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NUCLEAR ENERGY DEVELOPMENT

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

TO

RECEIVE TESTIMONY ON NUCLEAR ENERGY DEVELOPMENT

MARCH 18, 2009

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CONTENTS

STATEMENTS

APPENDIX

NUCLEAR ENERGY DEVELOPMENT

WEDNESDAY, MARCH 18, 2009

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:38 a.m. in room SD–366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. OK, why don't we go ahead with the hearing?

Our meeting this morning has two purposes, both to consider the nomination of David Hayes to be the Deputy Secretary of Interior and also to hear testimony on nuclear energy development.

To report the nomination or take any action on it, a quorum of 12 members must be present. In the absence of a reporting quorum, I would propose that we go ahead with the hearing at this time, and once a reporting quorum is present, then we could briefly recess the hearing and consider Mr. Hayes's nomination and then return to the hearing once that has been completed.

Nuclear power is an essential part of our energy mix. The 104 nuclear power plants now operating in this country supply 20 percent of our electricity. They do so reliably, cost effectively, and without emitting greenhouse gases.

Nuclear power is an essential part of our energy mix and must remain so for the foreseeable future. The current generation of nuclear power plants was mostly built in the 1960s and 1970s and 1980s. For nearly 30 years, utilities did not order a single new nuclear power plant. But in the last 2 years, 17 companies or groups of companies have ordered 26 new reactors.

Our focus this morning will be twofold. First, we have invited Dr. Dale Klein, who is the chairman of the Nuclear Regulatory Commission, to give us an overview of the licensing process that the commission uses to license new nuclear power plants and review for us the status of new reactor applications.

The original licensing process was often blamed for the construction delays and cost overruns that were experienced in the past. But the commission and the Congress replaced that process with a new, streamlined, one-step process that is now in place but has not yet—but has yet to be fully demonstrated.

So we look forward to hearing from Dr. Klein on this licensing system and on the status of applications.

Our second panel will focus on the financial challenges and other obstacles facing new nuclear power plant development. The high capital cost of building a new nuclear power plant is a serious obstacle to developing these plants. We have previously tried to address the financial challenge through loan guarantees, delay and accident insurance, and production tax credits, and we will ask the second panel for its perspective on these financial challenges and on any other problems facing the industry at this time.

What to do with the spent fuel from nuclear power plants is, of course, one of the biggest unsolved problems facing the nuclear industry. Nuclear waste is not the subject of today's hearing. I hope we can schedule a separate hearing on nuclear waste in the weeks ahead.

Nonetheless, I recognize the keen interest Senators have in the problem and in the Administration's decision to stop work at the Yucca Mountain repository. I expect we will have questions for the panel on the waste problem as well as part of this hearing.

So, with that, let me defer to Senator Murkowski.

STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Thank you, Mr. Chairman.

I appreciate the hearing on the development of nuclear energy here in the United States. We have seen a resurgence of the nuclear power industry with 26 license applications from 17 entities pending for new reactors. But even with the benefits of nuclear energy, which are no emissions, stable baseload, and large-scale job creation, there has been conflicting evidence from the new Administration on what role they will play to support this revival.

If nuclear power has a place in our overall energy policy to meet future energy needs and reduce greenhouse gas emissions, and I firmly believe that it does, then we in Washington need to be doing all that we can to move it forward now. While there has been some mention about nuclear energy being part of the overall energy strategy, the actions of the Administration do not necessarily support that claim.

So far, this Administration has sought to kill Yucca Mountain as a long-term repository for spent nuclear fuel without yet providing an alternative. They have shown an unwillingness to increase the loan guarantee program funding levels to support the construction of new nuclear plants, and they have focused on renewable and alternative fuel developments to reduce our carbon emissions literally without any mention of nuclear energy.

So where the nuclear energy as an initiative truly stands with the current Administration is a bit of a mystery to me.

The U.S. may have the largest number of nuclear power plants in the world, but no new reactors have been ordered in the United States since 1978. Since that time, over 250 new reactors were constructed outside the United States, compared to just over 50 domestically.

China alone has 24 new nuclear reactors under construction, which will be online between 2010 and 2015. Japan intends to increase the amount of electricity it gets from nuclear from today's 30 percent to over 40 percent by the year 2020. France already gets

78 percent of its electricity from nuclear. It is safe to say that nuclear has achieved a significant level of international acceptance.

Unfortunately, as other countries have moved forward, the United States has been stagnant in perhaps more ways than one. Not only did we effectively stop building new reactors 20 years ago, but we have allowed our nuclear work force and our manufacturing infrastructure to disappear. It will take hard work and investment as well as stable regulation and Government policies to reestablish our domestic nuclear industry and expand our Nation's primary source of carbon-free energy.

We have just begun to see the rebirth of the nuclear energy industry in this country, and I credit a great deal of that to the leadership of Senator Domenici, who sat next to you for so many years here, Mr. Chairman.

I look forward to working with my colleagues on this committee as well as those within the Administration to continue the development and look forward to the comments from the witnesses.

The CHAIRMAN. Let me ask Chairman Klein—Dale Klein, who is chairman of the Nuclear Regulatory Commission, to go ahead and take the chair here. Our first panel is made up of the Honorable Dale Klein. He is the chairman of the Nuclear Regulatory Commission, and we look forward to hearing from you as to your view on this set of issues.

Please go right ahead.

STATEMENT OF DALE E. KLEIN, CHAIRMAN, NUCLEAR REGULATORY COMMISSION

Mr. KLEIN. Thank you, Mr. Chairman, Senator Murkowski, and members of the committee.

I am pleased to appear before you today to talk about the Nuclear Regulatory Commission's new reactor licensing process. My written testimony provides considerable detail on this subject. So let me take this time to highlight the main points.

First, an update of the current status of new reactor applications; the second, how the agency has improved and streamlined the licensing process for proposed new reactor applications with no compromise of safety; and third, our extensive preparations to develop the staff and resources necessary to provide timely reviews of the applications.

As you indicated with regard to the current applications, the NRC has received 17 applications or combined operating license applications for a total of 26 new reactors. A map depicting the locations and types of proposed reactors is included in my written statement. Based on industry information submitted to the NRC, we could see up to five more COL applications for seven more reactors by the end of 2010.

Unlike the current combined license process, the commercial nuclear power plants currently operating in the United States were licensed under a two-step process—first for construction and a second step for operation. This led to a "design as you go" approach, which deferred resolution of important safety issues until plant construction was well underway, and it allowed commercial reactors to be built with an unusual degree of variability and diversity.

The Agency's new process approves a plant design before construction begins while maintaining significant public participation throughout the licensing application process. It also provides two other significant procedures—first, review and approval of standardized designs through a design certification rulemaking and, second, review and approval of a site suitability prior to a decision to build a particular plant through an early site permit. The applicant may also request a limited work authorization, which allows applicants to perform limited work activities to prepare the site.

I should mention that not all the applicants are taking full advantage of this new, improved licensing process. In addition, some applications received to date initially lacked information that the staff needs to complete this review. But the NRC is working with the stakeholders to overcome these challenges, and we are confident that the agency will be well prepared to make timely regulatory decisions.

To prepare for the increased licensing activity we are experiencing at the NRC, we made plans several years ago for the staffing. Most significantly, the Commission created the Office of New Reactors, or NRO, to lead the agency's effort to establish the regulatory and organizational foundation necessary to address the new reactor licensing demand. Staffing the new office was given high priority, and today, we have over 475 highly competent and trained employees.

We also created a new reactor construction inspection organization in Region II in our Atlanta, Georgia, location.

Mr. Chairman, my written testimony addresses other important subjects, such as our cooperative efforts with regulators abroad on construction and vendor inspection, but I think I have mentioned the highlights.

This concludes my overview of the NRC's licensing process for the new reactor applications and the current status of the license applications, and I will be pleased to answer questions you may have.

[The prepared statement of Mr. Klein follows:]

PREPARED STATEMENT OF DALE E. KLEIN, CHAIRMAN, NUCLEAR REGULATORY COMMISSION

Mr. Chairman, Senator Murkowski, and Members of the Committee, I am pleased to appear before you today to discuss the Nuclear Regulatory Commission's new reactor licensing processes.

Let me begin by noting that just last week the NRC hosted our annual Regulatory Information Conference, which was attended by nearly three thousand individuals, including regulators, members of industry, stakeholders, and representatives from 31 other nations. Our annual conference is part of the NRC's ongoing efforts to share information, best practices and lessons learned to enhance nuclear safety and security both domestically and abroad.

Mr. Chairman, my testimony will explain the current licensing process for new reactor applications; contrast this with the agency's older, less efficient, two-step process; and discuss the current status of new reactor applications.

Congress has provided the NRC with the resources needed to meet the growing renewed interest in additional commercial nuclear power in the United States. These resources have enabled the NRC to successfully complete, on schedule, significant new reactor licensing activities. Over a number of years, NRC has taken steps to improve the licensing process. These actions have served to increase the effectiveness, efficiency and predictability of licensing a new reactor while maintaining our focus on safety and security. All currently operating commercial nuclear power plants in the United States were licensed under a two-step process for approval of

construction and later for operation. But, all of the new reactor license applications have been submitted under a new combined license application approach (also known as "COL"), which essentially takes the previous two-step review process down to one step. To date, the NRC has received 17 COL applications for 26 new nuclear reactors. A map depicting the locations and types of proposed reactors is attached. Based on industry information submitted to the NRC, we could see up to five more COL applications for seven more reactors by the end of 2010.

In the simplest terms, under the original two-step licensing approach the NRC would first issue a construction permit, based on evaluation of preliminary safety and design information, to allow construction of a nuclear power plant, and then later issue an operating license upon completion of construction. The applicant was not required to submit a complete design at the construction permit phase. Before the scheduled completion of construction, (typically when the plant was 50% completed), the applicant filed an application for an operating license. At this point, the applicant had to provide the complete design bases and other information related to the safe operation of the plant, technical specifications for operation of the plant, and description of operational programs.

Criticism of the two-step process centered on a design-as-you-go approach to constructing the plant, which deferred resolution of important safety issues until plant construction was well underway. The deferral of design details until after construction was authorized allowed commercial reactors to be built with an unusual degree of variability and diversity—in effect, a set of custom-designed and custom-built plants. Other criticisms included regulatory requirements that kept changing, and a seemingly inefficient and duplicative review and hearing process.

To address these problems, the process set forth in Part 52 of the NRC's regulations allows an applicant to seek a combined license, which authorizes construction based on a complete design and provides conditional authority to operate the plant, subject to verification that the plant has been constructed in accordance with the license, design, and the Commission's regulations. Part 52 maintains significant public participation throughout the licensing application process. A graphic depiction of the licensing process is attached.

Part 52 provides two other significant procedures: (1) review and approval of standardized designs through a Design Certification rulemaking, and (2) review and approval of a site's suitability, prior to a decision whether to build a particular plant, through an Early Site Permit (ESP). The applicant may also request a Limited Work Authorization (LWA), which allows applicants to perform limited work activities to prepare the site before approval of the COL.

So far, only one of the five designs currently being referenced in COL applications—the Advanced Boiling Water Reactor—has completed the certification process and is only referenced in one COL application. It should be noted that although the Westinghouse AP1000 is also a certified reactor design, the design that was approved in 2006 has two revisions under review by the NRC. A final decision on the design changes is expected in 2010.

