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The Role of a Strong Regulator in Safe and Secure Nuclear Energy

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Commissioner
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Warren K. Sinclair Keynote Address
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Good morning. I am pleased and honored to be delivering the 6th Annual Warren K. Sinclair Keynote Address. The thoughts that I offer you today are from the perspective of a nuclear regulator. My principal message is that a strong independent regulatory authority is not only valuable but necessary for any country that utilizes nuclear energy in its quest for energy diversity and security. Specifically, I will address the value of the independent role played by the U.S. Nuclear Regulatory Commission (NRC), NRC's licensing process for new reactors, the current status of our new reactor licensing work, some of the current challenges, and what the future may hold for us. One caveat, my remarks today are my personal views, and may not represent the collective view of the Commission.

The NRC

To understand the importance of the independent role of NRC, one needs to first understand a little of the agency's history. The birth of commercial nuclear power in the United States (U.S.) was under the oversight of the U.S. Atomic Energy Commission (AEC) which Congress created in 1954. At that time, AEC's regulatory mandate was to ensure public health and safety without imposing excessive requirements that might inhibit the growth of the industry. This was a difficult balance to achieve for a single agency in an industry giving birth to a radically new technology. During the 1960s, an increasing number of critics charged that AEC's regulations were insufficiently rigorous in several important areas.

By the early 1970s, AEC's regulatory programs had come under such strong attack that Congress decided to abolish the agency. Supporters and critics of nuclear power agreed that the promotional and regulatory duties of the AEC should be separated and assigned to different agencies. In 1974, Congress did just that – assigning the regulatory function to the NRC. The NRC became the regulator for nuclear power reactors, as well as the regulator of all civilian use of radioactive materials, including fuel enrichment facilities, industrial and medical applications, and waste disposal facilities. The promotional role was assigned to the Energy Research Development Administration, or ERDA, with a single administrator, appointed through the traditional political routes and serving at the pleasure of the President. This latter agency eventually became the Department of Energy (DOE).

The point of reviewing this history is to emphasize that Congress understood the need for an independent regulatory authority. In addition, instead of a single administrator, Congress chose a Commission composed of a Chairman and four Commissioners to lead the NRC. It is clear that Congress understood the advantage of a regulatory authority whose policy-making is improved through a collegial process with each Commissioner serving a fixed term of office. Such a process results in policies that have generally greater support and stability over time. Today, NRC is a strong and technically competent regulatory authority, highly regarded within the international community of nuclear regulators. However, we are constantly looking for ways to improve.

My discussions with senior executives of the nuclear power industry indicate that they understand and appreciate the value of an independent and technically strong regulator, particularly in assuring the public that nuclear plants are being operated safely and securely. I believe that the level of public assurance depends on the NRC being a fair but tough regulator. Our job is to ask the tough questions and make the tough calls; however, we must do so in an environment that strives to be as open and transparent as possible. Thus, we make significant efforts to open our regulatory processes to public scrutiny and participation wherever appropriate. This includes utilizing input from organizations such as the NCRP to provide the scientific basis, which provides the foundation for our regulatory decisions.

The nuclear industry recognizes that any possibility of construction of new nuclear power plants in the U.S. depends directly on continued public assurance of safe and secure operations of existing power reactors in operation today. That said, we objectively evaluate the science and weigh the risks so as not to impose unnecessary regulatory burdens on our licensees. As we pursue our strategic mission to ensure that licensees continue to maintain adequate safety and security, we also pursue our strategic objective of organizational excellence to ensure that our regulatory actions are open, effective, and timely.

New Reactor Licensing

In an effort to improve efficiency and eliminate potential regulatory risks for licensing, construction and ultimately the operation of new reactors, NRC is implementing the 10 CFR Part 52 licensing process. Initially developed almost 20 years ago, this process, which we are now using for the first time, involves design certifications, early site permits and combined licenses. In order to provide you with an overview of our process, I will briefly explain each of these three elements.

The design certification process allows a reactor vendor to submit a design to NRC for review and certification that is independent of a site. Safety reviews of these designs require an essentially complete design. Certified designs actually become part of our regulations. For that reason, public notice and public comment opportunities apply to NRC's review of these applications. To date, we have certified four designs.

The early site permit process, on the other hand, allows an applicant to apply for a site permit independent of any particular design. In reviewing an early site permit application, NRC staff considers site safety issues, environmental protection issues, and plans for coping with emergencies, independent of the review of a specific nuclear plant design. During this process, NRC also allows public and other stakeholder involvement through public meetings and opportunities to request a hearing on the issuance of an early site permit.

