U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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Office of Public Affairs, Headquarters
Washington, DC. 20555-0001
www.nrc.gov ▪ opa.resource@nrc.gov

No: S-14-006
CONTACT: Eliot Brenner, 301-415-8200

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Chairman Allison Macfarlane
"Ensuring Safety and Security: How a Technical Agency Operates in a Policy World"
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Good afternoon. It's a pleasure to be here today to take part in these important discussions about energy policy in the United States. I appreciate the opportunity to offer my perspectives from the vantage point of a nuclear safety regulator, and I hope that what I'm about to talk about will complement what we've just heard from Commissioner Moeller. In my remarks today, I'll explore how the Nuclear Regulatory Commission, as a technical agency, operates in a policy-focused environment – the nexus of scientific, technical, and policy imperatives.

A Dynamic Environment

This is a dynamic time for the NRC and the nuclear industry. There are five reactors under construction in the United States, and five undergoing, or soon to undergo, decommissioning. We have 100 operating reactors that require our oversight. Our agency has approved requests from licensees seeking to extend the operating life of their facilities beyond 40 years. We're continuing to address lessons learned from the Fukushima Dai-ichi accident in Japan three years ago. And, as an agency and as a government, we've faced some challenging financial circumstances during the past few years, and we face ongoing challenges associated with an aging workforce.

I am often asked to offer my thoughts on the future of nuclear power in the United States, given the current landscape of issues I've just described. As regulators, we leave the job of predicting the future to others. But our mission is essential no matter what the future holds – our strong focus on nuclear safety and security is imperative for the nuclear power industry. To consistently ensure safety and security, the NRC must ensure that it's consistently making sound decisions.

As is the case in other agencies that oversee specialized industries, the NRC has a highly qualified staff of experts from a variety of scientific and technical disciplines. The Commission relies on the staff to conduct careful and often complex analyses to inform our decision-making. We endeavor to rely on the best and most current information available, whether we're seeking to understand the implications of an incident or addressing new developments in science or technology.

Research Science vs. Regulatory Science

As an academic who is now a regulator, I'm particularly impressed with Harvard professor Sheila Jasanoff's work on the relationship between research science and regulatory science. In her work, *The Fifth Branch*, she notes that scientists with the same skills and expertise may face very different circumstances depending on whether they pursue a regulatory career or an academic one.

One primary distinction is the presence or absence of rigid deadlines and requirements. In the research community, projects tend to be open-ended, with professional peers holding a scientist accountable for the veracity and originality of his or her work. In the regulatory community, a scientist's work may be constrained by statutory deadlines or other legal requirements, with additional, mandatory legislative or judicial oversight. In my opinion, even with all of these additional constraints, it is incumbent upon a regulatory scientist to conduct high-quality analysis as his or her academic counterpart.

The important consideration here is that, as regulators, we are often bound by deadlines that research scientists and technical specialists don't face in other contexts. This means that at some point, we must end our analysis and reach decisions based on a combination of the best available information and informed assumptions. The bottom line is that we owe it to the public, and to the industry we regulate, to ensure that our decisions are sound, well-informed, and best position us to continue protecting public health and safety.

Potential Policy Issues

As an independent regulator, it's important that the NRC follows its regulatory processes, which take a prescribed length of time and have a number of required steps. As an agency, we challenge ourselves to be aware of new scientific information. Our regulatory processes allow for the incorporation of new information into future revisions of our regulations.

Because we're an independent agency, our decisions are based on technical and regulatory considerations. However, at times, the NRC's work may also be affected by changes in national energy policy or legislation. An example of current interest is nuclear waste disposal. The NRC is responsible for issuing construction authorization and operating licenses for a nuclear waste repository, but it is up to Congress and the Executive Branch to dictate national waste policy and budget decisions.

The NRC also has an adjudicatory role, similar to the judicial branch of the Federal government. The decisions the NRC makes in this role can be challenged in court. These court decisions can also affect the NRC's activities, and in particular, how activities are prioritized. In 2012, the DC Circuit Court of Appeals ruled that the NRC's waste confidence rule had several flaws. The court ordered that the NRC reevaluate the rule and produce a corresponding generic environmental impact statement. In response, a special directorate of staff was created to focus exclusively on this issue and produce a new final product within two years. The Commission also directed that no final licensing actions dependent on the waste confidence rule be taken until the staff had completed its work. This is a good example of how the Commission sets agency priorities in response to decisions by other parts of the Federal government.

The Fukushima Dai-ichi Accident

Like so many others, the nuclear industry is a global industry. When an incident, such as a reactor accident, happens anywhere in the world, there are almost certainly lessons for other countries to learn. The Fukushima accident provides the most recent and most visible manifestation of this principle.

The accident had broad implications for all nuclear power programs worldwide. For example, in the United States, we hadn't previously considered the possibility that multiple units at the same site would suffer a loss of power simultaneously, or that a prolonged loss of offsite power could take so long to resolve. It caused regulators and operators around the world to rethink whether the accident prevention and mitigation measures currently in place at reactor sites would be sufficient in the face of extreme conditions.