In addition, the design certification applications and some COL applications received to date initially lacked information that the staff needs to complete its review. Staff reviews have been further complicated because some applicants are revising submission dates and submitting modifications to their applications, often with late notice to the staff, which is disruptive to the work planning process. The result is that the early COL applications are unlikely to achieve the full benefits of the Part 52 process. The NRC is working with stakeholders to overcome these challenges and is confident that the agency will be prepared to make timely regulatory decisions. As this process matures, the Commission will seek the continued support of Congress to sustain these efforts.

I would like to focus my comments briefly on improvements we have made to date, and what we expect down the road in new reactor licensing.

The NRC has sought to position itself strategically to be ready to respond to the new reactor licensing workload. The Commission created the Office of New Reactors, or NRO, to lead the agency effort to establish the regulatory and organizational foundation necessary to address the new reactor licensing demand. Staffing the new office was given high priority, and today NRO has over 475 highly competent and qualified employees.

The NRC has made great strides in addressing the new reactor licensing challenge:

- The NRC published a revised 10 CFR Part 52 (titled, "Licenses, Certifications, and Approvals for Nuclear Power Plants") in August 2007 to clarify the applicability of various requirements and to enhance regulatory effectiveness and efficiency in implementing the licensing and approval processes. The rule also in-

corporated lessons learned from the reviews of the first design certification and early site permit applications.

- Similarly, the NRC published a final rule on Limited Work Authorizations, or LWAs, which supplements the final rule on 10 CFR Part 52. This rule allows certain early construction activities to commence before a construction permit or combined license is issued. The rule specifies the scope of construction activities that may be performed under an LWA, and specifies activities that no longer require NRC approval. Like the Part 52 revision, these changes were adopted to enhance the efficiency of the licensing and approval process and to reflect more clearly NRC's authority.
- In March 2007, the NRC completed the first comprehensive update to the NRC's Standard Review Plan (SRP), which provides guidance to the staff on how to perform technical reviews. The update brought the SRP into conformance with the Part 52 revision, and extends the applicability of the SRP to the Part 52 licensing process.
- The NRC issued a new regulatory guide, RG 1.206 (titled, "Combined License Applications for Nuclear Power Plants"), which provides guidance to potential applicants on standard format and content of new reactor combined license applications, and also recently issued guidance for applicants on complying with the LWA rule.
- The NRC has implemented a computer-based project management system that significantly enhances the staff's ability to plan and schedule work.
- In 2004, the NRC promulgated substantially revised rules of practice intended to streamline and make the hearing process more effective.
- The NRC promulgated an electronic filing rule that is further increasing the efficiency of the hearing process.
- The NRC created a new reactor construction inspection organization in the Region II Office in Atlanta, Georgia. To prepare for the commencement of construction activities, the staff has observed ongoing new construction activities in China, Finland, France, Japan, Korea, and inspected the refurbishment and startup of the Tennessee Valley Authority (TVA) Browns Ferry Unit 1, which has been idle since 1975, and is currently inspecting the completion of TVA's Watts Bar Unit 2, which had been in a suspended state since 1985.
- Finally, the NRC conducted an efficient review of project management using the Six Sigma problem-solving methodology to streamline the design certification rulemaking process.

With these activities, I believe that the NRC has established a strong regulatory foundation for the review of new reactor license applications.

I should also mention that the agency has made a consistent effort to improve our coordination with other Federal agencies involved in new reactor licensing. For example, consistent with its lead responsibility for off-site nuclear emergency planning and response, the Federal Emergency Management Agency (FEMA) supports the NRC's COL application reviews by providing input to ensure that the off-site emergency plans are adequate.

In addition to COLs, the NRC staff has completed the review of three early site permit applications and is proceeding with the review of the fourth application. With respect to design certifications, the staff is continuing its review of General Electric's Economic Simplified Boiling Water Reactor, commonly referred to as the ESBWR; Areva Nuclear Power's U.S. Evolutionary Power Reactor, or U.S. EPR; Mitsubishi's U.S. Advanced Pressurized Water Reactor, or US-APWR; and amendments to Westinghouse's AP1000 design certification.

The NRC has completed preliminary work for the licensing of the Next Generation Nuclear Plant, or NGNP. In August 2008, the NRC and DOE delivered a licensing strategy to the Congress, as required by the Energy Policy Act of 2005.

I would like to touch briefly on the GAO's 2007 audit of the NRC's readiness to conduct reviews of COL applications. In general, the GAO's findings were positive assessments, acknowledging the NRC's extensive preparations and the quality of plans. The NRC continues to believe that the GAO assessments provide useful insights to the agency's management. The GAO identified four recommendations:

- Fully develop and implement criteria for setting priorities to allocate resources across applications by January 2008.
- Provide the resources for implementing reviewer and management tools needed to ensure that the most important tools will be available as soon as is practicable, but no later than March 2008.
- Clarify the responsibilities of Office of New Reactor's Resource Management Board in facilitating the coordination and communication of resource allocation decisions.

- Enhance the process for requesting additional information by (1) providing more specific guidance to staff on the development and resolution of requests for additional information within and across design centers and (2) explaining forthcoming workflow and electronic process revisions to combined license applicants in a timely manner.

I am pleased to report to you that the NRC has completed its work in response to these recommendations.

The NRC is also working with its international partners on many areas of common interest. One program that we have initiated is the Multi National Design Evaluation Program (MDEP) in order to take advantage of international experience in licensing and constructing two EPR plants in Europe to assist the NRC in its review of the US EPR application. The NRC also has recently established interactions with regulatory counterparts in China, Canada and the United Kingdom to exchange information on the licensing review of proposed AP1000 reactors in the United States.

In addition to focusing on completing licensing reviews, the NRC is working on the development and implementation of a new Construction and Vendor Inspection Program. The program is building upon prior experience, including lessons learned during the construction of the 104 currently operating reactors. Numerous historical lessons provide insights related to quality and oversight problems during the previous period of construction in the United States, and abroad. The most important of these lessons is that a commitment to quality, instilled early in a nuclear construction project, is vital to ensuring that the facility is constructed and will operate in conformance with its license and the regulations.

The NRC staff is working with the industry to ensure that a strong commitment to quality is part of the foundation of every new reactor project in the United States. Many of the components that will be used in the construction of possible new reactors in the U.S. will be manufactured abroad, so NRC inspectors are also visiting manufacturing facilities and working with our regulatory counterparts in other countries to ensure the quality of the manufactured components. Quality assurance (QA) inspections of engineering and site activities are contributing to the conduct of effective and efficient reviews of design certifications, COLs, and early site permit applications. The agency has also sought stakeholder involvement in an effort to make construction and vendor inspection a timely, accurate and transparent process.

While the Commission is satisfied that we have in place an effective regulatory process, we are always looking for ways to improve. Just as industry can become more efficient, the NRC is constantly working to improve its efficiency with no compromise in safety.

Mr. Chairman and Members of the Committee, this concludes my overview of the NRC's licensing process for new reactor applications, and the current status of license applications. I would be pleased to respond to any questions you may have.

The CHAIRMAN. Thank you very much.

Let me just ask what kind of a timeline you anticipate for actually—you have 17 applications pending. Is that correct?

Mr. KLEIN. That is correct.

The CHAIRMAN. How quickly do you expect that you will be able to act on these applications? Are some of them on track to be dealt with fairly soon, or what is the timeframe?

Mr. KLEIN. We are actively reviewing those applications, as we speak. What we do in our process, once an applicant submits their COLA, we will review for that application to review for its completeness.

Once it is completed, then we will docket that application, and we currently have many applications under review. So our 475 individuals are actively at work, as we speak, reviewing those applications.

The CHAIRMAN. So you have not yet docketed the applications?

Mr. KLEIN. We have docketed almost all of them.

The CHAIRMAN. Oh, you have docketed them.

Mr. KLEIN. Yes.

The CHAIRMAN. So, you are now in the review process, which will lead to a yes-or-no decision by the commission as to whether they can proceed.

Mr. KLEIN. That is correct. In this process, under this new approach, what we are expecting is that it will take us about 30 months for the initial technical review, and we are allowing another 12 months for the hearing process, for a total of 42 months.

We expect, as the second wave of these applications go through, we will have efficiency of scale and be able to reduce that time with no compromise on safety. One of the areas that we have little control over is that hearing process.

The CHAIRMAN. The 42 months, when would you say that began with regard to some of these applications?

Mr. KLEIN. The first applications that we received was in 2006.

The CHAIRMAN. OK. So the 42 months began in 2006?

Mr. KLEIN. That is correct.

The CHAIRMAN. You can count forward from that to see when you might actually be in a position to act.

Does the Nuclear Regulatory Commission have adequate staff to review all of the combined license and design certification and early site permit applications that it has received and expects to receive in the foreseeable future?

Mr. KLEIN. Mr. Chairman, we do. We have, I think, been successful in articulating our need for personnel. We have a highly trained staff. So, we have organized our New Reactor Office in such a manner that we believe we can do the timely review of those applications.

The CHAIRMAN. As to legal authority, are you satisfied that the NRC has all of the statutory authority that it needs to make this regulatory process work efficiently, or should we be legislating changes in the law to help you in this regard?

Mr. KLEIN. We believe currently we have the legal authority to make the necessary decisions for the licensing.

The CHAIRMAN. Let me ask about the so-called "waste confidence rule. As I understand the commission's original waste confidence rule, the commission was confident that we would have a repository available by the years 2007 through 2009 based, in part, on the Nuclear Waste Policy Act, which called for such a repository by 1998, I believe.

Last October, when we still thought that Yucca Mountain repository might some day open, the commission proposed amending the waste confidence rule to say that you were only confident that there would be a repository 50 to 60 years after the 60-year extended life of a reactor.

I guess my question is what effect will the Administration's announcement that it intends to not proceed with Yucca Mountain have on your proposed rulemaking and on your confidence in this area?

Mr. KLEIN. Mr. Chairman, as you indicated, we are going through our waste confidence rule process currently. The comments for the public portion ended recently, and our staff will be evaluating and giving a recommendation. We expect the Commission to make a decision on waste confidence this summer.

Based on our rationale, the reason we looked at the waste confidence was that we wanted to have a clear understanding of our confidence in the event that the Yucca Mountain site at the time was not successful. As you know, our job as a regulator and required by law is to evaluate that application. Because of the uncertainty of the license application, we wanted to make sure that we were confident in the case that the license application was not successful that there were options forward to handle safely the spent fuel.

The CHAIRMAN. So you expect this summer to make a new decision as to your view as to the confidence that you can have in this process?

Mr. KLEIN. Yes, sir. We do.

The CHAIRMAN. All right.

Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman.

I want to follow up with the chairman's inquiry here. The decision that was made by the Administration through the—actually, I shouldn't say it is a decision yet. But through the budget blueprint that essentially pulls back on Yucca to an extent that I think you have suggested makes it problematic in keeping to the deadlines, which you were required to meet. I understand that is by 2012.

Can you speak, just very quickly, to what the regulatory commission needs in terms of funding to meet that mandatory deadline?

Mr. KLEIN. Senator Murkowski, being a regulatory agency, we try to follow the law ourselves, and Congress had given us guidance that they expected us to evaluate the applications, once docketed, within a 3-year period, with 1 year additional in order to allow for contingencies. So that meant maximum of 4 years.

During our 2009 budget process, we were initially $36 million short of the funds we expected to be required to meet that timely response. During the omnibus bill that was recently passed, we were provided about $11 million of our $36 million additional that we needed.

