

Update on Tier 3 Activities

Periodic Confirmation of Seismic and Flooding Hazards

Near-Term Task Force (NTTF) Recommendation 2.2 recommended that the U.S. Nuclear Regulatory Commission (NRC) require licensees to periodically update external hazards based on any new and significant information since the most recent reevaluation. In SECY-11-0137, "Prioritization of Recommended Actions to Be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11272A111), NRC staff prioritized NTTF Recommendation 2.2 as Tier 3, because it depends on the insights gained from the seismic and flooding reevaluations currently in progress and because those evaluations are not complete, no updates are available to report.

Enhancements to the Capability to Prevent or Mitigate Seismically-Induced Fires and Floods

This lessons learned activity originated from NTTF Recommendation 3, and was intended to evaluate potential enhancements to the capability to prevent or mitigate seismically-induced fires and floods. In SRM-SECY-11-0137, the Commission directed the staff to start developing Probabilistic Risk Assessment (PRA) methods to evaluate potential enhancements to plants' capability to prevent or mitigate seismically-induced fires and floods as part of Tier 1 activities. However, to be consistent with the program plan for NTTF Recommendation 3 in Enclosure 3 to SECY-12-0095, "Tier 3 Program Plans and 6-Month Status Update in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Subsequent Tsunami" (ADAMS Accession No. ML12208A210), carrying out the broader evaluation (i.e., beyond the PRA methods) of potential enhancements to the capability to prevent or mitigate seismically-induced fires and floods would remain a longer-term Tier 3 activity. In SECY-12-0095, NRC staff supplied the following schedule and milestones to address NTTF Recommendation 3 for seismically-induced fires and floods:

- Continue development of PRA methods for seismically-induced fires and floods. This will include two main subtasks:
 - Engage PRA standards development organizations to develop the technical elements and standards for the PRA method (ongoing), and
 - Complete a feasibility scoping study to evaluate PRA approaches for assessing multiple concurrent events (December 2015);
- Reevaluate NTTF Recommendation 3 based on information obtained from Tier 1 activities and PRA method development activities, as well as recommend further activities (December 2016).

NRC staff continues to work with the ASME (formerly the American Society of Mechanical Engineers) and the American Nuclear Society (ANS) Joint Committee on Nuclear Risk Management (JCNRM) to leverage external stakeholders' expertise and to better focus future method-development efforts. After JCNRM approval of the incorporation of crosscutting issues in the ASME/ANS PRA standard, including concurrent initiating events such as seismically

induced fires and floods, implementation guidance has been supplied to the PRA writing groups associated with affected parts of the standard. NRC staff will continue working with ASME and ANS to support development of detailed standards requirements in this area.

After a December 2013 public workshop in Rockville, Maryland, and issuance of the associated workshop report (ADAMS Accession No. ML14022A249), work is continuing on the feasibility scoping study. The main objective of the study is to better define the objectives and potential approaches for a PRA method suitable for assessing seismically-induced fires and floods. This work is expected to benefit from the information and recommendations gathered in the workshop. As a part of the technical work plan developed for this project, a feasibility report is being prepared that will reflect input received at the workshop and subsequent discussion with subject matter experts. The feasibility report will also discuss risk analysis approaches, such as screening methods, that will not necessarily lead to complete PRAs.

During this reporting period, two expert panels have been formed to address several specific PRA modeling issues. The expert panels include subject matter experts (i.e., seismic analysis, PRA, and internal-fire analysis) from industry, national labs, and the NRC. One panel is addressing seismically-induced fire issues and includes experts in both seismic and fire risk analysis. The other panel is addressing seismically-induced floods and includes experts in seismic risk analysis and flooding risk. Both panels were supplied a questionnaire that requests guidance on: (1) what structures, systems, and components (SSCs) can be screened from a seismically-induced fire or flood analysis; (2) how the unscreened SSCs can best be treated; and (3) what other issues (e.g., operator response) need special considerations in seismically-induced fire and flood scenarios. NRC staff has been gathering responses from the expert panel members and is analyzing the inputs. The expert panel results, together with other information, will be used to produce the final feasibility report later in calendar year 2015. NRC staff will explore the possibility of performing a pilot application of the proposed risk assessment approach with industry stakeholders.

