

December 2, 2011

The Honorable Barbara Boxer  
Chairman, Committee on Environment  
and Public Works  
United States Senate  
Washington, D.C. 20510

Dear Madam Chairman:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of August 26, 2011, regarding NRC actions to ensure the safety of Americans from threats posed by nuclear facilities following a natural disaster, such as an earthquake or hurricane. Answers to your specific questions are included as an enclosure to this letter. In addition, the NRC was able to brief your staff on September 1, 2011, regarding the recent earthquake in central Virginia and more broadly on seismic safety issues.

We appreciate hearing your views and thank you for your interest in these matters. Please be assured that the NRC will take all actions necessary to adequately protect public health and safety. If you have any additional questions, please contact me or Ms. Rebecca Schmidt, Director of the Office of Congressional Affairs, at (301) 415-1776.

Sincerely,

*/RA/*

Gregory B. Jaczko

Enclosure:  
[As stated](#)

cc: Senator James M. Inhofe

**Response to Questions from Senator Barbara Boxer  
Letter of August 26, 2011**

**North Anna Nuclear Plant**

**1. Describe what occurred at the North Anna nuclear power plant as a result of the earthquake, including the sequence of events that led to the shutdown of the two reactors, the failures of any safety equipment to operate following the earthquake, and any problems that may have occurred when the plant restarted.**

Just after 2 p.m. on August 23, 2011, the North Anna Power Station declared an Alert condition due to significant seismic activity onsite. Both units experienced automatic reactor trips from 100 percent power and were stabilized in hot shutdown. All offsite electrical power to the site had been lost. All four emergency diesel generators (EDG) started automatically and provided power to the emergency buses. While operating, one EDG developed a coolant leak and was shut down. The corresponding emergency bus was re-energized with another diesel-powered generator.

On August 29, 2011, the Nuclear Regulatory Commission dispatched an Augmented Inspection Team (AIT) to NAPS to further review the effects of the earthquake, the operators' response, and the plant staff's activities to check equipment. The AIT findings included: (1) operators responded to the event in accordance with established procedures and in a manner that protected public health and safety; (2) the ground motion from the earthquake exceeded the plant's licensed design basis; (3) no significant damage to the plant was identified; (4) safety system functions were maintained; and (5) some equipment issues were experienced. Overall, the team concluded that the event did not adversely impact the health and safety of the public. Safety limits were not approached and there was no measurable release of radioactivity associated with the event. Additional information may be found in the AIT report published on October 31, 2011, "North Anna Power Station - Augmented Inspection Team." The AIT report describes what occurred at NAPS as a result of the earthquake, provides a detailed sequence of events associated with the shutdown of the two reactors, and includes a review of plant operator and safety equipment performance in response to the earthquake.

The NRC also sent a team of inspectors to NAPS to provide an assessment of the licensee's inspection and testing program and the licensee's readiness for restart. Overall, this team concluded that the licensee performed adequate inspections, walkdowns, and testing to ensure that safety-related structures, systems, and components have not been adversely affected by the earthquake.

In addition to the on-site inspection activities, the NRC performed an independent technical review of the information submitted by the licensee to demonstrate that no functional damage occurred at NAPS, as a result of the earthquake, to those features necessary for continued operation, in accordance with 10 CFR Part 100, Appendix A. The NRC published the results of this review on November 11, 2011, in a report, "North Anna Power Station, Units 1 and 2, Technical Evaluation, Review of Restart Readiness Determination Plan."

There was some earthquake-related damage to non-safety-related equipment observed at NAPS; however, this damage was considered minor (i.e., it was not functional damage that would preclude safe operation of the facility). In addition, there were some non-earthquake related issues identified as a result of the inspections performed. These issues are being

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addressed through established licensee and NRC processes to ensure they are adequately addressed without undue risk to the health and safety of the public.

Both North Anna Units have restarted and returned to full power operation with no significant issues.