So it will be a challenge for us to meet our statutory obligations on a 4-year——

Senator MURKOWSKI. Can you meet it? Can you meet it, given the funding that you have received through the omnibus, and meet that 3-year period?

Mr. KLEIN. We are early enough in the stage that it is hard to give you a definite answer. But it will be very difficult for us to meet the 4-year commitment with the limited funding that we have been receiving.

Senator MURKOWSKI. Let me ask you about the challenges that you face just with the staffing and the expertise that you need. You mentioned you have got 475 staff that have been brought on to handle the workload. What challenges do you see in these years ahead?

You are stepping up in terms of the workload and the handling the permits and the applications. What challenges do you see in terms of the staffing, recruitment, and retention within the Commission and being able to keep good people on for the extended periods of time?

I understand that while you have a sufficient number of employees, that slightly less than half of the staff have been with the agency for less than 5 years. Can you just speak to the manpower issue that we are facing?

Mr. KLEIN. Senator, as you indicated, we have been staffing up for the last several years in anticipation of our increased workload. The good news is, we have been able to recruit very talented individuals.

One of the reasons that has helped us recruit is that we were selected in 2007 as the best place to work in the Federal Government. So we take advantage of that in our recruiting activities.

So I think our challenges are twofold. One is training. We have a very massive training program because we do have a lot of new hires, and so we want to make sure that we train and give the resources needed for our individuals to make their proper decisions. So training is an area we focus heavily on.

I think our next challenge will simply be retention. As the industry starts construction and building up, I think we all know that industry oftentimes can pay more than the Federal Government. So we need to pay attention to the needs of our employees and continue with that number-one ranking so that our employees will want to stay with us rather than go elsewhere.

Senator MURKOWSKI. Do you have any concern that perhaps the signals that are coming out of the Administration right now in terms of, in my opinion, a lack of support for the nuclear industry may affect your ability to recruit and retain good, qualified, skilled individuals?

Mr. KLEIN. I think the area that we will have to watch, both the Government and the industry, is what the enrollments are our academic programs. We will need to watch those trends to make sure that people believe that they have viable careers in the nuclear field. So that is one area that I think we all need to watch.

Senator MURKOWSKI. I think we need to be watching it very, very carefully.

Very quickly, you mentioned 42 months in terms of the time required to complete these first reference licenses. Can you tell me how that compares to the international experience in terms of review and completion of the permits?

Mr. KLEIN. Senator, it is comparable. Our processes are a little different. As you might expect, each country will do things slightly different. France, for example, takes a little bit longer on their initial siting, and then they will still do the two-step process.

But in general, when we look at countries like France and Finland and Japan and Korea, most countries are about in the 3-to =year period when you compare all of it. So we are within the range. The UK is currently looking at their process, and they are pretty well following our process. So we are not outliers currently.

Senator MURKOWSKI. OK. Thank you, Mr. Chairman.

[Recessed.]

The CHAIRMAN. Senator Udall, why don't you go ahead with your questions?

Senator UDALL. Thank you, Mr. Chairman.

Mr. Klein, nice to see you here. Thank you for taking your time to come up and speak with us about this very important energy source.

I would like to focus on your workload. In that context, with so much that you are facing, do you have adequate budget and human resources? If we gave you more—that is, if the Congress provided you with more resources, what would be your priorities for using those resources?

Mr. KLEIN. Senator Udall, as you know, when we build our budgets, it is always a 2-year process where we start in the out-years, and then when we come to the actual fiscal year, we sometimes have to make adjustments. For 2009, the only area that we have funds that are of a concern would be enough resources for the evaluation of the Yucca Mountain application.

If we had more funds available in out-years, I would say we would probably look at additional types of training and also additional scholarships to recruit additional individuals into the nuclear profession.

Senator UDALL. Do you see a lack of people interested in being nuclear engineers and being part of the nuclear industry? Have you done inventories? Do you have a sense of that potential future work force?

Mr. KLEIN. I am on leave of absence from, as I often say, a small university in Texas, the University of Texas at Austin, where I taught nuclear engineering for a number of years. We did see declining numbers for a number of years in nuclear education and in health physics.

We are now seeing those numbers increase, and I think what we need to do is make sure we sustain those levels. Because if we send a signal that there may not be employment opportunities, we may see a drop-off again in the interest of the young people in the nuclear profession.

Senator UDALL. Moving to a related subject, this is this year, I believe, the 30th anniversary of the incident at Three Mile Island. The industry was directed to implement changes in procedures and safety protocols. What are you all doing to encourage 21st century safety culture at your existing facilities?

Mr. KLEIN. Senator, I think everyone learned a lot from the Three Mile Island accident—the industry, academia, Government—all across the board. Certainly, the NRC learned a lot. I believe that we are a much better regulator today. We have a much more rigorous reactor oversight program. We have a safety culture that is recognized both within the NRC and within the industry as important.

I think one of the most significant aspects after Three Mile Island was the creation of the Institute of Nuclear Power Operations by the industry, where the industry recognized that they needed to have more activity, more responsibility, more self-checking among themselves.

So I think post TMI, we have all learned lessons, and we have all implemented those lessons. I think the record speaks for that. The operational efficiencies are higher. The safety issues that we see are less, but the thing that we all need to watch is that we can never become complacent. We have to maintain high standards.

Senator UDALL. I know at a previous hearing, there was a discussion about Yucca Mountain. I know Senator McCain was particularly interested in what the plans were for Yucca Mountain. If Yucca Mountain were taken offline, what is plan B? What is the agency's approach to the waste at, I think, some 100 sites around the country?

Mr. KLEIN. As you know, we are the regulator. So we don't propose the solution. So what we would do is, we currently have an application that we are required by law to evaluate, and we are going through that process. That application is long. It is 8,000 pages, referencing a million documents, and it will take our staff several years to evaluate that application to see if it is sufficient.

In the interim, dry cask storage is safe. We license those facilities. We monitor them. So, at-reactor sites, dry cask storage currently is plan B.

Senator UDALL. When you provide those licenses for the dry cask storage, what is your estimate of the time that that storage can be utilized before your concerns rise? In other words, is it a 10-year timeline? Fifty years? What is the timeline you operate off of?

Mr. KLEIN. Currently, our staff has evaluated that issue, and in the past, we had looked at 100 years for the dry cask storage of being safe and secure. The current waste confidence that we are looking at may extend that an additional 20 years to look at maybe a 120-year period for the dry cask storage to be safe and secure.

Senator UDALL. Do you have any concerns about the security around that dry cask storage?

Mr. KLEIN. We watch it. Security is an issue that we always watch. So, we have policies and procedures in place to ensure that they are secure.

Senator UDALL. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Bennett.

Senator BENNETT. Thank you very much, Mr. Chairman.

Mr. Klein, I have been in the facility in France where the spent fuel rods are reprocessed, and instead of being stored—the final waste product, instead of being stored in something like Yucca Mountain, I asked where is it, and they said, "It is in that green building over there."

I said, "What happens when the green building gets filled?" They said, "Well, we will build another building."

The reduction in mass as well as the reduction in radioactivity is dramatic. I have been in the plant physically, and the degree of safety process is to make sure that anybody who is in the plant is properly taken care of, are very obvious and more than adequate.

I understand that we in this country decided not to do reprocessing. President Carter is the one who made that decision. Although President Reagan reversed it, by that time, the industry had pretty much left our shores or the boat had left the dock, and we have simply not done that. Other countries have.

My conviction is that we need to now say let us do reprocessing. Let us get into that business. Reverse the decision that Jimmy Carter made—factually, not just legally. What is your experience,

and what would be your recommendation with respect to reprocessing?

Mr. KLEIN. Senator, as the regulator, we need to be prepared to evaluate and establish the requirements in the regulations if we move toward recycling in the United States. So, we have been having consultations with the Department of Energy to understand what they might be proposing so that, as the regulator, we will be ready if they proceed forward in that direction, either they or private industry.

Senator BENNETT. You are a nuclear engineer. Do you see any technical or engineering problems with reprocessing?

Mr. KLEIN. I have visited the same facilities that you have in France, and I have talked to the regulators in France. Clearly, those facilities are operated safely and securely. If they were built in the United States, we would also operate and make sure they were built safely and securely as well. Technically, it is well understood.

Senator BENNETT. If we were to increase the number of nuclear plants, not just continue the current 20 percent, but if we were to say let us drive toward 30 percent or even 40 percent of American electricity generated by nuclear, how big a reprocessing plant would we need, and would we need more than one?

Mr. KLEIN. That would really be a question probably better directed toward industry and DOE. But if you look just at the size of the facilities, France has about 58, 59 reactors. They have the one facility that you visited in La Hague. We have about 104 running today, so one could scale accordingly.

Senator BENNETT. So, as I say, if we were to increase beyond the 100-some odd that we currently have, as I think we probably need to, then perhaps we would need 2 or even 3 of these in the United States to handle that load?

Mr. KLEIN. It would be likely that we would. As the regulator, we would make sure that those facilities were safely and securely operated.

Senator BENNETT. But you have no reason to believe that they would present any kind of safety hazard?

Mr. KLEIN. I believe that we would be able to evaluate those accordingly.

Senator BENNETT. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Shaheen.

Senator SHAHEEN. Thank you.

Good morning, Chairman Klein. Thank you for being here.

New Hampshire, as you may know, is home to the Seabrook nuclear power plant, which I believe was the last power plant licensed in the United States and actually constructed and operating. It was quite a process to get that plant operating. It took 10 years longer than expected, and it wound up costing 12 times more than projected. The final cost was over $6.5 billion.

The debt that resulted from the bankruptcy of Seabrook's major utility owner, Public Service Company of New Hampshire, was the fourth-largest bankruptcy in corporate history at the time. There are many of us for whom the challenges of Seabrook and the memories of that are still quite vivid.

One of—you talked about your process to streamline licensing of plants. Do you think that streamlined process would have made a difference in how long it took to license and have Seabrook begin to operate?

Mr. KLEIN. Senator, I think the answer is yes. I think, in other words, if we did a new Seabrook today, it would be, hopefully, more predictable. The regulator, namely the NRC, I think better understands our requirements today, and I think industry would have a better understanding of how they intended to build and design and operate those facilities.

As I indicated in my opening comments, one of the challenges that we had with the existing fleet is that every one is different. Standardization will make it a lot easier, both for the regulator and for the operator. So, I believe that we have done two things that are fundamentally different now than in the first wave, and that is standardization and a one-step licensing process with no compromise on safety.

Senator SHAHEEN. One of the things that I think drove up the cost of Seabrook was the fact that Three Mile Island happened in the middle of that construction, and there were significant changes made to what was required of the plan.

How would the one-step licensing process take into consideration any future Three Mile Islands or other accidents that might affect understanding of how construction should be done?

Mr. KLEIN. There were a lot of changes, as you indicated, immediately after Three Mile Island, both equipment and regulatory aspects. I think those have stabilized. I think we now articulate our requirements. The industry knows what those are.

So I don't believe that you would see those changing requirements today. I believe we have decades of years of experience since Three Mile Island. We now use a risk-informed regulatory process. We know better what to look for. We have a better oversight program, and we have a lot more experience not only in the United States, but nationwide.

Senator SHAHEEN. To switch topics to cost, which is obviously one of the big challenges with Seabrook, as you know the Energy Policy Act of 2005 authorized the Secretary of Energy to guarantee loans of up to 80 percent of construction costs for energy projects that reduce greenhouse gas emissions, including nuclear power.

