Reactor Oversight Process Enhancement Project
Baseline Inspection Program
Special Topic – Fukushima Follow-up

Background

As a result of the events at the Fukushima-Daichi nuclear power plant following the 9.0 magnitude Tōhoku earthquake and subsequent tsunami, the Commission directed the establishment of the Near-Term Task Force (NTTF) to conduct a systematic and methodical review of U.S. Nuclear Regulatory Commission (NRC) processes and regulations to determine whether the Agency should make additional improvements to its regulatory system. The NTTF made several recommendations that included clarifying the regulatory framework (Recommendations 1 thru 1.4), ensuring protection from external events (Recommendations 2 thru 2.3), mitigation (Recommendations 4 thru 8.4), Emergency Preparedness (EP) (Recommendations 9 thru 11.4) and NRC Programs (Recommendations 12 thru 12.4).

In SECY-11-0137, "Prioritization of Recommended Actions to Be Taken in Response to Fukushima Lessons Learned," the staff prioritized the Fukushima NTTF recommendations to reflect regulatory actions to be taken by the staff; identified implementation challenges; included the technical and regulatory bases for the prioritization; identified additional recommendations, if any; and included a schedule and milestones with recommendations for appropriate stakeholder engagement and involvement of the Advisory Committee on Reactor Safeguards.

The NRC staff proposed to the Commission three tiers of prioritization for the NTTF recommendations. The first tier consists of those NTTF recommendations which the staff determined should be started without unnecessary delay and for which sufficient resource flexibility, including availability of critical skill sets, exists. The second tier consists of those NTTF recommendations which could not be initiated in the near term due to factors that include the need for further technical assessment and alignment, dependence on Tier 1 issues, or availability of critical skill sets. These actions do not require long-term study and can be initiated when sufficient technical information and, as applicable, resources become available. The third tier consists of those NTTF recommendations that require further staff study to support a regulatory action, have an associated shorter-term action that needs to be completed to inform the longer-term action, are dependent on the availability of critical skill sets, or are dependent on the resolution of NTTF Recommendation 1.

The Tier 1 activities include:

- Mitigating Strategies – to enhance the capability to maintain plant safety during a prolonged loss of electrical power (addressed by Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events");
- Containment Venting – to provide reliable hardened vent system for Mark I or Mark II containment designs (addressed by Order EA-12-050, "Reliable Hardened Containment Vents");

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- Spent Fuel Pool (SFP) Instrumentation – to provide a reliable wide-range indication of water level in the spent fuel storage pools (addressed by Order EA-12-051, "Reliable Spent Fuel Pool Instrumentation");
- Seismic Reevaluation – to reanalyze potential seismic effects using present day information to determine if safety upgrades are needed (addressed by Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.54(f) letter request);
- Flooding Hazard Reevaluations – to reanalyze potential flooding effects using present day information to determine if safety upgrades are needed (addressed by 10 CFR 50.54(f) letter request);
- Seismic and Flooding Walkdowns – to inspect existing plant protection features against seismic and flooding events, and correct any degraded conditions (addressed by 10 CFR 50.54(f) letter request);
- EP Staffing and Communications – to assess staffing needs and communications capabilities to effectively respond to an event affecting multiple reactors at a site (addressed by 10 CFR 50.54(f) letter request);
- Station Blackout Mitigating Strategies – to enhance the capability to maintain plant safety during a prolonged loss of electrical power (addressed by Rulemaking);
- Onsite Emergency Response Capabilities – to strengthen and integrate different types of emergency procedures and capabilities at plants (addressed by Rulemaking);
- Filtration and Confinement Strategies – to evaluate potential strategies that may further confine or filter radioactive material if core damage occurs (addressed by Rulemaking).

Tier 2 activities include:

- SFP Makeup Capability – to provide a reliable means of adding extra water to SFPs (addressed by Order EA-12-051, consolidated into Mitigation Strategies);
- EP - to address three aspects of EP for multi-reactor and loss of power events (addressed by Order):
  - training and exercises (drills) (consolidated into Mitigating Strategies);
  - equipment, facilities, and related resources (consolidated into Mitigating Strategies); and
  - multi-unit dose assessment capability
- "Other" External Hazard Reevaluations – to reanalyze the potential effects of external hazards other than seismic and flooding events (which are being addressed under tier 1) (addressed by 10 CFR 50.54(f) letter request).

