Expanded NRC Questions and Answers related to the March 11, 2011 Japanese Earthquake and Tsunami (February 15, 2012)

ML120040283

Table of Contents

Japanese Power Plants

Fukushima Dai-ichi Hydrogen Explosion

Q: *Could explosions like those that occurred in Japan happen at a U.S facility? UPDATED*

A: The NRC is aware of the Japanese efforts to stabilize and control the plants. While we've learned a great deal, additional investigations and analyses will be necessary to provide a comprehensive and precise explanation for the explosions. In Units 1, 2, and 3 of Fukushima Dai-ichi, available evidence suggests the explosions were caused by the buildup of hydrogen gas within primary containment produced during fuel damage in the reactor and subsequent movement of that hydrogen gas from the drywell into secondary containment. Available evidence has yet to provide a compelling cause for the explosion in Unit 4. U.S. facilities of similar design have venting capabilities that would allow operators to release hydrogen or other combustible gases to prevent a concentrated buildup that could exceed the flammability limit. The NRC's near term review ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission) recommends making those venting capabilities a regulatory requirement. The NRC staff is implementing that recommendation, which will lead to hardened, reliable vents in all Mark I and Mark II containments.

Fukushima Dai-ichi Lessons Learned

Q: *Has the NRC changed any regulatory requirements that are now in effect as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the US NRC has not changed any regulatory requirements as a result of the Fukushima Dai-ichi event. However, the US NRC has identified several technical and regulatory topics on which it intends to pursue improvement at US nuclear power plants without unnecessary delay. These topics include: (1) updated evaluation of seismic and flooding hazards; (2) improvements in licensee ability to cope with prolonged station blackout events; (3) protection of equipment potentially capable of mitigating multiunit, beyond design basis events from natural hazards; (3) improved reliability and effectiveness of boiling water reactor Mark I and Mark II containment venting systems; (4) installation of enhanced spent fuel pool monitoring instrumentation; (5) improved integration of emergency operating procedures, severe accident management guidelines, and extensive damage mitigation guidelines; and (6) enhancements to licensee emergency preparedness programs. The US NRC is following its regulatory process to develop the appropriate regulatory products, including request for information letters, orders, or changes to US NRC regulations, to address each of the technical or regulatory topics noted above. The US NRC has also identified other technical or regulatory topics for longer term action (see US NRC SECY-11-0137) and is considering other technical or regulatory topics related to lessons learned from the Fukushima Dai-ichi event which may be added to the list above.

Q: *Has the NRC required any physical plant changes that have already been made or installed at U.S. nuclear power plants (NPPs) as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the United States Nuclear Regulatory Commission (US NRC) has required no physical plant changes at NPPs in the US as a result of the Fukushima Dai-ichi event. The US NRC has taken several steps, however, to verify that licensees of US NPPs have equipment and procedures in place which may be useful in responding to be beyond design basis seismic or flooding events, large fires, explosions, or prolonged station blackout events. Such equipment has been installed at US facilities in response to, for example, US NRC requirements in Title 10 of the Code of Federal Regulations 50.54(hh) regarding the mitigation of significant plant damage due to aircraft impact. Following the event at Fukushima Dai-ichi, the NRC performed inspections, as addressed by US NRC Temporary Instruction 183 issued March 18, 2011, at all US NPPs to independently assess the ability of licensees to respond to beyond design basis events. In US NRC Bulletin 2011-01 dated May 11, 2011, the NRC has also required licensees to provide information to the NRC to confirm that NPP staff and equipment were capable of implementing the mitigative strategies which may be useful in responding to the aforementioned beyond design basis events.

Japanese Power Plants

Q: *Have any lessons for US nuclear plants been identified? UPDATED*

A: The NRC is learning from the events at the Japanese reactors through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations. The task force has completed its near-term analysis of the events and their impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission). The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:

- Reevaluate seismic and flooding hazards
- Perform seismic and flooding hazard walkdowns
- Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO
- Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena
- Strengthen and integrate onsite emergency response capabilities
- Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO
- Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)
- Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:

- Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)
- Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:

- Ten-year confirmation of seismic and flooding hazards
- Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods
- Reliable hardened vents for other containment designs
- Hydrogen control and mitigation inside containment or in other buildings
- Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events
- EP topics for decision-making, radiation monitoring, and public education
- Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework
- Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The NRC's staff long-term analysis and implementation is now underway.

Japanese Power Plants

Q: *Have the owners or operators of U.S. nuclear power plants made any physical changes to the plants as a result of Fukushima? Please describe the changes. NEW!*

A: In response to the findings from our post-Fukushima inspections, licensees have undertaken efforts to correct any NRC-identified deficiencies at their plants. However, as of Dec. 6, 2011 the NRC is not aware of any significant plant modifications made by US licensees as a result of lessons-learned from the Fukushima Dai-ichi event. Nevertheless, US licenses are taking actions individually and collectively through the efforts of organizations such as the Institute for Nuclear Power Operations (INPO), the Nuclear Energy Institute (NEI) and the Electric Power Research Institute (EPRI) to identify facility modifications which would improve overall US NPP safety in relation to beyond design basis events.

Q: *How can the public be involved in the accelerated process? NEW!*

A: Members of the public are invited to provide input regarding the NRC's resolution of the Tier 1 Recommendations. Please provide any comments to: JLD_Public Resource@nrc.gov. Comments will be considered to the extent possible.

Q: *How will the U.S. learn from the failures at the Japanese reactors? UPDATED*

A: The NRC is learning from the events at the Japanese reactors through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC issued an information notice to inform licensees about the effects of the earthquake on nuclear power plants in Japan. In addition, the NRC's staff at every reactor site have performed targeted inspections to confirm facility responses to beyond design-basis events. The NRC has also issued Bulletin 2011-01 that requires all licensees to verify under oath and affirmation that their mitigation strategies and capabilities are in compliance with relevant NRC regulations.

In addition, the NRC established both short- and long-term analysis of the lessons that can be learned from the situation in Japan. The short-term review has been completed. The Near-Term Task Force provided its recommendations to the Commission in July 2011. Since then, the NRC staff has provided the Commission with those recommendations from the Near-Term Task Force Report that could be implemented without delay as well as the prioritization of the remaining items. The Commission has directed the staff to proceed on the recommendations that can be implemented without delay and on certain of the remaining recommendations. The agency's long-term analysis and implementation is now underway.

Japanese Power Plants

Q: *Is the NRC going to make changes to spent fuel storage/safety requirements in light of the Japanese events (including possibly requiring spent fuel to be transferred to dry cask storage after a certain period of time)? UPDATED*

A: The NRC continues to believe that U.S. nuclear power plants, including their spent fuel storage facilities, can and do operate safely. Following the events in Japan, the Commission directed the staff to establish a senior level task to conduct a methodical and systematic review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and make recommendations to the Commission for its policy direction. The task force has completed its near-term review and has recommended that the NRC require licensees to install instrumentation in the spent fuel pools to monitor key parameters, to provide safety-related AC electrical power for the spent fuel makeup system, and to have installed a seismically qualified means to spray water into the spent fuel pools. The task force was silent on whether to accelerate spent fuel transfers to dry cask storage.

The NRC staff is implementing that recommendation, which will lead to licensees installing instrumentation in their spent fuel pools. The NRC staff is also planning to implement the remaining two items, providing safety-related AC electrical power for the spent fuel makeup system and installing a seismically qualified means to spray water into the spent fuel pools.

BACKGROUND:

[In Staff Requirements Memorandum (SRM-SECY 09-0090) issued in September 2010, the Commission approved revisions to the draft final rule on nuclear waste confidence and directed the staff to initiate a long-term rulemaking to address impacts of storage of spent fuel at onsite storage facilities, offsite storage facilities or both for extended periods. The Commission affirmed its confidence that spent nuclear fuel can be stored safely and securely without significant environmental impacts for at least 60 years after operation at any nuclear power plant either in the SFP or either onsite or offsite ISFSIs. Prior to the events in Japan, the staff provided a proposed plan for the long-term update to the Waste Confidence Rule (10 CFR 51.23) to the Commission in SECY-11-0029 which may be accessed at the following link:http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2011/2011-0029scy.pdf.

Following the events in Japan, the Commission directed the staff to establish a senior level task to conduct a methodical and systematic review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and make recommendations to the Commission for its policy direction. This direction is provided in tasking memorandum (COMSECY-COMGBJ-11-0002 which may be accessed at the following link:http://www.nrc.gov/reading-rm/doc-collections/commission/comm-secy/2011/2011-0002comgbj-srm.pdf. The task force will provide briefings to the Commission on a 30-day quick look report, a 60-day status of the ongoing near term review, and a 90-day completion of near term review. The task force has completed its near term review. Its report is available on the NRC homepage, www.nrc.gov.]

Q: *What is the Japan Lessons-Learned Project Directorate? NEW!*

A: The Japan Lessons-Learned Project Directorate is the staff-level project management organization responsible, along with its Steering Committee and line organizations and other supporting bodies, for implementing the Commission's direction on the Near-Team Task Force Report recommendations. The charter for the agency's implementation of the Near Term Task Force (NTTF) recommendations was recently approved by the Commission. The charter outlines an organization structure consisting of a Steering Committee, the Japan Lessons-Learned Project Directorate (JLD), the line organizations, and other support bodies responsible for implementing the Commission's direction on the NTTF recommendations.

Q: *What other NRC activities will be affected by this change? NEW!*

A: Some lower priority work will be delayed as staff focues on these initiatives. Be assured that NRC staff will continue to manage resources and workloads to ensure public health and safety.

Q: *Why did Congress have to get involved before the NRC accelerated the implementation? NEW!*

A: Congressional input was only one of the reasons we are revising our schedule.

Japanese Power Plants

Q: *Why is the NRC only accelerating the implementation now? NEW!*

A: Recent events have caused the staff to reconsider its proposed approach and schedule for issuing Tier 1 Orders and 50.54(f) letters:

-House and Senate Hearings

-Language in the NRC's Appropriations Bill

-Advisory Committee on Reactor Safety letters dated October 13th and November 8th

-Nuclear Energy Institute letter dated December 16th

-Resolution of the six additional issues from SECY-11-0137

Q: *Why is the NRC only now accelerating the implementation of these items? NEW!*

A: NRC is attempting to balance current priorities and established processes with the need to act upon what we learned from the events at Fukushima. Staff believes that quick action on these items, while keeping our original schedule for other follow-up actions, is appropriate and necessary.

Fukushima Dai-ichi Reactor Design

Q: *How do the Japanese reactor designs compare to the US reactor designs of similar vintage?*

A: The NRC is not aware of all of the differences that may exist between the Japanese reactors that are of similar design and vintage as those operated in the U.S. Many improvements have been made to U.S boiling water reactors (BWRs). For example, NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen generated by damaged fuel, as may occur during severe accidents. Additional enhancements include:

- Emergency diesel generator (EDG) fuel oil tanks required by NRC regulations are sheltered in safety-related structures or underground in order to withstand an earthquake as well as flooding events. These tanks provide a reliable fuel supply to safety related AC and DC power systems for several days.

- The regulations in 10 CFR 50.63 require all U.S. nuclear power plants to cope with a loss of all AC power (i.e., station blackout) in the event of a loss of station on-site and normal off-site power sources. In addition, nuclear plants are required to have alternate AC sources from separate grid systems separate from the normal off-site power supply.

- A portable emergency diesel-driven water pump for emergency fuel pool cooling is available at all US nuclear sites.

- Emergency operating procedures as well as severe accident management guidelines ensure that the containment structure integrity takes priority in an accident situation. Therefore, in a beyond-design-basis event, such as the one at Fukushima Dai-ichi, U.S. BWR operators are trained to reduce the buildup of explosive concentrations of hydrogen and to preserve primary and secondary containment by venting.

- In parallel with the above, a U.S. facility’s emergency operating procedures would prioritize the restoration of offsite power in order to restore vital power needs following a severe event.

Japanese Power Plants

Q: *How many U.S. plants have designs similar to the affected Japanese reactors (and which ones)?*

A: Thirty-five of the 104 operating nuclear power plants in the U.S. are boiling water reactors (BWRs), as are the reactors at Fukushima. Twenty-three of the U.S. BWRs have the same Mark I containment as the Fukushima reactors.

Two of the U.S. BWRs with a Mark I containment have an early nuclear steam supply system (NSSS) design designated as BWR-2. Six of the U.S. BWRs with Mark I containments have another early design, designated BWR-3, which are similar to Fukushima Unit 1. The remaining fifteen of the Mark I BWRs have the BWR-4 NSSS, similar to Fukushima Units 2, 3, and 4. The following table lists the operating BWRs in the United States.

Plant Name	NSSS Type	Containment Design	Location
Browns Ferry 1	BWR-4	Mark I	AL
Browns Ferry 2	BWR-4	Mark I	AL
Browns Ferry 3	BWR-4	Mark I	AL
Brunswick 1	BWR-4	Mark I	NC
Brunswick 2	BWR-4	Mark I	NC
Clinton	BWR-6	Mark III	IL
Columbia Generating Station	BWR-5	Mark II	WA
Cooper	BWR-4	Mark I	NE
Dresden 2	BWR-3	Mark I	IL
Dresden 3	BWR-3	Mark I	IL
Duane Arnold	BWR-4	Mark I	IA
Fermi 2	BWR-4	Mark I	OH
FitzPatrick	BWR-4	Mark I	NY
Grand Gulf 1	BWR-6	Mark III	MS
Hatch 1	BWR-4	Mark I	GA
Hatch 2	BWR-4	Mark I	GA
Hope Creek 1*	BWR-4	Mark I	NJ
La Salle 1	BWR-5	Mark II	IL
La Salle 2	BWR-5	Mark II	IL
Limerick 1	BWR-4	Mark II	PA
Limerick 2	BWR-4	Mark II	PA
Monticello	BWR-3	Mark I	MN
Nine Mile Point 1	BWR-2	Mark I	NY
Nine Mile Point 2	BWR-5	Mark II	NY
Oyster Creek	BWR-2	Mark I	NJ
Peach Bottom 2	BWR-4	Mark I	PA
Peach Bottom 3	BWR-4	Mark I	PA
Perry 1	BWR-6	Mark III	OH
Pilgrim 1	BWR-3	Mark I	MA
Quad Cities 1	BWR-3	Mark I	IL
Quad Cities 2	BWR-3	Mark I	IL
River Bend 1	BWR-6	Mark III	LA
Susquehanna 1	BWR-4	Mark II	PA
Susquehanna 2	BWR-4	Mark II	PA
Vermont Yankee	BWR-4	Mark I	VT

*has concrete secondary containment unlike other BWRs of this type

Japanese Power Plants

Fukushima Dai-ichi U.S. Assistance

Q: *What is the NRC doing to ensure this (Japan event) doesn't happen at US plants? UPDATED*

A: The NRC is addressing the applicability of the events in Japan to US plants through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC has issued the following documents related to the events in Japan:

- Information Notice 2011-05 provided information to licensees on the effects of the earthquake and resultant tsunami on the Fukushima Dai-ichi nuclear power station in Japan.

- Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant.

- Temporary Instruction 2515/184 provided instructions for NRC inspectors to determine: (i) that the severe accident management guidelines (SAMGs) are available and how they are being maintained, and (ii) the nature and extent of licensee implementation of SAMG training and exercises.

- Bulletin 2011-01 required all holders of operating licenses for nuclear power reactors to provide a comprehensive verification of their compliance with the regulatory requirements in 10 CFR 50.54(hh) associated with mitigating strategies for beyond design basis events.

The task force has completed its near-term analysis of the events and their impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission). The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:
- Reevaluate seismic and flooding hazards
- Perform seismic and flooding hazard walkdowns
- Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO
- Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena -Strengthen and integrate onsite emergency response capabilities
- Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO
- Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)
- Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:
- Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)
- Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:
- Ten-year confirmation of seismic and flooding hazards
- Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods
- Reliable hardened vents for other containment designs
- Hydrogen control and mitigation inside containment or in other buildings

Japanese Power Plants

- Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events
- EP topics for decision-making, radiation monitoring, and public education
- Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework
- Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The agency's long-term analysis and implementation is now underway.

BWR Mark I Design

Q: *How are US BWRs similar and/or different from the plants that experienced problems in Japan?*

A: Thirty-five of the 104 operating nuclear power plants in the U.S. are boiling water reactors (BWRs), as are the reactors at Fukushima. Twenty-three of the U.S. BWRs have the same Mark I containment as the Fukushima reactors.

Two of the U.S. BWRs with a Mark I containment have an early nuclear steam supply system (NSSS) design designated as BWR-2. Six of the U.S. BWRs with Mark I containments have another early design, designated BWR-3, which are similar to Fukushima Unit 1. The remaining fifteen of the Mark I BWRs have the BWR-4 NSSS, similar to Fukushima Units 2, 3, and 4. The following table lists the operating BWRs in the United States.

The NRC is not aware of all differences that may exist between the Fukushima reactors and those of similar design and vintage operated in the U.S., neither do we have specific knowledge of implementation at Fukushima of the following improvements made to U.S. reactors:

Station Blackout (SBO) Rule - required the ability to cope with SBO for specified time and recover the plant

Anticipated Transient Without Scram (ATWS) Rule - required vendor specific improvements to enhance scram reliability

Hydrogen Control Rule - required modifications to reduce impact of hydrogen generated from beyond design basis events (DBEs)

Equipment Qualification Rule - required environmental qualification of electrical system equipment used for design basis accidents (DBAs)

Mark I Containment Improvement Program - (i) added hardened vent system for containment cooling and fission product scrubbing for beyond DBEs, and (ii) enhanced reliability of automatic despressurization system (ADS) and added an additional water injection capability independent of normal AC and emergency diesel power

Symptom-based Emergency Procedure Guides (EPGs) - provides emergency procedures that direct operator actions on the basis of critical safety parameter status rather than knowledge of the event initiator – applicable to any initiating event (DBA or beyond DBA).