**2. Described whether the North Anna plant fully addressed all past safety problems found at the facility, including the problems that the NRC detailed in the May 13, 2011 report and structural integrity issues or other problems that may have occurred as a result of the August 23, 2011 earthquake. If the plant has not fully addressed all of these safety issues, provide a timeline by which the plant will have addressed all such problems.**

NRC inspectors reviewed the Inspection Report of May 13, 2011, and conducted a detailed follow-up inspection. There were no inspection findings identified during this follow-up inspection. The AIT inspection conducted in response to the earthquake is complete and should provide more information. The AIT inspection report is scheduled to be issued in late October.

**3. Describe the seismic hazards that the plant is designed to withstand, the date that those hazards were estimated, the basis for estimated seismic hazards, and any more recent data on seismic hazards that may differ from the information used to originally estimate the seismic hazards for the North Anna plant.**

The North Anna Power Station (NAPS) has two design basis earthquake (DBE) ground motion design limits. The first is for structures, systems, and components (SSCs) founded on top of rock, and is anchored at 0.12g (12 percent of the force of gravity). The other DBE is for SSCs founded on top of soil, and is anchored at 0.18g, with the consideration that soil will amplify a quake's ground motion. These seismic hazards were estimated during the time that the construction permits for Units 1 and 2 were issued in 1971. These design values are addressed in the NAPS Final Safety Analysis Report (FSAR). The FSAR indicates that the estimates were based on the Modified Mercalli Intensity (MMI) rating of VII, which is associated with the largest potential earthquake related to the Arconia Syncline occurring close to the site area. The North Anna plant was evaluated as part of the Individual Plant Examination for External Events (IPEEE) effort in response to NRC Generic Letter 88-20, Supplement 4, and found to be capable to withstand a significantly higher seismic ground motion than the design basis earthquake. The seismic hazard analysis that was used for the Early Site Permit Application for the proposed North Anna, new Unit 3, differs from the earlier Units 1 and 2 estimate, in that it provides for a higher response spectrum, mostly with regards to the high frequency side for the site, using the performance-based approach, as recommended in Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," dated March 2007. That higher response spectrum established for Unit 3 likely would not have been exceeded by the ground motion from the recent earthquake.

**4. There have been reports that the plant was designed to withstand a 5.9-6.1 magnitude earthquake and the earthquake experienced was a 5.8 magnitude earthquake. Given the current understanding of the seismic risks, describe the difference in the margin of safety assumed at the time the plant was built versus when the earthquake occurred.**

As indicated in the response to Question 3 above, the design of NAPS is based on a Modified Mercalli Intensity (MMI) rating VII. This intensity does not correlate directly with the measured magnitude 5.8 experienced at the plant site. The preliminary information on the measured response spectra from the ground motion experienced by plant structures indicates that, except for some structures and components whose capacity is yet to be verified, ground motion exceeded the design spectra at certain frequencies. It should be noted that ground motion spectrum was well within the IPEEE review level earthquake mentioned above, and the observed ground motion does not appear to have appreciably encroached on the margin of safety for seismic design of safety-related structures and components. It should be further noted that the ground response spectrum from the recent earthquake experienced at North Anna is weaker than the anticipated response spectrum the licensee would be expected to use in its seismic risk evaluation in conjunction with the response to NRC's proposed generic letter for Generic Issue 199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants," currently under development.

#### **NRC's Review of Seismic Hazards**

**5. Following up on the NRC's September 2010 report titled "Implications of Outdated Probabilistic Seismic Hazard Estimates in the Eastern and Central United States on Existing Plants," describe:**

- a. Whether there are any new seismic-hazard estimates that the report anticipated would be finished in late 2010 or early 2011. If so, please provide those estimates;**
- b. The status of implementation of the report's recommendations, including a description of the plants that have and have not recalculated their seismic core damage frequency;**
- c. The timeline for completing individual safety reviews at all of the nation's nuclear power plants; and**
- d. Steps that the NRC could take to expedite the implementation of safety reviews and the completion of any work needed to address safety issues found during such a review.**