Tier 3 activities include:

- Periodic Confirmation of External Hazards: to ensure external hazards, such as seismic and flooding effects, are periodically reanalyzed during the lifetime of a plant (planned Rulemaking);
- Seismically-Induced Fires and Floods: to evaluate potential enhancements to the capability to prevent or mitigate seismically-induced fires and floods (longer-term evaluation);
- Venting Systems for Other Containment Designs: to evaluate the need for enhancements to venting systems in containment designs other than Mark I and II (which are addressed under Tier 1) (longer-term evaluation);

- Hydrogen Control: to evaluate the need for enhancements to hydrogen control and mitigation measures inside containment or other plant buildings – the resolution of EA-12-049 will include backup power for hydrogen igniters for Boiling Water Reactor (BWR) Mark III and Pressurized Water Reactor Ice Condenser containments (longer-term evaluation);
- EP: to evaluate additional enhancements to EP programs that go beyond the Tier 1 and Tier 2 EP-related activities (longer-term evaluation);
- Emergency Response Data System (ERDS) Capability: to enhance the capabilities of the ERDS (longer-term evaluation);
- Decision-making, Radiation Monitoring, and Public Education: to evaluate the need for enhancements to EP programs in the areas of decision-making, radiation monitoring, and education (longer-term evaluation);
- Reactor Oversight Process (ROP) Updates: to modify the ROP to reflect any changes to the NRC's regulatory framework (which is being pursued under a separate activity) (longer-term evaluation) (dependent on Regulatory Framework Activity);
- Training on Severe Accidents: to enhance training of NRC staff on severe accidents and related procedures (dependent on outcome of Onsite Emergency Response Capabilities (Tier 1));
- Emergency Planning Zone: to evaluate the basis for the size of the emergency planning zone;
- Potassium Iodide (KI): to evaluate existing programs for the pre-staging of KI (longer-term evaluation);
- Expedited Transfer of Spent Fuel to Dry Cask Storage: to evaluate the merits of expediting the transfer of spent nuclear fuel from storage pools to dry cask storage. (longer-term evaluation); and
- Reactor and Containment Instrumentation: To evaluate potential enhancements for instrumentation in the reactor and containment that can withstand severe accident conditions (longer-term evaluation).

In 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," the staff proposed to issue three orders. Two orders were issued to all reactor licensees regarding: (1) development of strategies to mitigate beyond design basis external events without limitation to natural phenomena which addresses both multi-unit events and reasonable protection of equipment identified under such strategies, and (2) installation of enhanced SFP instrumentation. The third order pertaining to reliable containment vents is proposed to be issued to licensees operating BWRs with Mark I and Mark II containments. SECY-12-0025 also notified the Commission of its intent to request information from licensees about Recommendations 2.1 (seismic and flooding hazard reevaluations), 2.3 (seismic and flooding hazard walkdowns) and 9.3 (study staff qualifications and communications capabilities in responding to a multi-unit event). Subsequently, the NRC staff issued three Orders per Commission direction: Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (EA-12-049), Reliable Hardened Containment Vents (EA-12-050), and Reliable SFP Instrumentation (EA-12-051). Additionally, the staff issued request for information letters to all licensees and construction permit holders (addressees).

For EA-12-049, the Commission determined that additional requirements must be imposed to mitigate beyond-design-basis external events. These required that licensees develop,

implement, and maintain guidance and strategies for the loss of power, motive force, and normal access to the ultimate heat sink to maintain or restore core cooling, containment, and SFP cooling capabilities. On August 29, 2012, the NRC staff issued implementation guidance JLD-ISG-2012-01 "Compliance with Order EA-12-049, 'Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,'" which provided one acceptable approach for satisfying those requirements and endorsed, with clarifications, the methodologies described in the industry guidance document, Nuclear Energy Institute (NEI) 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0. NEI 12-06 outlines an approach for adding diverse and flexible mitigation strategies—or FLEX— that will increase defense-in-depth for beyond-design-basis scenarios to address the extended losses of AC power and loss of ultimate heat sink simultaneously at all units on a site. For the FLEX strategy, facilities initially will rely on installed systems, which will be supplemented as soon as possible by onsite but not permanently installed resources. This could be augmented by offsite resources available from regional response centers.