A combined license, or COL, authorizes both construction and conditional operation of a nuclear power reactor. Although not required, the simplest form of a combined license application, and the most expeditious for the staff to review, combines a certified plant design and an approved early site permit. The Part 52 process does not require either a certified design or an early site permit; however, prior to the issuance of a COL the staff will have reviewed the application for characteristics of the site, including surrounding population, seismology, meteorology, geology and hydrology; design of the nuclear plant; anticipated response of the plant to hypothetical accidents; plant operations including the applicant's technical qualifications to operate the plant; discharges from the plant into the environment (i.e., radiological effluents); and emergency plans. As with the design certification process and the early site permit process, the COL process allow for public and other stakeholder participation through public meetings and hearings.

New Reactor Activities

NRC currently has 17 combined license applications for 26 reactors using five designs. To accommodate this extraordinary increase in regulatory review workload, NRC staff is implementing a design-centered approach to facilitate parallel review of multiple standardized combined license applications. This approach is directly dependent upon the industry's commitment to standardize COL applications for a specific reactor design. I believe this approach to licensing is crucial to completing timely reviews for multiple applications. It is based on the principle of "one issue, one review, one position" for multiple COL applications, and it is intended to optimize the NRC's review effort and the resources needed. The benefits of a design-centered licensing review will be achieved only to the extent that the reactor vendor and the utilities standardize the pertinent sections of the applications. In addition, reactor vendors and COL applicants must submit applications that are complete and meet very high-quality, technical standards. We will not compromise our standards to expedite approvals. NRC staff has developed guidance to assist the COL applicant's understanding of what is necessary to meet our standards. Future applicants should be paying close attention and learning from NRC's assessment of the first applications.

In addition to the licensing activities, both NRC and the U.S. nuclear industry have a lot of work ahead of us in preparing for new construction under the new licensing and approval process addressed in Part 52 of our regulations. NRC has been developing and will be implementing its new Construction Inspection Program. Our inspection focus will be centered out of our Atlanta regional office. Much of the efficiency and timeliness of our inspection activities will depend on how well industry adheres to the necessary high-quality standards required for a nuclear plant. As NRC continues to develop our inspection program and train our inspectors, we are using lessons learned from our regulatory partners in other countries, such as Finland, France, Taiwan, and Japan, who have very current experience. We are also exploring ways to test construction inspection methods using the current construction of Watts Bar 2. This facility was licensed for construction in 1973 under the 10 CFR Part 50 licensing process but stalled at approximately eighty percent completion in 1988. After a new plant is built under the Part 52 process, the Commission must find that all necessary inspections, tests, and analyses have been performed and associated acceptance criteria have been met before granting authorization to load fuel and begin operations.

To put NRC's tasks in perspective, we estimate that each Design Certification Review will require roughly 160,000 hours over about 42 months. A COL application is initially expected to require approximately 88,000 hours over about 30 months of review and 12 months of public hearings. In addition, our current estimate for inspections during an anticipated 4-year construction phase of a single reactor plant is 35,000 inspection hours. As you can see, the level of regulatory effort is substantial; however, this effort can not divert NRC's attention from the safe and secure operation of existing reactors.

Challenges

Let me turn now to a few of the important challenges that face both NRC and Industry. As you consider the importance and impact of each of these challenges, I offer a timeless perspective from Alfred North Whitehead. "The art of progress is to preserve order amid change and to preserve change amid order." This simple statement serves to underscore the importance of maintaining the safety of the nation's operating reactors as we move forward with challenges associated with the design, construction and operation of new reactors.

First among these challenges is for industry to ensure that applications submitted to NRC for design certifications and licenses for new plants are fully complete and of high quality. Prior to NRC being able to determine an application review schedule, the staff conducts an acceptance review to assure the application contains sufficient information to support the review process. Complete, high-quality applications should help bring regulatory predictability to our technical review schedules. Adhering to these review schedules, to the extent possible, is the challenge to the NRC.

Another challenge for industry is to maintain standardization. The extent to which new plants are standardized - throughout their design, licensing, construction, and operation - will have a significant impact on improved regulatory consistency and effectiveness, as well as life-cycle efficiencies for both the NRC and the licensees. This will be particularly true in the more technically-complex areas such as digital I&C and safety systems.

