Testimony Submitted by
James D. Boyd
Vice Chairman, California Energy Commission
California Liaison Officer to the
U.S. Nuclear Regulatory Commission
Before the Environment and Public Works Committee
Subcommittee on Air and Nuclear Safety
U.S. Senate
April 12, 2011

Review of the Nuclear Emergency in Japan and Implications for the U.S.

Thank you, Chairman Boxer, Chairman Carper, Ranking Members Inhofe and Barrasso, and Members of the Committee. I am Jim Boyd, Commissioner and Vice Chair, appearing on behalf of the California Energy Commission. I serve as the California Liaison Officer to the U.S. Nuclear Regulatory Commission (NRC). I appreciate the opportunity to appear before you today to discuss California's nuclear power plants in the wake of unfolding events at Japan's Fukushima Daiichi Nuclear Power Plant.

California's Nuclear Power Plants

The 9.0 earthquake, devastating tsunami, and their impacts on the Fukushima Daiichi Nuclear Plant in Japan underscore the importance of addressing seismic uncertainties at nuclear power plants. California has two large operating nuclear power plants located in earthquake prone areas on California's coastline and they are susceptible to tsunamis. Diablo Canyon Nuclear Power Plant, owned by Pacific Gas & Electric (PG&E), is a 2,160 MW two-unit plant located near San Luis Obispo. The San Onofre Nuclear Generating Station (SONGS) owned by Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E), is a 2,200 MW power plant located north of San Diego. These plants provide approximately 13 percent of California's overall electricity supply and are licensed to operate through the mid-2020s. Their construction permits were issued in the 1960-1970 timeframe and they began commercial operation in the mid-1980s. California also has three permanently shut down commercial power reactors: Rancho Seco, near Sacramento (closed in 1989), SONGS Unit 1 (closed in 1992) and Humboldt Bay 3 in northern California, which was closed in 1976 due to seismic concerns.

Seismic Safety Concerns at Diablo Canyon and San Onofre

Over the last few decades, earthquake and tsunami concerns have been raised at both Diablo Canyon and San Onofre. The Hosgri Fault, located only three miles offshore, was discovered during the construction of the Diablo Canyon plant. In January 1976, the USGS concluded that the Hosgri Fault should be considered capable of producing an earthquake with a magnitude 7.0 to 7.5. As a result, Diablo Canyon was redesigned

and upgraded for a 7.5 magnitude earthquake. Construction costs exceeded the initial $320 million estimate (1968 dollars) by more than $5 billion primarily due to required seismic upgrades. In 1978 the NRC required PG&E to implement a Long Term Seismic Program as a condition of Diablo Canyon's operating license. San Onofre, licensed and built before Diablo Canyon, was not under the same requirements.

In November 2008, the Energy Commission completed a two-year comprehensive study of the Diablo Canyon and San Onofre plants, as required by California legislation (Assembly Bill 1632, Blakeslee).[1] This assessment examined the vulnerability of these plants to a major disruption from an earthquake or plant aging, the impacts from such a disruption, and the costs and impacts of the accumulating nuclear waste at these plants.[2] Concurrent with the Energy Commission's adoption of this study and report in 2008, PG&E announced that the USGS had discovered a previously unknown major offshore fault—the Shoreline Fault—less than a mile from Diablo Canyon. This is the second major fault discovered near the plant. PG&E and NRC subsequently concluded that Diablo Canyon's design would withstand the potential ground motions from this fault. However, this fault's major characteristics are largely unknown including its length, whether it might extend beneath the plant, its relationship to the Hosgri Fault, and if these two faults may interact causing a larger earthquake than if either fault broke separately. The Energy Commission's 2008 study concluded that important data on Diablo Canyon's seismic hazard and plant vulnerabilities are incomplete and that advanced three-dimensional geophysical seismic reflection mapping and other advanced technologies could help resolve questions about the nature of the Hosgri Fault and change estimates of the seismic hazard at the plant.

The Energy Commission's study also found that data, which has become available since the San Onofre plant was built, indicate that this coastal power plant could experience larger and more frequent earthquakes than was anticipated when the plant was originally designed for a maximum 7.0 earthquake. A review in 2001 by the California Coastal Commission stated that, "there is credible reason to believe that the design basis earthquake approved by the NRC at the time of the licensing of SONGS 2 and 3… may underestimate the seismic risk at the time."[3] The Coastal Commission also recently concluded that, "more recent examinations indicate that a larger earthquake or a large submarine landslide could generate a tsunami larger than that considered by SCE or the NRC."[4] Although this new information does not necessarily imply that the facility is unsafe, since the plant was engineered with a large safety margin, the possibility that the safety margin is shrinking suggests that further study is essential to characterize the seismic and tsunami hazard for the site, especially since so much less is known about the seismic setting of SONGS than the seismic setting at Diablo Canyon.