In short, for the NRC and the U.S. nuclear industry, the accident required a lot of quick, but carefully considered, decisions. The first step was to verify that all of the U.S. plants were operating safely, and could continue to do so, based on what we were learning. It's important to emphasize that the NRC performed thorough assessments and concluded that all U.S. nuclear power plants were safe to continue operations; everything we've done since then is intended to enhance this high level of safety.

Fukushima: The NRC's Response

The NRC's response to the Fukushima accident in Japan is an ongoing example of how our agency balances the need for careful scientific and technical analysis with the need for timely decision-making. It's also an example of why a highly-specialized agency like the NRC needs a broad range of expertise to effectively accomplish its mission.

Within less than a month after the accident, the NRC assembled a team of high-caliber staff and managers called the Near-Term Task Force to make recommendations for potential safety enhancements or regulatory changes. Within three months, the Task Force produced a comprehensive report containing twelve such recommendations, which the Commission ultimately prioritized into three tiers.

The NRC has spent the past three years assessing lessons learned from the accident and requiring safety enhancements at all U.S. nuclear power plants and other nuclear facilities, as well as longer-term regulatory modifications. The agency endeavors to complete the most safety-significant work in or before 2016, and we continue to evaluate the necessity of longer-term actions.

Fukushima: Commission Orders

Based on the Near-Term Task Force recommendations, the Commission determined that immediate orders should be issued to nuclear power plants. The NRC issued a Mitigating Strategies order requiring all U.S. nuclear power plants to implement strategies to allow them to cope without their permanent electrical power sources for an indefinite amount of time. These strategies must keep the reactor core and spent fuel cool, as well as protect the thick concrete containment buildings that surround each reactor. The mitigation strategies are expected to use a combination of currently-installed equipment, additional portable equipment that's stored on-site, and equipment that can be flown in or trucked in from support centers.

The Commission also required plants to install instrumentation to more accurately monitor the water level in spent fuel pools. Finally, the Commission directed that boiling water reactors with Mark I and Mark II containments, like those at Fukushima Dai-ichi, must install severe-accident capable hardened vents.

Subduction Zones and Megaquakes

The Great Tōhoku Earthquake is an important example of how scientific understanding constantly evolves. You probably remember that, less than 10 years earlier in 2004, a massive earthquake hit the Sumatra region of Indonesia and created a devastating tsunami in the Indian Ocean. Prior to that time, seismologists thought that only some subduction zones – where one tectonic plate is being dragged beneath another – could generate "megaquakes" of a magnitude greater than 8.8. After the Sumatra quake, seismologists modified their understanding to all subduction zones of sufficient length are capable of producing megaquakes. Unfortunately, the Japanese earthquake and subsequent tsunami in 2011 further substantiated this new understanding of Earth processes.

Reevaluating Seismic Hazards in the Central and Eastern U.S.

Let me give you an example of an ongoing scientific and technical evaluation we're doing as part of our post-Fukushima activities.

Even before the Fukushima accident, the NRC recognized the importance of ensuring that its understanding of nuclear plants' ability to withstand seismic events was based on the most up-to-date scientific data available. We determined that particular attention should be paid to plants in the Central and Eastern United States, because there was new information on earthquake sources in the North American tectonic plate. The updated information had shown there may be increased earthquake potential in some areas. In 2012, the NRC, the Department of Energy, and the Electric Power Research Institute teamed up to update the so-called "seismic source model" for the Central and Eastern U.S.

Seismic Hazard Reevaluation: The Process

Immediately after the Fukushima accident, the NRC required operators to conduct thorough inspections at all reactor sites to ensure that the plants could withstand a seismic or flooding event within the current design basis. The NRC did its own inspections to verify the accuracy of our licensees' reporting.

As a next, more in-depth, step, the NRC has required all plants in the Central and Eastern United States to conduct seismic hazard reevaluations using the new seismic source model I just described. The first step was for plants to submit reports evaluating and updating the seismic hazard at their individual facilities. We received all the reports at the end of last month, and they're available on our website.

Earth scientists and reactor experts on the NRC staff are now carefully reviewing these reports to verify the licensees' analysis and address any errors. Based on these reviews, the NRC will require certain plants to conduct more extensive analyses of the probability of the events and their ability to safely respond. We've also been engaging with our licensees in a similar process to evaluate and update flooding hazard analyses.

Seismic Hazard Reevaluation: Western States

We're also requiring a separate analysis from all nuclear power plants in the Western United States. Because the geology in that part of the country is quite complex, it isn't possible to use a single model for this region. Each plant will use a specific seismic source model to accomplish the task, and we've given them a slightly longer period of time in which to complete the work.

The safety enhancements we may require as a result of these seismic and flooding hazard reevaluations are intended to further strengthen the already safe operation of nuclear facilities in the United States. The NRC's efforts in this area demonstrate the importance of, and our commitment to, keeping up with scientific and technological developments to ensure that U.S. nuclear facilities remain as safe as possible.