With new reactor designs come new construction techniques. One example is the utilization of modular construction. Some of the new designs feature modules that can be built off-site, transported to the site, installed and then tested. This approach stands in contrast to the previous generation of plants that were "stick built" on the final site. The scope of how new construction techniques will be employed is not fully known at this time. However, licensees implementing these techniques need to be mindful of the role of the regulator and the requirements of the part 52 licensing process. They must assure that NRC access and oversight is adequate to support the Commission's finding that the plant was built in accordance with the license and the regulations. NRC is working to understand the scope of these activities in order to be able to provide appropriate and timely oversight.

In addition to new construction techniques, technological advances in digital control and human interface systems add complexity to the design of these systems. Fueled by almost daily enhancements in the consumer electronics arena, designers and operators alike want to incorporate elements of these improvements in the control systems for new and existing reactors. All new reactors that may be built in the U.S. are expected to utilize a digitized, integrated control room and digital safety systems and controls. This technology holds the promise of significant improvements in safety and human-machine interface, but brings new complexities that must be thoroughly understood and accounted for in the safety analysis and design of the plant. Such a rapidly evolving technology presents continuing challenges for NRC to maintain stable regulatory requirements that address the new technical issues. We are working closely with experts in this field, with our applicants, and with the industry to ensure that our safety requirements are adequate and understood.

The global economy has also produced new reactor designs that are being marketed internationally. This has created challenges and opportunities for greater cooperation among regulatory authorities. NRC is actively engaged in a variety of international organizations and initiatives, including those involving research agreements, operating experience exchanges, improvement of regulatory practices, and commonalities among standards. As global nuclear power plant licensing and construction activities expand using new globally standardized reactor designs, we should also find new ways to expand our global regulatory exchanges.

The globalization of the nuclear supply chain has created an unprecedented diversity of global sources for nuclear components. This makes it increasingly important for regulatory bodies, as well as industry consensus standards organizations, to carefully coordinate to ensure both consistency and satisfaction of the standards. This isn't an academic or hypothetical point. NRC has previously identified counterfeit and deficient parts and continues to seek better ways of monitoring the increasing globalization of the nuclear supply chain through our international collaborations. Quality control issues in the 1970s contributed to halting several nuclear plants under construction. In today's global manufacturing economy, global collaboration will be imperative to the nuclear industry.

The global supply chain complicates the tasks of licensees and NRC to oversee the manufacturing of components, such as the reactor vessel, the reactor vessel head, or the pressurizer, as they are being manufactured abroad. Similar to the issues related to modular construction, licensees and vendors need to be mindful of the regulatory requirements and the need for licensees to oversee and document manufacturing activities necessary to support NRC's independent review of these items.

As procurement of nuclear grade components becomes more difficult, the industry will turn to increased use of commercial-grade dedication. As background, since the late 1980s NRC has endorsed a process by which off-the-shelf commercial grade components are thoroughly examined and tested to ensure that they meet the high quality standards necessary for safety-related use in a nuclear power plant. We call this process "commercial grade dedication." One reason for establishing this process is that the number of ASME Nuclear Certificates held worldwide fell sharply from nearly 600 in 1980, to under 250 in 1990. Although these numbers have started to rebound in the recent years, the total world wide is still below 200. More strikingly, the decline was due almost entirely to the loss of nuclear certificates among American companies. The number of certificates held by other nations has remained at about 100 since 1980, but the number of American certificate holders today is only one-fifth of what it was 28 years ago. We expect that commercial grade dedication will be utilized during the construction of new nuclear plants.

Possible pitfalls with the use of the commercial grade dedication process include hiring inexperienced contractors who don't understand the importance of nuclear-grade quality standards. Examples of this have occurred in plants under construction overseas, but a recent example in the U.S. came from the NRC's oversight inspection of the construction of the mixed-oxide, or MOX, nuclear fuel facility being built in South Carolina for DOE. In this example, a contractor for the MOX facility had been hired to perform commercial grade dedication on rebar, and we found significant inadequacies in its performance. Dedicating something like rebar seems to be a far simpler task than will be needed for dedicating more complicated components. The contractors, vendors, and licensees that will perform such dedication need to get it right the first time.

On a positive note, I was very encouraged by the turnout of approximately 500 industry representatives for a recent NRC-sponsored workshop on vendor oversight issues. During the two-day workshop, NRC highlighted key regulatory requirements and clarified its expectations for ways that vendors and licensees can comply with these regulations. The workshop also provided the opportunity for vendors and licensees to discuss issues and ask questions.