Severe Accident Management Guidelines (SAMGs) - guidelines for minimizing radiological consequences of a damaged core event. Focuses on maintaining containment integrity, controlling releases, and emergency planning interface

Aircraft Impact Requirements - requires procedures to use all available equipment for core cooling, containment protection, and spent fuel pool cooling assuming a significant damage to the facility from an airplane crash

Mark I Containment Hydrodynamic Load Issue Resolution - resulted in structural strengthening of Mark I containments to better handle reactor system depressurization forces

Emergency Core Cooling System (ECCS) Pump Suction Strainer Improvements - larger surface area strainers installed with higher debris loading tolerance to ensure ECCS pump operation

Hydrogen explosions have been a major aspect of the Fukushima accident. In the U.S., NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen generated by damaged fuel, as may occur during severe accidents.

U.S. Power Plants (General)

Q: *How many U.S. plants have designs similar to the affected Japanese reactors (and which ones)?*

A: Thirty-five of the 104 operating nuclear power plants in the U.S. are boiling water reactors (BWRs), as are the reactors at Fukushima. Twenty-three of the U.S. BWRs have the same Mark I containment as the Fukushima reactors.

Two of the U.S. BWRs with a Mark I containment have an early nuclear steam supply system (NSSS) design designated as BWR-2. Six of the U.S. BWRs with Mark I containments have another early design, designated BWR-3, which are similar to Fukushima Unit 1. The remaining fifteen of the Mark I BWRs have the BWR-4 NSSS, similar to Fukushima Units 2, 3, and 4. The following table lists the operating BWRs in the United States.

Plant Name	NSSS Type	Containment Design	Location
Browns Ferry 1	BWR-4	Mark I	AL
Browns Ferry 2	BWR-4	Mark I	AL
Browns Ferry 3	BWR-4	Mark I	AL
Brunswick 1	BWR-4	Mark I	NC
Brunswick 2	BWR-4	Mark I	NC
Clinton	BWR-6	Mark III	IL
Columbia Generating Station	BWR-5	Mark II	WA
Cooper	BWR-4	Mark I	NE
Dresden 2	BWR-3	Mark I	IL
Dresden 3	BWR-3	Mark I	IL
Duane Arnold	BWR-4	Mark I	IA
Fermi 2	BWR-4	Mark I	OH
FitzPatrick	BWR-4	Mark I	NY
Grand Gulf 1	BWR-6	Mark III	MS
Hatch 1	BWR-4	Mark I	GA
Hatch 2	BWR-4	Mark I	GA
Hope Creek 1*	BWR-4	Mark I	NJ
La Salle 1	BWR-5	Mark II	IL
La Salle 2	BWR-5	Mark II	IL
Limerick 1	BWR-4	Mark II	PA
Limerick 2	BWR-4	Mark II	PA
Monticello	BWR-3	Mark I	MN
Nine Mile Point 1	BWR-2	Mark I	NY
Nine Mile Point 2	BWR-5	Mark II	NY
Oyster Creek	BWR-2	Mark I	NJ
Peach Bottom 2	BWR-4	Mark I	PA
Peach Bottom 3	BWR-4	Mark I	PA
Perry 1	BWR-6	Mark III	OH
Pilgrim 1	BWR-3	Mark I	MA
Quad Cities 1	BWR-3	Mark I	IL
Quad Cities 2	BWR-3	Mark I	IL
River Bend 1	BWR-6	Mark III	LA
Susquehanna 1	BWR-4	Mark II	PA
Susquehanna 2	BWR-4	Mark II	PA
Vermont Yankee	BWR-4	Mark I	VT

*has concrete secondary containment unlike other BWRs of this type

U.S. Power Plants (General)

Q: *Some in the media and in Hill briefings are suggesting the BWR Mark I containment is flawed. What are the concerns about this type of containment? Are the US plants with this safe?*

A: BWR Mark I containments have relatively small volumes in comparison with pressureized water reactor (PWR) containments. This makes the BWR Mark I containment relatively more susceptible to containment failure given a core meltdown severe enough to (1) fail the reactor vessel and also (2) severe enough so that the core melt reaches the containment boundary. On the positive side, BWRs have more ways of adding water to the core than PWRs to prevent core meltdown. The following improvements have been made to U.S. Mark I containment reactors:

Station Blackout (SBO) Rule: Required the ability to cope with SBO for specified time and recover the plant

Anticipated Transient Without Scram (ATWS) Rule: Required vendor specific improvements to enhance scram reliability

Hydrogen Control Rule: Required modifications to reduce impact of hydrogen generated from beyond design basis events (DBEs)

Equipment Qualification Rule: Required environmental qualification of electrical system equipment used for design basis accidents (DBAs)

Mark I Containment Improvement Program: (i) Added hardened vent system for containment cooling and fission product scrubbing for beyond DBAs, and (ii) Enhanced reliability of automatic depressurization system (ADS) and added an additional water injection capability independent of normal AC and emergency diesel power

Symptom-based Emergency Procedure Guides (EPGs): Provides emergency procedures that direct operator actions on the basis of critical safety parameter status rather than knowledge of the event initiator – applicable to any initiating event (DBA or beyond DBA)

Severe Accident Management Guidelines (SAMGs): Guidelines for minimizing radiological consequences of a damaged core event. Focuses on maintaining containment integrity, controlling releases, and emergency planning interface

Aircraft Impact Requirements: Requires procedures to use all available equipment for core cooling, containment protection, and spent fuel pool cooling assuming a significant damage to the facility from an airplane crash

Mark I Containment Hydrodynamic Load Issue Resolution: Resulted in structural strengthening of Mark I containments to better handle reactor system depressurization forces

Emergency Core Cooling System (ECCS) Pump Suction Strainer Improvements: Larger surface area strainers installed with higher debris loading tolerance to ensure ECCS pump operation

Hydrogen explosions have been a major aspect of the Fukushima accident. In the U.S., NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen generated by damaged fuel, as may occur during severe accidents.

Continued Plant Safety

Q: *Has this incident changed the NRC perception about earthquake risk? UPDATED*

A: There has been no change in the NRC's perception of earthquake hazard (i.e. ground shaking levels) for US nuclear plants. The NRC continues to determine that US nuclear plants are safe. Even before the events in Japan, the NRC began reviewing the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE) effort in the 1990s. From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review referred to as GI-199, "Implications of Updated Probabilistic Seismic Estimates in Central and Eastern United States on Existing Plants," to again assess the resistance of US nuclear plants to earthquakes. In addition, the NRC has been reviewing new seismic information regarding the plants in California for many years.

The NRC senior level task force has completed its near-term review. In the report, the task force recommends that the NRC require licensees to update their analysis of natural events, such as flooding or earthquakes. The task force did not find an immediate safety concern; rather, the task force is recommending the update since the original analyses were done forty or more years ago for some plants.

The Commission has directed the NRC staff to pursue the reevaluation of seismic and flooding hazards without delay.

U.S. Power Plants (General)

Q: *Some in the media and in Hill briefings are suggesting the BWR Mark I containment is flawed. What are the concerns about this type of containment? Are the US plants with this safe?*

A: BWR Mark I containments have relatively small volumes in comparison with pressureized water reactor (PWR) containments. This makes the BWR Mark I containment relatively more susceptible to containment failure given a core meltdown severe enough to (1) fail the reactor vessel and also (2) severe enough so that the core melt reaches the containment boundary. On the positive side, BWRs have more ways of adding water to the core than PWRs to prevent core meltdown. The following improvements have been made to U.S. Mark I containment reactors:

Station Blackout (SBO) Rule: Required the ability to cope with SBO for specified time and recover the plant

Anticipated Transient Without Scram (ATWS) Rule: Required vendor specific improvements to enhance scram reliability

Hydrogen Control Rule: Required modifications to reduce impact of hydrogen generated from beyond design basis events (DBEs)

Equipment Qualification Rule: Required environmental qualification of electrical system equipment used for design basis accidents (DBAs)

Mark I Containment Improvement Program: (i) Added hardened vent system for containment cooling and fission product scrubbing for beyond DBAs, and (ii) Enhanced reliability of automatic depressurization system (ADS) and added an additional water injection capability independent of normal AC and emergency diesel power

Symptom-based Emergency Procedure Guides (EPGs): Provides emergency procedures that direct operator actions on the basis of critical safety parameter status rather than knowledge of the event initiator – applicable to any initiating event (DBA or beyond DBA)

Severe Accident Management Guidelines (SAMGs): Guidelines for minimizing radiological consequences of a damaged core event. Focuses on maintaining containment integrity, controlling releases, and emergency planning interface

Aircraft Impact Requirements: Requires procedures to use all available equipment for core cooling, containment protection, and spent fuel pool cooling assuming a significant damage to the facility from an airplane crash

Mark I Containment Hydrodynamic Load Issue Resolution: Resulted in structural strengthening of Mark I containments to better handle reactor system depressurization forces

Emergency Core Cooling System (ECCS) Pump Suction Strainer Improvements: Larger surface area strainers installed with higher debris loading tolerance to ensure ECCS pump operation

Hydrogen explosions have been a major aspect of the Fukushima accident. In the U.S., NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen generated by damaged fuel, as may occur during severe accidents.

U.S. Power Plants (General)

Q: *Why are US plants safe to operate considering the events in Japan?*

A: The NRC has been very closely monitoring the activities in Japan and reviewing all available information to allow us to conclude that the U.S. plants continue to operate safely. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth.

Every U.S. reactor is designed for natural events, based on the specific site where the reactor is located. Every U.S. reactor has multiple fission product barriers, as well as a wide range of diverse and redundant safety features. All these factors support the NRC's conclusion that public health and safety can be assured. The NRC has a long regulatory history of conservative decisionmaking. The NRC has been intelligently using risk insights to help inform the regulatory process and has required improvements to the plant designs as we learn from operating experience. Some of these include severe accident management guidelines, revisions to the emergency operating procedures, procedures and processes for dealing with large fires and explosions regardless of the cause, and requirements for coping with station blackout.

The NRC's task force examining the accident at Fukushima Dai-ichi and its impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission) has concluded that continued operation and continued licensing activities do not pose an imminent risk to public health and safety.

Coordination Efforts

Q: *How are the research activities conducted and coordinated at the NRC?*

A: NRC's Office of Research (RES) coordinates research activities with the other NRC program offices, as appropriate, and leads the agency's initiative for cooperative research with the U.S. Department of Energy (DOE) and other Federal agencies, the domestic nuclear industry, U.S. universities, and international partners. RES coordinates the development of consensus and voluntary standards for agency use, including appointment of agency staff to various standards committees. Based on research results and experience gained, RES works with the regulatory offices to develop appropriate regulatory actions to resolve potential safety issues for nuclear power plants and other facilities regulated by the NRC, including those issues designated as Generic Issues (GIs). GIs are technical or security issues that could impact two or more facilities or licensees. RES also develops the technical basis for those areas regulated by the NRC that have risk-informed, performance-based regulations.

RES supplies technical tools, analytical models, and experimental data needed to support the agency's regulatory decisions. RES does not conduct research for the primary purpose of developing improved technologies. That is more appropriately done by the Department of Energy or the nuclear industry. Rather, the NRC conducts research to confirm that the methods and data generated by the industry ensure that adequate safety margin is maintained.

RES activities support regulation of the commercial use of radioactive materials to protect public health and safety and to protect the environment. RES is also responsible for providing the technical basis for regulations to ensure the protection and safeguarding of nuclear materials and nuclear power plants in the interest of national security. Thus, while its primary focus is on supporting the licensing and regulatory process, the research conducted by and for the NRC plays an important role in supporting broad government-wide initiatives associated with national security.

U.S. Power Plants (General)

Q: *How does the NRC ensure people can escape if an accident occurs from a natural disaster when the infrastructure is also affected or destroyed in an area around a plant?*

A: Each US nuclear power plant has an Emergency Plan for ensuring the health and safety of people who live within the emergency planning zone. Emergency plans contain contingencies for alternate evacuation routes, alternate means of notification, and other backup plans in the event of a natural disaster that damages the surrounding infrastructure. Licensees exercise these plans on a regular basis. The NRC performs oversight to verify the acceptable performance of the licensee's response during exercises, drills, and actual incidents and events. The Federal Emergency Managment Agency (FEMA) provides oversight for offsite response.

For Incidents of National Significance where the critical infrastructure is severely damaged, the Department of Homeland Security (DHS) has a lead role as a coordinating agency to orchestrate Federal, State, and local assets. The Nuclear/Radiological Incident Annex to the National Response Framework provides for the NRC to be a coordinating agency for incidents involving NRC licensed materials.

U.S. Power Plants (General)

Q: *What is the NRC doing to ensure this (Japan event) doesn't happen at US plants? UPDATED*

A: The NRC is addressing the applicability of the events in Japan to US plants through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC has issued the following documents related to the events in Japan:

- Information Notice 2011-05 provided information to licensees on the effects of the earthquake and resultant tsunami on the Fukushima Dai-ichi nuclear power station in Japan.

- Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant.

- Temporary Instruction 2515/184 provided instructions for NRC inspectors to determine: (i) that the severe accident management guidelines (SAMGs) are available and how they are being maintained, and (ii) the nature and extent of licensee implementation of SAMG training and exercises.

- Bulletin 2011-01 required all holders of operating licenses for nuclear power reactors to provide a comprehensive verification of their compliance with the regulatory requirements in 10 CFR 50.54(hh) associated with mitigating strategies for beyond design basis events.

The task force has completed its near-term analysis of the events and their impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission). The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:
- Reevaluate seismic and flooding hazards
- Perform seismic and flooding hazard walkdowns
- Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO
- Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena -Strengthen and integrate onsite emergency response capabilities
- Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO
- Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)
- Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:
- Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)
- Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:
- Ten-year confirmation of seismic and flooding hazards
- Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods
- Reliable hardened vents for other containment designs
- Hydrogen control and mitigation inside containment or in other buildings
- Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events
- EP topics for decision-making, radiation monitoring, and public education

U.S. Power Plants (General)

- Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework
- Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The agency's long-term analysis and implementation is now underway.

Q: *Why are US plants safe to operate considering the events in Japan?*

A: The NRC has been very closely monitoring the activities in Japan and reviewing all available information to allow us to conclude that the U.S. plants continue to operate safely. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth.

Every U.S. reactor is designed for natural events, based on the specific site where the reactor is located. Every U.S. reactor has multiple fission product barriers, as well as a wide range of diverse and redundant safety features. All these factors support the NRC's conclusion that public health and safety can be assured. The NRC has a long regulatory history of conservative decisionmaking. The NRC has been intelligently using risk insights to help inform the regulatory process and has required improvements to the plant designs as we learn from operating experience. Some of these include severe accident management guidelines, revisions to the emergency operating procedures, procedures and processes for dealing with large fires and explosions regardless of the cause, and requirements for coping with station blackout.

The NRC's task force examining the accident at Fukushima Dai-ichi and its impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission) has concluded that continued operation and continued licensing activities do not pose an imminent risk to public health and safety.

Design: Risk-informed

Q: *Could there be core damage and radiation release at a U.S. plant if a natural disaster exceeding the plant design were to occur?*

A: U.S. nuclear power plants are built to withstand external hazards, including earthquakes, tsunamis, and flooding, as appropriate. The NRC has made substantial effort over time to ensure that vulnerabilities to both internal and external hazards were considered and mitigated in the plant current design and licensing basis of its regulated facilities. In 1988, the NRC's Generic Letter (GL) No. 88-20, "Individual Plant Examination [IPE] for Severe Accident Vulnerabilities," requested plant owners to perform a systematic evaluation of plant-specific vulnerabilities and report the results to the Commission. For many plants, the IPEs became the basis for the plant's initial Probabilistic Risk Assessment (PRA). Later the NRC issued Supplement 4 to GL 88-20, that requested licensees to evaluate vulnerabilities to external events (IPEEE). Most licensees made improvements to their facilities to reduce vulnerabilities identified in their IPEs and IPEEEs.

The ground motions that are used as seismic design bases at US nuclear plants are called the Safe Shutdown Earthquake (SSE) ground motions. In the 1990s, the NRC staff reviewed the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE). From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review (i.e., GI-199) to again assess the resistance of US nuclear plants to earthquakes. Based on NRC's preliminary analyses to date, the average probability of ground motions exceeding the SSE over the life of the plant for the plants in the Central and Eastern United States is less than about 1%. It is important to remember that structures, systems and components are required to have "adequate margin," meaning that they must continue be able withstand shaking levels that are above the plant's design basis.

U.S. Power Plants (General)

Q: *Given that low probability events do occur, how does the U.S. ensure that U.S. plant designs are not significantly degraded by risk-informed changes?*

A: The NRC has established a policy for using risk information in its regulatory decision making. The NRC's policy statement on probabilistic risk assessment (PRA) encourages greater use of this analysis technique to improve safety decisionmaking and improve regulatory efficiency. The use of PRA technology should be increased in all regulatory matters to the extent supported by the state of the art in PRA methods and data and in a manner that complements the NRC's deterministic approach and supports the NRC's traditional defense-in-depth philosophy. In implementing risk-informed decisionmaking, licensing basis changes are expected to meet a set of key principles. Some of these principles are written in terms typically used in traditional engineering decisions (e.g., defense in depth). While written in these terms, it should be understood that risk analysis techniques can be, and are encouraged to be, used to help ensure and show that these principles are met. These principles are:

1. The proposed change meets the current regulations unless it is explicitly related to a requested exemption or rule change, i.e., a"specific exemption" under 10 CFR 50.12 or a "petition for rulemaking" under 10 CFR 2.802.

