NRC STAFF REVIEW OF THE IAEA DIRECTOR GENERAL'S REPORT "THE FUKUSHIMA DAIICHI ACCIDENT"

At the International Atomic Energy Agency (IAEA) General Conference in September 2012, the IAEA Director General, Yukiya Amano, announced that the IAEA would prepare a comprehensive report on the Fukushima Daiichi accident. The Director General's report, "The Fukushima Daiichi Accident," was published in August 2015 and is the product of a multi-year international collaborative effort involving over 180 subject matter experts from 42 Member States and several international bodies.

This report consists of an Executive Summary and a Summary Report, which were derived from five detailed technical volumes totaling over 1,000 pages. The Summary Report provides a description of the accident and its causes, evolution, and consequences, and highlights the main observations and lessons. The Summary Report contains six sections:

1. Introduction.
2. The accident and its causes, including a description of the sequence of events and an assessment of how extreme natural events led to the severe nuclear accident.
3. Emergency preparedness and response, including the arrangements for the protection of emergency workers and the public and the implementation of these arrangements during and immediately after the accident.
4. The radiological consequences of the accident, including radiation exposure of workers and the public, and health and environmental effects.
5. Post-accident recovery activities, including decommissioning of the plant, remediation strategies for the off-site areas affected, waste management, and strategies for revitalization.
6. An overview of the activities of the IAEA and the Contracting Parties to the Convention on Nuclear Safety in response to the accident.

The main observations and lessons are detailed in Sections 2–5 of the report. The NRC staff has reviewed the observations and lessons and has concluded that they do not introduce issues that have not been considered by the U.S. Nuclear Regulatory Commission (NRC), the U.S. Government, or the U.S. nuclear industry, either as part of pre-existing programs or as post-Fukushima enhancements.

The NRC staff's assessment of each of the IAEA recommendations is provided in the attachment.

ATTACHMENT: U.S. NUCLEAR REGULATORY COMMISSION (NRC) STAFF'S ASSESSMENT OF INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) REPORT, "THE FUKUSHIMA DAIICHI ACCIDENT"	
IAEA Observations/Lessons Learned	NRC Staff Assessment
IAEA REPORT SECTION 2. NUCLEAR SAFETY CONSIDERATIONS	
Vulnerability of the Plant to External Events (Section 2.2.1)	
The assessment of natural hazards needs to be sufficiently conservative. The consideration of mainly historical data in the establishment of the design basis of NPPs [nuclear power plants] is not sufficient to characterize the risks of extreme natural hazards. Even when comprehensive data are available, due to the relatively short observation periods, large uncertainties remain in the prediction of natural hazards.	The NRC requires U.S. nuclear power plants to be designed to withstand the effects of natural phenomena such as earthquakes, floods, and high winds. These are commonly known as design-basis external events. The NRC's requirements in this area are primarily described in the General Design Criteria for licensing a plant, which are included in Appendix A to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR). The Fukushima accident was caused by beyond-design-basis seismic and flooding natural phenomena. The NRC had assessed beyond design basis hazards prior to the Fukushima accident under activities such as the Individual Plant Evaluation of External Events and Generic Issues programs. In response to the Fukushima accident, on March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The Order requires a three-phased approach to mitigating beyond-design-basis external events. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities.

	The second phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be maintained with offsite equipment and support. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. On August 29, 2012, the NRC issued interim staff guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." With JLD-ISG-2012-01, the NRC staff endorsed the development, implementation, and maintenance of strategies and guidance in conformance with the guidelines provided in Nuclear Energy Institute (NEI) 12-06, Revision 1, subject to clarifications, as an acceptable means of meeting the requirements of Order EA-12-049. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," was developed to provide guidance for compliance with EA-12-049 and outlines an approach for adding diverse and flexible mitigation strategies that will enhance the capability of U.S. nuclear plants to respond to beyond-design-basis risks of extreme natural hazards scenarios. Also in response to the Fukushima accident, on March 12, 2012, the NRC issued 10 CFR 50.54(f) letters to all licensees to request that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flooding hazard information and present-day regulatory guidance and methodologies. The NRC is requiring licensees be able to address the reevaluated seismic and flooding hazards within mitigating strategies for beyond-design-basis external events developed for each site.

	In November 2014, NRC staff provided the Commission with a flood hazard assessment research plan, which will be used to provide the technical bases and analytical tools to support probabilistic analysis of flood hazards, test these tools against three case studies, and provides regulatory guidance for use of the developed analytical tools. In May 2015, the Offices of Nuclear Reactor Regulation and New Reactors jointly issued a user need to the Office of Nuclear Regulatory Research to perform the necessary research to develop probabilistic flood hazard assessment (PFHA) approaches and methods. The staff's plan for evaluating external hazards other than seismic and flooding is described in SECY-15-0137, "Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations," which was provided to the Commission on October 29, 2015. In SECY-15-0137, the staff notes that although a safety benefit has been achieved in the near term for the external hazards other than seismic and flooding because they have been considered in the implementation of Order EA-12-049, additional reviews should be performed to determine if changes in the hazards warrant actions beyond those associated with Order EA-12-049. The staff concludes that pre-existing requirements for nuclear power plants to be designed to withstand the effects of natural phenomena, which are being augmented by the requirements of Order EA-12-049, in addition to the 10 CFR 50.54(f) letters to all licensees to request that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flooding hazard information and present-day regulatory guidance and methodologies, and staff's plans to perform additional reviews of external hazards other than seismic and flooding addresses IAEA's observation.
The safety of NPPs needs to be re-evaluated on a periodic basis to consider advances in knowledge, and necessary	The NRC continually monitors for advances in knowledge associated with nuclear power plant design, construction, and

corrective actions or compensatory measures need to be implemented promptly.	operation, and implements any necessary corrective actions or compensatory measures as appropriate to ensure the safety of U.S. nuclear power plants. The NRC accomplishes this objective through its comprehensive set of regulations, inspections, and safety review programs. An example is the NRC's generic issues program which included ongoing assessments of seismic and flooding issues at the time of the Fukushima accident. The U.S. regulatory structure was well established when the periodic safety review (PSR) approach was being developed. During the formulation of the License Renewal Rule in the early 1990s, the NRC considered the concept of performing a comprehensive review of a plant during the license renewal process to bring it closer to the current standards, which is a goal of the PSR approach. The Commission did not adopt this approach, in part because it believes that the NRC's robust and mature programs, including the onsite resident inspector program, generic issue identification, and systematic evaluation process, afford adequate protection to the public and accomplish the same objective of the PSR approach. The staff concludes that the NRC's comprehensive set of regulations, inspections, and safety review programs address the IAEA observation.
Operating experience programmes need to include experience from both national and international sources. Safety improvements identified through operating experience programmes need to be implemented promptly. The use of operating experience needs to be evaluated periodically and independently.	The NRC has an effective, coordinated program to review domestic and applicable international operating experience gained from the nuclear power industry, research and test reactors, and new reactor construction in a timely and systematic manner. The program provides means for assessing the significance of the information, providing timely and effective communication to stakeholders, and applying the lessons learned to regulatory decisions and programs affecting nuclear reactor safety.

	In a recent international peer review of the NRC's operating experience program, reviewers found that NRC has developed and implemented a dedicated comprehensive feedback program to collect, evaluate, communicate, and apply operating experience by taking regulatory actions to help prevent safety-significant events and inform NRC decision making. The staff concludes that the NRC's operating experience program addresses the IAEA observation.
Application of the Defence in Depth Concept (Section 2.2.2)	
The defence in depth concept remains valid, but implementation of the concept needs to be strengthened at all levels by adequate independence, redundancy, diversity and protection against internal and external hazards. There is a need to focus not only on accident prevention, but also on improving mitigation measures.	U.S. nuclear power plants are designed and licensed using a defense-in-depth safety approach that employs successive measures to prevent accidents or lessen the effects of damage if a malfunction or accident occurs at a nuclear facility. The philosophy ensures that safety will not be wholly dependent on any single element of the design, construction, maintenance, or operation of a nuclear facility. The Fukushima accident had a profound impact on the nuclear power industry worldwide because, in part, the defense-in-depth safety approach employed at Fukushima Daiichi had been challenged, resulting in core damage and off-site consequences. Evaluating the accident and identifying possible additional safety enhancements became an urgent priority for regulators and the nuclear industry in all countries with nuclear power plants. In response to the Fukushima accident, on March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The Order requires a three-