Another challenge is that following 9/11 many new requirements to enhance the security of nuclear power plants in the U.S. have been implemented. Substantial enhancements have been made. NRC is confident in the adequacy of security at operating reactors today and that new reactor designs will achieve this level of security with less reliance on operator actions. We continue to collaborate and strengthen our communications with other federal, state, and local agencies to monitor and assess potential threats. In addition, our open regulatory processes are continuing to provide for further dialogue with the public on security requirements.

NRC's decision process to further strengthen our security requirements, if necessary, is technically thorough, systematic, and fully collaborative with other agencies. Such careful consideration is needed due to the potential impact that security changes could have on safety measures. For example, if it were deemed necessary to improve security by installing locks on doors leading to certain safety equipment, consideration must also be given to the fact that such barriers may slow or prevent access by plant personnel during a non-security event. This is a simple example of a much larger set of important regulatory considerations that together must ensure that both safety and security are achieved in harmony with each other.

Complexities, such as the digital systems, serve to underscore the ongoing challenge of building up the necessary quality workforce and the educational infrastructure to maintain it. The human capital challenge that confronts the nuclear industry, academia, and NRC is immense. Future projections indicate that we need more trained workers, but many factors limit our ability to rapidly increase this workforce. One such factor is the expected retirement of the current workforce. It has been estimated that about 35 percent of those working at U.S. nuclear utilities will be eligible for retirement in the next 5 to 10 years and that 90,000 new workers will be needed by 2011, just to continue operating the existing plants. Within NRC, approximately 15 percent of our workforce is currently retirement eligible and that number increases to 33 percent becoming eligible within the next five years. The potential labor shortage not only affects utilities and the NRC, but also impacts the entire nuclear infrastructure, including national laboratories, other Federal and state agencies, nuclear technology vendors and manufacturing companies, nuclear construction companies, and university nuclear engineering departments.

However, I am pleased to note that NRC has made significant progress in this arena as we increased our staff to handle the new applications. For the past three years, NRC has added over 200 new hires a year above attrition to assure our ability to meet the demands of new reactor licensing. These new hires represent a mix of senior, mid-career, and entry-level personnel.

Additionally, NRC's FY 2008 Nuclear Education Scholarship and Fellowship Program provided an additional $15 million to support education in nuclear science, engineering, and related technologies. These funds were used for college scholarships and graduate fellowships in nuclear science, engineering, and health physics; faculty development grants supporting faculty in these academic areas; and scholarships for trade schools in the nuclear-related trades. Statistics collected by DOE indicate that student enrollment and graduation rates in nuclear engineering and radiation health programs are increasing. But even with these increases, there will still be a personnel shortfall, based on the projected demand.

Safety Culture & Materials Issues

Inherent to the quality workforce is the ongoing challenge to ensure that licensees maintain strong safety cultures within their organizations. NRC's Davis-Besse Lessons Learned Task Force concluded that a lack of safety culture was a root cause leading to the reactor head degradation you see on the screen. Nuclear plant safety performance should not be judged only by numerical measures. Even when such measures reflect good performance, the plant operator must constantly maintain a continuous commitment to safety that always supersedes production goals. Commitment to safety should be reflected in the vision of the most senior managers at every plant and required of every employee in the organization. Management at all levels should actively ensure that every employee feels free to express his or her views and concerns regarding safety, without fear of reprisal. This has an enormous benefit in helping to ensure that all aspects of an issue are fully explored before making decisions.

A strong safety culture is vital to safe operations, and one ongoing area reliant on safety culture involves aging effects on materials. In addition to the Davis-Besse issue, we have experienced other challenges, such as cracking in dissimilar metal welds.

As a result of the Davis-Besse reactor head degradation, NRC enhanced its inspection program utilized by resident inspectors permanently posted to every nuclear reactor site. These enhancements strengthened the inspector's abilities to monitor a licensee's safety culture. The new construction inspection program, currently under development, will also have dedicated resident inspectors at the construction sites and efforts are ongoing to determine the role of safety culture in this program. Any organization that does not have current nuclear experience and is interested in building nuclear plants must accept the need to constantly foster a strong safety culture in its nuclear organization. This is non-negotiable.

Perhaps no aspect of nuclear technologies causes greater public apprehension than the health effects of radiation. If any of you heard my remarks to the NCRP council members in April 2007, you know of my deep personal interest in better understanding the health effects of low doses of radiation. With this audience, I don't need to remind you that the scientific underpinnings for the use of the linear no-threshold, or LNT, hypothesis at low doses are sadly lacking. In those remarks two years ago, I noted my frustration at the continued use of the LNT model in the name of "prudent regulation." You also heard my frustration with the repeated misuse of "collective dose," contrary to recommendations of NCRP and ICRP, in ways designed to frighten the public with unjustified statements of risk among large populations.