---

[1] California Energy Commission, *An Assessment of California's Nuclear Power Plants: AB 1632 Report,* November 2008, CEC-100-2008-009-CMF.
[2] The Energy Commission in 2008 adopted the study and report entitled "*An Assessment of California's Nuclear Plants*: *AB 1632 Report (AB 1632 Report)* and the *Integrated Energy Policy Report (IEPR 2008).*
[3] California Coastal Commission, http://www.coastal.ca.gov/energy/E-00-014-3mmi.pdf, page 19.
[4] Mark Johnsson, Coastal Commission. "The Tohoku Earthquake of March 11, 2011: A Preliminary Report on Implications for Coastal California, March 24, 2011.

California Agencies' Recommendations

The California Energy Commission and the California Public Utilities Commission (CPUC) in 2009 directed PG&E and SCE to undertake the studies recommended in the AB 1632 Report as part of their license renewal evaluations. These studies include using three-dimensional geophysical seismic reflection mapping and other advanced techniques, such as those used in oil and gas exploration, to supplement ongoing seismic research programs at Diablo Canyon and San Onofre. These studies also include reviewing the tsunami hazards at their plants in light of recent research and improved scientific understanding of tsunamis. The Energy Commission also recommended in 2008 that PG&E and SCE should return their spent fuel pools to more open racking configurations as soon as feasible.

PG&E has begun some of the recommended advanced seismic studies and plans to complete them in 2013. SCE has applied to the CPUC for funds for these studies and plans to complete them in 2016. The Energy Commission also recommended that the NRC should consider the findings from these studies in its relicensing review. The NRC, PG&E and SCE disagree with this recommendation.

Plant License Renewal Review Process

Recent events in Japan reinforce California officials' position that the advanced seismic studies for Diablo Canyon and San Onofre should be completed, independently reviewed, and that the study findings should be included in the CPUC's and the NRC's relicensing evaluations for these plants. NRC's plant license renewal evaluations for these plants should include the advanced studies recommended in the Energy Commission's AB 1632 Report. They also should include any major additional equipment or follow-up actions required in response to the lessons learned from Japan. The 9.0 magnitude earthquake and resulting tsunami at the Fukushima Daiichi plant far exceeded the original design basis (7.9 magnitude earthquake) for this plant and underscores the importance of addressing seismic risk uncertainties for Diablo Canyon and San Onofre during license renewal evaluations.

In November 2009, PG&E filed an application with the NRC to renew Diablo Canyon's operating licenses (15 years before the licenses expire) before PG&E had completed the AB 1632 Report studies. By filing before completing these studies, the company ignored the Energy Commission's and the CPUC's directives to them that they first complete these studies before filing for license renewal. The California Energy Commission in formal comments to the NRC in 2010 requested that the NRC include in their license renewal evaluation for Diablo Canyon site-specific and updated analyses of seismic/tsunami risks, spent nuclear fuel management, safeguards and security, emergency response planning, plant safety culture, energy alternatives, and once-through plant cooling. These analyses are imperative to evaluate the true cost and benefits of an additional 20 years of Diablo Canyon's operation. However, the NRC has indicated that their license renewal review process does not evaluate seismic vulnerabilities and does not require that advanced seismic studies be included within

the scope of their review of a license extension application. As a result, the NRC's license renewal review for Diablo Canyon is proceeding without the benefit of the updated advanced seismic/tsunami studies that the California officials directed PG&E to perform. NRC plans to issue a Final Supplemental Environmental Statement for Diablo Canyon's license renewal review in early 2012.

The NRC's license renewal process focuses on plant aging and plant hardware issues, such as metal fatigue, and evaluates the environmental impacts from an additional 20 years of plant operation. NRC does not evaluate site-specific seismic issues during license renewal reviews and excludes from its license renewal proceedings issues that states and public interest groups have raised that are not directly related to plant aging or deficiencies in the environmental assessment. For example, during license renewal reviews for the Indian Point Power Plant in New York, the NRC dismissed from the proceeding the State of New York's contentions regarding seismic vulnerability, plant vulnerability to a terrorist attack, risk of spent fuel pool fires, and the inadequacy of emergency plant evacuation plans.