NRC staff will continue to monitor the progress of other recommendations related to this issue to factor appropriately more information related to seismic and flooding hazards, and mitigation strategies into the eventual resolution of NTTF Recommendation 3.

Reliable Hardened Vents for Other Containment Designs; and Hydrogen Control and Mitigation Inside Containment or Other Buildings

Both of these lessons learned activities originated from the NTTF report. NTTF Recommendation 5.2 identified a need to reevaluate hardened vents for containment designs other than boiling-water reactor Mark I and Mark II containments (which are being addressed under Tier 1). NTTF Recommendation 6 identified the need to obtain insights from Fukushima related to hydrogen control and mitigation inside containment or in other buildings and to determine whether regulatory action is warranted. While these activities are separate, NRC staff expects that insights from carrying out the order related to severe-accident-capable vents for Mark I and Mark II containments (Order EA-13-109, ADAMS Accession No. ML13130A067) will inform further evaluation and action for both activities. Additionally, the staff of the Office of Nuclear Regulatory Research (RES) is participating as a working group member in a study related to hydrogen generation, transport, and risk management organized by the Organisation

for Economic Cooperation and Development. The report has been completed. During this reporting period, RES staff completed its review.

NRC staff review indicates that use of passive autocatalytic recombiners in foreign plants is a dominant feature. Hydrogen control strategies outside the primary containment have not been fully developed and more work is needed. The report also noted that using an external filter should be considered in conjunction with other severe accident management measures. Once the related Tier 1 activities are completed, the staff will use these insights, as well as any other new information, in recommending how best to address NTTF Recommendations 5.2 and 6.

NRC staff will begin to evaluate existing plans for venting of other containment designs (e.g., Mark III, ice condenser, and large dry containments) and hydrogen control only after sufficient progress is made with the Mark I and Mark II issues. Once NRC staff has determined that sufficient insights have been gained from the Mark I and Mark II work and other related activities, it will begin evaluating other containment designs and hydrogen control to determine whether any regulatory action is warranted.

Activities Related to Emergency Preparedness

In SECY-12-0095 (ADAMS Accession No. ML12165A092), the following four Tier 3 items were included within one program plan:

- Emergency preparedness (EP) enhancements for prolonged station blackout (SBO) and multiunit events;
- Emergency response data system (ERDS) capability;
- Additional EP topics for prolonged SBO and multi-unit events; and
- EP topics for decisionmaking, radiation monitoring, and public education.

These items collectively originated from NTTF Recommendations 9.1, 9.2, 9.3, 10.1, 10.2, 10.3, 11.1, 11.2, 11.3, and 11.4. The program plan outlined in SECY-12-0095 described an approach to address these items collectively using an advance notice of proposed rulemaking (ANPR). An ANPR is a tool that allows the NRC staff to solicit early stakeholder input on a new potential rulemaking effort. The staff still intends to take this approach for certain Tier 3 EP activities (Recommendations 9.2, 9.3, 10.3 (related to ERDS), 10.1, 11.2, 11.3, and 11.4) and expects to use the ANPR feedback to help determine whether there is a need for rulemaking and, if so, what its scope and content should be.

No work was done during this period; however, NRC staff expects to issue the ANPR in fiscal year 2016. Several of the Tier 3 EP activities are being addressed through a consolidated rulemaking approved in SRM-SECY-14-0046 (see Enclosure 1, "Mitigation of Beyond-Design-Basis Events Rulemaking").

