

**Responses to Information Requests from Senator Dianne Feinstein
Letter of March 16, 2012**

1. **European nuclear regulators appear to be moving more aggressively than the NRC to address the lessons learned from Fukushima. According to a recent report by James Acton and Mark Hibbs of the Carnegie Endowment for International Peace: “In France alone, regulators will issue about one hundred new rules, and plant owner Electricite de France will implement scores of actions at 58 plants concerning issues such as the possible loss of power and loss of heat sinks during extreme events costing an estimated 10 billion euros.” Of particular note are requirements to harden and waterproof back up power systems on site to prevent the loss of power and heat sinks in the event of an external event.**

Based on the actions and reports thus far, it does not appear that the NRC plans to require the same degree of facility upgrades as French regulators. Please explain why the NRC has concluded that the large scale physical upgrades to nuclear power plants required in France are not also appropriate in the United States.

The NRC is taking appropriate regulatory action on a prioritized basis in response to lessons learned from the nuclear accident at the Fukushima Dai-ichi site in Japan. In determining the appropriate actions to take for U.S. nuclear plants, the NRC is closely monitoring steps being taken by the international community to address lessons learned from the Fukushima Dai-ichi accident. Based upon NRC staff attendance at several international conferences to discuss these issues, in addition to bilateral meetings with our European and Asian regulatory counterparts, the NRC has concluded that the broad objectives being addressed by the NRC's prioritized actions are consistent with those being pursued by other countries. Although many countries have started with different approaches, most countries appear to be recognizing the need to address the same basic issues: protection from external hazards, coping with long-term station blackout, and enhancing emergency preparedness. Further, it is not clear from a performance-based perspective that one particular solution (e.g., the French proposal to strengthen the protection for fixed plant equipment versus the U.S. proposal to implement additional mobile, diverse, and flexible equipment) is advantageous over any other.

On December 15, 2011, the Commission approved a three-tiered prioritization of the Near-Term Task Force recommendations. The Tier 1 recommendations are those actions that should be implemented without unnecessary delay. The Tier 2 recommendations are those actions that need further technical assessment or critical skill sets to implement. The Tier 3 recommendations are longer-term actions that depend on the completion of a shorter-term action or need additional study to support a regulatory action.

The NRC has taken action to implement all of the Tier 1 items. On March 12, 2012, the agency issued three orders that contained several requirements. One of the orders requires boiling water reactors (BWRs) with Mark I and Mark II containments to have reliable hardened vents to remove decay heat and maintain control of containment pressure following events that result in the loss of active containment heat removal capability or prolonged station blackout (SBO). In the longer term, the agency plans to explore whether such a requirement would be appropriate for other containment designs as well. The remaining two orders were issued to all reactor licensees, including holders of construction permits and holders of combined licenses. The first requires a three-phase approach to the

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development of strategies to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event. The second requires installation of enhanced SFP instrumentation. These enhancements are intended to address a broad range of beyond-design-basis external events that are more severe than those natural events expected to occur over the life of a nuclear power plant.

The agency anticipates issuing implementation guidance for the orders by August 31, 2012. Each licensee will be required to achieve full compliance within two refueling cycles after the issuance of the guidance, or by December 31, 2016, whichever comes first.

Request for Information letters also were issued on March 12, 2012, directing each nuclear power plant licensee to reevaluate the seismic and flooding hazards at its sites using present-day methods and information, conduct walkdowns of their facilities to ensure protection against the hazards in their current design basis, and reevaluate their emergency communications systems and staffing levels. The NRC expects most reactors will complete the walkdowns and emergency communications and staffing assessments within the next year. The majority of reactors, including those with the greatest potential seismic and flooding risks, are expected to complete the seismic and flooding reevaluations within the 5-year goal established by the Commission. Once responses are received to the letters, the staff will assess the response and make recommendations to the Commission on any additional safety requirements which may be warranted.

The remaining Tier 1 recommendations consist of two rulemakings addressing station blackout (SBO) and integration of emergency procedures at nuclear power plants. On March 20, 2012, the NRC issued an advanced notice of proposed rulemaking (ANPR) to solicit public input on the SBO rulemaking. This step moves the NRC closer to issuing a final rule within the 24 to 30-month schedule directed by the Commission. The NRC has requested public comments on the ANPR by May 4, 2012. On April 18, 2012, the staff issued another ANPR to solicit public input on the integration of emergency procedures at nuclear power plants. The NRC has requested public comments on the ANPR by June 18, 2012.