The NRC issued Order EA-12-050 on March 12, 2012, requiring all U.S. nuclear power plants with Boiling Water Reactor Mark I and II containment designs to install a reliable, hardened vent that can remove heat and pressure before potential damage to a reactor core occurs. On August 29, 2012, the staff issued JLD-ISG-2012-02, "Compliance with Order EA-12-050, 'Reliable Hardened Containment Vents'". This Interim Staff Guidance (ISG) provided an acceptable method for satisfying those requirements including the consideration of licensee's recommendations and provided administrative and design requirements for the hardened containment ventilation system. Additionally, the Commission directed the staff to issue a modification to Order EA-12-050 requiring licensees with Mark I and Mark II containments to upgrade or replace the reliable hardened vents required by Order EA-12-050 with a containment venting system designed and installed to remain functional during severe accident conditions. Subsequently, on June 6, 2013, the staff superseded EA-12-050 by issuing Order EA-13-109, "Issuance of Order to Modify Licenses With Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions" to capture this modification. Additionally, in SECY-12-0157, "Consideration of Additional Requirements for Containment Venting Systems for Boiling Water Reactors with Mark I and Mark II Containments," the Commission had approved on November 26, 2012, the development of technical bases and rulemaking for filtering strategies with drywell filtration and severe accident management of BWR Mark I and II containments. On November 14, 2013, the NRC issued JLD-ISG-2013-02, "Compliance with Order EA-13-109, Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation under Severe Accident Conditions," and endorsed, with exceptions and clarifications, the methodologies described in the industry guidance document, NEI 13-02, "Industry Guidance for Compliance with Order EA-13-109: BWR Mark I & II Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions." The purpose of NEI 13-02 is to assist nuclear power reactor licensees with the identification of measures needed to comply with the requirements of Order EA-13-109, covering wet and dry well vent boundary conditions for vent design and operation, design considerations, programmatic controls, operational considerations, and reporting requirements.

EA-12-051 ordered licensees to provide a primary and back-up level instrument that will monitor water level from the normal level to the top of the used fuel rack in the pool; provide a display in an area accessible following a severe event; and provide independent electrical power to each instrument channel and provide an alternate remote power connection capability. On August 29, 2012, the NRC staff issued implementation guidance JLD-ISG-2012-03, "Compliance with Order

EA-12-051, 'Reliable Spent Fuel Pool Instrumentation,'" and endorsed, with exceptions and clarifications, the methodologies described in the industry guidance document, NEI 12-02, "Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation'". NEI 12-02 provided the industry a suggested method for compliance with NRC Order EA-12-051 covering wide range pool level instrumentation (Level 1 – operation, Level 2 – shielding, and Level 3 – makeup water addition), instrumentation design features (mounting, independence, qualification, and power supplies) and program features (training, procedures, and testing and calibration).

On March 12, 2012, the Commission issued a request for information (50.54 (f)) letter to all addressees related to NTTF Recommendations 2.1, 2.3, and 9.3. In the 50.54 (f) letter for Recommendation 2.1 (seismic), the staff requested addressees perform a reevaluation of the seismic hazards at their sites using present-day NRC requirements and guidance to develop a ground motion response spectra and submit an interim evaluation and actions planned or taken to address situations where the reevaluated hazard exceeds the current design basis. In the 50.54 (f) letter for Recommendation 2.1 (flooding), the staff requested addressees review information concerning the current flooding hazard against the plant design, reevaluate the flood hazard based on present-day regulatory guidance and methodologies for each flood causing mechanism, determine whether the design basis flood bounds each reevaluated hazard, and submit a Hazard Reevaluation Report as necessary. For Recommendation 2.3 (seismic), the NRC staff requested in the 50.54 (f) letter that the addressees confirm that they intend to use the NRC-endorsed seismic walkdown procedures, or provide to the NRC a description of the process that will be used to conduct the walkdowns and to develop the needed information and submit its final response that includes a list of any areas that are unable to be inspected due to inaccessibility and a schedule for when the walkdown will be completed. For Recommendation 2.3 (flooding), the staff requested in the 50.54 (f) letter that each addressee confirm that it will use the industry-developed, NRC-endorsed, flooding walkdown procedures or provide a description of plant-specific walkdown procedures, conduct the walkdown, and submit a report. Finally, in the 50.54 (f) letter for Recommendation 9.3, the staff requested addressees to assess their current communications systems and equipment used during an emergency event and consider any enhancements that may be appropriate for the emergency plan with respect to communications.

In COMSECY-13-0002, "Consolidation of Japan Lessons Learned Near Term Task Force Recommendations 4 and 7 Regulatory Activities," the staff recommended to consolidate the rulemaking activities stemming from NTTF Recommendation 4 - to strengthen station blackout mitigation capability at all operating and new reactors for design-basis and beyond-design-basis external events - and NTTF Recommendation 7 - to enhance SFP makeup capability and instrumentation for the SFP - into one rulemaking, the "Station Blackout Mitigation Strategies Rulemaking." The Staff Requirements Memorandum for this SECY approved this proposal. Additionally, COMSECY-13-0010, "Schedule and Plans for Tier 2 Order on Emergency Preparedness for Japans Lessons-Learned," documented the staff's intention to accomplish some of the NTTF Recommendation 9.3 Tier 2 action items through the EA-12-049 effort.