You have pointed out that there are 17 pending applications before the Nuclear Regulatory Commission. My understanding is that there are about $18.5 billion in loan guarantees available for that program. How many plants do you think that funding could support in terms of the pending applications that are before you?

Mr. KLEIN. As a regulator, we tend not to look at the financing that much, and I think it depends on how the Department of Energy wants to run that program. That might be a better question to ask the next panel. As the regulator, we don't follow the loan guarantees, per se.

Senator SHAHEEN. OK. As you are thinking about economies of scale, which, hopefully, the standardization that you are talking about would help lead to, how many reactors do you think it would take to get to those economies of scale? Or do you think you have already done that?

Mr. KLEIN. We hope that with our standard design process and holding the industry to those standardization requirements, we hope to do the standardization through the design certification process and do that on the front end.

Now what happened was that there are more vendors than I think we initially expected. We thought there might have been three, and currently, there are a few more than that. So what we hope is within each vendor, we will have a standardized fleet, and we will do that standardization through the design certification process before construction starts.

Senator SHAHEEN. Thank you.

The CHAIRMAN. Senator McCain.

Senator MCCAIN. Thank you, Mr. Chairman.

Thank you for your good work, Commissioner Klein. Are you operating under the assumption that Yucca Mountain will become a reality?

Mr. KLEIN. No.

Senator MCCAIN. You are not.

Mr. KLEIN. Our staff has not yet evaluated the license application, and so we are beginning that process.

Senator MCCAIN. Are you operating under the assumption that Yucca Mountain will become a reality, that plans are in motion and the process is moving forward for Yucca Mountain to be a nuclear waste repository?

Mr. KLEIN. We are not counting on Yucca Mountain being successful.

Senator MCCAIN. You are not counting on it? Meaning, then what are you looking at for an alternative?

Mr. KLEIN. Dry cask. For the interim, dry cask storage.

Senator MCCAIN. Dry cask storage. Spent nuclear fuel sitting in pools and in dry casks at nuclear power plants all over America. Is that what you are planning on?

Mr. KLEIN. Yes, sir.

Senator MCCAIN. Have you consulted any experts on national security on this issue to have these spent nuclear fuel sitting around nuclear power plants all over America?

Mr. KLEIN. Yes. We have. We look at the security both of the operating facilities and of the dry cask storage, and we consult on a lot of our tactics and techniques with the Department of Defense.

Senator MCCAIN. They say that that is no national security threat?

Mr. KLEIN. I think there is always security threats. Before I came to the NRC, I was at the Department of——

Senator MCCAIN. What did they say?

Mr. KLEIN. I was at the Department of Defense, and there are a lot of targets, including chemical plants and other facilities. So, we have a wide variety of targets, including tall buildings, as 9/11 demonstrated.

Senator MCCAIN. I am asking again, what did the Department of Defense tell you about this threat to our national security if you consult with them?

Mr. KLEIN. The challenge the Department of Defense and all the intel agencies have is exactly where a terrorist might strike.

Senator MCCAIN. The point is, obviously, that we would rather have a one place where it can be stored. Any national security expert or amateur will tell you that we need to have one place to store it, and that is not going to happen now because the Administration has declared that.

So now your answer is dry cask storage all over the United States of America. I don't think many Americans believe that that is a good solution. There is now presently 104 nuclear power plants in operation. Is that correct, roughly?

Mr. KLEIN. Yes. That is correct.

Senator MCCAIN. How many of them will be in operation 20 years from now? The existing plants.

Mr. KLEIN. My guess, assuming that those whose licenses are about to expire do a license renewal and we approve those, all of those plants could be running in another 20 years from now.

Senator MCCAIN. I have talked to many utility executives who say they aren't going to continue that operation. Have you heard that?

Mr. KLEIN. No.

Senator MCCAIN. But you intend—you think that every one of those 104 that are now operating will be relicensed?

Mr. KLEIN. If they meet our requirements, yes, sir.

Senator MCCAIN. They can meet your requirements, you believe?

Mr. KLEIN. So far, 51 of the 104 have.

Senator MCCAIN. On this waste confidence issue, again, a repository can reasonably be expected to be available within 50 or 60 years beyond the license life for operation of any reactor. Do you think that with Yucca Mountain being canceled that you can meet the "waste confidence criteria," which has been changed, as we know?

Mr. KLEIN. We are going through that evaluation, and we hope to make that determination by this summer.

Senator MCCAIN. You mentioned to Senator Bennett that you have seen the reprocessing facilities in France?

Mr. KLEIN. Yes.

Senator MCCAIN. You believe that also that technology could be employed here in the United States?

Mr. KLEIN. I believe that the NRC could establish the frameworks, and that could be a viable option for the United States

Senator MCCAIN. Do you believe that there is a problem with the material that is reprocessed as far as a national security concern is involved?

Mr. KLEIN. I believe that we could establish rules and procedures that would make that a minimum issue.

Senator MCCAIN. But there are no plans, obviously, for any reprocessing here in the United States, at least that you are aware of?

Mr. KLEIN. No applicant has come forward with an application to the NRC.

Senator MCCAIN. I guess, finally, if it is 42 months, as you mentioned, the process of licensing now, and you mention in your testimony that first licensing began in 2006 application. Is that correct?

Mr. KLEIN. Yes. I think I made an error. I think we really started in 2007.

Senator MCCAIN. So that would mean that a license could be issued in late 2010, 2011?

Mr. KLEIN. The COL could be issued in that timeframe, and then the utility would start construction. So I think the first time electricity would be expected to be coming out of a new nuclear plant is in the order of 2016.

Senator MCCAIN. I thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Landrieu.

Senator LANDRIEU. Yes, Mr. Klein, I am very impressed with your grasp of this issue, and I understand that you have been doing this now for quite some time. I think my predecessor, Bennett Johnson, when he chaired this committee and authored the Yucca Mountain legislation, worked with you and all the way back to Speaker Wright.

So I am glad that someone that is knowledgeable, both with a background of defense and energy and with your academic background, is in that chair because my general feeling—and I am no expert, but I am a promoter of nuclear energy and power for this country—it really is a sad and expensive story of a policy that would make sense being torpedoed from the left years ago from environmentalists that couldn't quite understand the benefits of nuclear power to the country and from the right about America's natural—sometimes it works well, sometimes it doesn't—tendency for just let the free market build whatever kind of system.

The combination of it has been devastating. I hope that now President Obama can find a middle road between the kind of Government-private sector planning that is necessary for something this substantial and that we can put to bed forever some of these environmental concerns because the development of this industry has a record, particularly not—in Europe and other places of safety and security.

I want to point for the record a couple of things on the cost that I think is particularly interesting to my constituents on nuclear power and its cost in production of electricity. Since projected out and back through 2007, the kilowatt-hour of nuclear is $1.76. Coal is $2.47. Gas is $6.78, and petroleum is $10.26. I am sorry I don't have what it is for wind and solar.

But as you can see, not only is the cost lower for nuclear and coal, two completely different sources, but they are also stable. I think what America is looking for first are lower energy prices that are stable, a system of producing electricity in this country where we can produce as much domestically as possible or from friendly allies relatively close geographically, and energy that is clean.

I think you and, hopefully, some of the leaders in this Administration can understand that nuclear meets all of those objectives and must be pushed forward with great haste and needs to be a critical component of our energy regime in this country.

But let me ask you this, and you have talked a bit about this. I want to ask you two questions. In the cross-examination of Jeanne Shaheen or her comments—no, maybe I think it was Senator McCain—you said, Technically, it is well understood.

Do you remember that phrase that you used in conjunction? Could you elaborate a little bit about that? Technically, it is well understood.

Mr. KLEIN. It was regarding the reprocessing of the spent fuel and separating and getting the usable material out and then throwing away the residues. So, I think the technical community understands recycling. I think there is——

Senator LANDRIEU. Inferring that it is just the political situation that might be difficult. But technically, you think you have got it done?

Mr. KLEIN. I think there still needs to be some additional research on what might be the best technology. But I think we all understand the chemical processes. Reactor spent fuel has, as you know, been around for a long time. We know how it behaves.

Then there is a lot of experience, both in the laboratory and commercial sides, on the recycling options. The Department of Energy wants to look at maybe some optimal techniques on what you would do for what they call the back-end of the fuel cycle. What we need to do, as a regulator, is whatever the Department of Energy might propose, that we are ready to ensure that it can be done safely and securely.

Senator LANDRIEU. Let me ask you this. I hear the NRC has revamped its process for licensing new power plants. It is not progressing as well as some of us would like. Can you talk about some of those difficulties in a little bit more detail than you have? Under the combined licensing process, I know that you all are having some difficulties there, I hear. Can you explain a bit about that?

Mr. KLEIN. What we had hoped the way the process would work, and this is where you sort of design how you would like it to be, and then reality comes in. We would, as a regulator, we would have liked to have the plants completely certified and all of that finished before an application comes in.

Then we would like to look at the siting of that plant at a site, do an early site permit, and then look at the combined license application. So that is the way that we envisioned the process to work in the perfect world.

The perfect world is oftentimes overcome by reality, and there was a need for baseload electricity. So, we have received a lot of applications before we have completed the standardized designs.

Now we will not issue the combined license until those design certifications are finished, but we won't really optimize our one-step licensing process until we go through this complete system of design certification and then the combined license application.

Senator LANDRIEU. I know my time has expired. But for the record, you can submit this in writing. Would you outline for me, and I will share it with the members of the committee, the significant differences in design or licensing requirements between the United States and other countries, that perhaps we could learn a little bit more about the way they are doing it and improve our system here?*

Thank you so much.

Mr. KLEIN. Thank you.

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* See Appendix I.

The CHAIRMAN. Thank you very much for your excellent testimony. We appreciate you taking time out of your busy schedule to be here with us, and why don't we go on to the second panel at this point?

Mr. KLEIN. Thank you.

The CHAIRMAN. Our second panel is made up of Marvin Fertel, who is the president and chief executive officer and chief nuclear officer for the Nuclear Energy Institute here in Washington. Also Dr. Thomas Cochran, who is the senior scientist for the nuclear program with the National Resources Defense Council.

We appreciate both of you gentlemen being here and giving us your views. Why don't we start with you, Mr. Fertel, and then Dr. Cochran, and then we will have some questions for both of you.

So if you will just take 5 or 6 minutes each and tell us the main points you think we need to be aware of. Please.

STATEMENT OF MARVIN S. FERTEL, PRESIDENT AND CHIEF EXECUTIVE OFFICER, NUCLEAR ENERGY INSTITUTE

Mr. FERTEL. Thank you very much, Chairman Bingaman, Ranking Member Murkowski, Senator Udall.

We appreciate the opportunity to be here to share with you our thoughts on policies that could facilitate the deployment of new nuclear plants in our country. The U.S. nuclear industry's top priority is and always will be the safe and reliable operation of our existing fleet of plants.

As Chairman Bingaman said in his opening remarks, we have 104 nuclear plants, and they continue to sustain excellent levels of performance. In 2008, we achieved an average capacity factor of 91 percent and avoided emissions of almost 700 million metric tons of carbon dioxide.

Construction of new nuclear plants will address two of our Nation's top priorities—additional supplies of clean energy and creation of jobs. Today, nuclear energy provides approximately 75 percent of carbon-free electricity generation.

Even with aggressive efficiency measures and historically low growth in demand, the United States will need additional baseload generating capacity. Every form of clean energy technology, including nuclear, will be needed to reduce the electric sector's carbon footprint.