The NRC report is an Information Notice (IN) 2010-018, entitled "Implications of Updated Probabilistic Seismic Hazard Estimates in the Eastern and Central United States on Existing Plant." Generic Issue 199 (GI-199) was initiated in 2005 to provide an assessment of the implications of identified changes in seismic hazard estimates on operating nuclear power plants in the Central and Eastern U.S. (CEUS). Based on the evaluation contained in the safety/risk assessment of GI-199, the staff concluded that overall seismic risk estimates remain small in an absolute sense. The seismic risk metric that was used in the GI-199 assessment is seismic core damage frequency (SCDF). Based on the GI-199 assessment, all operating plants in the CEUS have SCDF values less than or equal to  $10^{-4}$ /year, confirming that there is no immediate concern regarding adequate protection. The changes in SCDF estimates developed in the safety/risk assessment for some plants meet the numerical risk criteria (contained in NRC directives) for an issue to continue to the regulatory assessment stage of the Generic Issue Program. Therefore, a Generic Letter (GL) is under preparation to request nuclear power plant

licensees to carry out new seismic safety assessments based on the current understanding of seismic hazard.

- a) The information on updated seismic hazard estimates is expected to be available at the end of calendar year 2011.
- b) According to the draft GL, addressees would start their evaluations following formal issuance of the final GL. The GL provides a proposed schedule for various milestones that they are required to follow for submitting the requested information.
- c) The above mentioned milestones specify proposed completion of seismic evaluations within one or two years from the date of issuance of the GL, depending on the chosen type of seismic evaluation (i.e., seismic margin assessment or seismic probabilistic risk assessment).
- d) The NRC may opt to use contractors to provide the NRC with technical assistance as part of NRC's review of licensees' seismic risk evaluations.

### **California Nuclear Power Plants**

#### **6. Describe the status of the San Onofre and Diablo Canyon Nuclear Power Plant reassessments of seismic risks. Please include the following information:**

##### **a. Will the NRC consider and utilize all of the new information on seismic risks generated by these plants in the licensing proceedings for these facilities? How will the NRC do so, and will it protect the ability of communities to challenge the NRC's relicensing decision?**

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

For the Diablo Canyon license renewal review, the staff has issued a safety evaluation report (SER). But the staff has delayed the overall review schedule based on a request by the applicant to allow completion of the State's processing of Diablo Canyon's coastal consistency certification. Therefore, prior to finalizing a decision on license renewal for Diablo Canyon, the staff will supplement the SER, as necessary, and consider any information that affects the information in the license renewal application and SER, including results from the seismic studies associated with age-related degradation. The staff will also consider any new and significant information from the site's seismic studies in the completion of its environmental review.

The scope of the Generic Issue 199 (GI-199) Safety/Risk Assessment Report is limited to plants in the Central and Eastern United States. Although, Western plants such as Diablo Canyon and

San Onofre sites are not included in the GI-199 Safety/Risk Assessment Report, the Information Notice on GI-199 is addressed to all operating power plants in the U.S. (as well as all independent spent fuel storage installation licensees). The staff plans to consider the inclusion of operating reactors in the Western U.S. in its future generic communication information requests.

In keeping with NRC's open and transparent processes, the NRC review will continue to have dialogue with all stakeholders, including public interest groups, industry, Federal, State, Tribes and local agencies, and members of the public, as well as making associated documents available on the NRC website, to enhance understanding of the regulatory decision-making process. In addition, members of the public have the opportunity to petition to intervene in the license renewal process.

**b. The Diablo Canyon Power Plant has recently asked to change the type of earthquake that the plant could safely withstand to focus on the Hosgri Fault. Describe whether the plant has proposed to use a method of seismic review that is consistent with NRC regulations, including 10 CFR 50.59 (concerning the completeness and accuracy of information presented to the NRC) and whether the plant has conducted any new studies to support this modification.**

In multiple public meetings, Pacific Gas and Electric Company (PG&E) has informed the NRC staff of its intention to submit a license amendment request (LAR) to: 1) change the Safe Shutdown Earthquake (SSE) from the double-design earthquake (DDE) to the Hosgri earthquake (HE), and 2) establish a methodology for the evaluation of new seismic information. The submission of this LAR is currently scheduled for late September 2011. In a meeting held on June 22, 2011, PG&E informed the NRC staff that there are no new calculations and no plant modifications being performed to support this request. The staff learned from this meeting that PG&E plans to request approval for this change based on existing licensing basis documentation that the HE is qualified to the standard accepted by the staff during the licensing process. PG&E performed an evaluation regarding this change and determined that NRC staff review and approval is required to make changes, as some of the methods used for the seismic reviews could not be reconciled under existing regulations.

