Statement of

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Chairman Boxer, Ranking Member Inhofe, and members of the subcommittee, thank you for the opportunity to appear before you today.

My name is Charles Pardee. I am Chief Operating Officer of Exelon Generation Company and former Chief Nuclear Officer of Exelon Nuclear. Exelon owns and operates 17 of the nation's 104 reactors. Our plants are located at 10 sites in Illinois, Pennsylvania, and New Jersey.

I appreciate your invitation to testify at today's hearing to discuss the status of the U.S. nuclear energy industry and the implications of the Fukushima nuclear accident on nuclear energy in the United States. I am testifying today on behalf of the Nuclear Energy Institute, the nuclear energy industry's Washington-based policy organization. NEI members include all companies licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

My remarks will cover four major points:

First, U.S. nuclear power plants are safe.

Second, safety is the U.S. nuclear energy industry's top priority.

Third, the U.S. nuclear energy industry has a long history, over several decades, of continuous learning from operational events, and we have incorporated lessons learned into our nuclear plant designs (through structural or systems upgrades) and our operating practices and training. We will do the same as a result of the Fukushima accident.

And fourth, the U.S. nuclear energy industry has already taken pro-active steps to verify and validate our readiness to manage extreme events. We took these steps early – without waiting for clarity on the sequence of events at Fukushima.

Before I address these four points, however, let me note that the U.S. nuclear energy industry works very hard not to grow complacent about safety. This is not always easy when our 104 nuclear power plants are operating well, with an average capacity factor above 90 percent for the

last 10 years. Similarly, we cannot be complacent about the accident at Fukushima. I am quite confident that we will learn important lessons from this experience and identify additional steps we can and will take to further improve safety and response capability at our nuclear plants.

U.S. Nuclear Power Plants Are Safe

That said, we do believe U.S. nuclear power plants are safe. They are designed and operated conservatively, to exacting standards, to manage the maximum credible challenges appropriate to each nuclear power plant site. U.S. nuclear power plants have also demonstrated their ability to maintain safety through extreme conditions, including floods, hurricanes and other natural disasters.

I can think of no better summary of the status of U.S. nuclear power plants than the one delivered by President Obama to the American people on March 17. President Obama said: "Our nuclear power plants have undergone exhaustive study, and have been declared safe for any number of extreme contingencies. But when we see a crisis like the one in Japan, we have a responsibility to learn from this event, and to draw from those lessons."

The industry invests heavily in our nuclear power plants to ensure safe, reliable operation. The industry invested approximately $7 billion in 2010 in our 104 reactors – to replace steam generators, reactor vessel heads and other equipment and in other capital projects.

U.S. reactors are designed to withstand earthquakes, tsunamis, hurricanes, floods, tornadoes and other natural events equal to the most significant historical event or the maximum projected event, plus an added margin for conservatism, without any breach of safety systems. We have many, many examples of U.S. nuclear power plants achieving safe shutdown during extreme events where offsite power was lost. During Hurricane Katrina in 2005, for example, the Waterford nuclear power plant in Louisiana shut down safely, lost all off-site power, and maintained safe shutdown on emergency diesel generators for three-and-a-half days until grid power was restored.

For earthquakes, nuclear plants are designed and constructed to withstand the maximum projected earthquake that could occur in its area, with additional margin added. Plant earthquake-induced ground motion is developed using a wide range of data and review of the impacts of historical earthquakes up to 200 miles away. Those earthquakes within 25 miles are studied in great detail. This research is used to determine the maximum potential earthquake that could affect the site. Each reactor is built to withstand the respective strongest earthquake; for example, a site that features clay over bedrock will respond differently during an earthquake than a hard-rock site.

It is important not to extrapolate earthquake and tsunami data from one location of the world to another when evaluating these natural hazards. These catastrophic natural events are location-specific, based on tectonic and geological fault line locations. The Tohoku earthquake that struck the Fukushima nuclear power plant occurred on a "subduction zone," the type of tectonic region that produces earthquakes of the largest magnitude. A subduction zone is a tectonic plate

boundary where one tectonic plate is pushed under another plate. Subduction zone earthquakes also produce the kind of massive tsunami seen in Japan.

In the continental United States, the only subduction zone is the Cascadia subduction zone which lies off the coast of northern California, Oregon and Washington. In an assessment released last week, the California Coastal Commission concluded that a "nuclear emergency such as is occurring in Japan is extremely unlikely at the state's two operating nuclear power plants. The combination of strong ground motion and massive tsunami that occurred in Japan cannot be generated by faults near the San Onofre Nuclear Generating Station and the Diablo Canyon Power Plant."

Safety Is the U.S. Nuclear Energy Industry's Top Priority

This leads to my second point: Safety is the U.S. nuclear energy industry's top priority, and complacence about safety performance is not tolerated.