	phased approach to mitigating beyond-design-basis events. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment, and SFP cooling capabilities. The second phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be maintained with offsite equipment and support. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. On August 29, 2012, the NRC issued interim staff guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." With JLD-ISG-2012-01, the NRC staff endorsed the development, implementation, and maintenance of strategies and guidance in conformance with the guidelines provided in NEI 12-06, Revision 1, subject to clarifications, as an acceptable means of meeting the requirements of Order EA-12-049. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," provides guidance for compliance with Order EA-12-049 and outlines an approach for adding diverse and flexible mitigation strategies that will increase defense- in- depth for beyond-design-basis scenarios occurring simultaneously at all units on a site. U.S. nuclear power plants are designed and licensed utilizing a defense-in-depth safety approach. That approach is being augmented by the requirements of Order EA-12-049. The staff concludes that the IAEA observation is being addressed.
Instrumentation and control systems that are necessary during beyond design basis accidents need to remain operable in order to monitor essential plant safety parameters and to facilitate plant operations.	In 1988, the NRC finalized the Station Blackout Rule to provide further assurance that a loss of emergency alternating current (AC) power systems would not adversely affect public health and safety. The rule requires, in part, that the reactor core and

	associated coolant, control, and protection systems, including station batteries and any other necessary support systems, must provide sufficient capacity and capability to ensure that the core is cooled and appropriate containment integrity is maintained in the event of a station blackout for the specified duration. The requirements imposed by the NRC also include the environmental qualification of electrical equipment important to safety and post-accident monitoring of key parameters (10 CFR 50.49). Licensees are also required to monitor the effectiveness of maintenance programs for Instrumentation and other equipment relied upon to address design-basis events or within emergency operating procedures (10 CFR 50.65). The earthquake that occurred off Japan's east coast on March 11, 2011, damaged electrical circuit breakers and distribution systems supplying electrical power to the site, resulting in the loss of all off-site power. Although onsite emergency diesel generators started and provided power to emergency systems, the tsunami resulting from the earthquake overwhelmed the site, flooding emergency diesel generator and switchgear rooms, rendering the emergency systems inoperable including much of the instrumentation and control system. Evaluating the accident and identifying possible safety enhancements became an urgent priority for regulators and the nuclear industry in all countries with nuclear power plants. In response to the Fukushima accident, on March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The Order requires a three-phased approach to mitigating beyond-design-basis events. The initial phase requires the use of installed equipment and

	resources to maintain or restore core cooling, containment, and SFP cooling capabilities. The second phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be maintained with offsite equipment and support. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. On August 29, 2012, the NRC issued interim staff guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." With JLD-ISG-2012-01, the NRC staff endorsed the development, implementation, and maintenance of strategies and guidance in conformance with the guidelines provided in NEI 12-06, Revision 1, subject to clarifications, as an acceptable means of meeting the requirements of Order EA-12-049. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," provides guidance for compliance with Order EA-12-049 and outlines an approach for adding diverse and flexible mitigation strategies that will increase defense-in-depth for beyond-design-basis scenarios occurring simultaneously at all units on a site. NEI 12-06 identifies key instrumentation that would be needed to mitigate beyond-design-basis events, and defines strategies to maintain or return that instrumentation to service for the period of time required. Staff concludes that the U.S. nuclear power plant design basis, augmented by the requirements such as the Station Blackout Rule and the implementation of the requirements of Order EA-12-049, adequately addresses the IAEA observation.

Assessment of the Failure to Fulfill Fundamental Safety Functions (Section 2.2.3)	
Robust and reliable cooling systems that can function for both design basis and beyond design basis conditions need to be provided for the removal of residual heat. There is a need to ensure a reliable confinement function for beyond design basis accidents to prevent significant release of radioactive material to the environment.	One of the primary lessons learned from the Fukushima accident was the significance of the challenge presented by a loss of safety related systems following the occurrence of a beyond-design-basis external event. In the case of the Fukushima Daiichi accident, the extended loss of AC power caused by the tsunami led to loss of core cooling and significant challenges to reactor containments. The NRC requires U.S. nuclear power plants to be designed to withstand the effects of natural phenomena, such as earthquakes, floods, and high winds. These are commonly known as design-basis external events. The NRC's requirements, including the General Design Criteria for licensing a plant, are described in 10 CFR Part 50. In 1988, the NRC finalized the Station Blackout Rule to provide further assurance that a loss of emergency AC power systems would not adversely affect public health and safety. The rule requires, in part, that the reactor core and associated coolant, control, and protection systems, including station batteries and any other necessary support systems, must provide sufficient capacity and capability to ensure that the core is cooled and appropriate containment integrity is maintained in the event of a station blackout for the specified duration. Evaluating the Fukushima accident and identifying possible safety enhancements became an urgent priority for regulators and the nuclear industry in all countries with nuclear power plants.

	In response to the Fukushima accident, on March 12, 2012, the NRC issued 10 CFR 50.54(f) letters to all licensees to request that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flooding hazard information and present-day regulatory guidance and methodologies. The NRC is requiring licensees be able to address the reevaluated seismic and flooding hazards within mitigating strategies for beyond-design-basis external events developed for each site. The staff's plan for evaluating external hazards other than seismic and flooding is described in SECY-15-0137, "Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations," which was provided to the Commission on October 29, 2015. In SECY-15-0137, the staff notes that although a safety benefit has been achieved in the near term for the external hazards other than seismic and flooding, because they have been considered in the implementation of Order EA-12-049, additional reviews should be performed to determine if changes in the hazards warrant other actions, beyond those associated with Order EA-12-049. In November 2014, NRC staff provided the Commission with a flood hazard assessment research plan, which will be used to provide the technical bases and analytical tools to support probabilistic analysis of flood hazards, test these tools against three case studies, and provides regulatory guidance for use of the developed analytical tools. In May 2015, the Office of Nuclear Reactor Regulation and the Office of New Reactors jointly issued a user need to the Office of Nuclear Regulatory Research to perform the necessary research to develop PFHA approaches and methods. Also in response to the Fukushima accident, on March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The

	Order requires a three-phased approach. The initial phase requires the use of installed plant equipment and resources to maintain or restore core cooling, containment, and SFP cooling capabilities. The second phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be maintained with offsite equipment and support. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. On August 29, 2012, the NRC issued interim staff guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." With JLD-ISG-2012-01, the NRC staff endorsed the development, implementation, and maintenance of strategies and guidance in conformance with the guidelines provided in NEI 12-06, Revision 0, subject to the clarifications to the ISG, as an acceptable means of meeting the requirements of Order EA-12-049. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," provides guidance for compliance with Order EA-12-049 and outlines an approach for adding diverse and flexible mitigation strategies that will increase defense-in-depth for beyond-design-basis scenarios occurring simultaneously at all units on a site. The NRC imposed additional requirements for boiling water reactors with Mark I and Mark II containments in Order EA-13-109. The Order requires these plants to install and maintain reliable hardened containment venting systems capable of operating under severe accident conditions.

	Staff concludes that actions taken in response to the 10 CFR 50.54(f) letters, Order EA-12-049, and Order EA-13-109 address the IAEA observation.
Assessment of Beyond Design Basis Accidents and Accident Management (Section 2.2.4)	
Comprehensive probabilistic and deterministic safety analyses need to be performed to confirm the capability of a plant to withstand applicable beyond design basis accidents and to provide a high degree of confidence in the robustness of the plant design. Accident management provisions need to be comprehensive, well designed and up to date. They need to be derived on the basis of a comprehensive set of initiating events and plant conditions and also need to provide for accidents that affect several units at a multi-unit plant. Training, exercises and drills need to include postulated severe accident conditions to ensure that operators are as well prepared as possible. They need to include the simulated use of actual equipment that would be deployed in the management of a severe accident.	The IAEA comments are predicated upon observations that the safety analyses conducted during the licensing process of Fukushima Daiichi failed to identify the vulnerability of the plant to flooding; weaknesses in operating procedures and accident management guidelines; operators not being prepared for the multi-unit loss of power and the loss of cooling caused by the tsunami; the lack of countermeasures to prevent simultaneous loss of all safety functions due to common causes; and the need for reevaluation of the impact of external events, such as earthquakes and tsunamis. Addressing the flooding and seismic issues first, in March 12, 2012, the NRC issued 10 CFR 50.54(f) letters to all licensees to request that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flooding hazard information and present-day regulatory guidance and methodologies. The NRC is requiring licensees be able to address the reevaluated seismic and flooding hazards within mitigating strategies for beyond-design-basis external events developed for each site. In addition, the staff's plan for evaluating external hazards other than seismic and flooding is described in SECY-15-0137, "Proposed Plans for Resolving Open Fukushima Tier 2 and 3 Recommendations," which was provided to the Commission on October 29, 2015. In SECY-15-0137, the staff notes that

