UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

CHAIRMAN

April 8, 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 March 17, 2011. In light of the recent events in Japan, you asked that NRC perform a thorough review of nuclear power plants and posed a number of questions. Detailed responses to the questions contained in your letter are provided in the enclosure.

Regarding a review of the California facilities, the Commission directed the NRC staff to establish a senior level agency task force to conduct a methodical and systematic review of our processes and regulations to determine whether the agency should make additional improvements to our regulatory system. This activity will have both near-term and longer-term objectives. We will keep you and our other stakeholders informed as we proceed.

While the NRC continues to provide assistance to the Japanese government, I want to assure you that we continue to make our domestic responsibilities for licensing and oversight of the U.S. licensees our top priority and that the U.S. plants continue to operate safely. With our near-term evaluation of the relevance of recent events to the U.S. fleet underway, we are continuing to gather the information necessary for us to take a longer, more thorough look at the events in Japan and their lessons for us. Based on these efforts, the agency will take all appropriate actions necessary to ensure the continuing safety of the American public.

Sincerely,

Gregory B. Jaczko

Enclosure: As stated

Identical letter sent to

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

The Honorable Tom Carper
United States Senate
Washington, D.C. 20510

**Responses to Questions from Senator Barbara Boxer and Senator Tom Carper**
**Letter of March 17, 2011**

**1. Please identify all U.S. nuclear facilities subject to significant seismic activity and/or tsunamis.**

Although we often think of the US as having "active " and non-active" earthquake zones, earthquakes can actually happen almost anywhere. Seismologists typically separate the US into low, moderate and high seismicity zones. The NRC requires that every nuclear plant be designed for site-specific ground motions that may be expected at their locations. In addition, the NRC has specified a minimum ground motion level to which all nuclear plants must be designed. The designation of the general type of seismic zone that may apply at any specific site is subject to interpretation but a conservative interpretation – meaning a larger zone—might include the following plants, based upon a preliminary estimate:

High Seismicity – Diablo Canyon, SONGS

Moderate Seismicity – Brunswick, Robinson, Summer, Vogtle, Hatch, Clinton, Watts Bar, Sequoya, North Anna

Low Seismicity – all other plants

**2. U.S. nuclear power plants are designed to be safe based on historical data of the area's maximum credible threat (including earthquakes and tsunamis). What extra safety features does the NRC currently require for facilities that have a credible threat of an earthquake or tsunami? In light of the recent events in Japan, we would also like the NRC to re-examine the assumptions used to determine the maximum credible threat and suggest additional options that could provide a greater margin for safety at plants nationwide that might be subject to challenges similar to this currently being seen in Japan following the earthquake and tsunami.**

The NRC requires that each plant be designed to withstand expected ground motion level specific to the site. Our regulations also require designs which consider the potential for a tsunami.

We have also taken advantage of the lessons learned from previous operating experience to implement a program of continuous improvement for the U.S. reactor fleet. This includes a number of new regulatory requirements imposed by the NRC that have enhanced the domestic reactor fleet's preparedness for some of the problems we are seeing in Japan.

The "station blackout" (SBO) rule requires every plant in this country to analyze what the plant response would be if it were to lose all alternating current so that it could respond using batteries for a period of time, and then have procedures in place to restore alternating current to

the site and provide cooling to the core. The hydrogen rule requires modifications to reduce the impacts of hydrogen generated in the event of a severe accident and core damage.

With regard to the type of containment design used by the most heavily damaged plants in Japan, the NRC initiated a Boiling Water Reactor (BWR) Mark I Containment Improvement Program in the late 1980. This led to installation of hardened vent systems for containment pressure relief, as well as enhanced reliability of the automatic depressurization system.

Additionally, following the 9/11 events, reactor licensees have been required to develop strategies to maintain and restore core cooling, containment, and spent fuel pool cooling capabilities under the circumstances associated with the loss of large areas of the plant due to explosions or fire. Licensees are required to develop strategies for fire fighting, operations to mitigate fuel damage, and actions to minimize radiological release

As a result of the events in Japan, the Chairman, with the full support of the Commission, has directed the NRC staff to establish a senior level agency task force to conduct a methodical and systematic review of our processes and regulations to determine whether the agency should make additional improvements to our regulatory system. This activity will have both near-term and longer-term objectives.

For the near term effort, we have begun a 90-day review. This review will evaluate all of the available information from the Japanese events to identify immediate or near-term operational or regulatory issues potentially affecting the 104 operating reactors in the U.S., including their spent fuel pools. Areas of investigation will include protection against earthquake, tsunami, flooding, hurricanes; station blackout and a degraded ability to restore power; severe accident mitigation; emergency preparedness; and combustible gas control. Over this 90-day period, we will develop recommendations, as appropriate, for changes to inspection procedures and licensing review guidance, and recommend whether generic communications, orders, or other regulatory requirements are needed.

The task force's longer-term review will begin as soon as the NRC has obtained sufficient technical information concerning the events in Japan. The longer term review will evaluate all technical and policy issues related to those events to identify additional potential research, generic issues, changes to the reactor oversight process, rulemakings, and adjustments to the regulatory framework that should be pursued by the NRC. We will also evaluate interagency issues, such as emergency preparedness, and examine the applicability of any lessons learned to non-operating reactors and materials licensees. We expect to seek input from stakeholders during this process. A report with appropriate recommendations will be provided to the Commission within 6 months of the start of this evaluation. Both the 90-day and final reports will be made publicly available.