As you heard from Chairman Klein, the Nuclear Regulatory Commission is reviewing construction operating licenses for 26 new reactors, totaling about 34,000 megawatts of capacity. Safety-related construction of the first new nuclear plants we believe will start in 2012, with four to eight in commercial operation by around 2016.

Because of these new plant projects, jobs related to nuclear energy are expanding rather than contracting in our country. Over the last several years, the nuclear industry has invested over $4 billion in new nuclear plants and will invest as much as $8 billion more before 2012.

Investment to date has already created 15,000 jobs over the last 2 to 3 years as reactor designers, equipment manufacturers, and fuel suppliers expand and build new facilities. The number of new

jobs will expand significantly early in the next decade when the first wave of new projects start construction.

If all 26 reactors currently in licensing were built, it would result in over 100,000 new jobs to support construction and operation. If the 26 reactors being licensed today were built by 2030, they would maintain nuclear at 20 percent of our electricity supply.

Increasing nuclear energy's contribution to meet the 2050 climate goals we are talking about requires a building rate of four to six plants per year. This rate was achieved in the 1970s and 1980s, despite the challenges we encountered during the period. With standardized designs and improved construction techniques, this deployment rate is achievable after the first wave of plants are constructed.

However, the electric power industry must invest between $1.5 trillion and $2 trillion by 2030 to meet increases in electricity demand and reduce carbon emissions. This is a formidable financing challenge. The loan guarantee program created in the 2005 Energy Policy Act is critical to ensure that capital is available to finance modernization of our electric infrastructure and to support financing of new generating facilities.

Achieving workable implementation of the title XVII loan guarantee program has been a challenge. However, many of the difficulties can be corrected through rulemaking, and NEI understands that DOE is developing revised rules to address the defects in the current rule and implement the new loan guarantee program authorized in the economic stimulus legislation.

This committee can play a key oversight role in ensuring that necessary revisions to the existing rule are promulgated appropriately and quickly. If the changes cannot be implemented through rulemaking, we encourage you to take statutory action to fix it.

Existing limitations on loan guarantee authority are also a constraint on expansion of nuclear energy and other technologies eligible for title XVII loan guarantees. Ten nuclear power projects have applied for approximately $93 billion in loan guarantees, well in excess of the current loan volume limitation of $18 billion.

The original goal of the title XVII loan guarantee program to jumpstart construction of the first innovative clean energy projects remains as valid today as it was in 2005. But today, the United States faces new and larger challenges. Financing large-scale deployment of clean energy technologies, the United States must have an effective long-term financing platform to ensure deployment of clean energy technologies in the numbers required.

During the last Congress, Chairman Bingaman introduced legislation to create a 21st century energy development corporation, and Senator Domenici, the ranking member of this committee during the last Congress, introduced legislation to create a clean energy bank. Both proposals have merit, and we encourage this committee to start with those legislative proposals and address clean energy technology financing in the new energy legislation now being developed.

Let me now comment briefly on the need to develop a sustainable used nuclear fuel strategy. Used nuclear fuel is managed safely and securely at nuclear power sites today and can be managed

safely and securely for an extended period of time either at sites or at centralized interim storage facilities.

For this reason, we don't believe used nuclear fuel represents an impediment to new nuclear plant deployment. It is, however, an issue that must be addressed for the long term. The nuclear industry has supported implementation of the Nuclear Waste Policy Act as the law of the land since 1982, and customers across our Nation have paid over $22 billion into the Nuclear Waste Fund.

We are not aware of any technical issue that would disqualify Yucca Mountain from the mission Congress assigned to it more than 20 years ago. Nonetheless, we recognize the position the Administration has taken with regard to the Yucca Mountain project.

Therefore, we support Secretary Chu's proposal to establish an independent qualified commission to undertake a reassessment of the Federal Government's program to manage used nuclear fuel and for it to produce a roadmap for a sustainable long-term program, including recommendations for legislative changes. In our view, a credible program includes interim storage, advanced recycling, and a permanent disposal facility. We encourage this committee to provide effective oversight of this independent commission activity.

We do not believe, however, that we can abandon current law before a new policy and associated program are defined. To do so would likely provoke additional litigation among the Federal Government, utility contract holders, and the State officials who have authorized collection of the nuclear waste fee from customers.

In conclusion, nuclear energy can and must play a strategic role in meeting national environmental, energy security, and economic development goals. The nuclear energy industry has a limited, well-defined public policy agenda to ensure our Nation continues to enjoy the benefits of nuclear energy.

That agenda includes near-term actions to ensure that the title XVII loan guarantee program works as intended; creation of a broader permanent financing platform to ensure access to capital for the large-scale deployment of advanced technologies, including nuclear energy facilities that will reduce carbon emissions; and a sustainable strategy for management of used nuclear fuel and ultimate disposal of waste byproducts.

I thank you for the opportunity to be here and look forward to your questions.

[The prepared statement of Mr. Fertel follows:]

PREPARED STATEMENT OF MARVIN S. FERTEL, PRESIDENT AND CHIEF EXECUTIVE OFFICER, NUCLEAR ENERGY INSTITUTE

Chairman Bingaman, Ranking Member Murkowski, and members of the committee, thank you for your interest in nuclear energy and in addressing the policies that can facilitate deployment of new nuclear plants to meet national energy needs and reduce carbon emissions.

My name is Marvin Fertel. I am the President and Chief Executive Officer of the Nuclear Energy Institute (NEI). NEI is responsible for establishing unified nuclear industry policy on regulatory, financial, technical and legislative issues affecting the industry. 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 testimony will cover five major areas:

1. Current status of the U.S. nuclear energy industry
2. The need for new nuclear generating capacity
3. Progress toward new nuclear power plant construction
4. Financial challenges facing the electric power sector
5. Policy actions necessary to address the challenges facing new nuclear plant development

I. Current Status of the U.S. Nuclear Power Industry

The U.S. nuclear energy industry's top priority is, and always will be, the safe and reliable operation of our existing plants. Safe, reliable operation drives public and political confidence in the industry, and America's nuclear plants continue to sustain high levels of performance.

Just last week, the Nuclear Regulatory Commission published a Fact Sheet highlighting the dramatic improvements in every aspect of nuclear plant performance over the last two decades: "The average number of significant reactor events over the past 20 years has dropped to nearly zero. Today there are far fewer, much less frequent and lower risk events that could lead to reactor core damage. The average number of times safety systems have had to be activated is about one-tenth of what it was 22 years ago. Radiation exposure levels to plant workers has steadily decreased to about one-sixth of the 1985 exposure levels and are well below federal limits. The average number of unplanned reactor shutdowns has decreased by nearly ten-fold. In 2007, there were two shutdowns compared to about 530 shutdowns in 1985."

This high level of performance continued last year. In 2008, the average capacity factor for our 104 operating nuclear plants was over 90 percent, and output of over 800 billion kilowatt hours represented nearly 75 percent of U.S. carbon-free electricity. According to the quantitative performance indicators monitored by the Nuclear Regulatory Commission, last year's performance was the best ever. This performance represents a solid platform for license renewal of the existing fleet and new nuclear plant construction.

II. The Need for New Nuclear Generating Capacity

Construction of new nuclear plants will address two of our nation's top priorities: Additional supplies of clean energy and creation of jobs.

Nuclear energy is one of the few bright spots in the U.S. economy—expanding rather than contracting, creating thousands of jobs over the past few years. Over the last several years, the nuclear industry has invested over $4 billion in new nuclear plant development, and plans to invest approximately $8 billion more to be in a position to start construction in 2011-2012.

The investment to date has already created 15,000 jobs over the last two to three years, as reactor designers, equipment manufacturers and fuel suppliers expand engineering centers and build new facilities in New Mexico, North Carolina, Tennessee, Pennsylvania, Virginia and Louisiana. These jobs represent a range of opportunities—from skilled craft employment in component manufacturing and plant construction, to engineering and operation of new facilities. The number of new jobs will expand dramatically early in the next decade when the first wave of new nuclear power projects starts construction. If all 26 reactors currently in licensing by the NRC were built, this would result in over 100,000 new jobs to support plant construction and operations, and does not include additional jobs created downstream in the supply chain. This would be in addition to the 30,000 new hires in the next 10 years to support operation of the existing fleet of plants through the extended license period of 60 years.

New nuclear plants will also help the United States meet its climate change objectives. Predominantly independent assessments of how to reduce U.S. electric sector CO2 emissions—by the International Energy Agency, McKinsey and Company, Cambridge Energy Research Associates, Pacific Northwest National Laboratory, the Energy Information Administration, the Environmental Protection Agency, the Electric Power Research Institute and others—show that there is no single technology that can slow and reverse increases in CO_2 emissions. A portfolio of technologies and approaches will be required, and that portfolio must include more nuclear power as well as aggressive pursuit of energy efficiency and equally aggressive expansion of renewable energy, advanced coal-based technologies, plug-in hybrid electric vehicles and distributed resources.

NEI is not aware of any credible analysis of the climate challenge that does not include substantial nuclear energy expansion as part of the technology portfolio. In fact, removing any technology from the portfolio places unsustainable pressure on those options that remain.

Analysis last year by the Energy Information Administration of the Lieberman-Warner climate change legislation (S. 2191) demonstrates the value of nuclear energy in a carbon-constrained world. In EIA's "Core" scenario, which included new nuclear plant construction, carbon prices in 2030 were 33 percent lower, residential electricity prices were 20 percent lower and residential natural gas prices were 19 percent lower than in the "Limited Alternatives" scenario, which severely limited new nuclear construction.

It is also clear that the United States will need new baseload electric generating capacity even with major improvements in energy efficiency. Recent analysis by The Brattle Group, an independent consulting firm, showed that the United States will need between 133,000 megawatts of new generating capacity (absent controls on carbon) and 216,000 megawatts (in a carbon-constrained world) by 2030. These numbers assume 0.7 percent per year growth in peak load—a significant reduction from historical performance. Annual growth in peak load between 1996 and 2006 was 2.1 percent, and the Energy Information Administration's Annual Energy Outlook assumes a 1.5-percent annual increase in peak load.

NEI estimates that if the 26 reactors being licensed today (approximately 34,000 MW) were built by 2030, this would simply maintain nuclear at 20 percent of U.S. electricity supply. To increase nuclear energy's contribution to 2050 climate goals, build rates of 4-6 plants per year must be achieved. This was possible in the 1970s and 1980s even with the old licensing process and lack of standardization. With standardized designs and improved construction techniques, this accelerated deployment is feasible after the first wave of plants are constructed.

III. Progress Toward New Nuclear Power Plant Construction

The Nuclear Regulatory Commission is reviewing construction and operating license applications from 17 companies or groups of companies for 26 new reactors totaling 34,200 MW. These new plants will be built at a measured pace over the next 10-15 years. Safety-related construction of the first new nuclear plants will start in 2012, and NEI expects four to eight new nuclear plants in commercial operation in 2016 or so. The exact number will, of course, depend on many factors—U.S. economic growth, forward prices in electricity markets, capital costs of all baseload electric technologies, commodity costs, environmental compliance costs for fossil-fueled generating capacity, natural gas prices, growth in electricity demand, availability of federal and state support for financing and investment recovery, and more. We expect construction of those first plants will proceed on schedule, within budget estimates, and without licensing difficulties, and a second wave will be under construction as the first wave reaches commercial operation.

Supported in part by government-industry cost-shared programs like the Department of Energy's Nuclear Power 2010 program, detailed design and engineering work on advanced reactor designs is nearing completion. This detailed design information will allow companies to develop firm cost estimates. Based on what is known today, however, there is a solid business case for new nuclear generating capacity.