Today, I can't say what should be used in place of the linear no-threshold model, but the excellent program on low dose effects sponsored by DOE, with its focus on understanding low dose effects at the molecular level, is at least able to provide a solid basis for questioning the LNT model. It remains my earnest hope that the research progress in the DOE program, which directly impacts many of the key issues studied by the NCRP, will eventually lead to a better understanding of the actual relationship.

In the meantime, I worry that the absence of better knowledge and the use of the so-called "prudent" LNT model leads to conclusions that may unduly alarm the public, may lead some to defer or avoid vital medical procedures, and may waste public funds in massive cleanup programs. I hope I don't need to convince folks in this audience that your work and the public are very well served by continued research in this complex field.

The NCRP and other organizations that deal with radiation, including the NRC, will be challenged by the anticipated final release of the new average dose levels within the U.S. New dose estimates would almost double the 360 mrem dose that has been used as the national average for many years. Careful discussion and public education efforts will be important to place these new figures in context with the source of the increase, the increased use of radiation-based technologies in medical diagnostic and therapeutic applications. Certainly those same technologies have opened new medical opportunities and many more patients can be helped with these evolving procedures. At the same time, it may be important in our discussions to reemphasize that such procedures should not be lightly undertaken and that undergoing some of the newer procedures without medical justification may be cause for concern.

<u>The Future</u>

Turning now to the future, provided that continued safety is demonstrated by the nations that operate reactors, reactor technology can be expected to progress, either more or less rapidly depending on marketplace factors, toward new generations of designs with demonstrably greater safety and potentially greater utility, especially for small modular types. Keeping up with the advancing technology, so as to permit adequate safety reviews, will be a challenge for the NRC – but one for which we are starting to prepare. Increasing concern for carbon-free electrical power and process heat may drive further interests in both new plants and in extending the operation of existing units. The requirement of the Energy Policy Act of 2005 for DOE to develop a next generation nuclear plant is one example of an initiative that will further advance nuclear technologies. Future challenges will include developing the licensing framework and expertise necessary for reviews of these advanced technologies. As such, NRC staff has already begun to consider a path forward, including modification of existing regulations and possible new rulemakings to address the safety and security requirements needed for these new technologies.

Another area of future challenge is related to spent fuel and waste management in the U.S. Management of both high- and low-level waste from these facilities may challenge industry, NRC, and the Agreement States. This past June, NRC received a license application from DOE for a deep, geological, permanent repository for high-level waste and spent fuel. The issues related to spent fuel management have precipitated a lot of thinking about the advantages of recycling spent nuclear fuel. Potentially this could significantly reduce the volume and toxicity of waste placed in a repository. Additionally, it could significantly expand the amount of usable fuel that can be extracted from the earth. Finally, it could substantially enhance proliferation resistance over existing recycling technologies. But it will come only with a substantial investment in the necessary research to develop the commercially usable technologies that would be needed.

Low-level waste issues may also present special challenges, especially since the Barnwell site closed to out-of-compact wastes last year. Many states could be without disposal for Classes B and C wastes, a far from ideal situation. The NRC and the states will be faced, in all probability, with assuring that the absence of disposal capacity for such wastes does not translate into unsafe storage of such wastes by the licensees generating it. NRC may even need to consider the first-time use of the provisions in 10 CFR Part 62, regarding emergency access to low-level waste disposal facilities.

In anticipation of this development, NRC and the Agreement States are taking steps that will help to mitigate the impact of the closure of Barnwell. NRC has issued revised low-level waste storage guidance for materials licensees. In addition, the nuclear power industry is developing low-level waste storage guidance, which it intends to submit to NRC for review and comment in the near future.

Closing

In closing, I hope I have accomplished four things today.

First, I hope you can agree that the maintenance of a strong and independent nuclear regulator is not only necessary, but adds significant value to public confidence and assurance.

Second, you should appreciate the amount of new licensing work that the NRC is expecting and has started, and our commitment to performing effective safety reviews in an efficient and timely manner.

Third, you should appreciate the challenges that face the nuclear industry as well as the NRC. Some of these challenges rely on continued progress by the NCRP.

And, fourth, you should have a better understanding of how the NRC continues to evolve in meeting our mission of protecting public health and safety and the environment. We are anticipating our challenges, learning from experience, preparing for the demands of new licensing work, collaborating internationally in an expanding global environment, ensuring that safety and security measures stay in harmony, and promoting a strong safety culture.

Thank you for your attention.