2. The proposed change is consistent with the defense-in-depth philosophy.

3. The proposed change maintains sufficient safety margins.

4. When proposed changes result in an increase in core damage frequency or risk, the increases should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.

5. The impact of the proposed change should be monitored using performance measurement strategies.

Design: Defense-in-Depth

Q: *Why are US plants safe to operate considering the events in Japan?*

A: The NRC has been very closely monitoring the activities in Japan and reviewing all available information to allow us to conclude that the U.S. plants continue to operate safely. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth.

Every U.S. reactor is designed for natural events, based on the specific site where the reactor is located. Every U.S. reactor has multiple fission product barriers, as well as a wide range of diverse and redundant safety features. All these factors support the NRC's conclusion that public health and safety can be assured. The NRC has a long regulatory history of conservative decisionmaking. The NRC has been intelligently using risk insights to help inform the regulatory process and has required improvements to the plant designs as we learn from operating experience. Some of these include severe accident management guidelines, revisions to the emergency operating procedures, procedures and processes for dealing with large fires and explosions regardless of the cause, and requirements for coping with station blackout.

The NRC's task force examining the accident at Fukushima Dai-ichi and its impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission) has concluded that continued operation and continued licensing activities do not pose an imminent risk to public health and safety.

U.S. Power Plants (General)

Design: External Events: Seismic

Q: *Are U.S. nuclear power plants designed to withstand earthquakes? What would the effect be on [plant X] if a 9.0 earthquake hit?*

A: All U.S. nuclear power plants are built to withstand external hazards, including earthquakes, flooding, and tsunamis, as appropriate. Even those plants that are located in areas with low and moderate seismic activity are designed for safety in the event of such a natural disaster. Each plant is designed to a ground-shaking level that is appropriate for its location, given the possible earthquake sources that may affect the site and its tectonic environment. Ground shaking is a function of both the magnitude of the earthquake and the distance from the fault plane to the specific site. The seismic responses of the structures, systems, and components associated with these facilities are site specific. The plants are analyzed for certain identified faults and tectonic capabilities in the area while others are analyzed for seismic zones.

Q: *Could there be core damage and radiation release at a U.S. plant if a natural disaster exceeding the plant design were to occur?*

A: U.S. nuclear power plants are built to withstand external hazards, including earthquakes, tsunamis, and flooding, as appropriate. The NRC has made substantial effort over time to ensure that vulnerabilities to both internal and external hazards were considered and mitigated in the plant current design and licensing basis of its regulated facilities. In 1988, the NRC's Generic Letter (GL) No. 88-20, "Individual Plant Examination [IPE] for Severe Accident Vulnerabilities," requested plant owners to perform a systematic evaluation of plant-specific vulnerabilities and report the results to the Commission. For many plants, the IPEs became the basis for the plant's initial Probabilistic Risk Assessment (PRA). Later the NRC issued Supplement 4 to GL 88-20, that requested licensees to evaluate vulnerabilities to external events (IPEEE). Most licensees made improvements to their facilities to reduce vulnerabilities identified in their IPEs and IPEEEs.

The ground motions that are used as seismic design bases at US nuclear plants are called the Safe Shutdown Earthquake (SSE) ground motions. In the 1990s, the NRC staff reviewed the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE). From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review (i.e., GI-199) to again assess the resistance of US nuclear plants to earthquakes. Based on NRC's preliminary analyses to date, the average probability of ground motions exceeding the SSE over the life of the plant for the plants in the Central and Eastern United States is less than about 1%. It is important to remember that structures, systems and components are required to have "adequate margin," meaning that they must continue be able withstand shaking levels that are above the plant's design basis.

Q: *Could this happen at any U.S. plant?*

A: The events that have occurred in Japan are the result of a combination of highly unlikely natural disasters. These include the fifth largest earthquake in recorded history and the resulting devastating tsunami. This earthquake occurred on a "subduction zone", which is the type of tectonic region that produces earthquakes of the largest magnitude. A subduction zone is a tectonic plate boundary where one tectonic plate is pushed under another plate. Subduction zone earthquakes are also required to produce the kind of massive tsunami seen in Japan. In the continental US, the only subduction zone is the Cascadia subduction zone which lies off the coast of northern California, Oregon and Washington. So, a continental earthquake and tsunami as large as in Japan could only happen there. The only nuclear plant near the Cascadia subduction zone is the Columbia Generating Station. This plant is located a large distance from the coast (approximately 225 miles) and the subduction zone (approximately 300 miles), so the ground motions estimated at the plant are far lower than those seen at the Fukushima plants. This distance also precludes the possibility of a tsunami affecting the plant. Outside of the Cascadia subduction zone, earthquakes are not expected to exceed a magnitude of approximately 8. Magnitude is measured on a log scale and so a magnitude 9 earthquake is 32 times larger than a magnitude 8 earthquake.

The NRC believes that it is highly unlikely that a similar combination of events could occur in the United States. NRC and industry practices of defense in depth, conservative decision making, use of risk insights, and industry actions and coordination through the Institute of Nuclear Power Operations provides for further assurance that the facilities are safe.

U.S. Power Plants (General)

Q: *Do U.S. nuclear plants have better capabilities to respond to natural disasters than the plants in Japan?*

A: The NRC is not yet aware of all of the differences that may exist between the reactors that are of similar design and vintage as those operated in the U.S. Many improvements have been made to U.S boiling water reactors (BWRs). For example, NRC Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn't have an existing strengthened or "hardened" pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen that could be generated by damaged fuel, as may occur during severe accidents. U.S. nuclear power plants are built to withstand external hazards, including earthquakes tsunamis, and flooding, as appropriate. In addition to the design of the plants, significant effort goes into emergency response planning, preparation, and training. The NRC has also completed substantial research and analysis that resulted in the development and use of severe accident management guidelines. These insights have informed our decision making and review of licensed activities.

Q: *Has this incident changed the NRC perception about earthquake risk? UPDATED*

A: There has been no change in the NRC's perception of earthquake hazard (i.e. ground shaking levels) for US nuclear plants. The NRC continues to determine that US nuclear plants are safe. Even before the events in Japan, the NRC began reviewing the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE) effort in the 1990s. From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review referred to as GI-199, "Implications of Updated Probabilistic Seismic Estimates in Central and Eastern United States on Existing Plants," to again assess the resistance of US nuclear plants to earthquakes. In addition, the NRC has been reviewing new seismic information regarding the plants in California for many years.

The NRC senior level task force has completed its near-term review. In the report, the task force recommends that the NRC require licensees to update their analysis of natural events, such as flooding or earthquakes. The task force did not find an immediate safety concern; rather, the task force is recommending the update since the original analyses were done forty or more years ago for some plants.

The Commission has directed the NRC staff to pursue the reevaluation of seismic and flooding hazards without delay.

Q: *How many US reactors are located in active earthquake zones?*

A: Although we often think of the US as having "active" and "non-active" earthquake zones, earthquakes can actually happen almost anywhere. Seismologists typically separate the US into low, moderate, and high seismicity zones. The NRC requires that every nuclear plant be designed for site-specific ground motions that are appropriate for their locations. In addition, the NRC has specified a minimum ground motion level to which nuclear plants must be designed.

Q: *Is the NRC relooking at seismic analysis for US plants?*

A: The ground motions that are used as seismic design bases at US nuclear plants are called the Safe Shutdown Earthquake ground motion (SSE). In the mid to late 1990s, the NRC staff reviewed the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE). From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review referred to as GI-199, "Implications of Updated Probabilistic Seismic Estimates in Central and Eastern United States on Existing Plants," to again assess the resistance of US nuclear plants to earthquakes. In addition, the NRC has been reviewing new seismic information regarding the plants in California for many years.

U.S. Power Plants (General)

Q: *Please explain the outcome at each plant (Pilgrim Station, Seabrook Station and Vermont Yankee) if it was hit with a 8.9 earthquake (i.e., the same as what hit Japan)?*

A: Each plant is designed to a ground-shaking level that is appropriate for its location, given the possible earthquake sources that may affect the site and its tectonic environment. Ground shaking is a function of both the magnitude of the earthquake and the distance from the fault plane to the site. The seismic hazards associated with the earthquake in Japan cannot be duplicated by the geology of New England, where the Pilgrim, Seabrook, and Vermont Yankee facilities are located, so this makes a postulated comparison of facility responses to the same seismic event even less likely.

Q: *What level of earthquake hazard are the US reactors designed for?*

A: Each reactor is designed for a different ground motion that is determined on a site-specific basis. The existing nuclear plants were designed on a "deterministic" or "scenario earthquake" basis that accounted for the largest earthquakes expected in the area around the plant, without consideration of the likelihood of the earthquakes considered. New reactors are designed using probabilistic techniques that characterize both the ground motion levels and uncertainty at the proposed site. These probabilistic techniques account for the ground motions that may result from all potential seismic sources in the region around the site. Technically speaking, this is the ground motion with an annual frequency of occurrence of 1x10-4/year, but this can be thought of as the ground motion that occurs every 10,000 years on average. One important aspect is that probabilistic hazard and risk-assessment techniques account for beyond-design basis events. NRC's Generic Issue 199 (GI-199) project is using the latest probabilistic techniques used for new nuclear plants to review the safety of the existing plants.

Q: *Why should the NRC not require the more sophisticated (3D) seismic studies being voluntarily conducted by licensees in California?*

A: Current NRC and American Nuclear Society (ANS) documentation provides guidance related to site investigations undertaken for the purpose of characterizing seismic sources and dynamic site properties. A variety of geophysical and geotechnical tools are available that can be used to investigate the earth from both a site-specific and a regional level. Each of these methods provides specific information by probing the earth in a different way. While some tools are universally useful, others are better suited to certain types of sub-surface materials and tectonic situations. While 3D seismic studies, such as those being performed in California, are sophisticated, they are not useful for all situations and the very large expense of the study could preclude broader application of techniques better suited to a specific site. The NRC would suggest the use of 3D seismic studies only in cases where it could be useful. The NRC attempts to provide regulations that call for techniques that would be the most suitable given the specific conditions of a plant and requested licensing actions.

Q: *With NRC moving to design certification, at what point is seismic capability tested – during design or modified to be site-specific? If in design, what strength seismic event must these be built to withstand?*

A: The regulations related to seismic requirements are contained in General Design Criterion 2 in Appendix A to Title 10 of the *Code of Federal Regulations*, Part 50.

During design certification, vendors propose a seismic design in terms of a ground motion spectrum for their nuclear facility. This spectrum is called a standard design response spectrum and is developed so that the proposed nuclear facility can be sited at most locations in the central and eastern United States. The vendors show that this design ground motion is suitable for a variety of different subsurface conditions such as hard rock, deep soil, or shallow soil over rock. Combined License and Early Site Permits applicants are required to develop a site specific ground motion response spectrum that takes into account all of the earthquakes in the region surrounding their site as well as the local site geologic conditions. Applicants estimate the ground motion from these postulated earthquakes to develop seismic hazard curves. These seismic hazard curves are then used to determine a site specific ground motion response spectrum that has a maximum annual likelihood of 1x10-4 of being exceeded. This can be thought of as a ground motion with a 10,000 year return period. This site specific ground motion response spectrum is then compared to the standard design response spectrum for the proposed design. If the standard design ground motion spectrum envelopes the site specific ground motion spectrum then the site is considered to be suitable for the proposed design. If the standard design spectrum does not completely envelope the site specific ground motion spectrum, then the COL applicant must do further detailed structural analysis to show that the design capacity is adequate. Margin beyond the standard design and site specific ground motions must also be demonstrated before fuel loading can begin.

Design: External Events: Tsunami

Q: *Are U.S. nuclear power plants designed to withstand tsunamis? What would the effect be on [plant X] if a subsequent tsunami hit?*

A: All U.S. nuclear power plants are built to withstand external hazards, including earthquakes, flooding, and tsunamis, as appropriate. Many nuclear plants are located in coastal areas that could potentially be affected by a tsunami resulting from an earthquake. Two nuclear plants, Diablo Canyon and San Onofre, are on the Pacific Coast, which is known to have a tsunami hazard. There are many nuclear plants on the Atlantic Coast or on rivers that may be affected by a tidal bore resulting from a tsunami. These include St. Lucie, Turkey Point, Brunswick, Oyster Creek, Millstone, Pilgrim, Seabrook, Calvert Cliffs, Salem/Hope Creek, and Surry. In addition, there are two nuclear plants on the Gulf Coast, South Texas and Crystal River, that could potentially be affected by tsunami. Although tsunami on the Gulf and Atlantic Coasts may occur, it is very rare. Generally the flooding anticipated from hurricane storm surge exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Recent studies have looked at the potential of tsunami hitting the Gulf and Atlantic coasts, and have found that for many parts of the coast, tsunamigenic landslide (i.e., tsunami resulting from an underwater landslide) have the potential to exceed the seismically-induced tsunami. This research shows that the tsunamis produced by underwater landslides are localized, but can be extremely destructive in the nearby areas. The licensing basis for the coastal plants (i.e., FSARs) mentioned above did not specifically consider or assess this possibility, as the phenomenon was not well understood at the time. However, research supported by the NRC has been studying the issue since 2006. Although studies of tsunamigenic landslide continue, the current results indicated that flooding anticipated from hurricane storm surge, evaluated as part of the licensing basis for these plants, generally exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Q: *Do U.S. nuclear plants have better capabilities to respond to natural disasters than the plants in Japan?*

A: The NRC is not yet aware of all of the differences that may exist between the reactors that are of similar design and vintage as those operated in the U.S. Many improvements have been made to U.S boiling water reactors (BWRs). For example, NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen that could be generated by damaged fuel, as may occur during severe accidents. U.S. nuclear power plants are built to withstand external hazards, including earthquakes tsunamis, and flooding, as appropriate. In addition to the design of the plants, significant effort goes into emergency response planning, preparation, and training. The NRC has also completed substantial research and analysis that resulted in the development and use of severe accident management guidelines. These insights have informed our decision making and review of licensed activities.

U.S. Power Plants (General)

Q: *How many reactors are along coastal areas that could be affected by a tsunami? Is plant X designed to withstand a tsunami (for each coastal plant)?*

A: All U.S. nuclear power plants are built to withstand external hazards, including earthquakes, flooding, and tsunamis, as appropriate. Many nuclear plants are located in coastal areas that could potentially be affected by a tsunami resulting from an earthquake. Two nuclear plants, Diablo Canyon and San Onofre, are on the Pacific Coast, which is known to have a tsunami hazard. There are many nuclear plants on the Atlantic Coast or on rivers that may be affected by a tidal bore resulting from a tsunami. These include St. Lucie, Turkey Point, Brunswick, Oyster Creek, Millstone, Pilgrim, Seabrook, Calvert Cliffs, Salem/Hope Creek, and Surry. In addition, there are two nuclear plants on the Gulf Coast, South Texas and Crystal River, that could potentially be affected by tsunami. Although tsunami on the Gulf and Atlantic Coasts may occur, it is very rare. Generally the flooding anticipated from hurricane storm surge exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Recent studies have looked at the potential of tsunami hitting the Gulf and Atlantic coasts, and have found that for many parts of the coast, tsunamigenic landslide (i.e., tsunami resulting from an underwater landslide) have the potential to exceed the seismically-induced tsunami. This research shows that the tsunamis produced by underwater landslides are localized, but can be extremely destructive in the nearby areas. The licensing basis for the coastal plants (i.e., FSARs) mentioned above did not specifically consider or assess this possibility, as the phenomenon was not well understood at the time. However, research supported by the NRC has been studying the issue since 2006. Although studies of tsunamigenic landslide continue, the current results indicated that flooding anticipated from hurricane storm surge, evaluated as part of the licensing basis for these plants, generally exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Emergency Preparedness

Q: *Do U.S. nuclear plants have better capabilities to respond to natural disasters than the plants in Japan?*

A: The NRC is not yet aware of all of the differences that may exist between the reactors that are of similar design and vintage as those operated in the U.S. Many improvements have been made to U.S boiling water reactors (BWRs). For example, NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen that could be generated by damaged fuel, as may occur during severe accidents. U.S. nuclear power plants are built to withstand external hazards, including earthquakes tsunamis, and flooding, as appropriate. In addition to the design of the plants, significant effort goes into emergency response planning, preparation, and training. The NRC has also completed substantial research and analysis that resulted in the development and use of severe accident management guidelines. These insights have informed our decision making and review of licensed activities.

Q: *How does the NRC ensure people can escape if an accident occurs from a natural disaster when the infrastructure is also affected or destroyed in an area around a plant?*

A: Each US nuclear power plant has an Emergency Plan for ensuring the health and safety of people who live within the emergency planning zone. Emergency plans contain contingencies for alternate evacuation routes, alternate means of notification, and other backup plans in the event of a natural disaster that damages the surrounding infrastructure. Licensees exercise these plans on a regular basis. The NRC performs oversight to verify the acceptable performance of the licensee’s response during exercises, drills, and actual incidents and events. The Federal Emergency Managment Agency (FEMA) provides oversight for offsite response.

For Incidents of National Significance where the critical infrastructure is severely damaged, the Department of Homeland Security (DHS) has a lead role as a coordinating agency to orchestrate Federal, State, and local assets. The Nuclear/Radiological Incident Annex to the National Response Framework provides for the NRC to be a coordinating agency for incidents involving NRC licensed materials.