Nuclear energy is a capital-intensive technology. NEI estimates a new nuclear power plant could cost $6 billion to $8 billion, including financing costs. This large capital investment does not mean that new nuclear plants will not be competitive. Capital cost is certainly an important factor in financing, but it is not the sole determinant of a plant's competitive position. The key factor is the cost of electricity from the plant at the time it starts commercial operation relative to the other alternatives available at that time. Based on NEI's own modeling, on the financial analysis performed by companies developing new nuclear projects, and on independent analysis by others, new nuclear capacity will be competitive. (NEI's white paper, "The Cost of New Generating Capacity in Perspective", is attached for further information on this topic.)

Florida Power and Light and Florida Progress demonstrated this in the financial modeling that supported their requests last year to the Florida Public Service Commission for "determinations of need" for new reactors at Turkey Point and Levy County. In FP&L's modeling, the only scenario in which nuclear was not preferred was a world in which natural gas prices were unrealistically low and there was no price on carbon. The Florida PSC has approved both projects. Independent analyses reach the same conclusion. In an integrated resource plan developed for Connecticut last year, The Brattle Group concluded that new nuclear plants are a lower-cost source of electricity in a carbon-constrained world than supercritical pulverized coal with carbon capture and storage (CCS), integrated gasification combined cycle with CCS and gas-fired combined cycle with CCS.

Understanding the Past.—Many of the nuclear power plants commissioned in the 1960s and early 1970s completed construction in four to five years with construction costs around $500 million. By the late 1970s and early 1980s, however, construction

was averaging 10 to 12 years, and construction costs ranged as high as $5 billion. The nuclear industry has conducted detailed and extensive analysis of this experience, which demonstrates that the nuclear plants built after the early 1970s were built under extremely unfavorable conditions—caused by several major factors converging at roughly the same time.

Nuclear energy technology in the United States scaled up quickly. The industry scaled from the first 200-megawatt-scale plants to 1,000-megawatt-plus plants in just a few years. This rapid increase in reactor size occurred at a time when electricity demand was growing at seven percent a year on average, which required a doubling of electric generating capacity every 10 years. In that business environment, bigger was better for new power plants. Larger plants meant greater economies of scale. Larger was also more complex, however, and that complexity coupled with other factors discussed subsequently created project management challenges. Construction times stretched out and economies of scale vanished with schedule delays and rising costs.

Changing regulatory requirements and licensing difficulties added to the challenge of managing these large construction projects to schedule and budget, but licensing and regulatory requirements were not the sole cause of cost increases and schedule delays. Construction started before design work was complete. Some projects were managed by companies with no prior nuclear construction experience. Project planning and management tools equal to the complexity of the task did not exist at the time.

Finally and of significant importance to the increasing cost, the first generation of nuclear power plants were built under difficult business and economic conditions. Growth in electricity demand slowed from six to seven percent a year to one to two percent in the mid-1970s. Many utilities intentionally slowed construction. The prime rate reached 20 percent in the early 1980s. As project schedules stretched out, costs increased and companies were forced to borrow more at double-digit interest rates.

Lessons Learned: Roadmap for a Successful Future.—The root causes of past construction delays are well understood and both industry and government have taken steps to ensure that past experience is not repeated.

The licensing process has been restructured to increase efficiency and effectiveness and reduce uncertainty and financial risk. Today's plants were licensed under a two-step process: Electric utilities had to secure two permits—a construction permit to build the plant and a second operating license to operate it. Under the new process, all major safety and regulatory issues—reactor design, site suitability—will be resolved before construction begins, and a company receives a single license to build and operate the plant. The use of certified standardized designs will also reduce licensing and construction times through repetition. Once a design has been certified, the NRC reviews will focus only on site suitability and plant operations. The industry is working together to ensure that the standardization carries over into their license applications, construction practices and operating procedures to fully enjoy the benefits of a standard fleet of plants.

As construction proceeds, inspections and tests are performed to ensure the plant has been built in accordance with the approved design. These inspections, tests, analyses and acceptance criteria—or ITAAC—are included in the plant's construction and operating license. ITAAC are a key risk-management tool. When the ITAAC are met, the NRC and the public know that the plant has been built according to its design and will operate safely.

In addition to an improved licensing process, the next generation of nuclear plants built in the United States will benefit from an industry-wide inventory of lessons-learned. The roadmap for future success includes:

Detailed design essentially complete before construction.—Companies planning to build new nuclear plants intend to have virtually all detailed design complete before construction is started.

Standardized, design-specific pre-build preparation.—Starting in 2006, the nuclear industry formed design-centered working groups (DCWG) with each reactor vendor. These groups are charged with maintaining standardization within each reactor design, which will enhance licensing, preparation for construction and construction.

Focus on quality assurance.—While quality assurance is a core competency at existing plants, in 2005, the U.S. nuclear industry formed a New Plant Quality Assurance Task Force. In conjunction with the Institute of Nuclear Power Operations (INPO), this task force is conducting a systematic lessons-learned review of past and present nuclear construction projects in the United States and around the world.

Corrective action programs.—The industry is adapting the corrective action program (CAP), which is standard at operating plants, for use in new plant construc-

tion. A CAP includes a structured database to capture and categorize potentially safety-significant items, enabling constructors to identify and trend quality deficiencies, record that corrective action was taken, and report to the appropriate levels of management.

Focus on safety culture as part of construction.—Safety culture, corrective action programs and programs that encourage employees to raise safety concerns are now an essential part of the operating philosophy at the 104 operating plants. The work force building new plants will have the same safety focus.

Preparation for construction inspection.—In 2001, the U.S. nuclear industry formed a New Plant Construction Inspection Program Task Force comprised of utilities, reactor vendors and major construction companies. The task force is formulating guidance and developing programs and processes to implement the inspections, tests, analyses and acceptance criteria that the NRC will use to determine whether the plant is built according to the approved design and is ready to operate safely.

Improved planning and construction management tools.—Project and construction management at new nuclear plants will benefit from a suite of sophisticated construction planning and management tools equal to the complexity of the task, none of which were developed when the last nuclear plants were built. Companies did not have computer-aided design (CAD) to enable design changes. Databases for tracking components and resources were not yet mature. Computerized tools that linked resources with design and construction schedules were in their infancy.

Improved construction techniques.—Construction of new nuclear plants in the U.S. will also benefit from improved construction techniques (such as modular construction), many of which were developed overseas, for the U.S. nuclear navy or for other industries.

Successful Track Record.—Recent construction and operational experience demonstrates that an experienced project management team—with effective quality assurance and corrective action programs, with detailed design completed before the start of major construction, with an integrated engineering and construction schedule—can complete projects on budget and on schedule. The global nuclear industry, including the U.S. nuclear industry, has performed projects ranging from major upgrades to plant restarts to refueling outages efficiently, without delay. As recently as 1990, maintenance and refueling outages at U.S. reactors lasted more than 100 days; today's average is 37 days. There are other examples that provide confidence that new nuclear plant development in the United States will proceed smoothly:

- The Tennessee Valley Authority returned Unit 1 of its Browns Ferry nuclear plant to commercial operation in May 2007. The five-year, $1.8-billion project was completed on schedule and only five percent over the original budget estimate, a significant achievement during a period of rapidly escalating commodity costs. The Browns Ferry 1 restart project was comparable in complexity to the construction of a new nuclear power plant. Most systems, components, and structures were replaced, refurbished, or upgraded, and all had to be inspected and tested.
- At the Fort Calhoun plant in Nebraska, Omaha Public Power District replaced the major primary system components—steam generators, reactor vessel head and rapid refueling package and pressurizer—as well as the low pressure turbines, the main transformer and hydrogen coolers, among other equipment. The outage began in September 2006 and ended in December of that year, lasting 85 days. The $417-million project was completed approximately $40 million under budget and five days ahead of schedule.
- Nuclear construction experience in South Korea over the last 15 years demonstrates the "learning curve" that can be achieved. The "first of a kind" nuclear power plants—Yonggwang Units 3 and 4—were built in the mid-1990s in 64 months. The next two units—Ulchin 3 and 4—were built in 60 months at 94 percent of the "first of a kind" cost. The next plants—Yonggwang 5 and 6—were built in 58 months for 82 percent of the "first of a kind" cost. By 2004, Ulchin 5 and 6 were built in 56 months for 80 percent of the "first of a kind" cost. The next two plants—Shin-Kori 1 and 2—will be in service next year. Construction duration: 53 months and 63 percent of what it cost to build Yonggwang 3 and 4. South Korea's goal is a 39-month construction schedule.
- Nuclear power plants in Japan achieve construction schedules similar to those in South Korea. The first two Advanced Boiling Water Reactors built were constructed in times that beat the previous world record and both were built on budget. Kashiwazaki-Kariwa Unit 6 began commercial operation in 1996, and Unit 7 began commercial operation in 1997. From first concrete to fuel load, it took 36.5 months to construct Unit 6 and 38.3 months for Unit 7. Unit 6 was

built 10 months quicker than the best time achieved for any of the previous boiling water reactors constructed in Japan.

- The Qinshan nuclear power plant in China consists of two 728-megawatt pressurized heavy-water reactors. First concrete was placed on June 8, 1998. Unit 1 began commercial operation on December 31, 2002, 43 days ahead of schedule. The construction period was 54 months from first concrete to full-power operation. Unit 2 began commercial operation on July 24, 2003, 112 days ahead of schedule.

U.S. projects will also benefit from this learning curve in other countries, since most of the reactors being licensed in the United States will be built overseas prior to U.S. construction. South Texas Project Units 3 and 4, for example, are Advanced Boiling Water Reactors of the type already built in Japan. There are 44 nuclear plants under construction worldwide, and 108 more ordered or planned.

IV. Financial Challenges Facing the Electric Power Sector

The U.S. electric industry faces a formidable investment challenge. Consensus estimates show that the electric sector must invest between $1.5 trillion and $2 trillion in new power plants, transmission and distribution systems, and environmental controls to meet expected increases in electricity demand by 2030. To put these numbers in perspective: the book value of America's entire electric power supply and delivery system today is only $750 billion, which reflects investments made over the last 60 years.

Addressing the financing challenge will require innovative approaches. Meeting these investment needs will require a partnership between the private sector and the public sector, combining all the financing capabilities and tools available to the private sector, the federal government and state governments—particularly at a time when the electric sector is already showing some signs of stress.

The financial crisis has forced investor-owned utilities to reduce capital spending for 2009 by approximately 10 percent, on average. The industry is experiencing downward pressure on equity returns, largely because rate increases have not kept pace with rising costs. Bond spreads are also wider (in some cases, significantly wider) and, although all-in debt costs are not dramatically higher because yields on Treasuries are so low, the cost of debt will be significantly higher than historical norms when Treasury yields recover if bond spreads remain at current levels. Industry leverage is beginning to rise—not to the levels seen in 2003, when debt represented about 61 percent of the investor-owned utilities' capital structure—but it has increased somewhat over the last three years and debt now represents about 56 percent of industry capital structure.

In summary, the electric power sector is in the early stages of a major, 20-year capital investment program, and is not as well positioned for these capital expenditures as it was in the 1970s and 1980s when it last undertook a major capital expansion program.