License Renewal

We spend a lot of time talking about Fukushima because it's been an important priority over the past three years. But the NRC applies a structured, technically-based approach to all of its work. Another example is our license renewal process. As many of you probably know, nuclear power plants in the United States were originally licensed to operate for 40 years. Many plants will soon, or have already exceeded this duration and have applied to the NRC for license extensions. Our regulations have a prescribed timeline that the NRC and our licensees must follow to complete this process.

As of this month, 28 units have entered into a period of extended operation. This figure includes Vermont Yankee and Oyster Creek, although they have both since indicated they would be ceasing operations. Seventy-three units have already received a renewed license, and there are 18 units currently under review. An additional nine units have sent letters of intent to submit a license renewal application. Licensees can apply for renewal up to 20 years before their license expires, but they must do so no later than five years prior to the license expiration to be eligible for timely renewal. The licensees must provide required information, as well as any additional information the NRC staff requires to conduct its analysis. The NRC's scientific and technical experts must use this information to reach a conclusion about the license extension.

License Renewal: Aging Management Issues

Aging management of reactor components is an important consideration in extending the operating life of a nuclear power plant. We've observed degradation of buried piping and concrete, among other things, in our inspections. The licensees must demonstrate that they're aware of, and can address, these kinds of issues in a period of extended operation – from 40 to 60 years. In particular, the NRC maintains an aging management program that imposes additional inspection requirements on plants after 40 years of operation. The NRC has expert staff who analyze various conditions and potential problems, conduct root-cause analyses, and recommend corrective actions.

As you can see from these examples, there are a number of components that contribute to the NRC's decision-making. We strive to stay informed about scientific and technological advances, like new seismic data or information about how reactor components behave over time. We have a highly competent staff with a broad range of expertise who monitor developments within their disciplines and incorporate what they've learned into the analyses they produce for the Commission.

Public Engagement

The NRC staff also seeks to learn whatever we can from external parties, whether industry, academia, local government, non-governmental organizations, members of the public, or our international counterparts. These groups may know something we don't, or have already encountered issues that we now face. We try to capture as many of these views as possible through our public comment process. Throughout my tenure as Chairman, I've made it a top priority to work with the staff to identify ways to further improve our public engagement and ensure we consider a full range of views.

Global Implications for Regulators

The NRC's ongoing effort to strike a balance between upholding our critical regulatory mission and maintaining the flexibility necessary to respond to dynamic circumstances is not unique. Regulators around the world find themselves in a similar position. In fact, this is one common area for discussion in the NRC's bilateral and multilateral engagement on nuclear safety and security. In the face of changing financial or policy circumstances, regulators must ensure that maintaining a high level of safety is always the top priority.

Human resource challenges are almost always involved, with the need to hire the right number, and the right kind, of experts. For countries seeking to develop or expand nuclear power programs, the regulator must keep pace with often aggressive schedules for planned development. In China, with more than 30 units under construction, the regulator has doubled its staff and is still seeking to hire additional specialized experts. For countries that have made policy decisions to slow or halt their nuclear programs, like Germany, the regulator must address the challenge of continuing to motivate its workforce to ensure the same high level of safety. This must occur amid concerns of possible downsizing, and with a potential lack of trained experts in the candidate pool to replace staff that may retire.

It is in part due to the need to remain flexible and highly capable regardless of policy circumstances that regulatory independence is so important. Undue influence from political, economic, or other factors can hamper a regulator's ability to make impartial decisions that affect safety. In the United States, the NRC's authority to issue orders to immediately enhance safety or security in a particular area, such as the three Fukushima orders I discussed earlier, is an important component in fulfilling our responsibility as an independent regulator.

Confidence in Decision-Making

So how can a scientific and technical agency have continued confidence in its decisions, given the budget and human capital constraints as well as dealing with new information and lessons learned? I believe one needs to be confident that the staff has done the best technical work, consulted the right people inside and outside the agency, and made a commitment to periodic evaluation of new scientific or technical information that may cause future thinking to evolve.

As a regulator who spent many years as a research scientist in the academic community, I find myself thinking often about the relative benefits and detriments of research science and regulatory science. There are certainly benefits to having unlimited time to do research, such as the possibility for

more diverse peer review or the ability to consider evolving data over a period of years before drawing a conclusion. But there are also limitations – the work progresses more slowly and requires continued funding for successful completion.

On the other hand, pros and cons also exist for regulatory analysis. Timeframes are often constrained based on external deadlines or policy issues, and decisions often need to be made quickly – but not hastily. It's essential to have a balance of qualified scientific and technical experts and policy specialists at the NRC or any regulatory agency to ensure that the agency is making high-quality decisions based on the best available information.

Conclusion

Whatever the future holds, the NRC remains responsible for ensuring the safe and secure operation, construction, and/or decommissioning of licensed nuclear facilities in the United States. I'm confident that we'll continue to execute this important mission with a continued commitment to sound decision-making that achieves this critical balance between high-quality analysis and policy imperatives.

I greatly appreciate the opportunity to speak to you today and would be pleased to answer your questions. Thank you.