**3. Which U.S. nuclear power plants share similar design features with the affected Japanese reactor facilities? Do these facilities have design vulnerabilities that should be addressed to ensure their cooling systems do not fail when confronted by stresses**

**including those similar to what we have seen in Japan following the earthquake and tsunami?**

Thirty-five of the 104 operating nuclear power plants in the U.S. are BWRs, as are the reactors at Fukushima. Twenty-three of the U.S. BWRs have the same Mark I containment as the Fukushima reactors. Four of the U.S. BWRs are early designs which are similar to Fukushima Unit 1. Nineteen U.S. BWRs are similar to Fukushima Unit 3.

BWR Mark I containments have different designs than other containments. However, the staff does not view the differences in design as vulnerabilities. For example, Mark I designs have relatively small volumes in comparison with most pressurized water reactor (PWR) containments. This makes the BWR Mark I containment relatively more susceptible to containment failure given a core meltdown severe enough to cause the reactor vessel to fail and to breach the containment boundary. On the positive side, BWRs have more ways of adding water to the core than PWRs. This includes the provision of two water injection sources which do not rely on AC electric power. For example these systems include Reactor Core Isolation Cooling (RCIC) and High pressure coolant injection (HPCI).

The NRC initiated a Boiling Water Reactor (BWR) Mark I Containment Improvement Program in the late 1980s. This led to installation of hardened vent systems for containment pressure relief, as well as enhanced reliability of the automatic depressurization system. These changes mitigate the small containment volume of the Mark I design.

The NRC task force will be looking at the sequence of events and status of equipment during the events in Japan and will consider based on our review whether revisions to our regulatory framework are needed..

**4. How comprehensive is the radiation monitoring system in Japan? Would the U.S. take a similar monitoring approach if a serious accident were to occur here? What increased risk is associated with exposure to mixed oxide fuel?**

The NRC does not currently have sufficient information to describe in detail the radiation monitoring system in Japan. In addition to the radiation monitoring that is required to be performed by all U.S. reactor licensees, the U.S. Environmental Protection Agency conducts environmental monitoring of radiation. Questions concerning the EPA's monitoring systems and actions should be directed to the EPA.

Mixed oxide (MOX) fuel involves the use of plutonium as a fuel, in addition to enriched uranium. Plutonium, like uranium is a long-lived alpha emitter, and they present similar biological risks. All commercial reactors produce plutonium from uranium during operation regardless of whether the material was there to begin with. Regarding exposure to mixed oxide fuel, in Japan, prompt evacuation has minimized radiation exposure to the public, so long-term public health consequences from radiation exposure resulting from the events, whether due to MOX or uranium fuel, are expected to be small. NRC has evaluated the use of MOX fuel and concluded

that the design basis accidents consequences were within the acceptance criteria and the differences between MOX and uranium fuel were within the dose consequences calculation uncertainties. The staff has concluded that the presence of a small number of MOX fuel assemblies in Fukushima Daiichi Unit 3 constitutes an insignificant change from non-MOX fuel in core operating conditions and accident consequences.

**5. Given what has happened at the Japanese facilities, please describe how the NRC currently ensures the safety of spent fuel pools at U.S. facilities and identify additional steps the NRC could take to better address the vulnerabilities of spent fuel pools at plants in the U.S.**

Information concerning the circumstances and specific sequence of events at the Fukushima plants is incomplete at this time, and the lessons to be learned from those events remain to be determined. The NRC's regulatory focus is to ensure that cooling capability, both for reactors and for spent fuel pools, is maintained in order to prevent fuel damage. This has been accomplished at U.S. plants by redundant and/or diverse capabilities to provide forced cooling and water addition

The NRC task force will be looking at a range of issues, including station blackout and severe accident mitigation at spent fuel pools.

**6. Has the NRC modeled what could happen if the U.S. had multiple nuclear accidents simultaneously? If so, how would the NRC respond to such a disaster?**

In general, the NRC applies the Commission's safety goals on a per-reactor basis. However, in security assessments of two dual-unit sites in the 2002-2004 timeframe, the NRC considered the potential consequences of events simultaneously involving both reactors. The study found that the reactor containments and spent fuel pools are robust structures and resistant to a terrorist attack. The study also found that radiological releases are delayed and smaller than those predicted in past studies. Subsequently, additional mitigation measures were required (10CFR50.44(hh)) to further enhance safety. All U.S. nuclear power plant licensees are required to develop plans to deal with emergencies at their facilities, including the loss of offsite power. In addition, site-specific offsite emergency preparedness plans are required to be developed and exercised on a regular basis, to provide reasonable assurance that adequate protective measures can and will be taken in the event of an emergency. While these capabilities and plans are site-specific, they would apply as well in the event of a broader emergency involving multiple sites.

With regard to the NRC's response to a disaster, the NRC has experience in responding to national events affecting multiple facilities including major hurricanes and regional power blackouts such as the 2003 Northeast blackout. The NRC maintains an emergency operations center that is staffed 24/7. In addition to this emergency response center, the NRC has a backup operations center. Operation of the emergency response centers are tested regularly during facility and national emergency response drills.