The staff anticipates being able to begin work on the Tier 2 recommendations after collecting information from the Tier 1 activities, and as soon as resources currently devoted to those activities become available. In July 2012, the NRC staff will provide the Commission with a plan for undertaking the remaining, longer-term Tier 3 activities.

2. **The Fukushima facility was struck by both an earthquake and tsunami beyond its “design basis,” and the event knocked out most of the plant's designed safety systems in a single common mode failure.**

Even a single event that exceeds the design basis of a nuclear power plant should alarm regulators, but in the past fifteen years beyond design basis events have occurred repeatedly. In 1999, a storm surge caused flooding at the Blayais Nuclear Power Plant in France. The 2004 Indian Ocean tsunami flooded seawater pumps at the Madras Atomic Power Station in India. In 2007, an earthquake exceeded the design basis of Japan's largest nuclear power plant, the Kashiwazaki-Kariwa Nuclear Power Station. And in August, an earthquake exceeded the design basis of the North Anna Nuclear Generating Station in Virginia.

These events demonstrate the need to improve the precision and methods for determining design basis, especially in the U.S. where reactors are all more than 20 years old. Scientific knowledge has advanced considerably over recent decades.

The NRC's Near Term Task Force recommended that nuclear plants undergo a full design basis review every ten years. Congress agreed, requiring in Public Law 112-74 that "the Nuclear Regulatory Commission shall require reactor licensees to re-evaluate the seismic, tsunami, flooding, and other external hazards at their sites ... as expeditiously as possible ... and require licensees to update the design basis for each reactor, if necessary."

Please explain what steps the Commission is taking to comply with the statutory requirement and provide a schedule for implementing this requirement.

On March 12, 2012, the NRC issued a request for information to power reactor licensees that required them to undertake a series of actions, including the following:

- Reevaluate seismic and flooding hazards at each site using present-day information, guidance, and methodologies.
- Perform seismic and flooding walkdowns to identify and address plant-specific degraded, nonconforming, or unanalyzed conditions.
- Reevaluate emergency communications systems and staffing levels.

Protection from natural phenomena is critical for continued safe operation of nuclear power plants. Given that new information has been developed on natural phenomena hazards since the licensing basis of currently operating plants was established, the NRC found it necessary to confirm the adequacy of the hazard assumptions for U.S. plants, and their ability to protect against them. These hazards include earthquakes, local intense precipitation, floods of streams and rivers, storm surges, seiches, tsunamis, and dam failures.

Regarding the schedule for seismic and flooding reevaluations, due to limited industry expertise to perform probabilistic safety analyses of seismic and flooding hazards, U.S. plants will be prioritized so that those with the highest risk will perform the analyses first. Completed licensee seismic and flooding hazard evaluations will be due in the 2013 – 2015 timeframe. The NRC will evaluate each licensee's response to the request for information and take additional regulatory action, if necessary, with licensee completion required between 2016 and 2019, based on risk prioritization. Industry representatives have indicated that they may propose an approach to assess the impact of the updated seismic and flooding hazards that may differ from the approaches the NRC is envisioning. If the NRC staff agrees with the industry proposal, this may have a positive effect on the overall schedule for some plants. Additionally, as a longer term action, the NRC staff will consider proposing a rulemaking for Commission consideration that will require licensees to confirm their seismic and flooding hazards every 10 years in order to address any new and significant information.

Regarding the schedule for seismic and flooding walkdowns, licensees will be required to provide the results of their walkdowns within 180 days after NRC endorsement of their proposed walkdown procedures (approximately during November 2012).

The NRC intends to address other external hazards, such as wind and missile loads from tornadoes and hurricanes, and snow and ice loads from winter weather, as a Tier 2 activity that will be initiated as soon as sufficient resources become available.

3. **The NRC recently allowed the North Anna plant to reopen after its beyond-design-basis earthquake without seismic retrofit, structural improvement, or a change to the plant's design basis. It appears that the NRC conducted an inspection and concluded that the facility was safe to reopen because it found no structural damage – even though the facility had never been designed to endure the earthquake that struck.**

NRC's conclusion has effectively eliminated the safety buffer that is supposed to exist between the maximum threat a nuclear plant is designed to endure and the maximum threat it will ever face. I am concerned that the NRC appears to have allowed North Anna to reopen without demanding evidence that the facility is engineered and built to survive earthquakes of similar size in the future.