U.S. Power Plants (General)

Q: *How does the process for taking protective measures following an accident (evacuation, sheltering, KI) work in the U.S. including the roles and responsibilities of Federal Government Agencies, State and local governments?*

A: Every nuclear power plant operator in the U.S. has an approved Emergency Plan that includes procedures for performing specific actions in response to an emergency, including the necessary interactions with State and Local authorities and responders. These Emergency Plans are exercised on a regular basis (i.e., every 2 years) and include participation of plant personnel, State and Local authorities and responders. The NRC also participates in these exercises in addition to providing oversight and evaluation of the exercise. In addition, the Federal Emergency Management Agency (FEMA) provides oversight of the offsite responses during these exercises. In the event of an emergency that would require activation of this plan, plant operators would work together with state and local authorities to direct and guide the actions of off-site responders and together would determine the need for evacuation and/or sheltering to minimize radiation exposure to the public. Decision-making regarding evacuation and/or sheltering would involve information regarding the actual emergency, conditions at the plant, mitigating actions being taken at the plant, meteorological conditions that could affect the direction of travel of any radioactive plume and potential dispersion of this plume. Although the NRC has been involved in providing funding for the purchase of potassium iodide (KI) for communities neighboring nuclear power plants, distribution of KI and directions for ingestion of KI are made at the State and Local levels. Federal government agencies involved in emergency response to nuclear power plant emergencies include the NRC and the FEMA. Other federal agencies that may become involved, depending on the severity of the situation, include the Department of Homeland Security (DHS) and other federal agencies. For Incidents of National Significance where the critical infrastructure is severely damaged, DHS has a lead role as a coordinating agency to orchestrate Federal, State, and local assets. The Nuclear/Radiological Incident Annex to the National Response Framework provides for the NRC to be a coordinating agency for incidents involving NRC licensed materials. Information regarding the National Response Framework is available at the following link: http://www.fema.gov/emergency/nrf/.

Q: *Why are US plants safe to operate considering the events in Japan?*

A: The NRC has been very closely monitoring the activities in Japan and reviewing all available information to allow us to conclude that the U.S. plants continue to operate safely. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth.

Every U.S. reactor is designed for natural events, based on the specific site where the reactor is located. Every U.S. reactor has multiple fission product barriers, as well as a wide range of diverse and redundant safety features. All these factors support the NRC's conclusion that public health and safety can be assured. The NRC has a long regulatory history of conservative decisionmaking. The NRC has been intelligently using risk insights to help inform the regulatory process and has required improvements to the plant designs as we learn from operating experience. Some of these include severe accident management guidelines, revisions to the emergency operating procedures, procedures and processes for dealing with large fires and explosions regardless of the cause, and requirements for coping with station blackout.

The NRC's task force examining the accident at Fukushima Dai-ichi and its impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission) has concluded that continued operation and continued licensing activities do not pose an imminent risk to public health and safety.

U.S. Power Plants (General)

Q: *Why does the NRC not establish a 50-mile EPZ in the U.S. if this was the NRC's recommendation for the accident in Japan?*

A: The United States government cannot intervene in the management of events internal to another sovereign nation. The US government can only make recommendations to its citizens in that country on actions for their safety. The State Department routinely issues such recommendations (known as travelers warning and advisories) for many different types of events; civil unrest, terrorism, natural disasters and technological accidents. It is within this context that the Nuclear Regulatory Commission made a recommendation to the US Ambassador in Japan for protective actions for US citizens residing in the regions surrounding the damaged Fukushima Dai-ichi Nuclear Power Plant site.

The decision-making environment that existed at the time in which the NRC decision was made was one in which: there was limited and often conflicting information about the exact conditions of the reactors and spent fuel pools at the Fukushima nuclear facility immediately following the earthquake and tsunami; radiation monitors showed significantly elevated readings in some areas of the plant site which would challenge plant crews attempting to stabilize the plant; analysis results from offsite samples indicated that some fuel damage had occurred; there was a level of uncertainty about whether or not efforts to stabilize the plant in the very near term were going to be successful, and; changing meteorological conditions resulted in the winds shifting rapidly from blowing out to sea to blowing back onto land.

In its evaluation of the rapidly changing and unprecedented event, the NRC performed a series of dose calculations to assess a "worst case" scenario. This was a conservative calculation which considered the rapidly changing course of the events and the very real possibility that these events were going to continue to degrade. As a result of these calculations, the progression of events and the uncertainty regarding the plans to bring the situation under control, the decision was made to recommend the evacuation of US citizens out to 50 miles from the facility.

In the United States, the NRC has direct access to the plant site including the control room and any and all vital plant areas. The NRC maintains two resident inspectors at each plant who have unfettered access to the site. In addition, the NRC has required that direct communications links between the NRC Operations Center and the plant be installed, tested, and routinely exercised. These links provide NRC staff and the Executive team with up-to-date and reliable information about the ongoing events at the plant. In addition, the Chairman can order the plant to take actions to mitigate the event if the NRC does not believe that the appropriate actions are being taken by the plant operators.

In the U.S., there are two emergency planning zones (EPZ) established around a nuclear power plant. The first zone, the 10-mile EPZ, is where exposure from a radiological release event would likely be from the radioactive plume and it is in this EPZ where protective actions such as sheltering and/or evacuation would be appropriate. Beyond the 10-mile EPZ and out to the 50-mile EPZ is the ingestion exposure pathway where exposure to radionuclides would likely be from ingestion of contaminated food/milk and surface water. Comprehensive planning is performed for these zones and is routinely tested and evaluated by way of the full participation exercises. These zones are not limits but rather provide for a comprehensive emergency planning framework that would allow expansion of the response efforts beyond the zones should radiological conditions warrant such expansion. Nuclear power plant licensees are required to have an emergency plan for both the onsite and offsite response that has been evaluated and tested prior to obtaining an operating license and must conduct such exercises on a biennial cycle. The NRC remains confident that its current regulatory framework for emergency preparedness, including the establishment of an EPZ, and the flexibility to respond to emergent radiological conditions, as necessary, provides adequate protection for the health and safety of the public.

The NRC's Near-Term Task Force issued its report on July 12 and it is available to the public (ADAMS Accession No. ML111861807). On July 19, 2011, the Task Force presented its findings to the Commission and proposed improvements in multiple areas including emergency preparedness. The Task Force considered the existing planning structure, including the 10-mile plume exposure pathway and 50-mile ingestion pathway emergency planning zones, and found no basis to recommend a change. The development of protective action recommendations by the Japanese government, including expansion of evacuations out to 20 km (~12 miles) from the plant supported effective and timely evacuation to minimize the impact of the radiological releases on public health and safety. Subsequent decisions by the Government of Japan to evacuate selected areas based on potential long-term exposures are consistent with the U.S. strategy to expand protective actions during an event consistent with developments at the time and provided timely and effective actions to protect the public in those areas. Therefore, the Task Force found no basis to recommend changes to the emergency planning zones.

Generic Issues Program

Q: *Is the NRC relooking at seismic analysis for US plants?*

A: The ground motions that are used as seismic design bases at US nuclear plants are called the Safe Shutdown Earthquake ground motion (SSE). In the mid to late 1990s, the NRC staff reviewed the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE). From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review referred to as GI-199, "Implications of Updated Probabilistic Seismic Estimates in Central and Eastern United States on Existing Plants," to again assess the resistance of US nuclear plants to earthquakes. In addition, the NRC has been reviewing new seismic information regarding the plants in California for many years.

GI-199

Q: *What level of earthquake hazard are the US reactors designed for?*

A: Each reactor is designed for a different ground motion that is determined on a site-specific basis. The existing nuclear plants were designed on a "deterministic" or "scenario earthquake" basis that accounted for the largest earthquakes expected in the area around the plant, without consideration of the likelihood of the earthquakes considered. New reactors are designed using probabilistic techniques that characterize both the ground motion levels and uncertainty at the proposed site. These probabilistic techniques account for the ground motions that may result from all potential seismic sources in the region around the site. Technically speaking, this is the ground motion with an annual frequency of occurrence of 1x10-4/year, but this can be thought of as the ground motion that occurs every 10,000 years on average. One important aspect is that probabilistic hazard and risk-assessment techniques account for beyond-design basis events. NRC's Generic Issue 199 (GI-199) project is using the latest probabilistic techniques used for new nuclear plants to review the safety of the existing plants.

License Renewal

Q: *Do you expect that applications for reactor extensions or power uprates will be slowed because of this review? What about new reactor licenses?*

A: The NRC will continue to process existing applications for power uprates and license renewal applications in accordance with the schedules that have been established. The NRC continues to believe that its regulatory framework and requirements provide for a rigorous and comprehensive license review process that examines the full extent of siting, system design and operations of nuclear power plants. The recommendations of the NRC's task force that was established to examine lessons learned from the events in Japan will certainly be taken into account in the performance of the NRC's review of these applications, as appropriate. Further, the NRC has the necessary regulatory tools to require changes to existing licenses or applications for certification should the agency determine that changes are necessary.

Q: *How will the events in Japan affect license renewal for U.S. plants?*

A: The NRC's recently initiated review of U.S. plants will examine current practice at operating reactors to ensure proper actions will be taken if a severe event occurs – this covers plants regardless of where they are in their license lifetime. The events in Japan, based on what's known at this time, appear to be unrelated to issues examined in license renewal. The NRC's long-term review of its regulations will determine whether any revisions to license renewal reviews are necessary.

U.S. Power Plants (General)

Q: *How will the NRC consider the seismic risks in license renewal decision?*

A: The NRC's regulations for license renewal (10 CFR Part 54) require licensees to manage the age-related degradation of passive systems, structures, and components (SSCs) to ensure they will fulfill their safety-related functions, as specified in the current licensing basis, that will continue into the period of extended operation. A plant's licensing basis, including its seismic design basis, is established during initial plant licensing. The licensing basis dynamically evolves during subsequent license amendments and licensing actions, as new information and plant modifications are incorporated into the plant design and license. The NRC has multiple processes to evaluate the adequacy of current plant operations and licensing bases (e.g., Reactor Oversight Process, Generic Issues Program). If new information or operating experience warrants, the NRC will direct additional measures to maintain established safety thresholds commensurate with risk and safety benefit (e.g., require plant improvements through the backfit process). Any age-related degradation of SSCs in the application's aging management plan affected by seismic events will be evaluated by the applicant and reviewed by the NRC staff as part of the license renewal process.

Q: *Why do license renewal reviews not include a review of the plant's response to external events?*

A: The regulations stipulating the requirements associated with license renewal were issued via rulemaking in 1991 (54 FR 64943). As described in the Statement of Considerations (SOC) for this license renewal rule, the Commission determined that, with the exception of age-related degradation unique to license renewal, the NRC's existing regulatory process is adequate to ensure that the licensing bases of all currently operating plants provide and maintain an acceptable level of safety for operation. The Commission considered whether or not to include plant responses to external events that may be outside the licensing basis but reasoned that the existing regulatory process was sufficient to address those instances while at the same time avoiding duplicative and, perhaps, less efficient assessments. With this understanding, the Commission maintained that the focus of license application renewals should be limited to the age-related degradation management for systems, structures and components (SSCs) that are included in the scope of license renewal (e.g., important to safety, or whose failure could impact safety equipment). As a consequence, license renewal reviews consider applicant activities to detect, manage, and correct the effects of age-related materials degradation on SSCs to ensure that the functionality of safety equipment is not adversely impacted during the renewed license operating period.

Recent proceedings associated with Oyster Creek license renewal have reiterated the Commission's position that the NRC's comprehensive and ongoing oversight of licensed facilities will assure that useful data, operating experience, lessons learned, etc. will be absorbed by changes in NRC rules, orders, and license amendments, as needed, accompanied by the public participation required by statute and regulation. Therefore, plant response to external events will be reviewed when the need is identified, irrespective of the plant's status regarding license renewal (e.g., post-Fukushima review is being done for all plants, and actions will be taken and applied based on plant designs). The NRC has completed its near-term review of lessons learned from the events at Fukushima. The Commission is currently reviewing the report and will provide the staff with direction. Any changes will be applied to plants irrespective of whether a plant has a renewed license or not.

New Nuclear Power Plants

Q: *Will this incident affect new reactor licensing?*

A: The NRC will continue to process existing applications for new reactor licenses (i.e., early site permits, design certifications, and combined licenses) in accordance with the schedules that have been established. The NRC continues to believe that its regulatory framework and requirements provide for a rigorous and comprehensive license review process that examines the full extent of siting, system design and operations of nuclear power plants. The recommendations of the NRC's task force that was established to examine lessons learned from the events in Japan will certainly be taken into account in the performance of the NRC's review of these applications, as appropriate. Further, the NRC has the necessary regulatory tools to require changes to existing licenses or applications for certification should the agency determine that changes are necessary.

U.S. Power Plants (General)

Q: *With NRC moving to design certification, at what point is seismic capability tested – during design or modified to be site-specific? If in design, what strength seismic event must these be built to withstand?*

A: The regulations related to seismic requirements are contained in General Design Criterion 2 in Appendix A to Title 10 of the *Code of Federal Regulations*, Part 50.

During design certification, vendors propose a seismic design in terms of a ground motion spectrum for their nuclear facility. This spectrum is called a standard design response spectrum and is developed so that the proposed nuclear facility can be sited at most locations in the central and eastern United States. The vendors show that this design ground motion is suitable for a variety of different subsurface conditions such as hard rock, deep soil, or shallow soil over rock. Combined License and Early Site Permits applicants are required to develop a site specific ground motion response spectrum that takes into account all of the earthquakes in the region surrounding their site as well as the local site geologic conditions. Applicants estimate the ground motion from these postulated earthquakes to develop seismic hazard curves. These seismic hazard curves are then used to determine a site specific ground motion response spectrum that has a maximum annual likelihood of 1x10-4 of being exceeded. This can be thought of as a ground motion with a 10,000 year return period. This site specific ground motion response spectrum is then compared to the standard design response spectrum for the proposed design. If the standard design ground motion spectrum envelopes the site specific ground motion spectrum then the site is considered to be suitable for the proposed design. If the standard design spectrum does not completely envelope the site specific ground motion spectrum, then the COL applicant must do further detailed structural analysis to show that the design capacity is adequate. Margin beyond the standard design and site specific ground motions must also be demonstrated before fuel loading can begin.

Power Supplies

Q: *Are U.S. nuclear power plants designed for scenarios similar to what happened in Japan where all power to the reactors (i.e., both the power grid and emergency onsite power) was lost as a result of the earthquake and resultant tsunami?*

A: The NRC requires that all nuclear power plants are able to withstand a station blackout (SBO) - a complete loss of AC electric power to the station. These requirements are specified in 10 CFR 50.63, Loss of all alternating current power, and a more detailed definition is provided in 10 CFR 50.2, Definitions. The definition of coping is the time it takes until off site power is restored (i.e., the grid) or an emergency diesel generator, located either onsite or offsite, is restored to service. To meet this requirement, all nuclear power plants performed an SBO coping analysis that determined how long the plant could cope without AC power. The NRC has provided guidance for determining a plant specific SBO duration in Regulatory Guide 1.155, "Station Blaskout," (August 1988). In general, SBO durations range from 2 to 16 hours, though licensees may propose alternate durations based on specific factors relating to the offsite and onsite power characteristics. There are two methods of coping with an SBO event. They are either: (i) AC independent (i.e., relying on battery power), or; (ii) alternate AC (AAC).

AC independent plants had to satisfy all the requirements for maintaining a plant in a safe condition for maximum duration of 4 hours.

If the configuration of offsite power (i.e., the grid system), onsite power (i.e., emergency diesel generators) and reliability of these sources could be affected by weather related events, and if restoration of these sources was not possible within 4 hours, then plants had to use an alternate AC source (i.e, AAC). Some plants decided to comply with the SBO rule by using the AAC as they alreay that capability on their sites. Plants using an AAC source had a variable coping duration between 2 hours and 16 hours. This duration was subject to factors affecting the restoration of onsite or offsite power sources. The capablity for coping with an SBO of specified duration must be determined by a coping analysis for plants with an AC independent method (i.e., batteries) and for plants with an AAC if that source is not available within 10 minutes of the initiating event.

U.S. Power Plants (General)

Q: *What are US plants required to have for backup power?*

A: U.S. plants are required to meet General Design Criterion 17 in Appendix A to Title 10 of the *Code of Federal Regulations*, Part 50. Reactor units must have 2 independent power supplies. All U.S. plants, except one (i.e., Oconee), have diesel generators and battery backup systems. The remaining plant has a hydroelectric power facility for backup. Most of the U.S. plants with diesels have two diesels per unit and those that have only one dedicated diesel have a swing diesel available. The regulations do not specify the length of time that the diesels and batteries must operate following a loss of offsite power (most sites plan to run the diesels for multiple days and have battery backup capability for 8 hours). Instead the amount of time is dependent on the site recovery strategy and is based on providing sufficient capacity to assure that the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents.

Price-Anderson Act

Q: *Has Price-Anderson ever been used? UPDATED*

A: The Price-Anderson Act applies to any public liability arising from a nuclear incident. Perhaps the most notable example of Price-Anderson at work was the 1979 accident at the Three Mile Island Power Plant. The day after the accident, insurance company representatives established a local claims office in Pennsylvania. Advertisements were placed in local newspapers to inform residents of claims procedures. The insurance paid for the living expenses of families who decided to evacuate, although evacuation was not immediately ordered. When Pennsylvania's governor recommended the evacuation of pregnant women and families with young children who lived near the plant, the insurance paid for those evacuation expenses, too. In 1979, more than 3,000 people received nearly $1.2 million in evacuation claims. More than 600 people were also reimbursed for lost wages as a result of the accident. In the months after the accident, numerous lawsuits were filed alleging various injuries and property damages. To date, the Price-Anderson insurance has paid about $71 million in claims and litigation costs associated with the Three Mile Island accident. All payments were made from the primary insurance coverage. Money from the secondary layer of insurance was not needed.