For new nuclear power plants, the financing challenge is structural. Unlike the many consolidated government owned foreign utilities and the large oil and gas companies, U.S. electric power sector consists of many relatively small companies, which do not have the size, financing capability or financial strength to finance power projects of this scale on their own, in the numbers required. Loan guarantees offset the disparity in scale between project size and company size. Loan guarantees allow the companies to use project-finance-type structures and to employ higher leverage in the project's capital structure. These benefits flow to the economy by allowing the rapid deployment of clean generating technologies at a lower cost to consumers. The recent stimulus bill recognized the need to provide access to low-cost capital to encourage rapid deployment of renewable energy projects. Similar support is required for nuclear energy since, in many cases, new nuclear plants and renewable energy projects are built by the same utilities.

Loan guarantees are a powerful tool and an efficient way to mobilize private capital. The federal government manages a loan guarantee portfolio of approximately $1.1 trillion to ensure necessary investment in critical national needs, including shipbuilding, transportation infrastructure, exports of U.S. goods and services, affordable housing, and many other purposes. Supporting investment in new nuclear power plants and other critical energy infrastructure is a national imperative.

The loan guarantee program created by title XVII of the Energy Policy Act is an essential and appropriate mechanism to enable financing of clean energy technologies. In fact, an effective and workable loan guarantee program is significantly more important today than it was when the Energy Policy Act was enacted in 2005.

The title XVII program currently includes 10 technologies that are eligible for loan guarantees. They include renewable energy systems, advanced fossil energy technology (including coal gasification), hydrogen fuel cell technology for residential,

industrial, or transportation applications, advanced nuclear energy facilities, efficient electrical generation, transmission, and distribution technologies, efficient end-use energy technologies, production facilities for fuel efficient vehicles, including hybrid and advanced diesel vehicles, and pollution control equipment. Each of these technologies presents different financing challenges.

The financing challenges are, of course, somewhat different for the regulated integrated utilities than for the merchant generating companies in those states that have restructured. But these challenges can be managed, with appropriate rate treatment from state regulators or credit support from the federal government's loan guarantee program, or a combination of both.

Supportive state policies include recovery of nuclear plant development costs as they are incurred, and Construction Work in Progress or CWIP, which allows recovery of financing costs during construction. Many of the states where new nuclear plants are planned—including Florida, Virginia, Texas, Louisiana, Mississippi, North Carolina and South Carolina—have passed legislation or implemented new regulations to encourage construction of new nuclear power plants by providing financing support and assurance of investment recovery. By itself, however, this state support may not be sufficient. The federal government must also provide financing support for deployment of clean energy technologies in the numbers necessary to address growing U.S. electricity needs and reduce carbon emissions.

The title XVII program also represents an innovative departure from other federal loan guarantee programs. It is structured to be self-financing, so that companies receiving loan guarantees pay the cost to the government of providing the guarantee, and all administrative costs. For this reason, a title XVII loan guarantee program is not a subsidy. In a well-managed program, in which projects are selected based on creditworthiness, extensive due diligence and strong credit metrics, there is minimal risk of default, and minimal risk to the taxpayer. In fact, the federal government will receive substantial payments from project sponsors.

V. Policy Actions Necessary for New Nuclear Plant Development

Financing

Since enactment of the Energy Policy Act in August 2005, achieving workable implementation of the title XVII loan guarantee program has been a challenge. The implementation difficulties predate formation of the Loan Guarantee Program Office. In fact, NEI is impressed with what a relatively small staff in the Loan Guarantee Program Office, operating under chronic budgetary constraints, have been able to accomplish in the time—slightly more than a year—that they have been at work.

Despite this significant progress, implementation of the program by the Executive Branch continues to be difficult, for reasons outside the control of the Loan Guarantee Program Office. The staff is working to address problems with the regulations governing this program that were promulgated by the Department of Energy in 2007, but one of the major difficulties stems from an unnecessarily narrow and restrictive reading of the original statutory language by the DOE Office of General Counsel. Section 1702(g)(2)(B) of title XVII asserts that "[t]he rights of the Secretary, with respect to any property acquired pursuant to a guarantee or related agreements, shall be superior to the rights of any other person with respect to the property." This language can be misinterpreted as a prohibition on pari passu financing structures, and a requirement that the Secretary must have a first lien position on the entire project. Counsel for NEI and many of the project sponsors, with substantial experience in project finance, believe that Section 1702(g)(2)(B) gives the Secretary a "superior right" to the property he guarantees, not to the entire project.

The current interpretation of this language is thus a major obstacle to co-financing of nuclear projects. Projects financed as undivided interests cannot proceed if this interpretation stands. Financing from export credit agencies in other countries like France and Japan, would be equally difficult. This result makes little sense since such co-financing will leverage the existing loan volume of $18.5 billion, and reduce the risk to which the Department of Energy is exposed.

NEI is encouraged by Energy Secretary Steven Chu's intent, expressed before this committee during his confirmation hearing and at other times, to address the difficulties that have arisen during implementation of the title XVII loan guarantee program. Many of these problems can be corrected through rulemaking, and NEI understands that DOE is developing revised rules to address defects in the current rule and to implement the new loan guarantee program authorized in the economic stimulus legislation. The Energy and Natural Resources Committee can play a key oversight role in ensuring that the necessary revisions to the existing rule are promulgated quickly, and do not become entangled in internal Executive Branch procedural difficulties, as has happened so often in the past. If the necessary changes

cannot be implemented through rulemaking, it will, of course, be necessary to seek statutory changes to accomplish the same purpose.

Insufficient Loan Volume.—The title XVII loan guarantee program was an important step in the right direction. That program was designed to jump-start construction of the first few innovative clean energy projects that use "technologies that are new or significantly improved . . . as compared to commercial technologies in service in the United States at the time the guarantee is issued."[1]

That goal remains as valid now as it was in 2005, but today the United States faces a larger, additional challenge—financing large-scale deployment of clean energy technologies, modernizing the U.S. electric power supply and delivery system, and reducing carbon emissions. As noted earlier, this is estimated to require investment of $1.5-2.0 trillion between 2010 and 2030.

The omnibus appropriations legislation for FY 2008 and FY2009 authorizes $38.5 billion in loan volume for the loan guarantee program—$18.5 billion for nuclear power projects, $2 billion for uranium enrichment projects, and the balance for advanced coal, renewable energy and energy efficiency projects.

DOE has issued solicitations inviting loan guarantee applications for all these technologies and, in all cases the available loan volume is significantly oversubscribed. For example, the initial nuclear power solicitation resulted in requests from 14 projects seeking $122 billion in loan guarantees, with only $18.5 billion available. NEI understands that 10 nuclear power projects submitted Part II loan guarantee applications, which represented $93.2 billion in loan volume. Two enrichment projects submitted Part II applications, seeking $4.8 billion in loan guarantees, with only $2 billion available. NEI also understands that the solicitation for innovative coal projects resulted in requests for $17.4 billion in loan volume, more than twice the $8 billion available.

It is, therefore, essential that limitations on loan volume—if necessary at all in a program where project sponsors pay the credit subsidy cost—should be commensurate with the size, number and financing needs of the projects. In the case of nuclear power, with projects costs between $6 billion and $8 billion, $18.5 billion is not sufficient.

The scale of the challenge requires a broader financing platform than the program envisioned by title XVII. An effective, long-term financing platform is necessary to ensure deployment of clean energy technologies in the numbers required, and to accelerate the flow of private capital to clean technology deployment.

During the 110th Congress, Senator Bingaman introduced legislation to create a 21st Century Energy Deployment Corporation. Senator Domenici, ranking member of this committee during the last Congress, introduced legislation to create a Clean Energy Bank. Both proposals address aspects of the financing challenge facing the United States and its electric power industry.

NEI believes that the existing title XVII program and the DOE Loan Guarantee Program Office, operating under workable rules, could serve as a foundation on which to build a larger, independent financing institution within the Department of Energy. There is precedent for such independent entities, equipped with all the resources necessary to accomplish their missions, in the Federal Energy Regulatory Commission and the Energy Information Administration. This approach could have significant advantages:

1. An independent clean energy financing authority within DOE could take advantage of technical resources available within the Department, to supplement its due diligence on prospective projects and to identify promising technologies emerging from the research, development and demonstration pipeline that might be candidates for loan guarantee support to enable and speed deployment.
2. An independent entity within DOE would have the resources necessary to implement its mission effectively, including its own legal and financial advisers with the training and experience necessary for a financing organization. Providing the independent entity with its own resources would eliminate the difficulties encountered during implementation of the title XVII program.
3. Programmatic oversight in Congress would remain with the Energy Committees, which have significantly more experience with energy policy challenges, and in structuring the institutions necessary to address those challenges.

Development of a National Used Fuel Strategy

Used nuclear fuel is managed safely and securely at nuclear plant sites today, and can be managed safely and securely for an extended period of time. For this reason,

[1] AEnergy Policy Act of 2005, Section 1703(a)(2)

used nuclear fuel does not represent an impediment to new nuclear plant development in the near term. It is, however, an issue that must be addressed for the long-term.

The Administration has made it clear that Yucca Mountain "is not an option."

The nuclear industry's position on used fuel management is clear:

- The Nuclear Waste Policy Act establishes an unequivocal federal legal obligation to manage used nuclear fuel, and remains the law of the land. Until that law is changed, the nuclear industry believes the NRC's review of the Yucca Mountain license application should continue.
- If the Administration unilaterally decides to abandon the Yucca Mountain project without enacting new legislation to modify or replace existing law, it should expect a new wave of lawsuits seeking further damage payments and refunds of at least $22 billion in the Nuclear Waste Fund already collected from consumers that has not been spent on the program.
- Given the uncertainties associated with the Yucca Mountain project, DOE should reduce the fee paid by consumers to cover only costs incurred by DOE, NRC and local Nevada government units that provide oversight of the program.
- A credible and effective program to manage used nuclear fuel must include three integrated components: interim storage of used nuclear fuel at centralized locations, technology development necessary to demonstrate the technical and business case for recycling used nuclear fuel and, ultimately, the licensing of a permanent disposal facility.

The nuclear energy industry supports creation by the Executive Branch of a bipartisan blue-ribbon commission of credible experts to undertake a reassessment of the federal government's program to manage used nuclear fuel, and produce a roadmap for a sustainable long-term program.

Regulatory Effectiveness and Predictability

An objective, effective Nuclear Regulatory Commission is a key factor in ensuring safe and secure operation of the 104 operating nuclear generating plants. An objective regulatory process—i.e., a process that is safety-focused and performance-based—will ensure that nuclear plant operators remain focused on safety-significant issues and that management attention is not diverted by matters of low safety or security significance. For new nuclear plants, a central element of the regulatory process is a predictable licensing process for the review and inspection of new reactor designs and new construction. The industry and the financial community must have confidence that the licensing process provides the level of predictability necessary to support large capital investments.

Research and Development

NEI appreciates this committee's recognition—in the draft research and development legislation published recently—of the strategic importance of increased funding for research and development. Substantial increases in energy R&D investment will be necessary in the years ahead to create a sustainable electric supply infrastructure. Unfortunately, recent trends are in the opposite direction. In a 2007 analysis, the Government Accountability Office found that DOE's budget authority for renewable, fossil and nuclear energy R&D declined by over 85 percent (in inflation-adjusted terms) from 1978 through 2005. The need for new technologies to address critical energy needs has not diminished over the same time period, however, nor have the energy and environmental imperatives facing the United States become any less urgent.

