UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

December 6, 2016

The Honorable Stephen G. Burns
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: DRAFT FINAL RULE 10 CFR 50.155, "MITIGATION OF BEYOND-DESIGN-BASIS EVENTS" AND ASSOCIATED REGULATORY GUIDANCE

Dear Chairman Burns:

During the 639th meeting of the Advisory Committee on Reactor Safeguards, November 30-December 2, 2016, we reviewed the following materials:

- Draft Final Rule 10 CFR 50.155, “Mitigation of Beyond-Design-Basis Events”
- Draft Final Regulatory Guide 1.226, “Flexible Mitigation Strategies for Beyond-Design-Basis Events”
- Draft Final Regulatory Guide 1.227, “Wide-Range Spent Fuel Pool Level Instrumentation”
- Draft Final Regulatory Guide 1.228, “Integrated Response Capabilities for Beyond-Design-Basis Events”

Our Fukushima Subcommittee reviewed these matters on May 6, 2015, February 18, 2016, April 22, 2016, August 17, 2016, and November 16, 2016. During these meetings, we had the benefit of discussions with representatives of the NRC staff, the Nuclear Energy Institute (NEI), the Union of Concerned Scientists, and NRC staff who do not concur fully with the final rulemaking package. We also had the benefit of the referenced documents.

RECOMMENDATIONS

1. Draft final rule 10 CFR 50.155 should be issued after consideration of the following recommendation:

   To ensure the rule consolidates and integrates requirements for equipment and strategies that licensees will use to mitigate the effects from a wide range of severe hazards, the equipment capability requirements in paragraph (c)(1) and the communications requirements in paragraph (c)(4) should apply for all of the strategies in paragraphs (b)(1) through (b)(3).

2. Draft final Regulatory Guide 1.226 should be revised to omit the overall seismic risk screening criteria that are recommended in Section H.4.5.3 of NEI 12-06, Revision 3.

3. It is important that Interim Staff Guidance JLD-ISG-2012-01, Revision 2, and Regulatory Guide 1.226 contain guidance that is functionally equivalent and applied consistently for all licensees. Draft final Regulatory Guide 1.226 should not be issued until it is reconciled with the final guidance in JLD-ISG-2012-01, Revision 2.

4. Draft final Regulatory Guides 1.227 and 1.228 should be issued.

5. The staff should review the mitigating strategies and the baseline FLEX Support Guidelines to ensure that they appropriately integrate contingency actions for loss of direct current (DC) power supplies, associated instrumentation requirements, and equipment operating practices.

BACKGROUND

In our April 22, 2015 letter report, we recommended that draft proposed rule 10 CFR 50.155 and its associated draft regulatory guidance be published for public comment. The staff has received substantial input through numerous public meetings and stakeholder feedback. Our Fukushima Subcommittee has followed the progression of the rule, its supporting regulatory guides, and the endorsed NEI implementation guidance as they evolved to their current versions. The references in this letter report list the most important interim products of that evolution. We are aware that changes will continue throughout the final staff concurrence process, before the rulemaking package is submitted to the Commission. Our observations, comments, conclusions, and recommendations are based on the version of the package that was made available to support this meeting.

DISCUSSION

We commend the staff on their efforts to develop clear and concise rule language and supporting guidance for several complex and important regulatory issues. The draft final rule and its associated regulatory guides strike an appropriate balance between formal regulatory requirements and the flexibility that is needed to implement effective plant-specific mitigation strategies.

The following sections summarize our comments on each major element of this rulemaking package and related material.

Draft Final Rule 10 CFR 50.155

The rule appropriately addresses requirements for licensees to develop mitigation strategies for beyond-design-basis external events consistently with the intent of NRC Order EA-12-049, including strategies that apply for the reevaluated seismic and external flooding hazards at each site. The rule relocates and integrates the requirements for licensees to develop and maintain

strategies to cope with the loss of a large area of the plant due to explosions or fire, which are currently specified under 10 CFR 50.54(hh)(2). Additionally, the rule incorporates the requirements for licensees to install reliable spent fuel pool instrumentation according to NRC Order EA-12-051. By consolidating these requirements, the rule establishes a consistent regulatory basis for licensees to develop coordinated and flexible strategies to maintain or restore core cooling, containment, and spent fuel cooling capabilities for a wide range of conditions that are beyond the licensing design basis for each plant. The draft final rule should be issued, after consideration of the following items.