Q: *I'll have to find another place to stay if I have to evacuate my home during a nuclear accident. I can't afford to pay for a hotel or apartment for several months while the government tries to clean things up. How am I supposed to pay for that?*

A: Insurance under the Price-Anderson Act covers bodily injury, sickness, disease or resulting death, property damage and loss, and reasonable living expenses for people who are evacuated from a nuclear accident. The Stafford Act is another federal law that provides disaster relief to state and local governments. If a nuclear accident is declared an emergency or major disaster by the President, the Stafford Act will also be available to provide assistance to accident victims. The Stafford Act allows the federal and state governments to share costs of temporary housing for up to 18 months. It also provides additional money for home repair and temporary mortgage or rental payments. Distribution of Stafford Act funding is done through the Federal Emergency Management Agency. Together, the Price-Anderson and Stafford Acts provide money for a variety of expenses following a nuclear accident.

Q: *More than a million people live within 50 miles of Plant X. How is a $375 million insurance policy supposed to cover all of us? UPDATED*

A: The Price-Anderson Act is a federal law that requires owners of nuclear power plants to purchase $375 million of offsite liability insurance for each reactor at the plant. If a nuclear accident causes damages of more than $375 million, the insurance is supplemented by additional coverage that is shared by every nuclear power plant in the country. There are currently 104 reactors licensed to operate in the United States, so this secondary pool of money contains about $12.2 billion . If all of this secondary money is used, Congress would determine whether to provide additional disaster relief.

Q: *My insurance agent said that my homeowner's insurance does not cover nuclear accidents. Does Price-Anderson protect me? UPDATED*

A: Your homeowner's insurance policy does not cover nuclear accidents because Price-Anderson covers claims related to nuclear accidents. By law, owners of nuclear power plants are required to purchase $375 million of offsite liability insurance for each reactor at the plant. If a nuclear accident causes damages of more than $375 million of primary financial protection, the insurance is supplemented by additional coverage that is shared by every nuclear power plant in the country. There are currently 104 reactors licensed to operate in the United States, so this secondary pool of money contains about $12.2 billion. If all of this secondary money is used, Congress would determine whether to provide additional disaster relief.

U.S. Power Plants (General)

Q: *My insurance company is a nationally known, reputable business that I trust. What insurance company does the nuclear plant use – a good one or the cheapest one they can find? UPDATED*

A: All U.S. nuclear power plant owners purchase their Price-Anderson insurance from American Nuclear Insurers (ANI), which is made of several large and reputable insurance companies. On average, a nuclear power plant owner pays about $820,000 per year for Price-Anderson insurance at a single-unit reactor site. For power plants with more than one reactor, the total annual insurance cost is typically discounted, similar to automobile insurance for households with more than one car.

Q: *The accidents in Japan affected the reactors and the spent fuel pools. Does the Price-Anderson Act cover all nuclear plant accidents or just some of them?*

A: The Price-Anderson Act covers all property and liability claims resulting from nuclear accidents at commercial nuclear power plants. This includes any incident related to the reactor or the spent fuel pool. Price-Andersen also covers claims related to transporting nuclear fuel and nuclear waste in and out of the plant.

Q: *The Price-Anderson Act is a federal law? Why does the government spend my tax dollars on providing nuclear insurance to big energy companies? UPDATED*

A: The Price-Anderson Act is a federal law, and nuclear power plants pay for the insurance required under the Act. The extra insurance protection required for large commercial nuclear power companies is purchased at no cost to the public or the federal government.

Q: *What is the Price-Anderson Act? UPDATED*

A: In 1957, a federal law called the Price-Anderson Act was established to ensure that adequate money would be available to pay insurance claims following an accident at a commercial nuclear power plant. That law is still in place to provide insurance to those that live around nuclear power plants.

Q: *When does the Price-Anderson Act expire?*

A: In 2005, the Price-Anderson Act was extended through December 31, 2025.

Q: *Why does the NRC let a private insurance company determine the amount of insurance coverage? Why does this private company control public protection? UPDATED*

A: Congress created the Price-Anderson Act to allow the government to regulate nuclear power safety while allowing the private insurance industry to provide financial protection. The NRC is responsible for ensuring that nuclear power plants are designed and operated in a way that protects public health and safety. Private market insurance capacity is not unlimited. However, the NRC is confident that existing private market capacity is adequate for most claims that could arise.

Radiation Protection

Q: *Why does the NRC not establish a 50-mile EPZ in the U.S. if this was the NRC's recommendation for the accident in Japan?*

A: The United States government cannot intervene in the management of events internal to another sovereign nation. The US government can only make recommendations to its citizens in that country on actions for their safety. The State Department routinely issues such recommendations (known as travelers warning and advisories) for many different types of events; civil unrest, terrorism, natural disasters and technological accidents. It is within this context that the Nuclear Regulatory Commission made a recommendation to the US Ambassador in Japan for protective actions for US citizens residing in the regions surrounding the damaged Fukushima Dai-ichi Nuclear Power Plant site.

The decision-making environment that existed at the time in which the NRC decision was made was one in which: there was limited and often conflicting information about the exact conditions of the reactors and spent fuel pools at the Fukushima nuclear facility immediately following the earthquake and tsunami; radiation monitors showed significantly elevated readings in some areas of the plant site which would challenge plant crews attempting to stabilize the plant; analysis results from offsite samples indicated that some fuel damage had occurred; there was a level of uncertainty about whether or not efforts to stabilize the plant in the very near term were going to be successful, and; changing meteorological conditions resulted in the winds shifting rapidly from blowing out to sea to blowing back onto land.

In its evaluation of the rapidly changing and unprecedented event, the NRC performed a series of dose calculations to assess a "worst case" scenario. This was a conservative calculation which considered the rapidly changing course of the events and the very real possibility that these events were going to continue to degrade. As a result of these calculations, the progression of events and the uncertainty regarding the plans to bring the situation under control, the decision was made to recommend the evacuation of US citizens out to 50 miles from the facility.

In the United States, the NRC has direct access to the plant site including the control room and any and all vital plant areas. The NRC maintains two resident inspectors at each plant who have unfettered access to the site. In addition, the NRC has required that direct communications links between the NRC Operations Center and the plant be installed, tested, and routinely exercised. These links provide NRC staff and the Executive team with up-to-date and reliable information about the ongoing events at the plant. In addition, the Chairman can order the plant to take actions to mitigate the event if the NRC does not believe that the appropriate actions are being taken by the plant operators.

In the U.S., there are two emergency planning zones (EPZ) established around a nuclear power plant. The first zone, the 10-mile EPZ, is where exposure from a radiological release event would likely be from the radioactive plume and it is in this EPZ where protective actions such as sheltering and/or evacuation would be appropriate. Beyond the 10-mile EPZ and out to the 50-mile EPZ is the ingestion exposure pathway where exposure to radionuclides would likely be from ingestion of contaminated food/milk and surface water. Comprehensive planning is performed for these zones and is routinely tested and evaluated by way of the full participation exercises. These zones are not limits but rather provide for a comprehensive emergency planning framework that would allow expansion of the response efforts beyond the zones should radiological conditions warrant such expansion. Nuclear power plant licensees are required to have an emergency plan for both the onsite and offsite response that has been evaluated and tested prior to obtaining an operating license and must conduct such exercises on a biennial cycle. The NRC remains confident that its current regulatory framework for emergency preparedness, including the establishment of an EPZ, and the flexibility to respond to emergent radiological conditions, as necessary, provides adequate protection for the health and safety of the public.

The NRC's Near-Term Task Force issued its report on July 12 and it is available to the public (ADAMS Accession No. ML111861807). On July 19, 2011, the Task Force presented its findings to the Commission and proposed improvements in multiple areas including emergency preparedness. The Task Force considered the existing planning structure, including the 10-mile plume exposure pathway and 50-mile ingestion pathway emergency planning zones, and found no basis to recommend a change. The development of protective action recommendations by the Japanese government, including expansion of evacuations out to 20 km (~12 miles) from the plant supported effective and timely evacuation to minimize the impact of the radiological releases on public health and safety. Subsequent decisions by the Government of Japan to evacuate selected areas based on potential long-term exposures are consistent with the U.S. strategy to expand protective actions during an event consistent with developments at the time and provided

timely and effective actions to protect the public in those areas. Therefore, the Task Force found no basis to recommend changes to the emergency planning zones.

Reactor Oversight

Q: *Why do license renewal reviews not include a review of the plant's response to external events?*

A: The regulations stipulating the requirements associated with license renewal were issued via rulemaking in 1991 (54 FR 64943). As described in the Statement of Considerations (SOC) for this license renewal rule, the Commission determined that, with the exception of age-related degradation unique to license renewal, the NRC's existing regulatory process is adequate to ensure that the licensing bases of all currently operating plants provide and maintain an acceptable level of safety for operation. The Commission considered whether or not to include plant responses to external events that may be outside the licensing basis but reasoned that the existing regulatory process was sufficient to address those instances while at the same time avoiding duplicative and, perhaps, less efficient assessments. With this understanding, the Commission maintained that the focus of license application renewals should be limited to the age-related degradation management for systems, structures and components (SSCs) that are included in the scope of license renewal (e.g., important to safety, or whose failure could impact safety equipment). As a consequence, license renewal reviews consider applicant activities to detect, manage, and correct the effects of age-related materials degradation on SSCs to ensure that the functionality of safety equipment is not adversely impacted during the renewed license operating period.

Recent proceedings associated with Oyster Creek license renewal have reiterated the Commission's position that the NRC's comprehensive and ongoing oversight of licensed facilities will assure that useful data, operating experience, lessons learned, etc. will be absorbed by changes in NRC rules, orders, and license amendments, as needed, accompanied by the public participation required by statute and regulation. Therefore, plant response to external events will be reviewed when the need is identified, irrespective of the plant's status regarding license renewal (e.g., post-Fukushima review is being done for all plants, and actions will be taken and applied based on plant designs). The NRC has completed its near-term review of lessons learned from the events at Fukushima. The Commission is currently reviewing the report and will provide the staff with direction. Any changes will be applied to plants irrespective of whether a plant has a renewed license or not.

Regulatory Requirements (US)

Q: *All the world's nuclear powers are reviewing the events at Fukushima. Is the NRC task force coordinating with any other countries to ensure a more consistent approach to lessons learned and potential need for additional regulations? UPDATED*

A: The NRC continues to interact with the international community through the International Atomic Energy Agency, the Nuclear Energy Agency, and other international bodies. The NRC supports ongoing discussions among the world's nuclear regulatory authorities with respect to lessons learned from the Fukushima accident. The NRC is focusing on where the insights from those interactions lead with respect to what can be learned for U.S. plants. The United States takes the position that nuclear safety is the responsibility of the sovereign nation, but that strong international cooperation among governments, industry, and multilateral organizations is essential.

U.S. Power Plants (General)

Q: *Has the NRC changed any regulatory requirements that are now in effect as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the US NRC has not changed any regulatory requirements as a result of the Fukushima Dai-ichi event. However, the US NRC has identified several technical and regulatory topics on which it intends to pursue improvement at US nuclear power plants without unnecessary delay. These topics include: (1) updated evaluation of seismic and flooding hazards; (2) improvements in licensee ability to cope with prolonged station blackout events; (3) protection of equipment potentially capable of mitigating multiunit, beyond design basis events from natural hazards; (3) improved reliability and effectiveness of boiling water reactor Mark I and Mark II containment venting systems; (4) installation of enhanced spent fuel pool monitoring instrumentation; (5) improved integration of emergency operating procedures, severe accident management guidelines, and extensive damage mitigation guidelines; and (6) enhancements to licensee emergency preparedness programs. The US NRC is following its regulatory process to develop the appropriate regulatory products, including request for information letters, orders, or changes to US NRC regulations, to address each of the technical or regulatory topics noted above. The US NRC has also identified other technical or regulatory topics for longer term action (see US NRC SECY-11-0137) and is considering other technical or regulatory topics related to lessons learned from the Fukushima Dai-ichi event which may be added to the list above.

Q: *Has the NRC required any physical plant changes that have already been made or installed at U.S. nuclear power plants (NPPs) as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the United States Nuclear Regulatory Commission (US NRC) has required no physical plant changes at NPPs in the US as a result of the Fukushima Dai-ichi event. The US NRC has taken several steps, however, to verify that licensees of US NPPs have equipment and procedures in place which may be useful in responding to be beyond design basis seismic or flooding events, large fires, explosions, or prolonged station blackout events. Such equipment has been installed at US facilities in response to, for example, US NRC requirements in Title 10 of the Code of Federal Regulations 50.54(hh) regarding the mitigation of significant plant damage due to aircraft impact. Following the event at Fukushima Dai-ichi, the NRC performed inspections, as addressed by US NRC Temporary Instruction 183 issued March 18, 2011, at all US NPPs to independently assess the ability of licensees to respond to beyond design basis events. In US NRC Bulletin 2011-01 dated May 11, 2011, the NRC has also required licensees to provide information to the NRC to confirm that NPP staff and equipment were capable of implementing the mitigative strategies which may be useful in responding to the aforementioned beyond design basis events.

Q: *How do we know that the spent fuel in pools at reactor sites is safe, in light of the knowledge of seismic risks?*

A: The agency continues to believe that spent fuel pools provide adequate protection of public health and safety. Over the course of many years, the NRC has taken advantage of the lessons learned from previous operating experience to implement a program of continuous improvement in the regulation of U.S. commercial nuclear reactors. This has included regular examination of topics related to spent fuel storage, as well as implementation of changes that have improved the safety of spent fuel pools. In addition, following the terrorist attacks of September 11, 2001, the NRC undertook an extensive re-examination of spent fuel pool safety and security. As a result of this reexamination, the Commission issued orders requiring licensees to implement additional strategies to keep spent fuel pools cool in the aftermath of a large explosion or fire at the plant. These requirements have since been incorporated into NRC regulations. The NRC's Japan Task Force has recommended the Commission consider additional enhancements to spent fuel pool makeup capability and instrumentation. As directed by the Commission, the NRC staff will implement any changes found to be appropriate to maintain the safety of spent fuel storage systems.

U.S. Power Plants (General)

Q: *The NRC has proposed recommendations regarding station blackout. Would NRC consider putting a hold on any changes to all plants for changes dealing with on-site power generation?*

A: The NRC requires that all nuclear power plants are able to withstand a station blackout (SBO) - a complete loss of AC electric power to the station. These requirements are specified in 10 CFR 50.63, Loss of all alternating current power, and in 10 CFR 50.2, Definitions. The NRC's Japan Task Force has recommended the agency use certain lessons learned from Fukushima to improve the NRC's regulatory framework. The Commission has noted that some Task Force's recommendations raise very complex technical and regulatory questions that will require significant analysis. Since the events in Japan continue to evolve, the NRC has used and will continue to use the analytical resources and stakeholder engagement capabilities of the agency to ensure the consideration of many issues. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth. Every U.S. reactor is designed for natural events based on the specific site where the reactor is located.

Research and Development

Q: *Does NRC have any research and development functions, especially in light of the events at Fukushima Dai-ichi Plant?*

A: The NRC's Office of Nuclear Regulatory Research (or RES), a major NRC program office, was mandated by Congress and created as part of the NRC in 1975. RES plans, recommends, and implements programs of nuclear regulatory research, standards development, and resolution of generic safety issues for nuclear power plants and other facilities regulated by the NRC. The Office coordinates research activities within and outside the agency, including NRC participation in national and international volunteer standards efforts. RES is responsible for developing methods, technical expertise and computer codes that are used by the NRC to assess safety and regulatory issues for materials licensees, fuel cycle facilities and operating reactors, as well as new and advanced reactor designs. RES develops the data needed to assess these codes by conducting experiments at national laboratories, universities, or in collaboration with international organizations.

The NRC regulatory research program addresses issues concerning nuclear reactors, nuclear materials, and radioactive waste. The research program is designed to improve the agency's knowledge where uncertainty exists, where safety margins are not well-characterized, and where regulatory decisions need to be confirmed in existing or new designs and technologies.

Q: *How are the research activities conducted and coordinated at the NRC?*

A: NRC's Office of Research (RES) coordinates research activities with the other NRC program offices, as appropriate, and leads the agency's initiative for cooperative research with the U.S. Department of Energy (DOE) and other Federal agencies, the domestic nuclear industry, U.S. universities, and international partners. RES coordinates the development of consensus and voluntary standards for agency use, including appointment of agency staff to various standards committees. Based on research results and experience gained, RES works with the regulatory offices to develop appropriate regulatory actions to resolve potential safety issues for nuclear power plants and other facilities regulated by the NRC, including those issues designated as Generic Issues (GIs). GIs are technical or security issues that could impact two or more facilities or licensees. RES also develops the technical basis for those areas regulated by the NRC that have risk-informed, performance-based regulations.

RES supplies technical tools, analytical models, and experimental data needed to support the agency's regulatory decisions. RES does not conduct research for the primary purpose of developing improved technologies. That is more appropriately done by the Department of Energy or the nuclear industry. Rather, the NRC conducts research to confirm that the methods and data generated by the industry ensure that adequate safety margin is maintained.

RES activities support regulation of the commercial use of radioactive materials to protect public health and safety and to protect the environment. RES is also responsible for providing the technical basis for regulations to ensure the protection and safeguarding of nuclear materials and nuclear power plants in the interest of national security. Thus, while its primary focus is on supporting the licensing and regulatory process, the research conducted by and for the NRC plays an important role in supporting broad government-wide initiatives associated with national security.