Our industry operates in an unforgiving environment where the penalties for mistakes are high and where credibility and public confidence, once lost, are difficult to recover.

All of the safety-related metrics tracked by industry and the Nuclear Regulatory Commission demonstrate high levels of excellence. Forced plant outage rates, unplanned safety system actuations, worker radiation exposures, events with safety implications, and lost-time accident rates have all trended down, year over year, for a number of years.

We have confidence in nuclear plant safety based on those indicators, but we should derive even greater confidence from the process that produces those indicators, from the institutions we have created to share best practices, to establish standards of excellence and to implement programs that hold us to those standards.

After the 1979 accident at Three Mile Island, the nuclear industry created the Institute of Nuclear Power Operations (INPO). In INPO, the nuclear industry — unique among American industries — has established an independent form of self-regulation through peer review and peer pressure. In fact, the President's Oil Spill Commission, in its report on the Deepwater Horizon accident, identified INPO as the model for self-regulation by the offshore oil and gas industry.

INPO is empowered to establish performance objectives and criteria, and nuclear plant operating companies are obligated to implement improvements in response to INPO findings and recommendations. INPO has some 400 people monitoring nuclear plant operations and management on a daily basis. INPO evaluates every U.S. nuclear plant every two years, and deploys training teams to provide assistance to companies in specific areas identified as needing improvement during an evaluation.

INPO provides management and leadership development programs, and manages the National Academy of Nuclear Training, which conducts formal training and accreditation programs for those responsible for reactor operation and maintenance.

Among its many activities, INPO maintains an industrywide database called EPIX — for Equipment Performance and Information Exchange — and all companies are required to report equipment problems into the database. EPIX catalogues equipment problems and shows, for example, expected mean time between failures, which allows the industry to schedule predictive and preventive maintenance, replacing equipment before it fails, avoiding possible challenges to plant safety. INPO also maintains a system called Nuclear Network that allows companies to report and share information about operating events, to ensure that an unexpected event at one reactor is telegraphed to all, to ensure that an event at one plant is not repeated elsewhere, to ensure high levels of vigilance and readiness.

It may not be obvious to the outside world, but we have an enormous self-interest in safe operations. The industry preserves and enhances the asset value of our 104 operating plants first and foremost by maintaining focus on safety. Safety is the basis for regulatory confidence, and for political and public support of this technology.

A Commitment to Continuous Learning

The U.S. industry routinely incorporates lessons learned from operating experience into its reactor designs and operations. U.S. nuclear power plants have implemented numerous plant and procedural improvements over the past 30 years. Some of these improvements have been designed to mitigate severe natural and plant-centered events similar to those experienced at the Fukushima nuclear power plant. In addition, the equipment and procedures could be used to mitigate other severe abnormal events. The type of events include a complete and sustained loss of AC power, a sustained loss of vital cooling water pumps, major fires and explosions that would prevent access to critical equipment, hydrogen control and venting, and loss of multiple safety systems.

Starting in the 1990s, U.S. nuclear power plants developed guidelines to manage and mitigate these severe events that are beyond the normal design specifications. Plants evaluated site-specific vulnerabilities and implemented plant and procedural improvements to further improve safety. These severe accident management guidelines were developed in response to probabilistic risk assessments (PRAs), which identified several high-risk accident sequences. These guidelines provide operators and emergency managers with pre-determined strategies to mitigate these events The strategies focus on protecting the reactor containment structure as it assumes the zirconium cladding around the fuel and reactor cooling system are lost.

I could point to many, many examples of improvements made to U.S. nuclear power plants over the years in response to lessons learned from operational events. Let me list just a few:

- In the 1970s, concerns were raised about the ability of the BWR Mark I containment to maintain its design during an event when steam is vented to the torus. Subsequently, every U.S. operator with a Mark I containment implemented modifications to dissipate energy released to the suppression pool and stringent supports to accommodate loads that could be generated.
- As a result of the Three Mile Island accident, the industry made significant improvements to control room configuration and operator training – making it easier for operators to

respond to plant issues, without taking time to diagnose what had occurred. The industry also learned significant lessons about emergency preparedness and the importance of ensuring the public receives timely and accurate information during a plant event. It was after TMI that the NRC required all sites have emergency plans including both an Emergency Operations Facility and a Joint Information Center. These offsite facilities were mandated to ensure the states and NRC could have direct access to the information coming from the station and that there was a means for the state, utility and NRC to communicate directly through the media to the public.

