Statement for the Record
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Chairman Thomas Carper, Ranking member George Voinovich, and distinguished members of the subcommittee, I am Anthony Pietrangelo, vice president at the Nuclear Energy Institute (NEI). I am honored to provide this testimony to address issues related to the nuclear energy industry before this subcommittee today.

NEI is responsible for developing policy for the U.S. nuclear industry. More than 320 NEI corporate and other members represent a broad spectrum of energy interests, including every electric utility 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.

As the country and the world confront the pressing and inexorably linked issues of energy and environmental policy, nuclear energy has received increased attention as a necessary technology for providing new sources of large-scale, reliable electricity while preventing greenhouse gas emissions. Indeed, emissions avoided by the U.S. nuclear industry for the 1995 – 2007 period included 8.7 billion metric tons of carbon dioxide ($CO_2$), 47.2 million tons of sulfur dioxide (S02), and 18.9 million tons of nitrogen oxide (N0x). At the same time, America's 104 commercial reactors generated 9.6 trillion kilowatt-hours of electricity.

My testimony today addresses the following issues:

- The performance of the 104 power reactors and the contribution nuclear energy makes toward the United States energy and environmental policies. Nuclear energy generates 20 percent of our nation's electricity supply, and is America's largest source of carbon-free electricity.

- The importance of license renewal to extending the value of nuclear power plant assets and the U.S. Nuclear Regulatory Commission's (NRC) license renewal process. License renewal contributes to the industry's ability to meet fast-

growing electricity demand while enhancing economic stability and employment in communities that host nuclear plants. The NRC will approve license renewal applications only after determining that a plant can continue to operate safely during the period of extended operation.

- The prospects for building new nuclear plants in the United States and the importance of an effective and efficient NRC licensing process for those projects. Because U.S. electricity demand is expected to grow 25 percent by 2030, according to the U.S. Energy Information Administration, there is an acute need for additional baseload electricity generation. The nuclear industry is already responding to the market, with electric companies having already submitted nine license applications to the NRC for 15 new reactors. NEI estimates that at least another five applications will be submitted this year. This could result in 15 to 20 new nuclear plants by 2020 providing an additional 20 gigawatts to 25 gigawatts of electric generating capacity.

## U.S. Nuclear Power Plant Are Operating at Record-High Levels

The nuclear power industry's commitment to safety and efficiency in 2007 resulted in a record year for U.S. nuclear plants, on average.

Safety remains the highest priority for the industry and we have demonstrated a continuous record of outstanding safety and reliability, which have led to increased efficiencies.

The industry's capacity factor—the amount of electricity produced relative to the amount that could have been produced operating each day around the clock—was a record-high 91.8 percent in 2007. U.S. reactors produced 806 billion kilowatt-hours of electricity at an average production cost of 1.76 cents per kWh—both new industry standards. The cost of producing electricity at nuclear power plants is more than three times lower than electricity produced using natural gas (6.78 cents/kWh) and is more competitive than coal (2.47 cents/kWh).

With this excellent performance, nuclear energy continues to generate about 20 percent of U.S. electricity despite the fact that nuclear power plants represent only about 12 percent of all of installed electric generating capacity nationwide.

Given the importance of emission-free electricity in a carbon-constrained economy, it is important to note that nuclear energy accounts for more than 70 percent of the nation's carbon-free electricity generation. In 2007, U.S. nuclear power plants prevented the discharge of 690 million metric tons of $CO_2$, nearly one million tons of NOx emissions, and three million tons of $SO_2$. The industry is committed to maintaining the clean air benefits of nuclear energy that the United States and the world have come to expect.

The extraordinary value of nuclear energy to a carbon-constrained electricity portfolio has been recognized internationally by the United Nations Intergovernmental Panel on Climate Change; the World Economic Forum and analyses conducted by the European Union and the OECD's Nuclear Energy Agency. Domestically, this role has been affirmed by the National Academy of Sciences, the Earth Institute at Columbia University and analyses by scientific, environmental and financial organizations.