U.S. Power Plants (General)

Q: *Is the NRC involved in research and development of new electric generation technologies? Is the NRC to taking action to ensure a robust fuel mix portfolio including nuclear power?*

A: The NRC plays no role in the promotion and research of energy technologies, including nuclear power. The Energy Reorganization Act of 1974 divided the former Atomic Energy Commission into the Energy Research and Development Administration, which later became the U.S. Department of Energy (DOE) and the NRC. DOE's mission is to perform research and development activities in support of a national goal of energy independence, whereas NRC's mission is to regulate the nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, to promote the common defense and security, and to protect the environment.

Severe Accidents

Q: *Could there be core damage and radiation release at a U.S. plant if a natural disaster exceeding the plant design were to occur?*

A: U.S. nuclear power plants are built to withstand external hazards, including earthquakes, tsunamis, and flooding, as appropriate. The NRC has made substantial effort over time to ensure that vulnerabilities to both internal and external hazards were considered and mitigated in the plant current design and licensing basis of its regulated facilities. In 1988, the NRC's Generic Letter (GL) No. 88-20, "Individual Plant Examination [IPE] for Severe Accident Vulnerabilities," requested plant owners to perform a systematic evaluation of plant-specific vulnerabilities and report the results to the Commission. For many plants, the IPEs became the basis for the plant's initial Probabilistic Risk Assessment (PRA). Later the NRC issued Supplement 4 to GL 88-20, that requested licensees to evaluate vulnerabilities to external events (IPEEE). Most licensees made improvements to their facilities to reduce vulnerabilities identified in their IPEs and IPEEEs.

The ground motions that are used as seismic design bases at US nuclear plants are called the Safe Shutdown Earthquake (SSE) ground motions. In the 1990s, the NRC staff reviewed the potential for ground motions beyond the design basis as part of the Individual Plant Examination of External Events (IPEEE). From this review, the staff determined that seismic designs of operating nuclear plants in the US have adequate safety margins for withstanding earthquakes. Currently, the NRC is in the process of conducting a generic review (i.e., GI-199) to again assess the resistance of US nuclear plants to earthquakes. Based on NRC's preliminary analyses to date, the average probability of ground motions exceeding the SSE over the life of the plant for the plants in the Central and Eastern United States is less than about 1%. It is important to remember that structures, systems and components are required to have "adequate margin," meaning that they must continue be able withstand shaking levels that are above the plant's design basis.

Q: *Do U.S. nuclear plants have better capabilities to respond to natural disasters than the plants in Japan?*

A: The NRC is not yet aware of all of the differences that may exist between the reactors that are of similar design and vintage as those operated in the U.S. Many improvements have been made to U.S boiling water reactors (BWRs). For example, NRC Generic Letter 89-16, "Installation of a Hardened Wetwell Vent," conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn't have an existing strengthened or "hardened" pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen that could be generated by damaged fuel, as may occur during severe accidents. U.S. nuclear power plants are built to withstand external hazards, including earthquakes tsunamis, and flooding, as appropriate. In addition to the design of the plants, significant effort goes into emergency response planning, preparation, and training. The NRC has also completed substantial research and analysis that resulted in the development and use of severe accident management guidelines. These insights have informed our decision making and review of licensed activities.

U.S. Power Plants (General)

Q: *How do we know that the spent fuel in pools at reactor sites is safe, in light of the knowledge of seismic risks?*

A: The agency continues to believe that spent fuel pools provide adequate protection of public health and safety. Over the course of many years, the NRC has taken advantage of the lessons learned from previous operating experience to implement a program of continuous improvement in the regulation of U.S. commercial nuclear reactors. This has included regular examination of topics related to spent fuel storage, as well as implementation of changes that have improved the safety of spent fuel pools. In addition, following the terrorist attacks of September 11, 2001, the NRC undertook an extensive re-examination of spent fuel pool safety and security. As a result of this reexamination, the Commission issued orders requiring licensees to implement additional strategies to keep spent fuel pools cool in the aftermath of a large explosion or fire at the plant. These requirements have since been incorporated into NRC regulations. The NRC's Japan Task Force has recommended the Commission consider additional enhancements to spent fuel pool makeup capability and instrumentation. As directed by the Commission, the NRC staff will implement any changes found to be appropriate to maintain the safety of spent fuel storage systems.

Q: *The NRC has proposed recommendations regarding station blackout. Would NRC consider putting a hold on any changes to all plants for changes dealing with on-site power generation?*

A: The NRC requires that all nuclear power plants are able to withstand a station blackout (SBO) - a complete loss of AC electric power to the station. These requirements are specified in 10 CFR 50.63, Loss of all alternating current power, and in 10 CFR 50.2, Definitions. The NRC's Japan Task Force has recommended the agency use certain lessons learned from Fukushima to improve the NRC's regulatory framework. The Commission has noted that some Task Force's recommendations raise very complex technical and regulatory questions that will require significant analysis. Since the events in Japan continue to evolve, the NRC has used and will continue to use the analytical resources and stakeholder engagement capabilities of the agency to ensure the consideration of many issues. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth. Every U.S. reactor is designed for natural events based on the specific site where the reactor is located.

Spent Fuel

Q: *Are the spent fuel pools at U.S. plants cooled by safety-related cooling systems at [Plant XYZ]?*

A: Whether the spent fuel pool cooling system is "safety-related" at a particular plant depends on the plants specific accident analysis. Each plant's spent fuel pool cooling system is designed to provide cooling for both normal and accident conditions.

Q: *Do U.S. nuclear power plants store their fuel above grade? Why is this considered safe?*

A: For boiling water reactor (BWR) Mark I and II designs, the spent fuel pool structures are located in the reactor building at an elevation several stories above the ground (about 50 to 60 feet above ground for the Mark I reactors). The spent fuel pools at other operating reactors in the U.S. are typically located with the bottom of the pool at or below plant grade level. Regardless of the location of the pool, its robust construction provides the potential for the structure to withstand events well beyond those considered in the original design. In addition, there are multiple means of restoring water to the spent fuel pools in the unlikely event that any is lost.

Q: *How are spent fuel pools kept cool? What happens if the cooling system fails?*

A: The spent fuel pool is cooled by an attached cooling system. The system keeps fuel temperatures low enough that, even if cooling were lost, operators would have substantial time to recover cooling before boiling could occur in the spent fuel pool. Licensees also have backup means to cool the spent fuel pool, using temporary equipment that would be available even after fires, explosions, or other unlikely events that could damage large portions of the facility and prevent operation of normal cooling systems. Operators have been trained to use this backup equipment, and it has been evaluated to provide adequate cooling even if the pool structure loses its water-tight integrity.

U.S. Power Plants (General)

Q: *How can operators get water back in the pool if there is a leak or a failure?*

A: All plants have systems available to replace water that could evaporate or leak from a spent fuel pool. Most plants have at least one system designed to be available following a design basis earthquake. In addition, the industry's experience indicates that systems not specifically designed to meet seismic criteria are likely to survive a design basis earthquake and be available to replenish water to the spent fuel pools. Furthermore, plant operators can use emergency and accident procedures that identify temporary systems to provide water to the spent fuel pool if normal systems are unavailable. In some cases, operators would need to connect hoses or install short pipes between systems. The fuel is unlikely to become uncovered rapidly because of the large water volume in the pool, the robust design of the pool structure, and the limited paths for loss of water from the pool.

Q: *How do we know that the spent fuel in pools at reactor sites is safe, in light of the knowledge of seismic risks?*

A: The agency continues to believe that spent fuel pools provide adequate protection of public health and safety. Over the course of many years, the NRC has taken advantage of the lessons learned from previous operating experience to implement a program of continuous improvement in the regulation of U.S. commercial nuclear reactors. This has included regular examination of topics related to spent fuel storage, as well as implementation of changes that have improved the safety of spent fuel pools. In addition, following the terrorist attacks of September 11, 2001, the NRC undertook an extensive re-examination of spent fuel pool safety and security. As a result of this reexamination, the Commission issued orders requiring licensees to implement additional strategies to keep spent fuel pools cool in the aftermath of a large explosion or fire at the plant. These requirements have since been incorporated into NRC regulations. The NRC's Japan Task Force has recommended the Commission consider additional enhancements to spent fuel pool makeup capability and instrumentation. As directed by the Commission, the NRC staff will implement any changes found to be appropriate to maintain the safety of spent fuel storage systems.

Q: *How long are ISFSIs at U.S. plants good for (or "designed for")? What kind of analysis does NRC do to support extending their licenses?*

A: Utilities can apply for a site specific license under 10 CFR 72.42 or a general license under 10 CFR 72.212. The general license limits storage of spent fuel in casks that have been pre-approved for use by the NRC. In both cases the NRC's regulations provide for an initial 20-year license term for ISFSI licenses. License renewals are submitted with information consistent with the original license and the NRC staff reviews this information for continued acceptability. Site specific renewals can be requested for a time period chosen and justified by the licensee. License renewals under the general license are limited to 20 years for each renewal application.

BACKGROUND:

[The NRC issued a renewed license in December 2004 for the Surry ISFSI for a 40-year renewal term, through an exemption (ML043430234). In March 2005, NRC also granted a 40-year renewal period for the H.B. Robinson ISFSI (ML050890357).]

U.S. Power Plants (General)

Q: *Is the NRC going to make changes to spent fuel storage/safety requirements in light of the Japanese events (including possibly requiring spent fuel to be transferred to dry cask storage after a certain period of time)? UPDATED*

A: The NRC continues to believe that U.S. nuclear power plants, including their spent fuel storage facilities, can and do operate safely. Following the events in Japan, the Commission directed the staff to establish a senior level task to conduct a methodical and systematic review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and make recommendations to the Commission for its policy direction. The task force has completed its near-term review and has recommended that the NRC require licensees to install instrumentation in the spent fuel pools to monitor key parameters, to provide safety-related AC electrical power for the spent fuel makeup system, and to have installed a seismically qualified means to spray water into the spent fuel pools. The task force was silent on whether to accelerate spent fuel transfers to dry cask storage.

The NRC staff is implementing that recommendation, which will lead to licensees installing instrumentation in their spent fuel pools. The NRC staff is also planning to implement the remaining two items, providing safety-related AC electrical power for the spent fuel makeup system and installing a seismically qualified means to spray water into the spent fuel pools.

BACKGROUND:

[In Staff Requirements Memorandum (SRM-SECY 09-0090) issued in September 2010, the Commission approved revisions to the draft final rule on nuclear waste confidence and directed the staff to initiate a long-term rulemaking to address impacts of storage of spent fuel at onsite storage facilities, offsite storage facilities or both for extended periods. The Commission affirmed its confidence that spent nuclear fuel can be stored safely and securely without significant environmental impacts for at least 60 years after operation at any nuclear power plant either in the SFP or either onsite or offsite ISFSIs. Prior to the events in Japan, the staff provided a proposed plan for the long-term update to the Waste Confidence Rule (10 CFR 51.23) to the Commission in SECY-11-0029 which may be accessed at the following link:http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2011/2011-0029scy.pdf.

Following the events in Japan, the Commission directed the staff to establish a senior level task to conduct a methodical and systematic review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and make recommendations to the Commission for its policy direction. This direction is provided in tasking memorandum (COMSECY-COMGBJ-11-0002 which may be accessed at the following link:http://www.nrc.gov/reading-rm/doc-collections/commission/comm-secy/2011/2011-0002comgbj-srm.pdf. The task force will provide briefings to the Commission on a 30-day quick look report, a 60-day status of the ongoing near term review, and a 90-day completion of near term review. The task force has completed its near term review. Its report is available on the NRC homepage, www.nrc.gov.]

Q: *What amount of fuel was originally intended for spent fuel pool storage when the plants in the U.S. were initially licensed (and for how long)?*

A: The amount of fuel that can be stored in a spent fuel pool is governed by each plants' Technical Specifications. The original limit, as well as any increases to the limit are reviewed by the NRC on a plant-specific basis. The spent fuel may be stored in the pool for the duration of the license, including the time taken to decommission the plant.

BACKGROUND:

[Most spent fuel pools at U.S. nuclear power plants were not originally designed to have a storage capacity for all the spent fuel generated by their reactors. Depending upon when a plant was licensed, long-term planning for the spent fuel considered either reprocessing or shipment to a geologic repository. Since reprocessing or storage in a geologic repository are not currently an available option, nuclear power plant licensees have had to employ other options such as increasing the capacity of the spent fuel pool or an independent spent fuel storage installation. Either of these options would receive NRC review and approval prior to use.]

Q: *What is the corresponding radiological risk to that amount of fuel, should there be a fuel pool event. Is that factored into the licensee's emergency planning?*

A: The Final Safety Analysis Report (FSAR) for each plant analyzes a spectrum of accidents, including those that could occur in the spent fuel pool. These analyses are reviewed by the NRC to ensure that they demonstrate that any postulated radiological release would be below regulatory limits. These limits are selected to protect the public health and safety.

A licensee's emergency plan is symptom based to deal with any radiological hazard that could occur onsite. Regardless of the source, it is designed to ensure that appropriate protective actions are taken onsite and appropriate protective actions are recommended offsite.

Q: *What keeps spent fuel from re-starting a nuclear chain reaction in the pool?*

A: Spent fuel pools are designed with appropriate space between fuel assemblies and neutron-absorbing plates attached to the storage rack between each fuel assembly. Under normal conditions, these design features mean that there is substantial margin to prevent criticality (i.e., a condition where nuclear fission would become self-sustaining). Calculations demonstrate that some margin to criticality is maintained for a variety of abnormal conditions, including fuel handling accidents involving a dropped fuel assembly.

Q: *What would happen to a spent fuel pool during an earthquake? How can I be sure the pool wouldn't be damaged?*

A: All spent fuel pools are designed to seismic standards consistent with other important safety-related structures on the site. The pool and its supporting systems are located within structures that protect against natural phenomena and flying debris. The pools' thick walls and floors provide structural integrity and further protection of the fuel from natural phenomena and debris. In addition, the deep water above the stored fuel (typically more than 20 feet above the top of the spent fuel rods) would absorb the energy of debris that could fall into the pool. Finally, the racks that support the fuel are designed to keep the fuel in its designed configuration after a seismic event.

Station Blackout

Q: *Are U.S. nuclear power plants designed for scenarios similar to what happened in Japan where all power to the reactors (i.e., both the power grid and emergency onsite power) was lost as a result of the earthquake and resultant tsunami?*

A: The NRC requires that all nuclear power plants are able to withstand a station blackout (SBO) - a complete loss of AC electric power to the station. These requirements are specified in 10 CFR 50.63, Loss of all alternating current power, and a more detailed definition is provided in 10 CFR 50.2, Definitions. The definition of coping is the time it takes until off site power is restored (i.e., the grid) or an emergency diesel generator, located either onsite or offsite, is restored to service. To meet this requirement, all nuclear power plants performed an SBO coping analysis that determined how long the plant could cope without AC power. The NRC has provided guidance for determining a plant specific SBO duration in Regulatory Guide 1.155, "Station Blaskout," (August 1988). In general, SBO durations range from 2 to 16 hours, though licensees may propose alternate durations based on specific factors relating to the offsite and onsite power characteristics. There are two methods of coping with an SBO event. They are either: (i) AC independent (i.e., relying on battery power), or; (ii) alternate AC (AAC).

AC independent plants had to satisfy all the requirements for maintaining a plant in a safe condition for maximum duration of 4 hours.

If the configuration of offsite power (i.e., the grid system), onsite power (i.e., emergency diesel generators) and reliability of these sources could be affected by weather related events, and if restoration of these sources was not possible within 4 hours, then plants had to use an alternate AC source (i.e, AAC). Some plants decided to comply with the SBO rule by using the AAC as they alreay that capability on their sites. Plants using an AAC source had a variable coping duration between 2 hours and 16 hours. This duration was subject to factors affecting the restoration of onsite or offsite power sources. The capablity for coping with an SBO of specified duration must be determined by a coping analysis for plants with an AC independent method (i.e., batteries) and for plants with an AAC if that source is not available within 10 minutes of the initiating event.

U.S. Power Plants (General)

Q: *The NRC has proposed recommendations regarding station blackout. Would NRC consider putting a hold on any changes to all plants for changes dealing with on-site power generation?*

A: The NRC requires that all nuclear power plants are able to withstand a station blackout (SBO) - a complete loss of AC electric power to the station. These requirements are specified in 10 CFR 50.63, Loss of all alternating current power, and in 10 CFR 50.2, Definitions. The NRC's Japan Task Force has recommended the agency use certain lessons learned from Fukushima to improve the NRC's regulatory framework. The Commission has noted that some Task Force's recommendations raise very complex technical and regulatory questions that will require significant analysis. Since the events in Japan continue to evolve, the NRC has used and will continue to use the analytical resources and stakeholder engagement capabilities of the agency to ensure the consideration of many issues. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth. Every U.S. reactor is designed for natural events based on the specific site where the reactor is located.

Statutory Responsibility

Q: *Does NRC have any research and development functions, especially in light of the events at Fukushima Dai-ichi Plant?*

A: The NRC's Office of Nuclear Regulatory Research (or RES), a major NRC program office, was mandated by Congress and created as part of the NRC in 1975. RES plans, recommends, and implements programs of nuclear regulatory research, standards development, and resolution of generic safety issues for nuclear power plants and other facilities regulated by the NRC. The Office coordinates research activities within and outside the agency, including NRC participation in national and international volunteer standards efforts. RES is responsible for developing methods, technical expertise and computer codes that are used by the NRC to assess safety and regulatory issues for materials licensees, fuel cycle facilities and operating reactors, as well as new and advanced reactor designs. RES develops the data needed to assess these codes by conducting experiments at national laboratories, universities, or in collaboration with international organizations.

The NRC regulatory research program addresses issues concerning nuclear reactors, nuclear materials, and radioactive waste. The research program is designed to improve the agency's knowledge where uncertainty exists, where safety margins are not well-characterized, and where regulatory decisions need to be confirmed in existing or new designs and technologies.