	although a safety benefit has been achieved in the near term for the external hazards other than seismic and flooding because they have been considered in the implementation of Order EA-12-049, additional reviews should be performed to determine if changes in the hazards warrant other actions, beyond those associated with Order EA-12-049. Also in response to the Fukushima accident, on March 12, 2012, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The Order requires a three-phased approach. The initial phase requires the use of installed plant equipment and resources to maintain or restore core cooling, containment, and SFP cooling capabilities. The second phase requires providing sufficient portable onsite equipment and consumables to maintain or restore these functions until they can be maintained with offsite equipment and support. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. On August 29, 2012, the NRC issued interim staff guidance JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." With JLD-ISG-2012-01, the NRC staff endorsed the development, implementation, and maintenance of strategies and guidance in conformance with the guidelines provided in NEI 12-06, Revision 0, subject to clarifications, as an acceptable means of meeting the requirements of Order EA-12-049. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," provides guidance for compliance with Order EA-12-049 and outlines an approach for adding diverse and flexible mitigation strategies that will increase defense-in-

	depth for beyond-design-basis scenarios occurring simultaneously at all units on a site. The NRC is also developing the Mitigation of Beyond-Design-Basis Events Rulemaking. Numerous emergency preparedness actions are being addressed as part of this rulemaking, including: • Staffing and communications issues • Facilities and equipment issues • Multi-unit dose assessment issues • Training and exercise issues • Onsite emergency resources The rulemaking will establish standards that ensure the plants can smoothly transition between the various procedures, keeping the plants' overall strategies coherent and comprehensive. The rule will have the plants improve strategies for large-scale events to promote effective decision-making at all levels. The rule will include training, qualification, and evaluation requirements for the key personnel expected to implement the procedures and strategies. Draft Regulatory Guide DG-1319 endorses, with clarifications, the methods and procedures promulgated by NEI in the following documents as methods the NRC staff considers acceptable for meeting portions of the regulations in 10 CFR 50.155 and 10 CFR Part 50, Appendix E, Section VII: NEI 12-01, "Guidelines for Assessing Beyond-Design-Basis Accident Response Staffing and Communication Capabilities," Revision 0, dated May 2012. This NEI document was previously endorsed by the NRC in a letter from Mr. David Skeen to Ms. Susan Perkins-Grew, dated May 15, 2012.

	NEI 13-06, “Enhancements to Emergency Response Capabilities for Beyond-Design-Basis Events and Severe Accidents,” Revision 0, dated September 2014. NEI 14-01, “Emergency Response Procedures and Guidelines for Beyond-Design-Basis Events and Severe Accidents,” Revision 0, dated September 2014. NEI 14-01 describes the nuclear industry’s development and implementation of Severe Accident Management Guidelines (SAMGs) to maintain or restore containment functions during beyond-design-basis accident scenarios. The guidelines are being updated to address insights from the Fukushima accident and include periodic emergency response personnel training, drills, and exercises. It should also be noted that in the staff requirements memorandum (SRM) to SECY-15-0065, the Commission directed the staff to update the Reactor Oversight Process (ROP) to explicitly provide periodic oversight of industry’s implementation of the SAMGs, and to ensure NRC guidance is clarified to discuss how deviations or performance deficiencies would be addressed. The staff concludes that the 10 CFR 50.54(f) letters to all licensees to request that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flooding hazard information and present-day regulatory guidance and methodologies, implementation of the requirements of Order EA-12-049, implementation of the requirements of the Mitigation of Beyond-Design-Basis Events Rulemaking, implementation of the guidance afforded in NEI 14-01, and implementation of Commission direction in the SRM to SECY-15-0065 in the aggregate, address IAEA’s observations.

Assessment of Regulatory Effectiveness (Section 2.2.5)	
In order to ensure effective regulatory oversight of the safety of nuclear installations, it is essential that the regulatory body is independent and possesses legal authority, technical competence and a strong safety culture.	The Energy Reorganization Act, signed into law October 11, 1974, established the NRC as an independent agency. NRC receives independent oversight by NRC's Office of the Inspector General and the General Accountability Office. The U.S. is a contracting party to the Convention on Nuclear Safety, which states, in part: > Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy. Every contracting party provides a national report for peer review every three years. The NRC prepares the U.S. national report and leads the U.S. delegation to the review meetings. Thus, the leadership of the NRC maintains an ongoing focus on sustaining its independence and submits to review by international regulators in that regard. With respect to technical competence, the NRC's Office of the Chief Human Capital Officer, provides overall leadership and management of agency-wide training and development policies, programs, and systems designed to establish, maintain, and enhance the skills employees need to perform their current jobs effectively and to meet the future skill needs of the agency.

	With respect to safety culture, the Commission, in the Safety Culture Policy Statement (76 FR 34773, issued June 14, 2011), sets forth the expectation that individuals and organizations establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions. The Safety Culture Policy Statement applies to all licensees; certificate holders; permit holders; authorization holders; holders of quality assurance program approvals; vendors and suppliers of safety-related components; and applicants for a license, certificate, permit, authorization, or quality assurance program approval, subject to NRC authority. The NRC also maintains internal programs to promote the safety culture within the agency and to provide every staff member with the ability to voice safety concerns. The NRC routinely assesses the safety culture internal to the agency though, for example, surveys conducted by the Office of the Inspector General. Staff concludes that the NRC's independence, legal authority, programs and processes to ensure technical competence, and safety culture address IAEA's observation.
Assessment of Human and Organizational Factors (Section 2.2.6)	
In order to promote and strengthen safety culture, individuals and organizations need to continuously challenge or re-examine the prevailing assumptions about nuclear safety and the implications of decisions and actions that could affect nuclear safety.	With respect to safety culture, the Commission in the Safety Culture Policy Statement (76 FR 34773, issued June 14, 2011) sets forth the expectation that individuals and organizations establish and maintain a positive safety culture commensurate with the safety and security significance of their activities and the nature and complexity of their organizations and functions.

A systemic approach to safety needs to consider the interactions between human, organizational and technical factors. This approach needs to be taken through the entire life cycle of nuclear installations.	The Safety Culture Policy Statement applies to all licensees; certificate holders; permit holders; authorization holders; holders of quality assurance program approvals; vendors and suppliers of safety-related components; and applicants for a license, certificate, permit, authorization, or quality assurance program approval, subject to NRC authority. Beginning in 1989, the NRC published two policy statements about safety culture at nuclear power plants. One described the Commission's expectations for the conduct of operations in control rooms and the second established the Commission's expectation for maintaining a safety-conscious work environment, in which workers are able to raise nuclear safety concerns without fear of retaliation. Following the discovery of degradation of the reactor pressure vessel head at Davis-Besse Nuclear Power Station in 2002, the NRC took additional steps within the ROP to strengthen the agency's ability to detect potential safety culture weaknesses during inspections and performance assessments. Since 2006, the NRC's oversight of safety culture for power reactors through the ROP has included guidance and procedures for inspecting and assessing aspects of each licensee's safety culture. In 2008, the NRC developed several additional changes to the guidance on oversight of safety culture in the ROP as a result of lessons learned from the supplemental inspection conducted at Palo Verde Nuclear Generating Station. The staff continues to enhance ROP guidance documents, as needed, based on lessons learned and stakeholder feedback. Staff concludes that NRC's approach to promote and strengthen nuclear safety culture addresses IAEA's observations.

IAEA REPORT SECTION 3. EMERGENCY PREPAREDNESS AND RESPONSE	
Initial Response in Japan to the Accident (Section 3.1)	
In preparing for the response to a possible nuclear emergency, it is necessary to consider emergencies that could involve severe damage to nuclear fuel in the reactor core or to spent fuel on the site, including those involving several units at a multi-unit plant possibly occurring at the same time as a natural disaster. The emergency management system for response to a nuclear emergency needs to include clearly defined roles and responsibilities for the operating organization and for local and national authorities. The system, including the interactions between the operating organization and the authorities, needs to be regularly tested in exercises.	For each U.S. nuclear power plant site, there are onsite and offsite emergency plans to assure that adequate protective measures can be taken to protect the public in the event of a radiological emergency. The NRC and Federal Emergency Management Agency (FEMA) share Federal oversight of emergency preparedness for licensed nuclear power plants. This sharing is facilitated through a Memorandum of Understanding (MOU). The MOU is responsive to the President's decision of December 7, 1979, that FEMA take the lead in overseeing offsite planning and response, and that NRC assist FEMA in carrying out this role. The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and has overall authority for both onsite and offsite emergency preparedness. Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees complying with NRC regulations and guidance. In addition, licensees and area response organizations must demonstrate they can effectively implement emergency plans and procedures during periodic evaluated exercises. As part of the ROP, the NRC reviews each licensee's emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees

	in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant owner is required to exercise its emergency plan with the NRC, FEMA, and offsite authorities at least once every two years to ensure State and local officials remain proficient in implementing their emergency plans. Licensees also self-test their emergency plans regularly by conducting drills. FEMA takes the lead in initially reviewing and assessing the offsite planning and response and in assisting State and local governments, while the NRC reviews and assesses the onsite planning and response. FEMA findings and determinations as to the adequacy and capability of implementing offsite plans are communicated to the NRC. The NRC reviews the FEMA findings and determinations, as well as the onsite findings. The NRC then makes a determination on the overall state of emergency preparedness. These overall findings and determinations are used by the NRC to make radiological health and safety decisions before issuing licenses and in the continuing oversight of operating reactors. The NRC has the authority to take action, including shutting down any reactor deemed not to provide reasonable assurance of the protection of public health and safety. The accident at Fukushima Daiichi highlighted how complicated emergency response can be if multiple reactors on the same site are affected at the same time and electrical power is unavailable. In response, the NRC asked U.S. nuclear power plants to assess how many emergency staff they will need to respond to a large accident that may affect multiple reactors at their site, and make changes to their emergency plans as necessary. The NRC also asked the plants to assess and ensure that they can power the communications equipment these staff will need to effectively respond to such an accident.