**License Renewal** -

Nuclear power plants are licensed by the federal government to produce electricity for 40 years. The 40-year license reflects the amortization period generally used by electric utility companies for large capital investments; it is not based on safety, technical or environmental factors. The Atomic Energy Act of 1954 permits energy companies to renew their nuclear plant operating licenses as long as the companies can demonstrate that the facilities will continue to meet federal safety standards for the additional period of operation. Interest in license renewal dates back to the late 1970s and early 1980s. Initial studies focused on technical and economic feasibility of operating beyond the 40 year license period, and identified the long-term material condition of large components such as pressure vessel integrity, cables, and critical concrete structures as the key determinants of whether a reactor can continue to operate beyond 40 years.

Sustained high levels of safety and operation at U.S. reactors have resulted in a steady progression of applications to renew operating licenses for an additional 20 years. To date, 48 license renewals have been granted by the NRC, 17 are under review, and companies have announced plans to pursue 30 additional license renewal applications. In parallel, companies are undertaking a series of material condition improvements, such as steam generator and reactor vessel head replacements, and turbine, generator and pump upgrades to ensure the existing fleet continues to operate safely and efficiently. These material improvements, in some cases, cost hundreds of millions of dollars and have been completed on-schedule and within the budgeted estimates.

<u>Background</u>

In 1982, the NRC established the Nuclear Plant Aging Research Program to assess materials and component aging issues related to continuing operations and license renewal of operating reactors. The program concluded that many aging phenomena are manageable and should not preclude license renewal for reactors. Subsequent to this finding, the NRC in 1991 issued 10 CFR Part 54, which included two fundamental principals: (1) The regulatory process will ensure that the licensing basis of all operating plants provides and maintains plant safety, and (2) the licensing basis must be maintained during the renewal period in the same manner and to the same extent as during the original licensing term.

A demonstration program to apply the rule to pilot plants and develop experience to establish implementation guidance was put in place. The pilot program confirmed that aging effects were being effectively managed by the industry during the initial license period. In addition, the license renewal review did not provide sufficient credit for existing programs, particularly those under NRC's maintenance rule. In 1995, the NRC amended the license renewal rule. The amended Part 54 established a regulatory process that is more efficient, more stable, and more predictable than the previous license renewal rule. The NRC's revised Part 54 clarified that the focus of license renewal activities should be on managing the adverse effects of aging. These rule changes were intended to ensure that important systems, structures, and components will continue to perform their intended function during the 20-year period of extended operation.

The NRC also developed license renewal guidance documents recommending safety standards for aging management programs and an acceptable format for the renewal applications. Today, NRC has developed a comprehensive license renewal process to evaluate applications for extended periods of operation. The license renewal process calls for both a technical review of safety issues and an environmental review.

NRC's responsibilities under the National Environmental Policy Act call for a review of the environmental impact of license renewal. In parallel with aging efforts, the NRC pursued a separate rulemaking, 10 CFR Part 51, to focus the scope of review of environmental issues. In 1996, the NRC published the Generic Environmental Impact Statement (GEIS), which examines the possible environmental impacts that could occur as a result of renewing licenses of individual nuclear power plants under 10 CFR Part 54. To the extent possible, it establishes the bounds and significance of these potential impacts. The analyses in the GEIS encompass all operating light-water power reactors. For each type of environmental impact, the GEIS attempts to establish generic findings covering as many plants as possible. While plant and site-specific information is used in developing the generic findings, the NRC does not intend for the GEIS to be a compilation of individual plant environmental impact statements.

The agency said many potential environmental impacts of license renewal are common to all nuclear power plants and could be resolved for all plants through the revised rule. A provision of the regulatory process allows the public an opportunity to express concerns about environmental impacts related to the license renewal application.

Additionally, the license renewal application review process includes an independent examination of reactor operations, the focus of which is directed at two questions:

> Does the reactor operator understand the effects of aging on critical safety components?
>
> Has the operator taken appropriate actions to assure safe operation?