Analysis

The NRC is currently evaluating the appropriate level of regulatory oversight to provide for each tier of the approach. For Recommendation 2.3, the NRC has issued and completed Temporary Instruction (TI) 2515/187, "Inspection of Near-Term Task Force Recommendation 2.3 Flooding

Walkdowns," and TI 2515/188, "Inspection of Near-Term Task Force Recommendation 2.3 Seismic Walkdowns," to independently verify that the licensee's external flood and seismic protection walkdown activities were conducted using NRC-endorsed industry guidance for assessing external flood protection and mitigation capabilities and for performing seismic walkdowns, respectively. NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Protection Features," guidance for assessing external flood protection and mitigation capabilities and EPRI 1025286, "Seismic Walkdown Guidance," guidance for performing seismic walkdowns were the two industry guides.

On May 1, 2013, NRC staff participated in a meeting to discuss options to update the ROP as part of the ROP Enhancement effort. Recommendations included using smart samples, conducting TIs, and using existing procedures and then assessing procedures for changes. Rulemaking for the tiered activities are under development and some tiered activities are either in progress or have been completed. Inspections of the tiered activities depend upon the licensees' implementation schedules. Therefore, revisions to ROP inspection procedures (IP) may not be prudent at this time.

However, on June 12, 2013, headquarters and regional staff participated in a teleconference to discuss improving IPs 71111.01, "Adverse Weather Protection," and 71111.06, "Flood Protection Measures," based on lessons-learned from conducting TIs 2515/187 and 188. The staff agreed to some minor procedure enhancements that were captured on feedback forms for consideration in future IP revisions. The NRC staff is continuing to evaluate lessons-learned from the flooding walkdowns and will incorporate improvements into ROP procedures accordingly. Lessons-learned from the seismic walkdowns are under evaluation.

The licensees have submitted their Overall Integrated Plan (OIP) that describes how the Orders will be met. The staff is currently reviewing these plans for technical adequacy and will conduct onsite audits as necessary and issue Interim Staff Evaluations. Verification of the OIP will be conducted under a TI after licensees have met compliance with the Orders (between end of Calendar Year (CY) 2014 and end of CY 2016). The activities to be verified will include coping with prolonged loss of mitigating equipment (EA-12-049) and some of the Tier 2 items such as SFP instrumentation (EA-12-051) and EP staffing and communication (Recommendation 9.3). The TI will be issued for the NRC staff to conduct walk-throughs and onsite reviews of procedures and operator actions; demonstrations of equipment to assess feasibility and effectiveness; storage, protection, and access for onsite equipment; and access for remote, offsite equipment and resources. The TI specifically informs compliance with the Order and for the NRC staff to use information discovered during the TI to assess ROP potential changes.

On August 12, 2013, the Office of Nuclear Reactor Regulation implemented an interim organizational change by initiating the Mitigating Strategies Directorate (MSD). The MSD is tasked with evaluating industry plans submitted in response to Order EA-12-049 and issuing a formal staff assessment of these plans. The Agency's efficient and effective review of industry's plans (NEI 12-06) to develop and implement these strategies will contribute to safety both by validating the licensees' plans to provide the requisite safety improvements and by avoiding unnecessary distractions from NRC's oversight of and licensees' execution of the day-to-day safe operation of the plants.

The staff is continuing to evaluate the long-term actions such as developing inspection-related documents for verifying EA-12-050 and the remaining Tier 1, 2 and 3 activities. Completion of

the remaining activities will be commensurate with rulemaking and licensee implementation schedules.

Recommendations

The NTTF made several recommendations that included clarifying the regulatory framework, ensuring protection from external events, mitigation, EP and NRC Programs. The Commission accepted the staff's proposal of three tiers of prioritization for implementing the NTTF recommendations. Consequently, the NRC issued Orders involving mitigating strategies, containment venting systems and SFP instrumentation and has issued request for information letters related to several NTTF recommendations. The NRC staff has either been evaluating or has completed some of those actions, most notably, the flooding and seismic walkdown TIs to verify the site's current licensing basis for protecting and/or mitigating the effects of design-basis flooding and seismic events. The NRC staff has met and collectively identified potential enhancements to existing flood-related IPs and generated feedback forms to be used as consideration for future IP revisions.

The NRC staff will issue and begin conducting a TI to verify the licensee's strategies for coping with prolonged loss of mitigating equipment (EA-12-049) and some of the Tier 2 items such as SFP instrumentation (EA-12-051) and EP staffing and communications (Recommendation 9.3). Verification of the requirements of EA-12-049 and EA-12-051 and Recommendation 9.3 implementation will be achieved after compliance is met on a rolling basis between the end of CY 2014 and CY 2016. The TI will inform compliance with Orders issued as a result of NTTF recommendations and for the NRC staff to use information discovered during conduct of the TI to assess ROP potential changes.

The staff will evaluate the information gathered from the TI conducted for verification of Order EA-12-049 and EA-12-051 and Recommendation 9.3. The staff will evaluate the need for and develop or revise and issue inspection-related documents (TIs, IPs, etc.) for the remaining tiered activities as necessary commensurate with rulemaking and licensee implementation schedules.