	This includes power for radios for response teams, cellular telephones, and satellite telephones. At Fukushima Daiichi, the combination of several severe events challenged the plant's emergency plans and procedures. The NRC is updating its regulations to strengthen and integrate the various emergency response capabilities at U.S. nuclear power plants. Currently, U.S. plants may have several categories of response procedures that they draw upon, depending on the incident at their site. The NRC is developing the Mitigation of Beyond-Design-Basis Events Rulemaking. Numerous emergency preparedness actions are being addressed as part of this rulemaking, including: • Staffing and communications issues • Facilities and equipment issues • Multi-unit dose assessment issues • Training and exercise issues • Onsite emergency resources The rulemaking will establish standards that ensure the plants can smoothly transition between the various procedures, keeping the plants' overall strategies coherent and comprehensive. The rule will have the plants improve strategies for large-scale events to promote effective decision-making at all levels. The rule will include training, qualification, and evaluation requirements for the key personnel expected to implement the procedures and strategies. Draft Regulatory Guide DG-1319 endorses, with clarifications, the methods and procedures promulgated by NEI in the following documents as methods the NRC staff considers acceptable for meeting portions of the regulations in 10 CFR 50.155 and 10 CFR Part 50, Appendix E, Section VII:

	NEI 12-01, "Guidelines for Assessing Beyond-Design-Basis Accident Response Staffing and Communication Capabilities," Revision 0, dated May 2012. This NEI document was previously endorsed by the NRC in a letter from Mr. David Skeen to Ms. Susan Perkins-Grew dated May 15, 2012. NEI 13-06, "Enhancements to Emergency Response Capabilities for Beyond-Design-Basis Events and Severe Accidents," Revision 0, dated September 2014. NEI 14-01, "Emergency Response Procedures and Guidelines for Beyond-Design-Basis Events and Severe Accidents." Revision 0, dated September 2014. NEI 14-01 describes the nuclear industry's development and implementation of SAMGs to maintain or restore containment functions during beyond-design-basis accident scenarios. The guidelines are being updated to address insights from the Fukushima Daiichi accident and include periodic emergency response personnel training, drills, and exercises. It should also be noted that in the SRM to SECY-15-0065, the Commission directed the staff to update the ROP to explicitly provide periodic oversight of industry's implementation of the SAMGs, and ensure that NRC guidance clarify how deviations or performance deficiencies would be addressed. In July 2015, the NRC, along with State and local officials in South Carolina, Duke Energy, FEMA, and the Department of Energy (DOE), staged a full-scale exercise at the Robinson nuclear plant in South Carolina. The exercise brought together not only the usual exercise participants, but also many other agencies that would have a role in a real event. Exercises such as this provide valuable experience and make the overall emergency response program better.

	Staff concludes that NRC's emergency response programs and processes address IAEA's comments.
Protecting Emergency Workers (Section 3.2)	
Emergency workers need to be designated, assigned clearly specified duties, regardless of which organization they work for, be given adequate training and be properly protected during an emergency. Arrangements need to be in place to integrate into the response those emergency workers who had not been designated prior to the emergency, and helpers who volunteer to assist in the emergency response.	For each U.S. nuclear power plant site, there are onsite and offsite emergency plans to assure that adequate protective measures can be taken to protect the public in the event of a radiological emergency. NRC regulations at 10 CFR 50.47(b) require, in part, that: • A range of protective actions has been developed for the plume exposure pathway emergency planning zone (EPZ) for emergency workers and the public. In developing this range of actions, consideration has been given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of potassium iodide (KI), as appropriate. Evacuation time estimates have been developed by applicants and licensees. Licensees shall update the evacuation time estimates on a periodic basis. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place, and protective actions for the ingestion exposure pathway EPZ appropriate to the locale have been developed. • Means for controlling radiological exposures, in an emergency, are established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with the Environmental Protection Agency (EPA) Emergency Worker and Lifesaving Activity Protective Action Guides.

	• Arrangements are made for medical services for contaminated injured individuals. • Periodic exercises are (will be) conducted to evaluate major portions of emergency response capabilities, periodic drills are (will be) conducted to develop and maintain key skills, and deficiencies identified as a result of exercises or drills are (will be) corrected. • Radiological emergency response training is provided to those who may be called on to assist in an emergency. The NRC and FEMA share Federal oversight of emergency preparedness for licensed nuclear power plants. This sharing is facilitated through an MOU. The MOU is responsive to the President's decision of December 7, 1979, that FEMA take the lead in overseeing offsite planning and response, and that NRC assist FEMA in carrying out this role. The National Response Framework (NRF) is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The Nuclear/Radiological Incident Annex (NRIA) to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents

	may occur on Federally-owned or licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and has overall authority for both onsite and offsite emergency preparedness. Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees complying with NRC regulations and guidance. In addition, licensees and area response organizations must demonstrate they can effectively implement emergency plans and procedures during periodic evaluated exercises. As part of the ROP, the NRC reviews each

	licensee's emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant owner is required to exercise its emergency plan with the NRC, FEMA, and offsite authorities at least once every two years to ensure State and local officials remain proficient in implementing their emergency plans. Licensees also self-test their emergency plans regularly by conducting drills. FEMA takes the lead in initially reviewing and assessing the offsite planning and response and in assisting State and local governments, while the NRC reviews and assesses the onsite planning and response. FEMA findings and determinations as to the adequacy and capability of implementing offsite plans are communicated to the NRC. The NRC reviews the FEMA findings and determinations as well as the onsite findings. The NRC then makes a determination on the overall state of emergency preparedness. These overall findings and determinations are used by the NRC to make radiological health and safety decisions before issuing licenses and in the continuing oversight of operating reactors. The NRC has the authority to take action, including shutting down any reactor deemed not to provide reasonable assurance of the protection of public health and safety. The accident at Fukushima highlighted how complicated emergency response can be if multiple reactors on the same site are affected at the same time and electrical power is unavailable. In response, the NRC asked U.S. nuclear power plants to assess how many emergency staff they will need to respond to a large accident that may affect multiple reactors at their site, and make changes to their emergency plans as necessary. The NRC also asked the plants to assess and ensure that they can power the communications equipment

	these staff will need to effectively respond to such an accident. This includes power for radios for response teams, cellular telephones, and satellite telephones. At Fukushima Daiichi, the combination of several severe events challenged the plant's emergency plans and procedures. The NRC is revising its rules to strengthen and integrate the various emergency response capabilities at U.S. nuclear power plants. Currently, U.S. plants may have several categories of response procedures that they draw upon, depending on the incident at their site. The NRC is developing the Mitigation of Beyond-Design-Basis Events Rulemaking. Numerous emergency preparedness actions are being addressed as part of this rulemaking, including: • Staffing and communications issues • Facilities and equipment issues • Multi-unit dose assessment issues • Training and exercise issues • Onsite emergency resources The rulemaking will establish standards that ensure the plants can smoothly transition between the various procedures, keeping the plants' overall strategies coherent and comprehensive. The rule will have the plants improve strategies for large-scale events to promote effective decision-making at all levels. The rule will include training, qualification, and evaluation requirements for the key personnel expected to implement the procedures and strategies. Draft Regulatory Guide DG-1319 endorses, with clarifications, the methods and procedures promulgated by NEI in the following documents as methods the NRC staff considers acceptable for meeting portions of the regulations in 10 CFR 50.155 and 10 CFR Part 50, Appendix E, Section VII:

	NEI 12-01, "Guidelines for Assessing Beyond-Design-Basis Accident Response Staffing and Communication Capabilities," Revision 0, dated May 2012. This NEI document was previously endorsed by the NRC in a letter from Mr. David Skeen to Ms. Susan Perkins-Grew, dated May 15, 2012. NEI 13-06, "Enhancements to Emergency Response Capabilities for Beyond-Design-Basis Events and Severe Accidents," Revision 0, dated September 2014. NEI 14-01, "Emergency Response Procedures and Guidelines for Beyond-Design-Basis Events and Severe Accidents." Revision 0, dated September 2014. NEI 14-01 describes the nuclear industry's development and implementation of severe accident management guidelines to maintain or restore containment functions during beyond-design-basis accident scenarios. The guidelines are being updated to address insights from the Fukushima accident and include periodic emergency response personnel training, drills and exercises. It should also be noted that in the SRM to SECY-15-0065, the Commission directed the staff to update the ROP to explicitly provide periodic oversight of industry's implementation of the SAMGs, and to ensure that NRC guidance clarify how deviations or performance deficiencies would be addressed. In July 2015, the NRC, along with State and local officials in South Carolina, Duke Energy, FEMA, and DOE, staged a full-scale exercise at the Robinson nuclear plant in South Carolina. The exercise brought together not only the usual exercise participants, but also many other agencies that would have a role in a real event. Exercises such as this provide valuable

	experience and make the overall emergency response program better. Staff concludes that NRC's emergency response programs and processes address IAEA's comments.
Protecting the Public (Section 3.3)	
Arrangements need to be in place to allow decisions to be made on the implementation of predetermined, urgent protective actions for the public, based on predefined plant conditions. Arrangements need to be in place to enable urgent protective actions to be extended or modified in response to developing plant conditions or monitoring results. Arrangements are also needed to enable early protective actions to be initiated on the basis of monitoring results. Arrangements need to be in place to ensure that protective actions and other response actions in a nuclear emergency do more good than harm. A comprehensive approach to decision making needs to be in place to ensure that this balance is achieved. Arrangements need to be in place to assist decision makers, the public and others (e.g., medical staff) to gain an understanding of radiological health hazards in a nuclear emergency in order to make informed decisions on protective actions. Arrangements also need to be in place to address public concerns locally, nationally and internationally.	For each U.S. nuclear power plant site, there are onsite and offsite emergency plans to assure that adequate protective measures can be taken to protect the public in the event of a radiological emergency. NRC and FEMA regulations require the development of predetermined, urgent protective actions for the public, based on predefined plant conditions. In addition NRC and FEMA require that emergency response officials (onsite and offsite) be capable of modifying protective actions in response to developing events. 10 CFR 50.47(b)(10) requires that a range of protective actions be developed for the plume exposure pathway EPZ for emergency workers and the public. In developing this range of actions, consideration must be given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of KI, as appropriate. Evacuation time estimates must be developed by applicants and licensees. Licensees are required to update the evacuation time estimates on a periodic basis. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, must be developed and put in place, and protective actions for the ingestion exposure pathway EPZ appropriate to the locale must be developed.

	The NRF is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF.

	• Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. The NRC and FEMA share Federal oversight of emergency preparedness for licensed nuclear power plants. This sharing is facilitated through an MOU. The MOU is responsive to the President's decision of December 7, 1979, that FEMA take the lead in overseeing offsite planning and response, and that NRC assist FEMA in carrying out this role. NRC regulations require licensees to periodically communicate with the public and decision makers. 10 CFR 50.47(b) requires, in part, that: • Procedures be established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow up messages to response organizations and the public must be established; and means to provide early notification and clear instruction to the populace within the plume exposure pathway EPZ must be established. • Provisions must exist for prompt communications among principal response organizations to emergency personnel and to the public. • Information must be made available to the public on a periodic basis on how they will be notified and what their initial actions should be in an emergency (e.g., listening to a local broadcast station and remaining indoors), the principal points of contact with the news media for dissemination of information during an emergency (including the physical location or locations) must be

	established in advance, and procedures for coordinated dissemination of information to the public must be established. The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and has overall authority for both onsite and offsite emergency preparedness. Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees complying with NRC regulations and guidance. In addition, licensees and area response organizations must demonstrate they can effectively implement emergency plans and procedures during periodic evaluated exercises. As part of the ROP, the NRC reviews each licensee's emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant owner is required to exercise its emergency plan with the NRC, FEMA, and offsite authorities at least once every two years to ensure State and local officials remain proficient in implementing their emergency plans. Licensees also self-test their emergency plans regularly by conducting drills. FEMA takes the lead in initially reviewing and assessing the offsite planning and response and in assisting State and local governments, while the NRC reviews and assesses the onsite planning and response. FEMA findings and determinations as to the adequacy and capability of implementing offsite plans are communicated to the NRC. The NRC reviews the FEMA findings and determinations as well as the onsite findings. The NRC then makes a determination on the overall state of emergency preparedness. These overall findings and

	determinations are used by the NRC to make radiological health and safety decisions before issuing licenses and in the continuing oversight of operating reactors. The NRC has the authority to take action, including shutting down any reactor deemed not to provide reasonable assurance of the protection of public health and safety. The accident at Fukushima highlighted how complicated emergency response can be if multiple reactors on the same site are affected at the same time and electrical power is unavailable. In response, the NRC asked U.S. nuclear power plants to assess how many emergency staff they will need to respond to a large accident that may affect multiple reactors at their site, and make changes to their emergency plans as necessary. The NRC also asked the plants to assess and ensure that they can power the communications equipment these staff will need to effectively respond to such an accident. This includes power for radios for response teams, cellular telephones, and satellite telephones. At Fukushima Daiichi, the combination of several severe events challenged the plant's emergency plans and procedures. The NRC is revising its rules to strengthen and integrate the various emergency response capabilities at U.S. nuclear power plants. Currently, U.S. plants may have several categories of response procedures that they draw upon, depending on the incident at their site. The NRC is developing the Mitigation of Beyond-Design-Basis Events Rulemaking. Numerous emergency preparedness actions are being addressed as part of this rulemaking, including: • Staffing and communications issues • Facilities and equipment issues • Multi-unit dose assessment issues • Training and exercise issues • Onsite emergency resources

	The rulemaking will establish standards that ensure the plants can smoothly transition between the various procedures, keeping the plants' overall strategies coherent and comprehensive. The rule will have the plants improve strategies for large-scale events to promote effective decision-making at all levels. The rule will include training, qualification, and evaluation requirements for the key personnel expected to implement the procedures and strategies. Draft Regulatory Guide DG-1319 endorses, with clarifications, the methods and procedures promulgated by NEI in the following documents as methods the NRC staff considers acceptable for meeting portions of the regulations in 10 CFR 50.155 and 10 CFR Part 50, Appendix E, Section VII: NEI 12-01, "Guidelines for Assessing Beyond-Design-Basis Accident Response Staffing and Communication Capabilities," Revision 0, dated May 2012. This NEI document was previously endorsed by the NRC in a letter from Mr. David Skeen to Ms. Susan Perkins-Grew, dated May 15, 2012. NEI 13-06, "Enhancements to Emergency Response Capabilities for Beyond-Design-Basis Events and Severe Accidents," Revision 0, dated September 2014. NEI 14-01, "Emergency Response Procedures and Guidelines for Beyond-Design-Basis Events and Severe Accidents," Revision 0, dated September 2014. NEI 14-01 describes the nuclear industry's development and implementation of severe accident management guidelines to maintain or restore containment functions during beyond-design-basis accident scenarios. The guidelines are being updated to address insights from the Fukushima accident and

	include periodic emergency response personnel training, drills and exercises. It should also be noted that in the SRM to SECY-15-0065, the Commission directed the staff to update the ROP to explicitly provide periodic oversight of industry's implementation of the SAMGs, and that NRC guidance should clarify how deviations or performance deficiencies would be addressed. The NRC exchanges safety-related information through both formal and informal arrangements, including conventions and treaties, codes of conduct, bilateral agreements, and memoranda of understanding with international stakeholders to help fulfill safety and security obligations and to promote cooperation. Although the goal to enhance safety at operating power plants based on lessons learned from the Fukushima accident is a common objective, countries have addressed this issue and others with different approaches, in part, because not every country is starting from the same point in that their regulatory infrastructure may not be as advanced as other countries and because some national standards or safety requirements are very country specific. In July 2015 the NRC, along with State and local officials in South Carolina, Duke Energy, FEMA, and DOE, staged a full-scale exercise at the Robinson nuclear plant in South Carolina. The exercise brought together not only the usual exercise participants, but also many other agencies that would have a role in a real event. Exercises such as this provide valuable experience and make the overall emergency response program better. Staff concludes that NRC's emergency response programs and processes address IAEA's comments.