- In 1988, the Nuclear Regulatory Commission concluded that additional Station Black Out (SBO) regulatory requirements were justified and issued the Station Black Out rule (10 CFR 50.63) to provide further assurance that a loss of both offsite and onsite emergency AC power systems would not adversely affect public health and safety. The SBO rule was based on several plant-specific probabilistic safety studies; operating experience; and reliability, accident sequence and consequence analyses completed between 1975 and 1988.
- Since the terrorist events of September 11, 2001, U.S. nuclear plant operators identified other beyond-design-basis vulnerabilities. As a result, U.S. nuclear plant designs and operating practices since 9/11 are designed to mitigate severe accident scenarios such as aircraft impact, which include the complete loss of offsite power and all on-site emergency power sources *and* loss of large areas of the plant. The industry developed additional methods and procedures to provide cooling to the reactor and the spent fuel storage pool, and staged additional equipment at all U.S. nuclear power plant sites to ensure that the plants are equipped to deal with extreme events and nuclear plant operations staff are trained to manage them.

The U.S. Nuclear Energy Industry Has Already Taken Steps in Response to Fukushima

The U.S. nuclear energy industry has already started an assessment of the events in Japan and is taking steps to ensure that U.S. reactors could respond to events that may challenge safe operation of the facilities. These actions include:

- Verifying each plant's capability to manage major challenges, such as aircraft impacts and losses of large areas of the plant due to natural events, fires or explosions. Specific actions include testing and inspecting equipment required to mitigate these events, and verifying that qualifications of operators and support staff required to implement them are current.
- Verifying each plant's capability to manage a total loss of off-site power. This will require verification that all required materials are adequate and properly staged and that procedures are in place, and focusing operator training on these extreme events.
- Verifying the capability to mitigate flooding and the impact of floods on systems inside and outside the plant. Specific actions include verifying required materials and equipment are properly located to protect them from flood.
- Performing walk-downs and inspection of important equipment needed to respond successfully to extreme events like fires and floods. This work will include analysis to identify any potential that equipment functions could be lost during seismic events

appropriate for the site, and development of strategies to mitigate any potential vulnerabilities.

Until we understand clearly what has occurred at the Fukushima Daiichi nuclear power plants, and any consequences, it is difficult to speculate about the long-term impact on the U.S. nuclear energy program. The U.S. nuclear industry, the U.S. Nuclear Regulatory Commission, the Institute of Nuclear Power Operations, the Nuclear Energy Institute, the World Association of Nuclear Operators and other expert organizations in the United States and around the world will conduct detailed reviews of the accident, identify lessons learned (both in terms of plant operation and design), and we will incorporate those lessons learned into the design and operation of U.S. nuclear power plants. When we fully understand the facts surrounding the event in Japan, we will use those insights to make nuclear energy even safer.

In the long-term, we believe that the U.S. nuclear energy enterprise is built on a strong foundation:

- reactor designs and operating practices incorporate a defense-in-depth approach and multiple levels of redundant systems
- oversight by a strong, independent regulatory infrastructure, which includes continuous assessment of every U.S. reactor by the Nuclear Regulatory Commission, with independent inspectors permanently on site and additional oversight from NRC regional offices and headquarters
- transparent regulatory process that provides for public participation in licensing decisions, and
- continuing and systematic processes to identify and incorporate lessons learned from operating experience.

I would like to take a moment to address an issue that came up during a hearing last week in the House Energy and Commerce Committee. The Union of Concerned Scientists (UCS) released excerpts of information they obtained from the NRC under a Freedom of Information Act request regarding the Commission's unfinished State-of-the-Art Reactor Consequence Analyses (SOARCA) project that has been undertaken to better understand the impact of severe accidents scenarios depending on whether steps to mitigate the accident are taken or not.

Exelon's Peach Bottom plant in Pennsylvania is one of two representative plants chosen by the NRC for analysis. According to the UCS memo released last week, even in extreme and "highly unlikely" disaster scenarios during which Peach Bottom's backup power sources are unavailable, the station would suffer no core damage or release radiation when all people and emergency equipment actually available at the site are factored in.

In the unlikely event of a loss of both off-site power and diesel generators, Peach Bottom has eight hours of battery power available and a direct, underground connection to a dedicated turbine at Conowingo Dam that would provide ample power to operate emergency cooling systems for an indefinite period of time. These emergency cooling systems include nineteen separate methods for cooling the reactors and spent fuel pool. Peach Bottom's emergency planning exercises and other regular NRC reviews have consistently confirmed our ability to

utilize a number of redundant systems to safely shut down its twin reactors in the event of a power loss.

And while I understand that analyses such as these can raise concerns if presented without context, risk-based improvements to our plants and operating strategies can only be identified and adopted if extreme scenarios such as these are generated and studied.

In conclusion, let me leave you with a short-term and a longer-term perspective.

In the short term, all of us involved with the production of electricity from nuclear energy in the United States stand in awe of the commitment and determination of our colleagues in Japan, as they struggle to bring these reactors to safe shutdown.

In the longer term, it will be some time before we understand the precise sequence of what happened at Fukushima, before we have a complete analysis of how the reactor performed, how equipment and fuel performed, and how the operators performed. As we learn from this event, however, you may rest assured that we will internalize those lessons and incorporate them into our designs and training and operating procedures.

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