### **Preparedness and Evacuation Plans**

**7. The Fukushima disaster proves that in a major event, the evacuation zone must be greatly expanded. What is the NRC doing now to ensure that nuclear power plants update their preparedness and evacuation plans to include protections for the millions of people living within 50 miles of those facilities?**

One of the objectives of emergency response planning is to minimize the potential for public radiation exposure from a spectrum of accidents or incidents that could produce offsite doses in excess of protective action guidelines (PAGs). Two well-defined emergency planning zones have been established around domestic nuclear power plants: the 10-mile "plume exposure" emergency planning zone (EPZ) and the 50-mile "ingestion pathway" EPZ.

The size of the 10-mile EPZ is based on two principal factors: (1) projected doses from design basis accidents would not exceed the PAGs beyond 10 miles, and (2) projected doses from very low probability "worst-case" core damage accidents would not exceed doses harmful to human health outside the 10-mile zone. In addition, the NRC and FEMA have concluded that detailed planning within 10 miles provides a substantial basis for expansion of response efforts in the event that expansion proves necessary. During the emergency at Fukushima, conditions

degraded to a point that Japanese officials required additional protective actions beyond the established 10-km (6-mile) area around the facility. While the U.S. emergency preparedness (EP) framework has always considered the potential for expansion of the EPZ should it be necessary, the events in Japan provided a “real-world” look at the implementation of such an expansion. The NRC, as part of its longer-term review of its EP regulations, plans to examine the insights and lessons learned from the phased evacuations conducted beyond the established plume exposure EPZ around Fukushima.

A second and larger EPZ covers an area of about 50 miles around domestic nuclear power plants. The predominant concern for this area is exposure to radionuclides through ingestion. The predetermined protection action plans in place for the domestic 50-mile EPZ include prompt interdiction of contaminated food, dairy, and water products, as well as directives to provide stored feed to livestock and to remove them from pasture. Scientific studies of the Chernobyl accident have shown that ingestion was the predominant exposure pathway to populations living at distances beyond the evacuation area. This ingestion exposure (e.g., drinking contaminated milk) resulted in elevated thyroid doses and the later development, in some children, of thyroid cancer. In the days after the releases from the Fukushima site, Japanese officials worked quickly to monitor, identify, and interdict contaminated food products to prevent them from being consumed.

The NRC has conducted numerous studies on evacuations and their associated phenomena, including assessments of several large-scale, mostly “ad-hoc” evacuations that have occurred within the U.S. over the past 15 years. From this research, the NRC gained valuable insights into the evacuation process (as well as affirmed that evacuations are an effective tool to protect public health and safety). As a result, the revisions to the NRC’s EP regulations update the NRC requirements for the evacuation time estimates (ETEs) that licensees must prepare. ETEs are used as a tool to develop and improve evacuation plans in advance of an accident and to decide whether sheltering or evacuation is the appropriate protective action following an accident. The NRC issued Draft NUREG/CR-7002, “Criteria for Development of Evacuation Time Estimate Studies,” (available electronically in the NRC’s Agencywide Documents Access and Management System (ADAMS), Accession No. ML102790350) in May 2010 to provide the latest guidance for licensees on how to develop a comprehensive set of ETEs.

Finally, the NRC continues to work actively with its Federal (EPA, HHS, and DHS/FEMA), State, and local partners to continue to enhance the state of emergency preparedness around domestic nuclear power plants. These efforts include the distribution of potassium iodide (to date 26 million potassium iodide tablets have been distributed to States), revisions to the NRC and FEMA EP regulations and requirements, and enhancements and updates to the EPA PAG Manual.