Transition From the Emergency Phase to the Recovery Phase and Analysis of the Response (Section 3.4)	
Arrangements need to be developed at the preparedness stage for termination of protective actions and other response actions, and for transition to the recovery phase. Timely analysis of an emergency and the response to it, drawing lessons and identifying possible improvements, enhances emergency arrangements.	In July 2015, the NRC, along with State and local officials in South Carolina, Duke Energy, FEMA, and DOE, staged a full-scale exercise at the Robinson nuclear plant in South Carolina. The exercise brought together not only the usual exercise participants, but also many other agencies that would have a role in a real event. Exercises such as this provide valuable experience and make the overall emergency response program better. Staff concludes that NRC's emergency response programs and processes address IAEA's comments. NRC regulations require the development of recovery plans following an accident. 10 CFR 50.47(b)(13) requires that general plans for recovery and reentry be developed consistent with NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," page 70, "Recovery and Reentry Planning and Post accident Operations." For each U.S. nuclear power plant site, there are onsite and offsite emergency plans to assure that adequate protective measures can be taken to protect the public in the event of a radiological emergency. The NRC and FEMA share Federal oversight of emergency preparedness for licensed nuclear power plants. This sharing is facilitated through an MOU. The MOU is responsive to the President's decision of December 7, 1979, that FEMA take the lead in overseeing offsite planning and response, and that NRC assist FEMA in carrying out this role.

	The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and has overall authority for both onsite and offsite emergency preparedness. Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees complying with NRC regulations and guidance. In addition, licensees and area response organizations must demonstrate they can effectively implement emergency plans and procedures during periodic ROP inspections, the NRC reviews licensees' emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant owner is required to exercise its emergency plan with the NRC, FEMA, and offsite authorities at least once every two years to ensure State and local officials remain proficient in implementing their emergency plans. Licensees also self-test their emergency plans regularly by conducting drills. FEMA takes the lead in initially reviewing and assessing the offsite planning and response and in assisting State and local governments, while the NRC reviews and assesses the onsite planning and response. FEMA findings and determinations as to the adequacy and capability of implementing offsite plans are communicated to the NRC. The NRC reviews the FEMA findings and determinations as well as the onsite findings. The NRC then makes a determination on the overall state of emergency preparedness. These overall findings and determinations are used by the NRC to make radiological health and safety decisions before issuing licenses and in the continuing oversight of operating reactors. The NRC has the authority to take action, including shutting down any reactor

	deemed not to provide reasonable assurance of the protection of public health and safety. The accident at Fukushima Daiichi highlighted how complicated emergency response can be if multiple reactors on the same site are affected at the same time and electrical power is unavailable. In response, the NRC asked U.S. nuclear power plants to assess how many emergency staff they will need to respond to a large accident that may affect multiple reactors at their site, and make changes to their emergency plans as necessary. The NRC also asked the plants to assess and ensure that they can power the communications equipment these staff will need to effectively respond to such an accident. This includes power for radios for response teams, cellular telephones, and satellite telephones. At Fukushima, the combination of several severe events challenged the plant's emergency plans and procedures. The NRC is revising its rules to strengthen and integrate the various emergency response capabilities at U.S. nuclear power plants. Currently, U.S. plants may have several categories of response procedures that they draw upon, depending on the incident at their site. The NRC is developing the Mitigation of Beyond-Design-Basis Events Rulemaking. Numerous emergency preparedness actions are being addressed as part of this rulemaking, including: • Staffing and communications issues • Facilities and equipment issues • Multi-unit dose assessment issues • Training and exercise issues • Onsite emergency resources The rulemaking will establish standards that ensure the plants can smoothly transition between the various procedures, keeping the plants' overall strategies coherent and

	comprehensive. The rule will have the plants improve strategies for large-scale events to promote effective decision-making at all levels. The rule will include training, qualification, and evaluation requirements for the key personnel expected to implement the procedures and strategies. Draft Regulatory Guide DG-1319 endorses, with clarifications, the methods and procedures promulgated by NEI in the following documents as methods the NRC staff considers acceptable for meeting portions of the regulations in 10 CFR 50.155 and 10 CFR Part 50, Appendix E, Section VII: NEI 12-01, "Guidelines for Assessing Beyond-Design-Basis Accident Response Staffing and Communication Capabilities," Revision 0, dated May 2012. This NEI document was previously endorsed by the NRC in a letter from Mr. David Skeen to Ms. Susan Perkins-Grew, dated May 15, 2012. NEI 13-06, "Enhancements to Emergency Response Capabilities for Beyond-Design-Basis Events and Severe Accidents," Revision 0, dated September 2014. NEI 14-01, "Emergency Response Procedures and Guidelines for Beyond-Design-Basis Events and Severe Accidents." Revision 0, dated September 2014. NEI 14-01 describes the nuclear industry's development and implementation of severe accident management guidelines to maintain or restore containment functions during beyond-design-basis accident scenarios. The guidelines are being updated to address insights from the Fukushima accident and include periodic emergency response personnel training, drills and exercises.

	It should also be noted that in the SRM to SECY-15-0065, the Commission directed the staff to update the ROP to explicitly provide periodic oversight of industry's implementation of the SAMGs, and to ensure that NRC guidance clarifies how deviations or performance deficiencies would be addressed. Staff concludes that NRC's emergency response programs and processes address IAEA's comments.
Response Within the International Framework for Emergency Preparedness and Response (Section 3.5)	
The implementation of international arrangements for notification and assistance needs to be strengthened. There is a need to improve consultation and sharing of information among States on protective actions and other response actions.	With respect to the need to strengthen international arrangements for notification and assistance, the NRC would be pleased to participate in discussions concerning these issues in multilateral fora such as the IAEA or NEA. The NRF is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response

	and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. The Department of State (DOS) is responsible for the conduct of relations between the U.S. Government and other governments and international organizations and for the protection of U.S. interests and citizens abroad. In a radiological emergency outside the United States, DOS is responsible for coordinating U.S. Government actions concerning the event in the country where it occurs (including evacuation of U.S. citizens, if necessary) and internationally.

	In a domestic radiological emergency with potential international trans-boundary consequences, DOS will coordinate all contacts with foreign governments and agencies except where existing bilateral agreements provide for direct exchange of information. DOS is responsible for conveying the U.S. Government response to foreign offers of assistance.
IAEA REPORT SECTION 4. RADIOLOGICAL CONSEQUENCES	
Radioactivity in the Environment (Section 4.1)	
In case of an accidental release of radioactive substances to the environment, the prompt quantification and characterization of the amount and composition of the release is needed. For significant releases, a comprehensive and coordinated programme of long term environmental monitoring is necessary to determine the nature and extent of the radiological impact on the environment at the local, regional and global levels.	NRC regulations require licensees to monitor any release. 10 CFR 50.47(b)(9) requires adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition. The NRF is a guide to how the U.S responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response

	and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. The Federal Radiological Monitoring and Assessment Center (FRMAC) is a Federal asset available on request by the Department of Homeland Security (DHS) and State and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency organization with representation from the National Nuclear Security Agency (NNSA), the Department of Defense (DOD), the EPA, the Department of Health and Human Services (HHS), Federal Bureau of Investigations (FBI), and other Federal agencies. The mission of the FRMAC is to coordinate and manage all Federal radiological environmental

	monitoring and assessment activities during a nuclear or radiological incident, within the U.S. in support of State, local, tribal governments, DHS, and the Federal coordinating agency.
Protecting People Against Radiation Exposure (Section 4.2)	
Relevant international bodies need to develop explanations of the principles and criteria for radiation protection that are understandable for non-specialists in order to make their application clearer for decision makers and the public. As some protracted protection measures were disruptive for the affected people, a better communication strategy is needed to convey the justification for such measures and actions to all stakeholders, including the public. Conservative decisions related to specific activity and activity concentrations in consumer products and deposition activity led to extended restrictions and associated difficulties. In a prolonged exposure situation, consistency among international standards, and between international and national standards, is beneficial, particularly those associated with drinking water, food, non-edible consumer products and deposition activity on land.	With respect to the need for the international community to develop explanations of the principles and criteria for radiation protection and develop better communication strategies, the NRC would be pleased to participate in discussions concerning these issues in multilateral fora such as the IAEA or NEA. The NRF is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. One of the main objectives of the NRF is the delivery of coordinated, prompt, reliable, and actionable information to the whole community[1] through the use of clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard

[1] Whole community includes: individuals, families, households, communities, the private and nonprofit sectors, faith-based organizations, and local, State, tribal, territorial, and Federal governments.

	and, as appropriate, the actions being taken and the assistance being made available. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. The DOS is responsible for the conduct of relations between the U.S. Government and other governments and international organizations and for the protection of U.S. interests and citizens abroad.