The draft final rule indicates that the equipment capability requirements under paragraph (c)(1) and the communications requirements under paragraph (c)(4) do not apply to the strategies that are developed under paragraph (b)(3) to cope with the loss of a large area of the plant due to explosions or fire. We were informed that this omission is intentional. There is concern that these considerations would be interpreted as additional regulatory requirements for currently operating plants that already comply with the provisions of 10 CFR 50.54(hh)(2), which does not explicitly require these capabilities. We are not persuaded by that rationale. The intent of 10 CFR 50.155 is to consolidate and integrate requirements for equipment and strategies that licensees will use to mitigate the effects from a wide range of severe external hazards. Adequate capability of the equipment and communications used to implement those strategies is essential to their success. Furthermore, the provisions of paragraph (b)(1) and paragraph (b)(3) will apply for all new plant license applicants. The requirements under paragraph (c)(1) and paragraph (c)(4) should apply consistently to all relevant strategies developed by those future licensees. Current licensees who cannot demonstrate adequate equipment capacities and communications capabilities to implement their Extensive Damage Mitigation Guidelines can request a specific exemption from those requirements. The rule should specify that the equipment capability requirements in paragraph (c)(1) and the communications requirements in paragraph (c)(4) apply for all of the strategies in paragraphs (b)(1) through (b)(3).

We considered whether paragraph (c) in the draft final rule provides adequate assurance that equipment used to implement the strategies required under paragraph (b) will receive sufficient maintenance and testing to demonstrate that it is reliable and available for use when needed. Some of our members prefer that explicit requirements for maintenance and testing should be specified in the rule to ensure adequate regulatory emphasis. The majority of the Committee agrees that the intent of the rule is clear and that the need for maintenance and testing is addressed effectively in the supporting regulatory guidance. That conclusion is based in part on the *Federal Register* Notice statement of considerations for paragraph 50.155(b), where the intent of the term "maintain" is clarified to include maintenance of the mitigation equipment. Draft final Regulatory Guide 1.226 endorses, with clarifications, the guidance in NEI 12-06, Revision 3, for implementation of the strategies that are required under paragraph (b)(1) and paragraph (b)(2) of the rule. That guidance addresses the need for maintenance and testing of onsite and offsite equipment, and it indicates that maintenance requirements should be described in each plant's overall integrated plan. Section 19.4 of the Standard Review Plan (NUREG-0800) indicates that staff reviewers should similarly verify that licensees have established adequate maintenance and testing requirements for equipment that is used to implement the strategies that are currently required by 10 CFR 50.54(hh)(2) and are subsumed into paragraph (b)(3) of this rule. Mitigation equipment that is determined to be sufficiently important to overall plant safety would also be subject to the Maintenance Rule provisions in 10 CFR 50.65.

Regulatory Guide 1.226

Draft final Regulatory Guide 1.226 endorses, with clarifications, the methods that are described in NEI 12-06, Revision 3, for developing and implementing diverse and flexible (FLEX) strategies to cope with the effects of external events that are beyond the plant licensing design basis. The guidance addresses the strategies that may be developed for compliance with the requirements of paragraph (b)(1) and paragraph (b)(2) of draft final rule 10 CFR 50.155. For sites where the magnitude of the reevaluated seismic or external flooding hazard exceeds the current design basis, the guidance provides additional methods to demonstrate adequate plant-specific coping capabilities, including the use of risk-informed approaches.

Contingencies for Loss of All Alternating Current Power

The *Federal Register* Notice summary of public comments and discussion of the regulatory bases for draft final rule 10 CFR 50.155 clarify the staff's interpretation and intent regarding the need for mitigating strategies to cope with a loss of all alternating current (AC) power. We understand that the baseline FLEX strategies are based on the assumption that no AC power is available from any source, except for power from inverters that are supplied by the plant's batteries. We also understand that the implementing guidelines for those strategies will include contingencies and alternative means to cope with failures of the DC power supplies. Section C.1.2 of draft final Regulatory Guide 1.226 contains guidance related to those contingencies.

If plant-specific integrated assessments of the reevaluated seismic and flooding hazards identify conditions which could simultaneously damage AC and DC power supplies, it is expected that the affected licensees will take appropriate actions to either protect the necessary equipment or implement alternative mitigating strategies to assure core cooling, containment, and spent fuel cooling without AC and DC power. The staff should review the integrated mitigating strategies and their supporting guidelines to ensure that contingency actions for loss of DC power supplies, associated instrumentation requirements, and equipment operating practices are apparent and are described clearly when personnel are using the baseline FLEX Support Guidelines.