Constellation Energy's Calvert Cliffs plant in Maryland was the first to file a renewal application in April 1998 and the NRC approved the application for renewal of two reactors at the site in March 2000. Duke Energy's Oconee plant (07/98 to 05/00), Entergy's Arkansas Nuclear One (02/00 to 06/01, and Southern Company's Hatch (03/00 to 01/02) plants followed. Lessons learned from these first license renewal approvals resulted in the creation of the Generic Aging Lessons Learned Report (GALL). The GALL report contains the staff's generic evaluation of the existing plant programs and documents the technical basis for determining where existing programs are adequate without modification and where existing programs should be augmented for the extended period of operation. The NRC staff's evaluation documented in the GALL report indicate that many of the existing industry programs successfully manage the aging effects for many structures or components for license renewal without change.

The GALL report also contains recommendations on specific areas for which existing programs should be augmented for license renewal. An applicant may reference the GALL report in a license renewal application to demonstrate that the programs at the applicant's facility correspond to those reviewed and approved in the GALL report and that no further staff review is required. The focus of the staff review is on the augmented existing programs for license renewal. The incorporation of the GALL report information into the NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," as directed by the Commission, should improve the efficiency of the license renewal process.

Developing license renewal applications involves tens of thousands of man-hours and millions of dollars to demonstrate to the NRC that the licensee can monitor and manage the effects of aging on major passive structures and components during the renewal period. Applicants must identify all systems, structures and components that would be affected by extending the operating period at a specific plant and they must analyze the environmental effects of extended reactor operation

Typically, a license renewal team collectively work 60,000 hours preparing a 1,800-page application. This involves review of thousands of documents, a detailed review of equipment and component performance, and a rigorous review of the existing maintenance and engineering programs to ensure that the licensee is capable of maintaining plant systems over the extended license period.

The license renewal activities and the material condition improvements will provide the nation with another 20 years of stable, low-cost, zero-$CO_2$ emitting electricity generation. This will assist our nation in meeting state, regional and emerging national greenhouse gas reduction programs and enable U.S. industry to become more competitive in an era of increasing energy costs.

## New Plants

### Global Expansion of Nuclear Energy

Mr. Chairman, as of this date, there are 35 new nuclear power plants under construction world-wide representing approximately 30 gigawatts of additional electric power generation, according to the International Atomic Energy Association. Additionally, 200 projects are under consideration in 27 countries as reflected in statements of intent and various proposals. The interest in nuclear power is spurred by the need for electricity, energy economics, health – water, sanitation, deployment of health technologies, and improving education. The U.S. is poised to take a leadership role in sharing its regulatory framework, operational safety practices, and security programs for countries considering nuclear power around the world.

U.S.-based nuclear plant designers such as GE and Westinghouse are involved in international discussions with government officials and utility executives. The need for industry infrastructure, workforce and manufacturing capabilities may provide an opportunity for U.S.-based manufacturing companies and factories to be a part of the global resurgence, depending in part on the growth of the U.S. nuclear energy market

### U.S. New Nuclear Plant Activities

U.S. energy companies have submitted nine combined construction and operating license applications for 15 advance-designed reactors, and at least four more applications for eight additional reactors are expected to be submitted to the Nuclear Regulatory Commission by the end of the summer. NRC reviews of these applications are in the early stage. As expected, there have been some issues related to learning the extent of information required by the NRC in this new licensing process. The lessons learned from the early submittals have been distributed to other applicants throughout the industry reactor design-centered working groups.

Additionally, an NRC rulemaking on “waste confidence” is moving forward. Upon completion, the NRC’s rulemaking on this issue is expected to strengthen the regulatory basis for used nuclear fuel management as the industry moves further into the licensing process. The continuing interest and oversight of the Senate Subcommittee on Clean Air and Nuclear Safety has been beneficial and has provided direction that has enabled the industry and NRC to continue to move in the right direction. The industry is appreciative of the Chairman and Ranking members efforts to encourage the NRC to update its waste confidence ruling.

### A Clear Need for New Nuclear Plants

There is a growing need for baseload power plants as part of the electricity portfolio that must be developed to meet the 25% increase in electricity demand by 2030. In

some states, it has been nearly 20 years since baseload coal or nuclear power plants were built, yet the economy and population have continued to grow. Now, some companies are experiencing annual customer growth rates of 20,000 to 30,000 new customers per year. As a result, electricity generating margins are shrinking. The Southeast, Southwest and Mid-Atlantic regions already are below accepted reserve margins for electricity generation. Even with expanded energy efficiency and conservation programs that many electric companies are putting in place, utility planning forecasts show a need for additional baseload generation.

