the initiating event is a beyond-design-basis external

event. The remainder of this Step provides an acceptable approach for the determination of applicable extreme external hazards.

Section F.6 Step 2B: Standard Design External Flooding Margin Assessment
Staff position: NEI 12-06, Section F.6, Step 2B is not endorsed as written. The treatment of external flooding should be similar to operating plants. The following is an acceptable approach for standard design external flooding margin assessment for AP1000 COL holders:

The AP1000 design basis (see Table 2-1, Site Parameters, of the AP1000 site-specific [Final Safety Analysis Report] FSAR) demonstrates the wide range of extreme environmental conditions covered by the design. Because of the conservatisms that are incorporated into the selection of these site environmental conditions, they are expected to bound extreme site-specific values.

For the indefinite extension of the passive system coping time, the environmental condition should be assessed, consistent with the plant licensing basis, to verify the capability of the FLEX equipment to perform its mission to extend the coping time indefinitely under this range of conditions. In general, FLEX equipment, as described in Section F.3.2, may be stored at a sufficient distance from the site such that it would not reasonably be subject to the same external hazard and would therefore be expected to be available following the 72 hour coping period for AP1000. However, appropriate conditions will need to be defined to ensure the FLEX equipment, once deployed, will maintain its operability over the appropriate range of external conditions considering the site conditions that may exist 72 hours after the initial event.

Considering the deployment, procedural interfaces, and offsite resources for FLEX equipment, Sections 6.2.3.2 – 6.2.3.4 are incorporated in their entirety into this Appendix. This ensures that the AP1000 FLEX equipment is designed to function under the extreme conditions of external flooding.

Section F.7 Step 2C: Assess Impact of Severe Storms with High Winds

Staff position: NEI 12-06, Section F.7, Step 2 is not endorsed as written. The following is an acceptable approach for assessing the impact of severe storms with high winds:

See considerations provided for Section F.6.

Considering the deployment, procedural interfaces, and offsite resources for FLEX equipment, Sections 7.3.2 – 7.3.4 are incorporated in their entirety into this Appendix. This ensures that the AP1000 FLEX equipment is designed to function under the extreme conditions of severe storms with high winds.

Section F.8 Step 2D: Assess Impact of Snow, Ice and Extreme Cold

Staff position: NEI 12-06, Section F.8, Step 2D is not endorsed as written. The following is an acceptable approach for assessing the impact of snow, ice and extreme cold:

See considerations provided for Section F.6.

Considering the deployment, procedural interfaces, and offsite resources for FLEX equipment, Sections 8.3.2 – 8.3.4 are incorporated in their entirety into this Appendix. This ensures that the AP1000 FLEX equipment is designed to function under the extreme conditions of snow, ice, and extreme cold.

Section F.9 Step 2E: Assess Impact of High Temperature

Staff position: NEI 12-06, Section F.9, Step 2E is not endorsed as written. The following is an acceptable approach for assessing the impact of high temperature:

See considerations provided for Section F.6.

Considering the deployment, procedural interfaces, and offsite resources for FLEX equipment, Sections 9.3.2 – 9.3.4 are incorporated in their entirety into this Appendix. This ensures that the AP1000 FLEX equipment is designed to function under the extreme conditions of high temperatures.

10.0 Reporting Requirements

All holders of operating licenses issued under Part 50 shall submit to the Commission for review an overall integrated plan including a description of how compliance with the requirements described in Attachment 2 will be achieved.

All holders of CPs issued under Part 50 or COLs issued under Part 52 shall submit to the Commission for review an overall integrated plan including a description of how compliance with the requirements described in Attachment 2 or Attachment 3 or other instrument imposing such requirements, will be achieved.

Staff Position: The overall integrated plan submittal shall contain information with the necessary detail to demonstrate how compliance with the requirements described in Attachment 2 or Attachment 3 of EA-12-049 will be achieved. Licensees shall provide a complete description of the system, including important operational characteristics. The level of detail generally considered adequate is consistent to the level of detail contained in the Licensee's Final Safety Analysis Report (FSAR). In addition, the NRC staff expects the Licensee's submittal will provide the following information:

- Description of the guidance and strategies to be developed to meet the requirements contained in Attachment 2 or Attachment 3.
- Description of major system components and the applicable protection being incorporated for the associated equipment from external events, including applicable quality requirements.
- Demonstration how the strategies will be implemented in all modes.
- Demonstration of the necessary procedures, guidance, training, acquisition, staging, or installation of equipment needed for the strategies, including necessary modifications necessary.
- Piping and instrumentation diagram (P&ID), as necessary to indicate equipment which is installed or equipment hookups necessary for the strategies.

The submittal shall also include an update of implementation schedule milestones.

All Licensees and holders of CPs shall provide an initial status report **sixty (60) days** following issuance of the final ISG or as directed by your COL license condition and at **six (6)-month** intervals following submittal of the overall integrated plan, as required in Condition C.1, which delineates progress made in implementing the requirements of this Order.

Staff Position: The report should include an update of accomplishments since the last status report, including any changes to the schedule. The report should also include a listing of equipment procured, modifications made to the unit, and any changes which need to be submitted to the overall integrated plan.

All Licensees and CP holders shall report to the Commission when full compliance with the mitigating strategies requirements is achieved.

Staff Position: The report shall include the date full compliance was achieved along with the location of necessary reports, analysis and other information necessary for the NRC staff to conduct an inspection that the Licensee is in compliance with the mitigating strategies requirements.