Treatment of Reevaluated Flooding Hazards

Appendix G of NEI 12-06 describes five possible paths for performing a mitigating strategies assessment for the reevaluated flooding hazard. In general, selection of the path depends on progressively more significant differences between characteristics of the reevaluated hazard and flooding parameters that were used initially for the FLEX equipment design, storage locations, and implementation strategies.

Path 1: All reevaluated flooding parameters are bounded by the existing FLEX design bases

Path 2: Some reevaluated flooding parameters exceed the FLEX design bases, but successful mitigation can be achieved with the existing FLEX equipment and strategies

Path 3: The FLEX equipment or strategies can be modified to successfully mitigate all reevaluated floods

Path 4: Alternate mitigating strategies are needed for specific flooding scenarios

Path 5: Targeted hazard mitigating strategies are needed for specific flooding scenarios

Along any of the first three paths, the existing FLEX strategies or modifications to those strategies can adequately maintain core cooling, containment, and spent fuel cooling for all reevaluated external flooding conditions. The last two paths develop alternate or targeted hazard mitigating strategies that are focused on preservation of key safety functions during specific flooding scenarios, as determined from the site-specific hazard and vulnerability analyses. These alternative strategies may use combinations of plant equipment and FLEX equipment in ways that are not outlined in the baseline FLEX Support Guidelines. Furthermore, targeted strategies may be limited to only maintenance or restoration of core cooling and spent fuel cooling. Licensees who adopt alternate mitigating strategies or targeted hazard mitigating strategies must supplement their FLEX Support Guidelines with additional direction for those responses.

We concur with this guidance for the reevaluated flooding hazard mitigating strategies assessments. Our letters of May 18, 2016 and September 19, 2016 contain our comments and recommendations on parallel Interim Staff Guidance JLD-ISG-2016-01. That guidance provides information to licensees and guidance for staff reviews of the focused evaluations and integrated assessments of capabilities to cope with the reevaluated external flooding hazards, which are being submitted in response to the NRC's March 12, 2012 request for information. We will continue to work with the staff to resolve our recommendations related to their reviews performed according to that guidance.

Treatment of Reevaluated Seismic Hazards

Appendix H of NEI 12-06 describes five possible paths for performing a mitigating strategies assessment for the reevaluated seismic hazard. In general, selection of the path depends on progressively more significant characteristics of the reevaluated ground motion response spectrum (GMRS), such as its relationship to the current safe shutdown earthquake (SSE), the vibratory frequency range over which the GMRS exceeds the SSE, and the magnitude of the exceedance.

Path 1: The reevaluated GMRS is bounded by the SSE

Path 2: The reevaluated GMRS exceeds the SSE only at frequencies above 10 Hz

Path 3: The reevaluated GMRS exceeds the SSE at frequencies below 10 Hz, but is less than the plant capacity spectrum used for the Individual Plant Examination of External Events (IPEEE) analyses

Path 4: The reevaluated GMRS is less than twice the SSE at frequencies below 10 Hz

Path 5: The reevaluated GMRS is more than twice the SSE at frequencies below 10 Hz

Deterministic assessments are typically performed to demonstrate the effectiveness of existing FLEX equipment and strategies for the conditions in Path 2 and Path 4. The assessment guidance for the conditions in Path 3 and Path 5 contains risk-informed alternatives. Path 3 uses the IPEEE study results to demonstrate an adequate plant-level seismic capacity, provided that the NRC staff has reviewed and accepted the scope of the IPEEE study as technically adequate for this application. We were informed that only a small number of sites currently plan to perform assessments according to the Path 3 option. To support a risk-informed Path 5 assessment, the licensee must develop a probabilistic risk assessment of the reevaluated seismic hazard that is consistent with the guidance for technical adequacy in Regulatory Guide 1.200 and is subject to an independent peer review.

The guidance for a risk-informed Path 5 assessment contains two evaluations, described in Sections H.4.5.3 and H.4.5.5 of NEI 12-06. Section H.4.5.3 contains specific risk-based screening criteria that are anchored to overall plant seismic risk metrics. In particular, if the total core damage frequency from the reevaluated seismic hazard is less than $5x10^{-5}$ event per year and the total large early release frequency is less than $5x10^{-6}$ event per year, no further examination of the mitigating strategies' effectiveness to maintain core cooling and containment functions is needed.[1]

According to the guidance for establishing GMRS for the reevaluated seismic hazard, the mean recurrence frequency will be in the range from approximately $1x10^{-5}$ event per year to $1x10^{-4}$ event per year. The seismic risk screening criterion for core damage frequency in Section H.4.5.3 is in the arithmetic middle of this range, and the nominal large early release frequency screening criterion may be only slightly below it. Thus, the proposed screening criteria may indicate that no further analysis is needed, despite the fact that the mitigating strategies could have little margin to withstand the reevaluated hazard. This screening process could mask the regulatory intent that structures and equipment which are used to implement the mitigating strategies should be relatively robust with respect to the reevaluated hazard (i.e., they should have sufficient capacities to withstand the reevaluated hazard with a relatively low likelihood of failure) or that their failure during a seismic event would have a minimal effect on plant risk.