	In a radiological emergency outside the United States, DOS is responsible for coordinating U.S. Government actions concerning the event in the country where it occurs (including evacuation of U.S. citizens, if necessary) and internationally. In a domestic radiological emergency with potential international trans-boundary consequences, DOS will coordinate all contacts with foreign governments and agencies, except where existing bilateral agreements provide for direct exchange of information. DOS is responsible for conveying the U.S. Government response to foreign offers of assistance. The NRC maintains “regulator to regulator” bilateral agreements with the nuclear regulatory organizations in Canada and Mexico. These agreements reinforce the importance direct communication on matters pertaining to emergency preparedness and response. The NRC practices communication with these regulatory bodies during periodic emergency preparedness exercises, as appropriate. The NRC also has two treaties in place involving interaction with the IAEA on communications of disasters: • IAEA’s Early Notification and Assistance Convention (ENAC) was developed after the Chernobyl accident to provide an international framework to facilitate the exchange of information and prompt provisions of assistance in the event of a nuclear or radiological emergency with the aim of minimizing consequences. Since the Fukushima accident, the NRC has participated in a number of exercises that included the use of the ENAC. • IAEA’s Unified System for Information Exchange in Incidents and Emergencies (USIE), which is a centralized repository for the collection of information

	from countries which may be experiencing an emergency. USIE promotes information sharing by allowing other countries access to consistent and current information. USIE has been in development since 2011 and the NRC participated in its use.
Radiation Exposure (Section 4.3)	
Personal radiation monitoring of representative groups of members of the public provides invaluable information for reliable estimates of radiation doses and needs to be used together with environmental measurements and appropriate dose estimation models for assessing public dose. While dairy products were not the main pathway for the ingestion of radioiodine in Japan, it is clear that the most important method of limiting thyroid doses, especially to children, is to restrict the consumption of fresh milk from grazing cows. A robust system is necessary for monitoring and recording occupational radiation doses, via all relevant pathways, particularly those due to internal exposure that may be incurred by workers during severe accident management activities. It is essential that suitable and sufficient personal protective equipment be available for limiting the exposure of workers during emergency response activities and that workers be sufficiently trained in its use.	The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and has overall authority for both onsite and offsite emergency preparedness. Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees complying with NRC regulations and guidance. In addition, licensees and area response organizations must demonstrate they can effectively implement emergency plans and procedures during periodic evaluated exercises. As part of the ROP, the NRC reviews licensees' emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant owner is required to exercise its emergency plan with the NRC, FEMA, and offsite authorities at least once every two years to ensure State and local officials remain proficient in implementing their emergency plans. Licensees also self-test their emergency plans regularly by conducting drills. FEMA takes the lead in initially reviewing and assessing the offsite planning and response and in assisting State and local

	governments, while the NRC reviews and assesses the onsite planning and response. FEMA findings and determinations as to the adequacy and capability of implementing offsite plans are communicated to the NRC. The NRC reviews the FEMA findings and determinations as well as the onsite findings. The NRC then makes a determination on the overall state of emergency preparedness. These overall findings and determinations are used by the NRC to make radiological health and safety decisions before issuing licenses and in the continuing oversight of operating reactors. The NRC has the authority to take action, including shutting down any reactor deemed not to provide reasonable assurance of the protection of public health and safety. The NRF is a guide to how the U.S. to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or

	deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. FEMA is responsible for coordinating offsite Federal response activities and Federal assistance to State and local governments for functions other than radiological monitoring and assessment. FEMA's coordination role is to promote an effective and efficient response by Federal agencies at both the national level and at the scene of the emergency. FEMA coordinates the activities of Federal, State, and local agencies at the national level through the use of its Emergency Support Team and at the scene of the emergency with its Emergency Response Team. This is discussed in 10 CFR 50.47(b)(10) and NUREG-0654/FEMA REP-1 Planning Standard J, "Protective Response." The FRMAC is a Federal asset available on request by DHS and State and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency

	organization with representation from NNSA, DOD, the EPA, HHS, FBI, and other Federal agencies. The mission of the FRMAC is to coordinate and manage all Federal radiological environmental monitoring and assessment activities during a nuclear or radiological incident, within the U.S. in support of State, local, tribal governments, DHS, and the Federal coordinating agency.
Health Effects (Section 4.4)	
The risks of radiation exposure and the attribution of health effects to radiation need to be clearly presented to stakeholders, making it unambiguous that any increases in the occurrence of health effects in populations are not attributable to exposure to radiation if levels of exposure are similar to the global average background levels of radiation. After a nuclear accident, health surveys are very important and useful, but should not be interpreted as epidemiological studies. The results of such health surveys are intended to provide information to support medical assistance to the affected population. There is a need for radiological protection guidance to address the psychological consequences to members of the affected populations in the aftermath of radiological accidents. A Task Group of the ICRP [International Council on Radiation Protection] has recommended that "strategies for mitigating the serious psychological consequences arising from radiological accidents be sought."	The NRF is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. One of the main objectives of the NRF is the delivery of coordinated, prompt, reliable, and actionable information to the whole community[2] through the use of clear, consistent, accessible, and culturally and linguistically appropriate methods to effectively relay information regarding any threat or hazard and, as appropriate, the actions being taken and the assistance being made available.

[2] Whole community includes: individuals, families, households, communities, the private and nonprofit sectors, faith-based organizations, and local, State, tribal, territorial, and Federal governments.

Factual information on radiation effects needs to be communicated in an understandable and timely manner to individuals in affected areas in order to enhance their understanding of protection strategies, to alleviate their concerns and support their own protection initiatives.	The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. FEMA is responsible for coordinating offsite Federal response activities and Federal assistance to State and local governments for functions other than radiological monitoring and assessment. FEMA's coordination role is to promote an effective and efficient response by Federal agencies at both the national level and at the scene of the emergency. FEMA coordinates the activities of Federal, State, and local agencies

	at the national level through the use of its Emergency Support Team and at the scene of the emergency with its Emergency Response Team. The FRMAC is a Federal asset available on request by DHS and State and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency organization with representation from NNSA, DOD, the EPA, HHS, FBI, and other Federal agencies. The mission of the FRMAC is to coordinate and manage all Federal radiological environmental monitoring and assessment activities during a nuclear or radiological incident, within the U.S. in support of State, local, tribal governments, DHS, and the Federal coordinating agency.
Radiological Consequences for Non-Human Biota (Section 4.5)	
During any emergency phase, the focus has to be on protecting people. Doses to the biota cannot be controlled and could be potentially significant on an individual basis. Knowledge of the impacts of radiation exposure on non-human biota needs to be strengthened by improving the assessment methodology and understanding of radiation-induced effects on biota populations and ecosystems. Following a large release of radionuclides to the environment, an integrated perspective needs to be adopted to ensure sustainability of agriculture, forestry, fishery and tourism, and of the use of natural resources.	The NRF is a guide to how the U.S responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response

	and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. FEMA is responsible for coordinating offsite Federal response activities and Federal assistance to State and local governments for functions other than radiological monitoring and assessment. FEMA's coordination role is to promote an effective and efficient response by Federal agencies at both the national level and at the scene of the emergency. FEMA coordinates the activities of Federal, State, and local agencies at the national level through the use of its Emergency Support Team and at the scene of the emergency with its Emergency Response Team.

	The FRMAC is a Federal asset available on request by DHS and State and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency organization with representation from NNSA, DOD, the EPA, HHS, FBI, and other Federal agencies. The mission of the FRMAC is to coordinate and manage all Federal radiological environmental monitoring and assessment activities during a nuclear or radiological incident, within the U.S. in support of state, local, tribal governments, DHS, and the Federal coordinating agency. Based on Commission direction, the NRC staff focuses on radiological protection of humans rather than non-human biota (because protection of humans would inherently lead to protection of flora and fauna). However, the NRC's Office of Nuclear Regulatory Research has conducted research to support understanding of the food chain pathway by evaluating the items below and recommending parameter values to be used in the GENII Biosphere Code for Assessing Radionuclide Releases to Atmosphere and Water: • Assess regional factors affecting radionuclide uptake in plants • Determine radionuclide soil-to-plant concentration ratios in plants • Determine radionuclide uptake factors in fruit and nut trees • Review archived data for radionuclide animal product transfer coefficients • Consider interception fraction for radionuclides deposited on leaves