- a. **Did the NRC reevaluate the seismic threat at North Anna, in consultation with seismic experts, using the new data from the August 2011 earthquake, in order to establish a new understanding of the seismic threat at this plant? If not, why not?**

The ground motion from the magnitude 5.8 Mineral, VA earthquake exceeded the North Anna plants' Safe Shutdown Earthquake (SSE), the ground motion the plant was designed to withstand and remain functional. Prior to restarting, the licensee was required to meet NRC regulation 10 CFR Part 100, Appendix A, Section V, "Seismic and Geological Design Bases," (a)(2), "Determination of Operating Basis Event Earthquake." This regulation states that:

"if vibratory ground motion exceeding that of the Operating Basis Earthquake occurs, shutdown of the nuclear power plant will be required. Prior to resuming operations, the licensee will be required to demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operation without undue risk to the health and safety of the public."

To meet this regulation and to ensure the safe restart of the plant, the licensee performed several activities and analyses, including extensive walkdown inspections, to determine if there was any damage to structures, systems, and components.

The results of these activities demonstrated no observed functional damage to the features necessary for continued operation of the plant without undue risk to the health and safety of the public. The NRC staff's review was performed in accordance with Regulatory Guide 1.167, "Restart of a Nuclear Power Plant Shutdown by a Seismic Event," which confirmed the licensee's finding of no damage to plant structures, systems, and components, and, as a result, the NRC permitted the restart of the North Anna plant.

As a long-term commitment, the licensee agreed to respond to NRC Generic Issue (GI) -199, "Implications of Updated Seismic Hazard Estimates in Central and Eastern US on Existing Plants." GI-199 was initiated due to the higher seismic hazards observed for some of the early site permit applications for new reactors in the central and eastern U.S. The NRC staff's preliminary safety/risk assessment of GI-199 concluded that, despite likely increases in seismic hazard for some operating reactors, the plants remain safe for operation. Subsequently, the

GI-199 issue has been subsumed into the staff's actions involving 10 CFR 50.54(f) letters that were issued in conjunction with Recommendations 2.1 and 2.3 from the NRC's Near Term Task Force report (Agencywide Documents Access and Management System [ADAMS] Accession No. ML111861807). The 10 CFR 50.54(f) letter requests that the licensees of operating nuclear power plants reevaluate seismic hazards for the regions surrounding their plant sites, using current NRC regulations and guidance. The licensees have been requested to use the latest seismic source models for the central and eastern U.S. that were developed jointly by the NRC and industry. The letter requests that licensees reevaluate their seismic hazards within 1.5 years of the issuance of the March 2012 letter. This information will be evaluated by the staff to facilitate NRC's determination whether there is a need to update plants' seismic standards.

- b. Did the NRC study the margins of safety built into the North Anna reactors' designs and determine what size of earthquake the plant can safely withstand? Did the NRC determine whether a significant revision of the design basis at North Anna would necessitate extensive physical renovations? Did NRC conduct a detailed technically-informed analysis of the newly identified seismic risk at North Anna before allowing the plant to reopen?**

The design of structures, systems, and components in nuclear power plants is based on conservative assumptions of postulated seismic demand. However, the actual margin of safety in the design is considerably higher due to the use of many layers of conservative assumptions and built-in factors of safety in the design process. In the early 1990's, the seismic hazards for operating reactors (including North Anna) were evaluated by the licensees as part of their response to Generic Letter 88-20, Supplement 4, "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities." In its IPEEE evaluation, the North Anna licensee provided its seismic margin assessment of structures, systems, and components required for safe shutdown of the plant, which indicated the ground acceleration that the plant can safely withstand without a loss of function.

As a condition for plant restart, the NRC determined that revision of the design basis at North Anna was not warranted for the structures, systems, and components installed at the time of the earthquake. However, the licensee did commit to use the recent ground motion spectrum from the August 23 earthquake in conjunction with the original design basis earthquake for the seismic qualification of new and replacement equipment or modifications.

The restart of the North Anna plant was approved based on three factors. The first factor included the licensee's successful performance of extensive plant walkdowns, sampling evaluations and testing of components in accordance with Electric Power Research Institute's (EPRI's) NP-6695, "Guidelines for Nuclear Plant Response to an Earthquake," which is endorsed by Regulatory Guide 1.167, "Restart of a Nuclear Power Plant Shutdown by a Seismic Event." The second factor was the licensee's commitment, as documented in the staff's "Confirmatory Action Letter, North Anna Power Station (NAPS), Unit Nos. 1 and 2, Commitments to Address Exceeding Design Bases Seismic Event," dated November 11, 2011, to perform the long term evaluation of structures, systems, and components in accordance with the provisions of the EPRI NP-6695 guidelines. The third factor is the licensee's commitment to use the recent ground motion spectrum from the August 23rd earthquake, in conjunction with the original design basis earthquake for the seismic qualification of new and replacement equipment or modifications.