Q: *Is the NRC involved in research and development of new electric generation technologies? Is the NRC to taking action to ensure a robust fuel mix portfolio including nuclear power?*

A: The NRC plays no role in the promotion and research of energy technologies, including nuclear power. The Energy Reorganization Act of 1974 divided the former Atomic Energy Commission into the Energy Research and Development Administration, which later became the U.S. Department of Energy (DOE) and the NRC. DOE's mission is to perform research and development activities in support of a national goal of energy independence, whereas NRC's mission is to regulate the nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, to promote the common defense and security, and to protect the environment.

U.S. Response (Immediate actions at U.S. reactors)

Q: *All the world's nuclear powers are reviewing the events at Fukushima. Is the NRC task force coordinating with any other countries to ensure a more consistent approach to lessons learned and potential need for additional regulations? UPDATED*

A: The NRC continues to interact with the international community through the International Atomic Energy Agency, the Nuclear Energy Agency, and other international bodies. The NRC supports ongoing discussions among the world's nuclear regulatory authorities with respect to lessons learned from the Fukushima accident. The NRC is focusing on where the insights from those interactions lead with respect to what can be learned for U.S. plants. The United States takes the position that nuclear safety is the responsibility of the sovereign nation, but that strong international cooperation among governments, industry, and multilateral organizations is essential.

U.S. Power Plants (General)

Q: *Based on the information that has been learned so far about the reactors and spent fuel at Fukushima, has the NRC task force identified any technical areas or issues that it is focusing on for lessons learned or additional NRC action? UPDATED*

A: It is important to note that the NRC Near-Term Task Force's work reinforces the NRC's confidence in the continued safety and emergency planning for U.S. nuclear power plants. The task force found that the operating nuclear power plants are protected against low likelihood severe natural phenomena and have accident mitigation capabilities such that continued operation poses no imminent risk to public health and safety.

The task force has completed its near-term analysis of the events and their impact on U.S. plants. The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:

-Reevaluate seismic and flooding hazards

-Perform seismic and flooding hazard walkdowns

-Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO

-Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena

-Strengthen and integrate onsite emergency response capabilities

-Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO

-Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)

-Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:

-Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)

-Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:

-Ten-year confirmation of seismic and flooding hazards

-Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods

-Reliable hardened vents for other containment designs

-Hydrogen control and mitigation inside containment or in other buildings

-Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events

-EP topics for decision-making, radiation monitoring, and public education

U.S. Power Plants (General)

-Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework

-Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The agency's long-term analysis and implementation is now underway.

Q: *Has the NRC changed any regulatory requirements that are now in effect as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the US NRC has not changed any regulatory requirements as a result of the Fukushima Dai-ichi event. However, the US NRC has identified several technical and regulatory topics on which it intends to pursue improvement at US nuclear power plants without unnecessary delay. These topics include: (1) updated evaluation of seismic and flooding hazards; (2) improvements in licensee ability to cope with prolonged station blackout events; (3) protection of equipment potentially capable of mitigating multiunit, beyond design basis events from natural hazards; (3) improved reliability and effectiveness of boiling water reactor Mark I and Mark II containment venting systems; (4) installation of enhanced spent fuel pool monitoring instrumentation; (5) improved integration of emergency operating procedures, severe accident management guidelines, and extensive damage mitigation guidelines; and (6) enhancements to licensee emergency preparedness programs. The US NRC is following its regulatory process to develop the appropriate regulatory products, including request for information letters, orders, or changes to US NRC regulations, to address each of the technical or regulatory topics noted above. The US NRC has also identified other technical or regulatory topics for longer term action (see US NRC SECY-11-0137) and is considering other technical or regulatory topics related to lessons learned from the Fukushima Dai-ichi event which may be added to the list above.

Q: *Has the NRC required any physical plant changes that have already been made or installed at U.S. nuclear power plants (NPPs) as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the United States Nuclear Regulatory Commission (US NRC) has required no physical plant changes at NPPs in the US as a result of the Fukushima Dai-ichi event. The US NRC has taken several steps, however, to verify that licensees of US NPPs have equipment and procedures in place which may be useful in responding to be beyond design basis seismic or flooding events, large fires, explosions, or prolonged station blackout events. Such equipment has been installed at US facilities in response to, for example, US NRC requirements in Title 10 of the Code of Federal Regulations 50.54(hh) regarding the mitigation of significant plant damage due to aircraft impact. Following the event at Fukushima Dai-ichi, the NRC performed inspections, as addressed by US NRC Temporary Instruction 183 issued March 18, 2011, at all US NPPs to independently assess the ability of licensees to respond to beyond design basis events. In US NRC Bulletin 2011-01 dated May 11, 2011, the NRC has also required licensees to provide information to the NRC to confirm that NPP staff and equipment were capable of implementing the mitigative strategies which may be useful in responding to the aforementioned beyond design basis events.

Q: *Have the owners or operators of U.S. nuclear power plants made any physical changes to the plants as a result of Fukushima? Please describe the changes. NEW!*

A: In response to the findings from our post-Fukushima inspections, licensees have undertaken efforts to correct any NRC-identified deficiencies at their plants. However, as of Dec. 6, 2011 the NRC is not aware of any significant plant modifications made by US licensees as a result of lessons-learned from the Fukushima Dai-ichi event. Nevertheless, US licenses are taking actions individually and collectively through the efforts of organizations such as the Institute for Nuclear Power Operations (INPO), the Nuclear Energy Institute (NEI) and the Electric Power Research Institute (EPRI) to identify facility modifications which would improve overall US NPP safety in relation to beyond design basis events.

U.S. Power Plants (General)

Q: *How will the U.S. learn from the failures at the Japanese reactors? UPDATED*

A: The NRC is learning from the events at the Japanese reactors through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC issued an information notice to inform licensees about the effects of the earthquake on nuclear power plants in Japan. In addition, the NRC's staff at every reactor site have performed targeted inspections to confirm facility responses to beyond design-basis events. The NRC has also issued Bulletin 2011-01 that requires all licensees to verify under oath and affirmation that their mitigation strategies and capabilities are in compliance with relevant NRC regulations.

In addition, the NRC established both short- and long-term analysis of the lessons that can be learned from the situation in Japan. The short-term review has been completed. The Near-Term Task Force provided its recommendations to the Commission in July 2011. Since then, the NRC staff has provided the Commission with those recommendations from the Near-Term Task Force Report that could be implemented without delay as well as the prioritization of the remaining items. The Commission has directed the staff to proceed on the recommendations that can be implemented without delay and on certain of the remaining recommendations. The agency's long-term analysis and implementation is now underway.

Q: *What has the NRC task force learned from the targeted inspections performed at U.S. nuclear power plants in response to the events at Fukushima?*

A: The task force has completed its near-term review and concluded that continued operation and continued licensing activities do not pose an imminent risk to public health and safety. The task force made several recommendations in its report, such as evaluating seismic and flooding protection at plants, ensuring that existing mitigation equipment is stored in areas that are protected from severe flooding, and strengthening emergency plan staffing and facilities to address multi-unit events.

Based on the targeted inspections performed in response to Temporary Instructions 2515/183, none of the observations made by the NRC inspectors posed a significant safety issue. Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant. In summary, observations were made that there were discrepancies in terms of procedures, equipment, and training. The detailed inspection reports for these inspections are available at the NRC's public webpage at the following link: http://www.nrc.gov/japan/japan-activities.html.

Q: *What is the Japan Lessons-Learned Project Directorate? NEW!*

A: The Japan Lessons-Learned Project Directorate is the staff-level project management organization responsible, along with its Steering Committee and line organizations and other supporting bodies, for implementing the Commission's direction on the Near-Team Task Force Report recommendations. The charter for the agency's implementation of the Near Term Task Force (NTTF) recommendations was recently approved by the Commission. The charter outlines an organization structure consisting of a Steering Committee, the Japan Lessons-Learned Project Directorate (JLD), the line organizations, and other support bodies responsible for implementing the Commission's direction on the NTTF recommendations.

U.S. Power Plants (General)

Q: *What short-term and long-term actions to ensure the safety of the U.S. operating nuclear power plants is the NRC taking in response to the events at the Japanese nuclear power plants at Fukushima Dai-ichi? UPDATED*

A: Shortly after the March 11, 2011, earthquake and tsunami and the resulting crisis at the Japanese Fukushima Dai-ichi nuclear power plant, the NRC launched a review of U.S. nuclear power plant safety. The NRC is addressing the applicability of the events in Japan to US plants through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC issued four documents that had immediate applicability to the operating reactors:

- Information Notice 2011-05 provided information to licensees on the effects of the earthquake and resultant tsunami on the Fukushima Dai-ichi nuclear power station in Japan.

- Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant.

- Temporary Instruction 2515/184 provided instructions for NRC inspectors to determine: (i) that the severe accident management guidelines (SAMGs) are available and how they are being maintained, and (ii) the nature and extent of licensee implementation of SAMG training and exercises.

- Bulletin 2011-01 required all holders of operating licenses for nuclear power reactors to provide a comprehensive verification of their compliance with the regulatory requirements in 10 CFR 50.54(hh) associated with mitigating strategies for beyond design basis events.

In addition, the NRC's Near-Term Task Force was established to (1) conduct a systematic and methodical review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and (2) make recommendations to the Commission for its policy direction. The Near-Term Task Force, made up of senior managers and staff with relevant experience, conducted a short-term review of the lessons that can be learned from the situation in Japan, and issued its report on July 12, 2011. The task force's report is available to the public (ADAMS Accession No. ML111861807). On July 19, 2011, the Task Force presented its findings to the Commission and proposed improvements in areas ranging from loss of power to earthquakes, flooding, spent fuel pools, venting and emergency preparedness.

On October 18, 2011, the Commission directed the staff to begin actions on the NTTF recommendations that the staff proposed should be initiated without delay. For each of the NTTF recommendations approved for near-term action, NRC staff will be responsible for engaging external stakeholders for the purpose of developing the technical and regulatory basis necessary to implement the NTTF recommendation. Once a sound technical and regulatory basis exists, the development of appropriate regulatory implementation tools, such as orders, 50.54(f) letters, and rules, can proceed.

The Commission has directed staff to strive to complete and implement the lessons-learned from the Fukushima accident within five years—by 2016. In order to succeed, the staff will be challenged to develop creative and flexible performance-based requirements intended to enhance nuclear safety with proper consideration of the beyond design basis nature of the events. A key aspect of this effort will be early and frequent interaction with external stakeholders to determine the appropriate acceptance criteria.

U.S. Power Plants (General)

U.S. Response (Long-term actions at U.S. reactors)

Q: *All the world's nuclear powers are reviewing the events at Fukushima. Is the NRC task force coordinating with any other countries to ensure a more consistent approach to lessons learned and potential need for additional regulations? UPDATED*

A: The NRC continues to interact with the international community through the International Atomic Energy Agency, the Nuclear Energy Agency, and other international bodies. The NRC supports ongoing discussions among the world's nuclear regulatory authorities with respect to lessons learned from the Fukushima accident. The NRC is focusing on where the insights from those interactions lead with respect to what can be learned for U.S. plants. The United States takes the position that nuclear safety is the responsibility of the sovereign nation, but that strong international cooperation among governments, industry, and multilateral organizations is essential.

U.S. Power Plants (General)

Q: *Based on the information that has been learned so far about the reactors and spent fuel at Fukushima, has the NRC task force identified any technical areas or issues that it is focusing on for lessons learned or additional NRC action? UPDATED*

A: It is important to note that the NRC Near-Term Task Force's work reinforces the NRC's confidence in the continued safety and emergency planning for U.S. nuclear power plants. The task force found that the operating nuclear power plants are protected against low likelihood severe natural phenomena and have accident mitigation capabilities such that continued operation poses no imminent risk to public health and safety.

The task force has completed its near-term analysis of the events and their impact on U.S. plants. The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:

-Reevaluate seismic and flooding hazards

-Perform seismic and flooding hazard walkdowns

-Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO

-Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena

-Strengthen and integrate onsite emergency response capabilities

-Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO

-Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)

-Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:

-Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)

-Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:

-Ten-year confirmation of seismic and flooding hazards

-Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods

-Reliable hardened vents for other containment designs

-Hydrogen control and mitigation inside containment or in other buildings

-Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events

-EP topics for decision-making, radiation monitoring, and public education

U.S. Power Plants (General)

-Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework

-Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The agency's long-term analysis and implementation is now underway.

Q: *Has the NRC changed any regulatory requirements that are now in effect as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the US NRC has not changed any regulatory requirements as a result of the Fukushima Dai-ichi event. However, the US NRC has identified several technical and regulatory topics on which it intends to pursue improvement at US nuclear power plants without unnecessary delay. These topics include: (1) updated evaluation of seismic and flooding hazards; (2) improvements in licensee ability to cope with prolonged station blackout events; (3) protection of equipment potentially capable of mitigating multiunit, beyond design basis events from natural hazards; (3) improved reliability and effectiveness of boiling water reactor Mark I and Mark II containment venting systems; (4) installation of enhanced spent fuel pool monitoring instrumentation; (5) improved integration of emergency operating procedures, severe accident management guidelines, and extensive damage mitigation guidelines; and (6) enhancements to licensee emergency preparedness programs. The US NRC is following its regulatory process to develop the appropriate regulatory products, including request for information letters, orders, or changes to US NRC regulations, to address each of the technical or regulatory topics noted above. The US NRC has also identified other technical or regulatory topics for longer term action (see US NRC SECY-11-0137) and is considering other technical or regulatory topics related to lessons learned from the Fukushima Dai-ichi event which may be added to the list above.

Q: *Has the NRC required any physical plant changes that have already been made or installed at U.S. nuclear power plants (NPPs) as a result of the Fukushima Dai-ichi event? NEW!*

A: As of Dec. 6, 2011, the United States Nuclear Regulatory Commission (US NRC) has required no physical plant changes at NPPs in the US as a result of the Fukushima Dai-ichi event. The US NRC has taken several steps, however, to verify that licensees of US NPPs have equipment and procedures in place which may be useful in responding to be beyond design basis seismic or flooding events, large fires, explosions, or prolonged station blackout events. Such equipment has been installed at US facilities in response to, for example, US NRC requirements in Title 10 of the Code of Federal Regulations 50.54(hh) regarding the mitigation of significant plant damage due to aircraft impact. Following the event at Fukushima Dai-ichi, the NRC performed inspections, as addressed by US NRC Temporary Instruction 183 issued March 18, 2011, at all US NPPs to independently assess the ability of licensees to respond to beyond design basis events. In US NRC Bulletin 2011-01 dated May 11, 2011, the NRC has also required licensees to provide information to the NRC to confirm that NPP staff and equipment were capable of implementing the mitigative strategies which may be useful in responding to the aforementioned beyond design basis events.

U.S. Power Plants (General)

Q: *Have any lessons for US nuclear plants been identified? UPDATED*

A: The NRC is learning from the events at the Japanese reactors through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations. The task force has completed its near-term analysis of the events and their impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission). The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:

- Reevaluate seismic and flooding hazards
- Perform seismic and flooding hazard walkdowns
- Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO
- Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena
- Strengthen and integrate onsite emergency response capabilities
- Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO
- Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)
- Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:

- Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)
- Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:

- Ten-year confirmation of seismic and flooding hazards
- Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods
- Reliable hardened vents for other containment designs
- Hydrogen control and mitigation inside containment or in other buildings
- Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events
- EP topics for decision-making, radiation monitoring, and public education
- Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework
- Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The NRC's staff long-term analysis and implementation is now underway.

U.S. Power Plants (General)

Q: *Have the owners or operators of U.S. nuclear power plants made any physical changes to the plants as a result of Fukushima? Please describe the changes. NEW!*

A: In response to the findings from our post-Fukushima inspections, licensees have undertaken efforts to correct any NRC-identified deficiencies at their plants. However, as of Dec. 6, 2011 the NRC is not aware of any significant plant modifications made by US licensees as a result of lessons-learned from the Fukushima Dai-ichi event. Nevertheless, US licenses are taking actions individually and collectively through the efforts of organizations such as the Institute for Nuclear Power Operations (INPO), the Nuclear Energy Institute (NEI) and the Electric Power Research Institute (EPRI) to identify facility modifications which would improve overall US NPP safety in relation to beyond design basis events.

Q: *How can the public be involved in the accelerated process? NEW!*

A: Members of the public are invited to provide input regarding the NRC's resolution of the Tier 1 Recommendations. Please provide any comments to: JLD_Public Resource@nrc.gov. Comments will be considered to the extent possible.

Q: *How will the U.S. learn from the failures at the Japanese reactors? UPDATED*

A: The NRC is learning from the events at the Japanese reactors through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC issued an information notice to inform licensees about the effects of the earthquake on nuclear power plants in Japan. In addition, the NRC's staff at every reactor site have performed targeted inspections to confirm facility responses to beyond design-basis events. The NRC has also issued Bulletin 2011-01 that requires all licensees to verify under oath and affirmation that their mitigation strategies and capabilities are in compliance with relevant NRC regulations.

In addition, the NRC established both short- and long-term analysis of the lessons that can be learned from the situation in Japan. The short-term review has been completed. The Near-Term Task Force provided its recommendations to the Commission in July 2011. Since then, the NRC staff has provided the Commission with those recommendations from the Near-Term Task Force Report that could be implemented without delay as well as the prioritization of the remaining items. The Commission has directed the staff to proceed on the recommendations that can be implemented without delay and on certain of the remaining recommendations. The agency's long-term analysis and implementation is now underway.