Completion of the risk-informed Path 5 assessment process according to the guidance in Section H.4.5.5 of NEI 12-06 would provide improved understanding of the contributions to seismic risk, the available margins to failure of the structures and equipment that are included in the scenario-specific strategies, and the risk reduction that could be achieved by further improvements. That information will better facilitate risk-informed decisions by the licensee and the staff as to whether additional enhancements are warranted. Regulatory Guide 1.226 should be revised to omit the overall seismic risk screening criteria that are recommended in Section H.4.5.3 of NEI 12-06, Revision 3.

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[1] Most probabilistic risk assessments do not currently include models for spent fuel cooling. For this reason, all Path 5 assessments must separately evaluate the strategies' effectiveness to maintain that function.

Regulatory Guide 1.227

Draft final Regulatory Guide 1.227 endorses, with exceptions and clarifications, the methods for providing reliable spent fuel pool level instrumentation that are described in NEI 12-02, Revision 1. During our briefings, we were informed that all systems that are currently being designed and installed provide continuous level measurement with uniform output resolution over the full range from normal pool level to the top of the fuel racks. These features will provide operators with information about the actual pool level, the rate at which level is changing, and the available margin until the fuel racks begin to uncover. Draft final Regulatory Guide 1.227 should be issued.

Regulatory Guide 1.228

Draft final Regulatory Guide 1.228 endorses, with clarifications, the methods and guidelines for assessing staffing and communications capabilities that are described in NEI 12-01, Revision 0; enhancements, training, and drills for onsite and offsite emergency response capabilities described in NEI 13-06, Revision 1; and integration of emergency response procedures and guidelines described in NEI 14-01, Revision 1.

This guidance supports the development and demonstration of an integrated response capability to mitigate the effects of a wide range of beyond-design-basis events that may affect all units at a site. It includes integration of the site-specific FLEX Support Guidelines and Extensive Damage Mitigation Guidelines with the plant Emergency Operating Procedures and the licensee's Severe Accident Management Guidelines. It also confirms that adequate staffing, command, and control are available to implement the mitigating strategies, including functions of the Emergency Response Organization and mobilization of needed offsite resources. Our understanding of how these procedures, guidelines, and functions will be integrated in practice benefited substantially from industry briefings and a tabletop demonstration of response to a beyond-design-basis accident scenario using a plant-specific pilot application of the guidance. Draft final Regulatory Guide 1.228 should be issued.

Interim Staff Guidance JLD-ISG-2012-01, Draft Revision 2

Interim Staff Guidance JLD-ISG-2012-01, Draft Revision 2, provides information to licensees and guidance for staff reviews of the mitigating strategies for beyond-design-basis external events that are currently being developed for compliance with NRC Order EA-12-049. The draft revised guidance has been issued for public comment. We have not reviewed this version of the guidance.

We understand that the revised interim staff guidance is needed to facilitate reviews of licensee submittals that will be filed before 10 CFR 50.155 and Regulatory Guide 1.226 become effective. The timing of these activities is unfortunate because stakeholder feedback on some specific elements of the interim guidance could result in a divergence between that guidance and draft final Regulatory Guide 1.226. That situation would then necessitate further near-term revisions to the interim guidance or the regulatory guide to ensure consistent interpretation and application of the regulatory requirements in the Order and the rule.

It is important that JLD-ISG-2012-01, Revision 2, and Regulatory Guide 1.226 contain guidance that is functionally equivalent and applied consistently for all licensees. Draft final Regulatory Guide 1.226 should not be issued until it is reconciled with the final guidance in JLD-ISG-2012-01, Revision 2. We would like an opportunity to review JLD-ISG-2012-01, Revision 2, and the corresponding version of Regulatory Guide 1.226 after the staff resolves public comments on the interim guidance.

Sincerely,

/RA/

Dennis C. Bley
Chairman

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