Reactor Oversight Process Modifications to Reflect Recommended Defense-in-Depth Framework

This lessons learned activity originated from NTTF Recommendation 12.1 to expand the scope of the annual Reactor Oversight Process (ROP) self-assessment and biennial ROP realignment to include more fully any defense-in-depth considerations that might result from resolution of NTTF Recommendation 1. In SRM-SECY-13-0132, "U.S. Nuclear Regulatory Commission Staff Recommendation for the Disposition of Recommendation 1 of the Near-Term Task Force Report" (ADAMS Accession No. ML14139A104), the Commission provided the following guidance about NTTF Recommendation 1:

The objectives of Improvement Activities 1 [design-basis extension category] and 2 [defense-in-depth] should be reevaluated, as appropriate, in the context of the Commission direction on a long-term Risk Management Regulatory Framework (RMRF), more specifically, the proposed policy statement. Work on the RMRF and other interrelated activities should be treated outside the scope of the NRC's post-Fukushima actions. With these decisions, the Near-Term Task Force Report Recommendation 1 is closed.

Therefore, carrying out NTTF Recommendation 12.1 now depends on RMRF, which is ongoing.

NRC staff is identifying and evaluating improvements to the ROP based on insights from carrying out a range of other internal lessons learned reviews and external audit activities. For example, NRC inspectors have found ways to improve the inspection program—a key component of the ROP—from inspections of licensee walkdowns of flooding-protection features. In December 2014, NRC staff completed proposed changes to Inspection Procedure 71111.01, "Adverse Weather Protection" to incorporate lessons learned from these walkdowns. The revised procedure is in the approval process.

NRC staff has issued Temporary Instruction (TI)-191, "Inspection of the Implementation of Mitigation Strategies and Spent Fuel Pool Instrumentation Orders and Emergency Preparedness Communication/Staffing/Multi-Unit Dose Assessment Plans." NRC staff will use this TI to verify the licensee's mitigation strategies (Order EA-12-049) and other Tier 1 items such as the Spent Fuel Pool Instrumentation Order EA-12-051 and Emergency Preparedness Staffing and Communications (NTTF Recommendation 9.3)

The staff will evaluate the information gathered from the TI and assess the need to revise or issue new inspection-related documents. Information obtained from other NTTF activities (such as lower tiered activities) will be assessed as necessary commensurate with NRC prioritization, rulemaking and licensee implementation schedules. Office of Nuclear Reactor Regulation staff from the Division of Inspection and Regional Support and the Japan Lessons-Learned Division meet periodically to discuss improvements to these documents.

NRC Staff Training on Severe Accidents and Severe Accident Management Guidelines

This lessons learned activity originated from NTTF Recommendation 12.2 to enhance NRC staff training on severe accidents, including resident inspector training on severe accident management guidelines (SAMGs). Because the Mitigation of Beyond-Design-Basis Events

(MBDBE) rulemaking (Tier 1) is expected to require better integration of emergency procedures, including SAMGs, this activity partially depends on the final outcome of that rulemaking activity.

However, NRC staff is working toward carrying out several potential enhancements related to severe accident training:

- Increasing the frequency of severe accident courses, including exporting the courses to the regional offices;
- Updating courses with lessons learned from the Fukushima accident;
- Modifying existing qualification programs to include requirements for severe accident courses;
- Adding SAMG courses to qualification program training; and
- Developing new and additional courses that focus on severe accidents.

NRC staff recognizes that more changes could be developed because of the State-of-the-Art Reactor Consequence Analysis study, the ongoing Level 3 probabilistic risk-assessment (PRA) study, and any future Fukushima lessons learned insights.

While part of this activity depends on the outcome of the MBDBE rulemaking, NRC staff has substantial information on severe accidents and believes that increasing its knowledge in this area is beneficial.