While PG&E has undertaken some recent seismic evaluations and has received funding for the advanced seismic/tsunami studies at Diablo Canyon, PG&E has regularly indicated that these studies will not be completed during the NRC's license renewal proceeding. SCE has also indicated that seismic issues will not be part of their license renewal activities for SONGS.

Lessons Learned from Japan's Nuclear Plant Crisis

Several national and international organizations, including the International Atomic Energy Agency (IAEA), NRC, Nuclear Energy Institute (NEI), and the Institute for Nuclear Power Operations (INPO) will examine the events and lessons learned from the Fukushima Daiichi Nuclear Plant. Although it is too soon to identify any lessons learned from Japan, follow-up actions most certainly will be required from these studies. As was the case after the Three-Mile Island accident and 9/11, the costs associated with operating nuclear power plants likely will increase as additional measures and equipment are required to provide additional assurances that U.S. reactors will not be susceptible to events similar to those occurring at the Fukushima plant.

NRC should include the lessons learned from these studies in NRC's plant license renewal reviews and should more closely scrutinize significant plant or site-specific issues, including seismic and tsunami issues, in these proceedings. NRC has initiated a 30-day and a 90-day review related to the nuclear plant crisis in Japan to identify potential near-term actions that affect U.S. power reactors. These include actions related to spent fuel pools, station blackout (loss of all A/C power for a reactor), external events that could lead to a prolonged loss of cooling, plant capabilities for preventing or dealing with such circumstances and emergency preparedness. We strongly support these efforts. If normal or backup power had been restored at Fukushima before the back-up batteries were depleted, the devastating events at this plant likely could have been avoided.

In addition to the lessons learned studies already underway, we recommend that the following issues be reexamined:

1. **Waste Confidence Decision:** NRC's Waste Confidence Decision, which concluded that spent nuclear fuel can be stored safely onsite at reactor sites for at least 100 years, should be reexamined particularly spent fuel stored in seismically active coastal areas. The safety of long-term storage of spent fuel in seismically active or tsunami prone areas needs to be reevaluated in light of events at the Fukushima Daiichi plant.

2. **Spent Fuel Management:** The nation's spent fuel management system and practices should be reevaluated, including the current practice of storing spent fuel in pools in tighter storage configuration than original plant designs. Storing more spent fuel in pools in closer configuration creates greater heat loads thereby increasing the risks of potential fires. As more and more spent fuel accumulates at reactors sites, plant owners have had to rerack their spent fuel pools multiple times to increase their onsite spent fuel storage capacity. The National Research Council of the National Academies' in 2006 recommended that the NRC should analyze the vulnerabilities and consequences of loss-of-pool-coolant events that could lead to propagating fires and the release of large quantities of radioactive materials to the environment. They recommended that the NRC take actions to address any significant vulnerabilities identified. These recommendations are even more vital today, given events in Japan.

3. **Spent Fuel Pool Overheating:** The risks of loss-of-coolant events in spent fuel pools should be reexamined. Actions needed to reduce the consequences of such events should be recommended and implemented as soon as feasible. The severe spent fuel pool overheating problems at Fukushima highlight the importance of ensuring that plant operators take prompt and effective measures to reduce the consequences of loss-of-pool-coolant events in spent fuel pools that could lead to fires. The Energy Commission in 2008 recommended that PG&E and SCE should return their spent fuel pools to more open racking configurations as soon as feasible.

Conclusions

The 9.0 magnitude earthquake in Japan and resulting tsunami greatly exceeded the plant's earthquake design (7.9 magnitude) and tsunami predictions. These events and the resulting devastation at the Fukushima Daiichi plant underscore the importance of completing the advanced seismic and tsunami studies at Diablo Canyon and San Onofre and having these studies included in NRC's license renewal evaluations for these plants. Like the Fukushima Daiichi plant, California's nuclear power plants are older plants with significant inventories of spent nuclear fuel located near major earthquake faults on the coast.

Analyses of the lessons learned from Japan will be important to determine what measures and equipment might be necessary to ensure that US plants are not susceptible to conditions and events similar to those that occurred in Japan. The NRC has announced a short-term and long-term review of events at Fukushima. If their response to the Three Mile Island accident is any indication, we can expect a thorough investigation of the lessons learned with comprehensive recommendations for addressing the problems revealed in Japan. It is essential that Congress support the NRC in these efforts and help ensure that the necessary follow-up actions are implemented at U.S. reactors as soon as feasible. These studies should be completed as soon as feasible and any significant measures or major additional equipment needed to reduce potential vulnerabilities at U.S. plants should be identified and the costs included as part of license renewal evaluations.

That completes my prepared remarks. I would be happy to answer any questions.