Q: *The NRC has proposed recommendations regarding station blackout. Would NRC consider putting a hold on any changes to all plants for changes dealing with on-site power generation?*

A: The NRC requires that all nuclear power plants are able to withstand a station blackout (SBO) - a complete loss of AC electric power to the station. These requirements are specified in 10 CFR 50.63, Loss of all alternating current power, and in 10 CFR 50.2, Definitions. The NRC's Japan Task Force has recommended the agency use certain lessons learned from Fukushima to improve the NRC's regulatory framework. The Commission has noted that some Task Force's recommendations raise very complex technical and regulatory questions that will require significant analysis. Since the events in Japan continue to evolve, the NRC has used and will continue to use the analytical resources and stakeholder engagement capabilities of the agency to ensure the consideration of many issues. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the NRC licensees. Contributors to the conclusion that the current fleet of reactors and materials licensees continue to protect the public health and safety are based on a number of principles, including defense in depth. Every U.S. reactor is designed for natural events based on the specific site where the reactor is located.

U.S. Power Plants (General)

Q: *What has the NRC task force learned from the targeted inspections performed at U.S. nuclear power plants in response to the events at Fukushima?*

A: The task force has completed its near-term review and concluded that continued operation and continued licensing activities do not pose an imminent risk to public health and safety. The task force made several recommendations in its report, such as evaluating seismic and flooding protection at plants, ensuring that existing mitigation equipment is stored in areas that are protected from severe flooding, and strengthening emergency plan staffing and facilities to address multi-unit events.

Based on the targeted inspections performed in response to Temporary Instructions 2515/183, none of the observations made by the NRC inspectors posed a significant safety issue. Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant. In summary, observations were made that there were discrepancies in terms of procedures, equipment, and training. The detailed inspection reports for these inspections are available at the NRC's public webpage at the following link: http://www.nrc.gov/japan/japan-activities.html.

Q: *What is the Japan Lessons-Learned Project Directorate? NEW!*

A: The Japan Lessons-Learned Project Directorate is the staff-level project management organization responsible, along with its Steering Committee and line organizations and other supporting bodies, for implementing the Commission's direction on the Near-Team Task Force Report recommendations. The charter for the agency's implementation of the Near Term Task Force (NTTF) recommendations was recently approved by the Commission. The charter outlines an organization structure consisting of a Steering Committee, the Japan Lessons-Learned Project Directorate (JLD), the line organizations, and other support bodies responsible for implementing the Commission's direction on the NTTF recommendations.

U.S. Power Plants (General)

Q: *What is the NRC doing to ensure this (Japan event) doesn't happen at US plants? UPDATED*

A: The NRC is addressing the applicability of the events in Japan to US plants through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC has issued the following documents related to the events in Japan:

- Information Notice 2011-05 provided information to licensees on the effects of the earthquake and resultant tsunami on the Fukushima Dai-ichi nuclear power station in Japan.

- Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant.

- Temporary Instruction 2515/184 provided instructions for NRC inspectors to determine: (i) that the severe accident management guidelines (SAMGs) are available and how they are being maintained, and (ii) the nature and extent of licensee implementation of SAMG training and exercises.

- Bulletin 2011-01 required all holders of operating licenses for nuclear power reactors to provide a comprehensive verification of their compliance with the regulatory requirements in 10 CFR 50.54(hh) associated with mitigating strategies for beyond design basis events.

The task force has completed its near-term analysis of the events and their impact on U.S. plants ("Recommendations for the Enhancing Reactor Safety in the 21st Century: The Near-term Task Force Review of Insights from the Fukushima Dai-ichi Accident," July 12, 2011, Nuclear Regulatory Commission). The report included 12 overarching recommendations, which the NRC staff has since prioritized into three tiers.

The first tier includes those recommendations that the NRC intends to pursue without delay. They are:
- Reevaluate seismic and flooding hazards
- Perform seismic and flooding hazard walkdowns
- Modify station blackout (SBO) rule to require enhanced capability to mitigate prolonged SBO
- Protect mitigation equipment (intended for events that damage large areas at multiunit sites) from natural phenomena -Strengthen and integrate onsite emergency response capabilities
- Require Emergency Planning (EP) staffing and communications equipment to respond to multiunit events and prolonged SBO
- Require reliable hardened vent designs in Boiling Water Reactors (BWRs) with Mark I and II containments (added since the Near-Term Task Force Report)
- Enhance spent fuel pool instrumentation (added since the Near-Term Task Force Report)

The second tier consists of recommendations that can be initiated when sufficient technical information and applicable resources become available. They are:
- Spent fuel pool (SFP) makeup capability (including safety-related AC electrical power for makeup, the inclusion of electrical power for SFP in the plant's technical specifications, and installing a seismically qualified means to spray water into the SFPs)
- Emergency preparedness regulatory actions (including addressing multiunit incidents in training and exercises; prolonged SBO scenarios; guidance for multiunit dose assessment, and the sufficiency of equipment and facilities; and practicing the acquisition of offsite resources)

Tier 3 consists of the 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, which recommended a defense-in-depth framework. The tier 3 recommendations include:
- Ten-year confirmation of seismic and flooding hazards
- Potential enhancements to the capability to prevent or mitigate seismically induced fires and floods
- Reliable hardened vents for other containment designs
- Hydrogen control and mitigation inside containment or in other buildings
- Emergency preparedness (EP) enhancements for prolonged station blackout and multiunit events
- EP topics for decision-making, radiation monitoring, and public education

U.S. Power Plants (General)

- Reactor Oversight Process modifications to reflect the recommended defense-in-depth framework
- Staff training on severe accidents and resident inspector training on Severe Accident Management Guidelines (SAMGs)

The Commission has directed the staff to move forward with Tier 1 and Tier 2 activities. The Commission has also asked the staff to provide more information on the planned implementation of Tier 3 activities. The agency's long-term analysis and implementation is now underway.

Q: *What other NRC activities will be affected by this change? NEW!*

A: Some lower priority work will be delayed as staff focues on these initiatives. Be assured that NRC staff will continue to manage resources and workloads to ensure public health and safety.

U.S. Power Plants (General)

Q: *What short-term and long-term actions to ensure the safety of the U.S. operating nuclear power plants is the NRC taking in response to the events at the Japanese nuclear power plants at Fukushima Dai-ichi? UPDATED*

A: Shortly after the March 11, 2011, earthquake and tsunami and the resulting crisis at the Japanese Fukushima Dai-ichi nuclear power plant, the NRC launched a review of U.S. nuclear power plant safety. The NRC is addressing the applicability of the events in Japan to US plants through temporary instructions and generic communications, a Near-Term Task Force review, and the implementation of the task force's recommendations.

The NRC issued four documents that had immediate applicability to the operating reactors:

- Information Notice 2011-05 provided information to licensees on the effects of the earthquake and resultant tsunami on the Fukushima Dai-ichi nuclear power station in Japan.

- Temporary Instruction 2515/183 provided instructions for NRC inspectors to perform independent assessments of the adequacy of industry-initiated efforts to respond to the fuel damage events at the Fukushima Dai-ichi nuclear station. This involves a high-level look at industry's preparedness for events that may exceed the design for a plant.

- Temporary Instruction 2515/184 provided instructions for NRC inspectors to determine: (i) that the severe accident management guidelines (SAMGs) are available and how they are being maintained, and (ii) the nature and extent of licensee implementation of SAMG training and exercises.

- Bulletin 2011-01 required all holders of operating licenses for nuclear power reactors to provide a comprehensive verification of their compliance with the regulatory requirements in 10 CFR 50.54(hh) associated with mitigating strategies for beyond design basis events.

In addition, the NRC's Near-Term Task Force was established to (1) conduct a systematic and methodical review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and (2) make recommendations to the Commission for its policy direction. The Near-Term Task Force, made up of senior managers and staff with relevant experience, conducted a short-term review of the lessons that can be learned from the situation in Japan, and issued its report on July 12, 2011. The task force's report is available to the public (ADAMS Accession No. ML111861807). On July 19, 2011, the Task Force presented its findings to the Commission and proposed improvements in areas ranging from loss of power to earthquakes, flooding, spent fuel pools, venting and emergency preparedness.

On October 18, 2011, the Commission directed the staff to begin actions on the NTTF recommendations that the staff proposed should be initiated without delay. For each of the NTTF recommendations approved for near-term action, NRC staff will be responsible for engaging external stakeholders for the purpose of developing the technical and regulatory basis necessary to implement the NTTF recommendation. Once a sound technical and regulatory basis exists, the development of appropriate regulatory implementation tools, such as orders, 50.54(f) letters, and rules, can proceed.

The Commission has directed staff to strive to complete and implement the lessons-learned from the Fukushima accident within five years—by 2016. In order to succeed, the staff will be challenged to develop creative and flexible performance-based requirements intended to enhance nuclear safety with proper consideration of the beyond design basis nature of the events. A key aspect of this effort will be early and frequent interaction with external stakeholders to determine the appropriate acceptance criteria.

Q: *Why did Congress have to get involved before the NRC accelerated the implementation? NEW!*

A: Congressional input was only one of the reasons we are revising our schedule.

U.S. Power Plants (General)

Q: *Why is the NRC only accelerating the implementation now? NEW!*

A: Recent events have caused the staff to reconsider its proposed approach and schedule for issuing Tier 1 Orders and 50.54(f) letters:

-House and Senate Hearings

-Language in the NRC's Appropriations Bill

-Advisory Committee on Reactor Safety letters dated October 13th and November 8th

-Nuclear Energy Institute letter dated December 16th

-Resolution of the six additional issues from SECY-11-0137

Q: *Why is the NRC only now accelerating the implementation of these items? NEW!*

A: NRC is attempting to balance current priorities and established processes with the need to act upon what we learned from the events at Fukushima. Staff believes that quick action on these items, while keeping our original schedule for other follow-up actions, is appropriate and necessary.

Diablo Canyon

Q: *Why should the NRC not require the more sophisticated (3D) seismic studies being voluntarily conducted by licensees in California?*

A: Current NRC and American Nuclear Society (ANS) documentation provides guidance related to site investigations undertaken for the purpose of characterizing seismic sources and dynamic site properties. A variety of geophysical and geotechnical tools are available that can be used to investigate the earth from both a site-specific and a regional level. Each of these methods provides specific information by probing the earth in a different way. While some tools are universally useful, others are better suited to certain types of sub-surface materials and tectonic situations. While 3D seismic studies, such as those being performed in California, are sophisticated, they are not useful for all situations and the very large expense of the study could preclude broader application of techniques better suited to a specific site. The NRC would suggest the use of 3D seismic studies only in cases where it could be useful. The NRC attempts to provide regulations that call for techniques that would be the most suitable given the specific conditions of a plant and requested licensing actions.

U.S. Power Plants (Plant-specific)

U.S. BWR Mark I Plants

Q: *Some in the media and in Hill briefings are suggesting the BWR Mark I containment is flawed. What are the concerns about this type of containment? Are the US plants with this safe?*

A: BWR Mark I containments have relatively small volumes in comparison with pressureized water reactor (PWR) containments. This makes the BWR Mark I containment relatively more susceptible to containment failure given a core meltdown severe enough to (1) fail the reactor vessel and also (2) severe enough so that the core melt reaches the containment boundary. On the positive side, BWRs have more ways of adding water to the core than PWRs to prevent core meltdown. The following improvements have been made to U.S. Mark I containment reactors:

Station Blackout (SBO) Rule: Required the ability to cope with SBO for specified time and recover the plant

Anticipated Transient Without Scram (ATWS) Rule: Required vendor specific improvements to enhance scram reliability

Hydrogen Control Rule: Required modifications to reduce impact of hydrogen generated from beyond design basis events (DBEs)

Equipment Qualification Rule: Required environmental qualification of electrical system equipment used for design basis accidents (DBAs)

Mark I Containment Improvement Program: (i) Added hardened vent system for containment cooling and fission product scrubbing for beyond DBAs, and (ii) Enhanced reliability of automatic depressurization system (ADS) and added an additional water injection capability independent of normal AC and emergency diesel power

Symptom-based Emergency Procedure Guides (EPGs): Provides emergency procedures that direct operator actions on the basis of critical safety parameter status rather than knowledge of the event initiator – applicable to any initiating event (DBA or beyond DBA)

Severe Accident Management Guidelines (SAMGs): Guidelines for minimizing radiological consequences of a damaged core event. Focuses on maintaining containment integrity, controlling releases, and emergency planning interface

Aircraft Impact Requirements: Requires procedures to use all available equipment for core cooling, containment protection, and spent fuel pool cooling assuming a significant damage to the facility from an airplane crash

Mark I Containment Hydrodynamic Load Issue Resolution: Resulted in structural strengthening of Mark I containments to better handle reactor system depressurization forces

Emergency Core Cooling System (ECCS) Pump Suction Strainer Improvements: Larger surface area strainers installed with higher debris loading tolerance to ensure ECCS pump operation

Hydrogen explosions have been a major aspect of the Fukushima accident. In the U.S., NRC Generic Letter 89-16, “Installation of a Hardened Wetwell Vent,” conveyed the importance of having a robust pathway for venting primary containment, which contains the suppression pool, in certain severe accident scenarios. In response, all BWRs with Mark I containments that didn’t have an existing strengthened or “hardened” pathway for venting directly from primary containment to the outside, made modifications to the plant consistent with the intent of the Generic Letter. This design feature permits a controlled depressurization of primary containment as well as a controlled release of radioactive materials and combustible hydrogen generated by damaged fuel, as may occur during severe accidents.

U.S. Coastal Plants

Q: *Are U.S. nuclear power plants designed to withstand tsunamis? What would the effect be on [plant X] if a subsequent tsunami hit?*

A: All U.S. nuclear power plants are built to withstand external hazards, including earthquakes, flooding, and tsunamis, as appropriate. Many nuclear plants are located in coastal areas that could potentially be affected by a tsunami resulting from an earthquake. Two nuclear plants, Diablo Canyon and San Onofre, are on the Pacific Coast, which is known to have a tsunami hazard. There are many nuclear plants on the Atlantic Coast or on rivers that may be affected by a tidal bore resulting from a tsunami. These include St. Lucie, Turkey Point, Brunswick, Oyster Creek, Millstone, Pilgrim, Seabrook, Calvert Cliffs, Salem/Hope Creek, and Surry. In addition, there are two nuclear plants on the Gulf Coast, South Texas and Crystal River, that could potentially be affected by tsunami. Although tsunami on the Gulf and Atlantic Coasts may occur, it is very rare. Generally the flooding anticipated from hurricane storm surge exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Recent studies have looked at the potential of tsunami hitting the Gulf and Atlantic coasts, and have found that for many parts of the coast, tsunamigenic landslide (i.e., tsunami resulting from an underwater landslide) have the potential to exceed the seismically-induced tsunami. This research shows that the tsunamis produced by underwater landslides are localized, but can be extremely destructive in the nearby areas. The licensing basis for the coastal plants (i.e., FSARs) mentioned above did not specifically consider or assess this possibility, as the phenomenon was not well understood at the time. However, research supported by the NRC has been studying the issue since 2006. Although studies of tsunamigenic landslide continue, the current results indicated that flooding anticipated from hurricane storm surge, evaluated as part of the licensing basis for these plants, generally exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Q: *How many reactors are along coastal areas that could be affected by a tsunami? Is plant X designed to withstand a tsunami (for each coastal plant)?*

A: All U.S. nuclear power plants are built to withstand external hazards, including earthquakes, flooding, and tsunamis, as appropriate. Many nuclear plants are located in coastal areas that could potentially be affected by a tsunami resulting from an earthquake. Two nuclear plants, Diablo Canyon and San Onofre, are on the Pacific Coast, which is known to have a tsunami hazard. There are many nuclear plants on the Atlantic Coast or on rivers that may be affected by a tidal bore resulting from a tsunami. These include St. Lucie, Turkey Point, Brunswick, Oyster Creek, Millstone, Pilgrim, Seabrook, Calvert Cliffs, Salem/Hope Creek, and Surry. In addition, there are two nuclear plants on the Gulf Coast, South Texas and Crystal River, that could potentially be affected by tsunami. Although tsunami on the Gulf and Atlantic Coasts may occur, it is very rare. Generally the flooding anticipated from hurricane storm surge exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

Recent studies have looked at the potential of tsunami hitting the Gulf and Atlantic coasts, and have found that for many parts of the coast, tsunamigenic landslide (i.e., tsunami resulting from an underwater landslide) have the potential to exceed the seismically-induced tsunami. This research shows that the tsunamis produced by underwater landslides are localized, but can be extremely destructive in the nearby areas. The licensing basis for the coastal plants (i.e., FSARs) mentioned above did not specifically consider or assess this possibility, as the phenomenon was not well understood at the time. However, research supported by the NRC has been studying the issue since 2006. Although studies of tsunamigenic landslide continue, the current results indicated that flooding anticipated from hurricane storm surge, evaluated as part of the licensing basis for these plants, generally exceeds the flooding expected from a tsunami for nuclear plants on these coasts.

U.S. Power Plants (Plant-specific)

Q: *Why should the NRC not require the more sophisticated (3D) seismic studies being voluntarily conducted by licensees in California?*

A: Current NRC and American Nuclear Society (ANS) documentation provides guidance related to site investigations undertaken for the purpose of characterizing seismic sources and dynamic site properties. A variety of geophysical and geotechnical tools are available that can be used to investigate the earth from both a site-specific and a regional level. Each of these methods provides specific information by probing the earth in a different way. While some tools are universally useful, others are better suited to certain types of sub-surface materials and tectonic situations. While 3D seismic studies, such as those being performed in California, are sophisticated, they are not useful for all situations and the very large expense of the study could preclude broader application of techniques better suited to a specific site. The NRC would suggest the use of 3D seismic studies only in cases where it could be useful. The NRC attempts to provide regulations that call for techniques that would be the most suitable given the specific conditions of a plant and requested licensing actions.