The outstanding safety and operational performance of U.S. nuclear power plants, coupled with high and volatile fossil fuel prices, make new nuclear plants an attractive proposition for new electricity production. Baseload generating option assessments are complex and focus on plant cost, environmental factors, fuel price and availability and other factors. One of the most important factors in today's energy environment is the long-term cost of generating electricity once the plant is in service. Extensive sensitivity analyses demonstrate that new nuclear generating plants are among the best options, especially when considering the long term stability in the cost of electricity generated from the plant that benefits the retail, commercial and industrial rate payers. In separate analyses of the Florida and Connecticut markets, only natural gas-fired plants without carbon sequestration are forecasted to be less expensive than advanced nuclear power plants for new electricity generation.

A recent assessment by the Brattle Group found that, between 2004 and 2007, the cost of steam generation plants, transmission projects and distribution equipment rose by 25-35 percent, compared to an eight percent increase in the GDP deflator. The cost of gas turbines: Up by 17 percent in 2006 alone. Prices for wind turbines: Up by more than $400/kWe between 2002 and 2006. Prices for iron ore are up by 60 percent between 2003 and 2006, and for steel scrap up by 150 percent. Aluminum prices doubled between 2003 and 2006, and copper prices almost quadrupled. These cost increases hit all new generating capacity – nuclear, coal-fired, gas-fired and renewables.

The benefits of new nuclear plants also are linked to environmental considerations given that nuclear power plants do not generate greenhouse gases during the production of electricity.

Current schedules developed by energy companies and the NRC show that the first permits for new reactors could be issued in 2011, with preconstruction activities (land clearing, construction of support buildings, excavation) starting at some sites next year

The industry expects that four to eight plants will move directly into construction as soon as the combined construction permits and operating licenses are issued. If these plants move forward on schedule and remain within budget estimates, confidence in and within the industry will increase. This could result in an additional 55 gigawatts

(about 40 plants) of new nuclear generation by 2030, preventing an additional 260 million metric tons of $CO_2$ emissions per year.

## Long-term energy challenges require short- and long-term solutions

The implementation of the new licensing process did not contemplate today's energy landscape of shrinking electric capacity margins, high, volatile fossil fuel costs, and state, regional and national policies to reduce the nation's carbon footprint. The result is that some companies are moving forward with new reactor projects in a more expeditious manner than was initially envisioned.

COL applications are being submitted before some new reactor designs are certified, and few companies are using the early site permit process. In addition, the learning process that normally evolves from the first license application submittals is being accelerated through the use of design-centered working groups. Experiences are being incorporated into lessons learned, which are being distributed to other applicants through these working groups. They are working on issues as they pertain to each of the five new reactor designs. The intent is to further improve standardization within a particular reactor design, accepting that there will be some differences because of unique site-specific circumstances, topography, geology and location (such as, whether it is adjacent to a river, lake or ocean.)

In addition to improving the quality of NRC license submittals, we believe that there are procedural improvements that could be made once the industry has completed the first reviews. This was true in the case of safety certification for advanced reactor designs. The NRC and industry also have developed lessons learned from the early site permit projects. The NRC is preparing a plan to improve the environmental review process within the bounds of the National Environmental Policy Act (NEPA). If the recommendations from the lessons learned are fully implemented, the licensing schedules for subsequent licensing projects could be significantly reduced.

## Toward construction of new reactors

Initial steps are being taken by the industry to set the stage for construction of new reactors, principally in the Mid-Atlantic and Southeastern states. Two electric utilities have signed engineering, procurement and construction contracts with a consortium of reactor designers and construction firms, and other companies are in intense negotiation with designers and architect-engineers. Long-lead items, such as ultra heavy forgings for reactor pressure vessels and turbines, are being ordered.

Public dialogue with the NRC on construction inspection and the implementation of inspections, tests, analyses and acceptance criteria (ITAAC) of the new licensing process has started as the industry and NRC look beyond the initial licensing processes.

Detailed implementation guidelines have been drafted and are being reviewed by the NRC. Interactions have started within the industry on assuring that there is a common licensing basis and understanding for implementing quality assurance programs, a major lesson learned from the nuclear plant construction projects of the 1970s.