- c. It has been reported that NRC only conducted a thorough inspection of one of the two North Anna reactors, while one reactor was allowed to restart under cautious**

procedures instead. Is this true? If so, why didn't NRC conduct a complete and thorough inspection of both reactors?

As noted above, the NRC staff performed a review of licensee activities conducted in accordance with Regulatory Guide 1.167, which confirmed the licensee's finding of no damage to plant systems, structures, and components. The NRC independently conducted walkdowns and inspections of both units, which included an independent assessment of Dominion's activities to inspect, test, and evaluate systems, structures and components. NRC's inspection activities were performed on a sampling basis. It is noted that, with adequate justification, there were a few cases where the NRC was satisfied with Dominion inspecting one of the unit's components as the basis for demonstrating no functional damage for both units.

- 4. NRC requires all nuclear power plants to provide "adequate safety" regardless of cost. However, it is my understanding that the Commission considers preparation for a beyond-design-basis event to be beyond the requirements of "adequate safety." Therefore, all requirements to prepare for such an event are subject to a cost-benefit evaluation.**

- a. In making decisions about whether to require power plants to enhance the redundancy of safety systems designed to maintain safety, cooling, and heat sinks during station blackouts in the aftermath of beyond-design-basis events, to what degree has the use of this cost benefit evaluation formed the basis of the Commission's decisions to require less redundancy than regulators have required in Europe?**

The NRC staff has been focused over the past year on assessing the identified lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami; and making the necessary enhancements to its regulatory system in a systematic and methodical manner. As such, the staff continues to affirm that current regulatory requirements and existing plant capabilities allow for the determination that a sequence of events like the Fukushima Dai-ichi accident is unlikely to occur in the U.S. Therefore, the continued licensing and operation of U.S. nuclear plants does not pose an imminent threat to public health and safety.

However, the NRC's assessment of lessons-learned from the Fukushima Dai-ichi events has led the staff to conclude that additional requirements should be imposed on licensees to increase the capability of nuclear power plants to mitigate beyond-design-basis external natural events. The staff provided a notation vote paper to the Commission dated February 17, 2012, entitled "Proposed Orders and Requests for Information in Response to Lessons-Learned from Japan's March 11, 2011, Great Tōhoku Earthquake and Tsunami." The Commission approved the issuance of three proposed Orders on March 9, 2012, addressing "Mitigation Strategies for Beyond-Design Basis External Events," "Reliable Hardened Containment Vents (Mark I and II Boiling Water Reactors)," and "Reliable Spent Fuel Pool Instrumentation." Each of the orders was focused on enhancing the redundancy and diversity of plant equipment necessary to respond to a beyond design basis natural event. The regulatory basis for the first two Orders was ensuring continued "adequate protection," and the regulatory basis for the third order was an administrative exemption to the "Backfit Rule." As such, the bases for the NRC's issuance of these Orders did not rely on a comparison of cost or benefits.

Consistent with the NRC's mission, the NRC staff will continue to monitor all lessons-learned activities developed by domestic stakeholders and international counterparts to ensure that U.S. nuclear power plants continue to operate safely.

- b. When considering the potential costs of a nuclear crisis, is it correct that the NRC does not factor in the potential economic impact of evacuations that may be necessary in the event of a beyond design basis event? The costs associated with an evacuation of citizens near plants, even if the crisis is controlled without radiation leaks, could run into the billions of dollars. This is especially true for plants near large population centers. Why does NRC choose not to consider these costs when evaluating safety improvements?**

On a case-by-case basis, the Commission may deem safety improvements for protection against a beyond-design-basis event necessary for adequate protection of public health and safety. In such circumstances, the Commission will impose those safety improvements and does not consider costs of the regulatory action. For evaluation of safety enhancements that are not necessary for adequate protection, the NRC does factor economic impacts of accidents, including evacuation costs, when evaluating safety improvements. When evaluating potential safety improvements for protection against beyond design basis events, the NRC completes a cost-benefit analysis in which it considers offsite impacts such as the potential exposure of the public to radiation, and the costs associated with evacuation, relocation, cleanup, and decontamination.

The Commission will be receiving a paper from the NRC staff late this summer on the regulatory framework for conducting cost-benefit analyses when assessing the impacts of offsite contamination and economic considerations following an accident.