NRC staff has been conducting a series of agencywide seminars on the state-of-the-art understanding of severe accidents. Presenters include at least two experts—an in-house expert and an external expert—to offer diverse perspectives to enable NRC staff to more fully understand each severe accident phenomenon. The seminars began on March 6, 2014, and are held quarterly. Two seminars have been held in the last six months, one on steam explosion and one on in-vessel melt progression and retention of a degraded core. Each future seminar will cover one severe-accident phenomenon (e.g., hydrogen combustion or molten core/concrete interactions). Video recordings of the seminars will be added to iLearn for knowledge management purposes.

Basis of Emergency Planning Zone Size and Pre-Staging Potassium Iodide Beyond 10 Miles

These activities were not in the original NTTF report; however, in SECY-11-0137 the NRC staff recommended that evaluating the basis of the Emergency Planning Zone (EPZ) size warranted further consideration.

NRC staff remains confident that the EP programs in support of nuclear power plants provide an adequate level of protection of the public health and safety and that appropriate protective actions can and will be taken in the event of a radiological event. This includes evacuations and the use of potassium iodide (KI). Available information and studies from the Fukushima accident have not changed the staff's position. The current size of EPZs provides reasonable

assurance that adequate protective measures can and will be taken in the event of a radiological emergency at an existing nuclear power plant. Nonetheless, the staff plans to use insights from the NRC's Level 3 PRA project, as well as information obtained from international organizations, to inform the resolution of this recommendation. The United Nations Scientific Committee on the Effects of Atomic Radiation is preparing a scientific report to assess the radiation doses and associated effects on health and the environment. Also, the Fukushima Prefecture launched the Fukushima Health Management Survey to investigate long-term low-dose radiation exposure caused by the accident. On December 25, 2014, the Japanese Investigation Committee on the Fukushima Health Survey released results on external radiation exposure dose estimates and thyroid doses, using survey information from over 531,000 affected people in the Fukushima Prefecture. NRC staff is in process of obtaining and reviewing this information for insights on the EPZ size and KI approach within the U.S. The dose estimates do not appear to call the EPZ or KI approach into question. The World Health Organization is studying the protective actions taken during the accident. NRC staff is engaged with the Nuclear Energy Agency, International Atomic Energy Agency (IAEA), and scientific forums to study the effect of releases from Fukushima on public health, the use of KI, and thyroid disease. NRC staff will monitor the results of these efforts for applicability to the NRC's EP regulatory framework and guidance, including EPZ size and KI use.

Expedited Transfer of Spent Fuel to Dry Cask Storage

In SRM-COMSECY-13-0030, "Staff Requirements - Staff Evaluation and Recommendation for Japan Lessons Learned Tier 3 Issue on Expedited Transfer of Spent Fuel to Dry Cask Storage," dated May 23, 2014, the Commission agreed with the NRC staff's recommendation that this issue be closed. The Commission also directed the staff to complete a number of related activities. A brief description of the related activities and the staff's completed action follows:

- Develop an information notice to inform licensees of the potential added safety benefit of adopting a "1 × 8" spent fuel pool (SFP) loading configuration: Information Notice 2014-14 (ADAMS Accession No. ML14218A493) was issued on November 14, 2014;
- Modify the regulatory analysis to explain why the "1 × 8" configuration was not found to offer a substantial increase in safety: An addendum to Enclosure 1 of COMSECY--13-0030 (ADAMS Accession No. ML14252A708), dated September 22, 2014, completed the required modification to the regulatory analysis;
- Evaluate whether to modify through amendment or errata the existing process for seismic-hazard reevaluation (Phase 1 of 10 CFR 50.54(f)) to eliminate the SFP evaluation step: NRC staff concluded that an appropriate SFP seismic evaluation should be conducted for plants that "screen-in" and plants that used the results of their Individual Plant Examination of External Events (IPEEE) analyses to "screen-out" of conducting a seismic risk evaluation (the IPEEE program did not analyze SFP structures, systems, and components). All other plants that "screen-out" will not conduct a SFP seismic evaluation;
- Provide an information paper detailing staff's views and considerations about the treatment of limited-term operational vulnerabilities associated with the discharge of

spent fuel from cores into pools: SECY-14-0136 (ADAMS Accession No. ML14297A232), dated November 26, 2014, provided this information; and

- Provide a technical overview of the operational and safety attributes of spent fuel rack designs used in other countries: NRC Staff response to SRM-M140106A and SRM-COMSECY-13-0030, dated August 1, 2014, (ADAMS Accession No. ML14108A244) provides the staff response.