The industry also is working with Japanese and French companies to gain insights on building nuclear plants using modular construction techniques. As a result, the schedule for the first construction projects from first concrete pour of the power block to fuel load is 48 months to 54 months, followed by a four-to-six month start-up and testing schedule. Most recently, Japanese nuclear plants are being built in 39 months, followed by the start-up phase. Based on these schedules, the first U.S. plants will be in commercial operation around 2016-17.

## Industry is committed to reactor standardization

The U.S. nuclear power industry is fully committed to nuclear power plant standardization. The industry is focusing on all aspects of plant licensing and construction—from the scope and content of license applications through the development of procurement and construction specification into construction. This is being controlled through the five design-centered working groups. The industry is striving for at least a 70% level of standardization.

This concept of standardization is being taken to the component level, with companies who intend to build the same reactor design seeking to use the same plant configuration, valves, breakers, cabling, instrumentation, and computer systems. The degree of component specification may be governed by supplier capacity, such as the supply of large turbines.

## Financing

Consensus estimates suggest that the electric power industry, over the next 15 years, must invest between $750 billion and $1 trillion in new generating capacity, new transmission and distribution infrastructure, and environmental controls. This new capital spending represents a major challenge to the electric power industry.

The Energy Policy Act of 2005 recognized this financing challenge and provided limited investment stimulus for construction of new baseload power plants. In the case of nuclear power, that stimulus includes:

- a production tax credit of $18 per megawatt-hour for 6,000 megawatts of new nuclear capacity for the first 8 years of operation.

- a form of insurance (called standby support) under which the federal government will cover debt service for the first few plants if commercial

operation is delayed. This coverage is capped at $500 million for the first two reactors, and $250 million for the next four reactors. The delays covered include NRC failure to meet schedules and litigation.

— federal loan guarantees for up to 80 percent of total project cost.

Of the three major incentives for new nuclear power plant development provided by the Energy Policy Act, the loan guarantee program is the most effective in addressing the major challenge facing new nuclear power plant construction – construction financing.

A properly priced loan guarantee program would enable companies to employ project financing on a non-recourse basis. The ability to use non-recourse project finance structures offsets one of the most significant financing challenges facing new nuclear power plant construction – the cost of these projects relative to the size, market value and financing capability of the companies that will build them. A new nuclear plant is a $5-7 billion project (including interest during construction). Although $5-7 billion projects are not unique in the energy business, such projects are typically built by consortia of major oil companies with market values many times larger than the largest electric companies.

Project financing, supported by loan guarantees, also allows a more efficient, leveraged capital structure, which reduces the weighted average cost of capital and thus provides a substantial consumer benefit in the form of lower electricity prices. Loan guarantees also mitigate the impact on the balance sheet of these large capital projects which would otherwise place stress on credit quality and bond ratings.

The Department of Energy finalized the loan guarantee program in October 2007. According to the final rule, a guarantee may cover 100 percent of the project debt, provided that the debt does not exceed 80 percent of the project's cost. In December 2007, Congress authorized DOE to grant $18.5 billion worth of loan guarantees to new nuclear projects.

Now that the rules and authorization are in place and the Energy Department has released its solicitation for new nuclear projects, we expect that energy companies will submit applications and begin to negotiate terms and conditions of the guarantee later this year. Industry believes that the recent proposals in the Senate and House appropriations, when combined, will be beneficial and provide long-term benefit to American consumers.

## Concluding Statement

The nuclear industry appreciates the Congressional oversight, which has been very beneficial and should continue to ensure that the full value of the incentives in the 2005 Energy Policy Act are attained, not only for nuclear, but for all non-emitting, innovative

generating technologies. Progress towards new nuclear plant deployment is being made. Combined licenses are being reviewed and schedules have been established; construction and procurement contracts are being signed; the manufacture and fabrication of long-lead components has started; and financing discussions are taking place. The industry is reasonably confident that at least four new nuclear plants will be operational around 2016. How many more projects move into the construction phase depends on numerous factors, which include the implementing conditions imposed on the loan guarantee provisions in the 2005 Energy Policy Act.