IAEA REPORT SECTION 5. POST-ACCIDENT RECOVERY	
Off-Site Remediation of Areas Affected by the Accident (Section 5.1)	
Pre-accident planning for post-accident recovery is necessary to improve decision making under pressure in the immediate post-accident situation. National strategies and measures for post-accident recovery need to be prepared in advance in order to enable an effective and appropriate overall recovery programme to be put in place in case of a nuclear accident. These strategies and measures need to include the establishment of a legal and regulatory framework; generic remediation strategies and criteria for residual radiation doses and contamination levels; a plan for stabilization and decommissioning of damaged nuclear facilities; and a generic strategy for managing large quantities of contaminated material and radioactive waste. Remediation strategies need to take account of the effectiveness and feasibility of individual measures and the amount of contaminated material that will be generated in the remediation process. As part of the remediation strategy, the implementation of rigorous testing and controls on food is necessary to prevent or minimize ingestion doses.	NRC regulations require the development of recovery plans following an accident. 10 CFR 50.47(b)(13) requires that general plans for recovery and reentry be developed consistent with NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," page 70, "Recovery and Reentry Planning and Post accident Operations." The NRF is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRF is an essential component of the National Preparedness System mandated in Presidential Policy Directive (PPD)-8, "National Preparedness." PPD-8 is aimed at strengthening the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the Nation. PPD-8 defines five mission areas—Prevention, Protection, Mitigation, Response,

	and Recovery—and mandates the development of a series of policy and planning documents to explain and guide the Nation's collective approach to ensuring and enhancing national preparedness. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. FEMA is responsible for coordinating offsite Federal response activities and Federal assistance to State and local

	governments for functions other than radiological monitoring and assessment. FEMA's coordination role is to promote an effective and efficient response by Federal agencies at both the national level and at the scene of the emergency. FEMA coordinates the activities of Federal, State, and local agencies at the national level through the use of its Emergency Support Team and at the scene of the emergency with its Emergency Response Team. The FRMAC is a Federal asset available on request by DHS and State and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency organization with representation from NNSA, DOD, the EPA, HHS, FBI, and other Federal agencies. The mission of the FRMAC is to coordinate and manage all Federal radiological environmental monitoring and assessment activities during a nuclear or radiological incident, within the U.S. in support of State, local, tribal governments, DHS, and the Federal coordinating agency.
Further international guidance is needed on the practical application of safety standards for radiation protection in post-accident recovery situations.	DOS is responsible for the conduct of relations between the U.S. Government and other governments and international organizations and for the protection of U.S. interests and citizens abroad. In a radiological emergency outside the United States, DOS is responsible for coordinating U.S. Government actions concerning the event in the country where it occurs (including evacuation of U.S. citizens, if necessary) and internationally. With respect to the need for the international community to develop additional guidance on the practical application of safety standards for radiation protection in post-accident recovery situations, the NRC would be pleased to participate in discussions concerning additional guidance in multilateral fora such as the IAEA or NEA.

	The NRC also has two treaties in place involving interaction with the IAEA on communications of disasters: • The ENAC was developed after the Chernobyl accident to provide an international framework to facilitate the exchange of information and prompt provisions of assistance in the event of a nuclear or radiological emergency with the aim of minimizing consequences. Since the Fukushima accident, the NRC has participated in a number of exercises that included the use of the ENAC. • The USIE, which is a centralized repository for the collection of information from countries which may be experiencing an emergency. USIE promotes information sharing by allowing other countries access to consistent and current information. USIE has been in development since 2011 and the NRC participated in its use. In a domestic radiological emergency with potential international trans-boundary consequences, DOS will coordinate all contacts with foreign governments and agencies except where existing bilateral agreements provide for direct exchange of information. DOS is responsible for conveying the U.S. Government response to foreign offers of assistance.
On-Site Stabilization and Preparations for Decommissioning (Section 5.2)	
Following an accident, a strategic plan for maintaining long-term stable conditions and for the decommissioning of accident-damaged facilities is essential for on-site recovery. The plan	The NRF is a guide to how the Nation responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities

needs to be flexible and readily adaptable to changing conditions and new information. Retrieving damaged fuel and characterizing and removing fuel debris necessitate solutions that are specific to the accident, and special methods and tools may need to be developed.	across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. It should be noted that the nuclear utilities have the responsibility for consequence management actions within the facility boundary, including the disposal of rubbish, wastes and fuels. The nuclear utilities may elect to contract with external assets in order to develop special methods and tools if needed. The Federal Government will maintain regulatory oversight over the utility's onsite recovery actions. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to

	nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities. FEMA is responsible for coordinating offsite Federal response activities and Federal assistance to State and local governments for functions other than radiological monitoring and assessment. FEMA's coordination role is to promote an effective and efficient response by Federal agencies at both the national level and at the scene of the emergency. FEMA coordinates the activities of Federal, State, and local agencies at the national level through the use of its Emergency Support Team and at the scene of the emergency with its Emergency Response Team. The FRMAC is a Federal asset available on request by DHS and State and local agencies to respond to a nuclear or radiological incident. The FRMAC is an interagency organization with representation from NNSA, DOD, the EPA, HHS, FBI, and other Federal agencies. The mission of the FRMAC is to coordinate and manage all Federal radiological environmental monitoring and assessment activities during a nuclear or radiological incident, within the U.S. in support of State, local, tribal governments, DHS, and the Federal coordinating agency. DOS is responsible for the conduct of relations between the U.S. Government and other governments and international organizations and for the protection of U.S. interests and citizens abroad.

	In a radiological emergency outside the United States, DOS is responsible for coordinating U.S. Government actions concerning the event in the country where it occurs (including evacuation of U.S. citizens, if necessary) and internationally. In a domestic radiological emergency with potential international trans-boundary consequences, DOS will coordinate all contacts with foreign governments and agencies except where existing bilateral agreements provide for direct exchange of information. DOS is responsible for conveying the U.S. Government response to foreign offers of assistance.
Management of Contaminated Material and Radioactive Waste (Section 5.3)	
National strategies and measures for post-accident recovery need to include the development of a generic strategy for managing contaminated liquid and solid material and radioactive waste, supported by generic safety assessments for discharge, storage and disposal.	The nuclear utilities have the responsibility for consequence management actions within the facility boundary, including liquid and solid material and radioactive waste. The Federal Government will maintain regulatory oversight over the utility's onsite recovery actions. The NRF is a guide to how the U.S. responds to all types of disasters and emergencies. It is built on scalable, flexible, and adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas.

	The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers, or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities.
Community Revitalization and Stakeholder Engagement (Section 5.4)	
It is necessary to recognize the socioeconomic consequences of any nuclear accident and of the subsequent protective	The NRF is a guide to how the Nation responds to all types of disasters and emergencies. It is built on scalable, flexible, and

actions, and to develop revitalization and reconstruction projects that address issues such as reconstruction of infrastructure, community revitalization and compensation. Support by stakeholders is essential for all aspects of post-accident recovery. In particular, engagement of the affected population in the decision-making processes is necessary for the success, acceptability and effectiveness of the recovery and for the revitalization of communities. An effective recovery programme requires the trust and the involvement of the affected population. Confidence in the implementation of recovery measures has to be built through processes of dialogue, the provision of consistent, clear and timely information, and support to the affected population.	adaptable concepts identified in the National Incident Management System to align key roles and responsibilities across the Nation. This framework describes specific authorities and best practices for managing incidents that range from the serious but purely local to large-scale terrorist attacks or catastrophic natural disasters. The NRF describes the principles, roles and responsibilities, and coordinating structures for delivering the core capabilities required to respond to an incident and further describes how response efforts integrate with those of the other mission areas. The NRF is an essential component of the National Preparedness System mandated in PPD-8, "National Preparedness." PPD-8 is aimed at strengthening the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the Nation. PPD-8 defines five mission areas—Prevention, Protection, Mitigation, Response, and Recovery—and mandates the development of a series of policy and planning documents to explain and guide the Nation's collective approach to ensuring and enhancing national preparedness. In PPD-8, the term "recovery" refers to those capabilities necessary to assist communities affected by an incident to recover effectively, including, but not limited to, rebuilding infrastructure systems; providing adequate interim and long-term housing for survivors; restoring health, social, and community services; promoting economic development; and restoring natural and cultural resources. The NRIA to the NRF describes the policies, situations, concepts of operations, and responsibilities of the Federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactive materials to address the consequences of the event. These incidents may occur on Federally-owned or -licensed facilities, privately-owned property, urban centers,

	or other areas and may vary in severity from the small to the catastrophic. The incidents may result from inadvertent or deliberate acts. The NRIA applies to incidents where the nature and scope of the incident requires a Federal response to supplement the State, tribal, or local incident response. The purpose of this annex is to: • Define the roles and responsibilities of Federal agencies in responding to the unique characteristics of different categories of nuclear/radiological incidents. • Discuss the specific authorities, capabilities, and assets the Federal Government has for responding to nuclear/radiological incidents that are not otherwise described in the NRF. • Discuss the integration of the concept of operations with other elements of the NRF, including the unique organization, notification, and activation processes and specialized incident-related actions. • Provide guidelines for notification, coordination, and leadership of Federal activities.