Based on the above, this Tier 3 issue is closed.

Enhanced Reactor and Containment Instrumentation for Beyond-Design-Basis Conditions

During its review of the NTTF recommendations in SECY-11-0124 and SECY-11-0137, the Advisory Committee on Reactor Safeguards (ACRS) noted that Section 4.2 of the NTTF report discusses how the Fukushima operators faced significant challenges in understanding the condition of the reactors, containments, and SFPs because the existing design-basis instrumentation was either lacking electrical power or providing erroneous readings. As a result, an additional recommendation was developed to address the regulatory basis for requiring reactor and containment instrumentation to be enhanced to withstand beyond-design-basis accident conditions. This activity was prioritized as Tier 3 because it requires further staff study and depends on the outcome of other lessons learned activities. The program plan for this recommendation, "Enhanced Reactor and Containment Instrumentation," was detailed in SECY-12-0095.

The following activities have been completed:

- Reviewed the Department of Energy (DOE) modeling of the Fukushima event;
- Met with DOE and the Electric Power Research Institute (EPRI) regarding research activities;
- Participated in the EPRI Working Group for Severe Accident Instrumentation;
- Participated in the development of the IAEA Nuclear Energy series of documents on accident instrumentation;
- Met with the American Nuclear Society Standards Board;
- Analyzed appropriate Tier 1 activities for instrumentation needs formulations; and
- Interfaced with the Institute of Electrical and Electronics Engineers (IEEE) Standards Committee for IEEE-497, "Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations."

During this reporting period, the staff reviewed NRC and NEI guidance, such as NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," a representative sampling of licensee submittals for Mitigating Strategies Order EA-12-049, and proposed

updates to the BWR and PWR Owners' Groups guidance to licensees for developing plant-specific SAMGs. The staff has also met with and submitted recommendations concerning a need for licensee assurance of the reliability and survivability of severe accident instrumentation to the Mitigation of Beyond-Design-Basis Events Rulemaking team for their consideration, and reviewed the draft NEI implementing guidance NEI 14-01, "Emergency Response Procedures and Guidelines for Extreme Events and Severe Accidents."

On September 16, 2014, the Tier 3 team staff provided an update to the ACRS Fukushima Subcommittee. NRC staff continues to work with the standards-development organizations to develop criteria for severe accident instrumentation, support IAEA in issuing its document on accident-monitoring instrumentation, and continue research collaboration with EPRI and DOE.

During this reporting period, IEEE Working Group 6.1 developed a draft revision to IEEE Standard 497 (IEEE Standard for Accident Monitoring Instrumentation for Nuclear Power Generating Stations), which includes criteria for instrumentation needed for beyond-design-basis events and severe accidents. Criteria will be included to identify required operating time, environmental qualification considerations, independence of power supplies from design basis-related power supplies, and the need for some form of vulnerability or survivability analysis to be completed. The working group is also facilitating future harmonization with International Electrotechnical Commission standards. Balloting on the revised IEEE 497 is expected in 2015.

Once the NRC staff has accumulated sufficient knowledge and data, regulatory action will be taken, if needed, through the appropriate mechanism, such as additional guidance, rulemaking, or generic communication for any safety-significant instrumentation performance gaps. The staff also will consider the endorsement of any appropriate industry standards addressing severe-accident instrumentation in its guidance documents (e.g., Regulatory Guide 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants").

NRC staff plans on making a regulatory determination by December 2015.