The Electric Power Research Institute (EPRI) has estimated that the United States must increase investment in energy R&D by $1.4 billion annually between now and 2030 to develop and demonstrate the technology portfolio necessary to bring electric sector carbon emissions back to 1990 levels by 2030. That additional cumulative investment of approximately $32 billion in R&D would reduce by $1 trillion the cost to the U.S. economy of bringing electric sector emissions back to 1990 levels, according to EPRI's analysis.

A robust research and development program is necessary if nuclear energy is to realize its full potential in the nation's energy portfolio. In 2008, the directors of the 10 DOE national laboratories, including now Secretary of Energy Chu, published a report recognizing that "nuclear energy must play a significant and growing role in our nation's energy portfolio in the context of broader global energy, environmental, and security issues." The report also expressed support for the required R&D effort: "The national laboratories, working in collaboration with industry, academia, and the international community, are committed to leading and providing the research and technologies required to support the global expansion of nuclear energy."

The report from the national laboratory directors identified areas of research that were incorporated, earlier this year, into a comprehensive strategy for nuclear R&D developed by EPRI and the Idaho National Laboratory. NEI supports the R&D priorities identified:

- Maintaining the high performance of today's light water reactors and extend their operating life beyond 60 years, to 80 years. R&D will be required, among other items, to develop advanced diagnostic and maintenance techniques, to extend component life and introduce new technologies, and to enhance fuel reliability and performance.
- Completing the cost-shared government-industry Nuclear Power 2010 Program, to complete the design and engineering work that will support the nuclear plants on track to start construction over the next several years.
- Developing proliferation-resistant recycling technologies that will capture the vast amount of energy that remains in used nuclear fuel and reduce the volume and toxicity of the waste by-product that requires permanent disposal.
- Developing high-temperature gas-cooled reactors to produce electricity and for non-electric applications. High-temperature reactors can reduce greenhouse gas emissions from large-scale process heat operations in the petroleum and chemical industries currently fired by liquid fuels and natural gas. This technology will also be capable of producing hydrogen economically for fuel-cell vehicles and industrial applications, as well as desalinating water cost-effectively.

The national laboratory directors, EPRI and INL point out that the leadership position of the U.S. in the global nuclear enterprise is at stake. Participation in the development of advanced nuclear energy technologies will allow the U.S. to influence energy technology choices around the world, and to ensure that non-proliferation regimes are in place as other countries develop commercial nuclear capabilities. Therefore, technical leadership is in the interest of the Administration, the congress, and the industry.

Supply Chain

During the 1970s, the United States had the manufacturing capability to produce the large vessels, steam generators and other components necessary for nuclear power plant construction. Much of that capability—and the associated jobs—moved offshore over the last 30 years.

In the nuclear sector, there are signs that U.S. manufacturing capability is being rebuilt. In North Carolina, Indiana, Pennsylvania, Virginia, Tennessee, Louisiana, Ohio and New Mexico, among other states, U.S. companies are adding to design and engineering staff, expanding their capability to manufacture nuclear-grade components, or building new manufacturing facilities and fuel facilities—partly in preparation for new reactor construction in the United States, partly to serve the growing world market.

Last year, for example, AREVA and Northrop Grumman Shipbuilding formed a joint venture to build a new manufacturing and engineering facility in Newport News, Va. This $360-million facility will manufacture heavy components, such as reactor vessels, steam generators and pressurizers. Global Modular Solutions, a joint venture of Shaw Group and Westinghouse, is building a fabrication facility at the Port of Lake Charles to produce structural, piping and equipment modules for new nuclear plants using the Westinghouse AP1000 technology. In New Mexico, LES is well along with construction of a $3-billion uranium enrichment facility, scheduled to begin production this year. Even for ultra-heavy forgings, Japan Steel Works is expanding capacity, and companies in South Korea, France and Great Britain are planning new facilities.

Although progress in this area is encouraging, federal government policy could accelerate the process of creating new jobs and generating economic growth. Specifically, the expansion and extension of investment tax credits for investments in manufacturing provided in the stimulus would ensure continued expansion of the U.S. nuclear supply chain and help restore U.S. leadership in this sector.

Work Force

The U.S. nuclear industry recognizes the critical importance of a skilled, well-trained and dedicated work force to operate and maintain the 104 nuclear plants that supply 20 percent of America's electricity, and to build and operate new nuclear plants in the years ahead.

The nuclear industry is working with the federal government, state governments, universities and community colleges, high schools, labor unions, utilities, other trade associations and professional organizations to address the work force challenge.

Electric utilities have created 42 partnerships with community colleges to train the next generation of nuclear workers. The industry is developing standardized, uniform curricula to ensure that graduates will be eligible to work at any nuclear plant. Sixteen states have developed programs to promote skilled craft development. Enrollment in nuclear engineering programs has increased over 500 percent since 1999. Grant programs from the NRC, the Department of Energy, the Department of Labor and the Department of Defense for education and training are having a major impact on increasing our trained workforce.

NEI commends Senators Bingaman and Murkowski for the attention to workforce development in the draft legislation published recently on research and development. As with the nuclear supply chain, targeted tax credits to encourage companies to invest in apprenticeship programs and other work force development would accelerate job creation and training in the nuclear energy sector.

VI. Conclusion

In conclusion, the need for advanced nuclear plants is well established. Nuclear energy clearly can and must play a strategic role in meeting national environmental, energy security and economic development goals. The nuclear energy industry has a limited and well-defined public policy agenda to ensure our nation continues to derive the benefits that nuclear power provides. Those policy conditions include:

1. near-term actions to ensure that the title XVII loan guarantee program is working as intended, and creation of a broader, permanent financing platform to ensure access to capital for the large-scale deployment of advanced technologies including nuclear facilities that will reduce carbon emissions,
2. a sustainable strategy for the management and ultimate disposal of used nuclear fuel,
3. an effective and predictable licensing process, and
4. a research and development program that will allow the nation to meet environmental goals and provide leadership on issues related to expansion of nuclear technology and non-proliferation.

Mr. Chairman, thank you for the opportunity to testify, and this completes my testimony.

The CHAIRMAN. Thank you very much.

Dr. Cochran, go right ahead.

STATEMENT OF THOMAS B. COCHRAN, PH.D., SENIOR SCIENTIST, NUCLEAR PROGRAM, AND CHRISTOPHER E. PAINE, DIRECTOR, NUCLEAR PROGRAM, NATURAL RESOURCES DEFENSE COUNCIL, INC.

Mr. COCHRAN. Mr. Chairman, Ranking Member Murkowski, Senator Udall, Senator Sessions, thank you for providing the Natural Resources Defense Council the opportunity to present its views on several current issues related to nuclear energy.

Our testimony focuses on three issues—whether additional Federal loan guarantees should be provided to construct new nuclear power plants, whether the United States should engage in reprocessing of spent nuclear fuel, and whether Congress should intervene in the Nuclear Regulatory Commission's proposed rulemakings on temporary storage of spent fuel and the so-called waste confidence rule.

Turning to the first issue, Congress should not provide additional loan guarantees to construct new nuclear plants. Sufficient nuclear loan guarantee authority already exists to accomplish the legitimate public purpose that is involved here—namely, to shift much of the downside financial risk involved in the initial commercial deployment of new or significantly improved low-carbon energy technologies from private interests to the Federal taxpayers.

To avoid serious and lasting distortion of the U.S. energy marketplace and an economically inefficient decarbonization effort, nu-

clear loan guarantees should be limited to the lead units of new nuclear plant designs not previously deployed in the United States or in similar markets abroad with comparable regulatory requirements. These designs must incorporate substantial design innovations promising improved safety, increased operating efficiency, significantly reduced capital costs, and lower environmental impacts.

In our view, few, if any, of the Generation III+ reactors being proposed today plausibly meet this description. But if any of them do, it could only be the lead units of new passive safety, small-footprint, less capital-intensive designs that have not yet been deployed elsewhere. Fitting this description currently are the AP1000 and the ESBWR. Possibly later, the very high-temperature gas-cooled reactor under development by the Department of Energy might also qualify.

But even here, we find there are currently three regulated utilities, each proposing to add two AP1000 units to their respective rate bases. These do not appear to require loan guarantees for financing, or at least full loan guarantee coverage at 80 percent of the total project cost.

Thus, we believe the $18.5 billion is already sufficient to support construction of more than just the lead units of the innovative standardized reactor designs currently available to the United States market. Therefore, no additional loan guarantee authority is needed.

More loan guarantee support to underwrite the U.S. market penetration of additional designs already deployed or under construction in foreign markets would only further distort the energy marketplace and undermine the goal of design standardization, which is a widely shared objective of DOE, NRC, the nuclear industry, and others concerned about the future effectiveness of NRC safety regulations.

Federal loan guarantees should not be abused to insulate an entire industry from competition with a host of new energy technologies that promise comprehensive environmental and social benefits. Unlike improvements in efficiency and renewable technologies, nuclear power is a decarbonization solution packaged with a host of noncarbon environmental, security, and waste problems.

For these reasons, nuclear power should not be considered for inclusion in any renewable electric standard Congress may legislate.

Turning to the second issue, the Federal Government should not encourage or support commercial spent fuel reprocessing. Reprocessing of commercial spent fuel, as it is practiced today in France, Russia, and Japan, offers no advantages and numerous disadvantages over continuing to rely on the once-through nuclear fuel cycle as practiced in the United States and most countries with nuclear power plants. The trend in recent years has been for more countries to abandon reprocessing than to initiate reprocessing.

Relative to the existing open fuel cycle, the use of a closed or partially closed MOX fuel cycle in thermal reactors has proven to be more costly, less safe, leads to greater routine releases of radioactivity into the environment, greater worker exposure to radiation, larger inventories of nuclear waste that must be managed, and it does not appreciably reduce the geologic repository requirements for spent fuel or high-level waste.

Putting aside for the moment the serious proliferation and security concerns involved in any future global shift toward reprocessing, it is clear that combating climate change is an urgent task that requires near-term investments yielding huge decarbonization dividends in a 5- to 20-year timescale. For thermal reactors, the closed fuel cycle is unlikely ever to be less costly than the once-through fuel cycle, even assuming significant carbon controls.

But setting aside even these near-term cost barriers, commercial viability for a closed fuel cycle employing fast reactors is an even longer-term proposition. So even fervent advocates of nuclear power need to put the reprocessing agenda aside for a few decades and focus on swiftly deploying and improving the low-carbon energy solutions.

Spent fuel reprocessing, plutonium recycle, and fast reactor transmutation are currently uneconomical, high-risk, 100-year answers to an urgent climate question that now requires low-risk, 5- to 10-year solutions. For now, Congress and the new Administration should terminate the Global Nuclear Energy Partnership program of the Department of Energy and its associated efforts to close the nuclear fuel cycle and introduce fast burner reactors into the United States.

Finally and very quickly turning to the last issue, as the political sun sets on the proposed Yucca Mountain project, the Federal Government needs to begin identifying alternative geologic disposal sites for the country's nuclear waste. Congress should initiate a search for a new geologic—one or more new geologic repository sites for the disposal of spent fuel and to assure adequate Federal funding—ensure that adequate Federal funding is available to retain the technical community associated with the Yucca Mountain project so that this expertise will be available to assess and develop new proposed geologic waste disposal sites.

Congress should not interfere in the NRC's ongoing waste confidence and temporary storage rulemakings and let this regulatory body attempt to fulfill its independent regulatory mandate.

Thank you very much, Mr. Chairman. I would be pleased to answer questions.

[The prepared statement of Mr. Cochran follows:]

PREPARED STATEMENT OF THOMAS B. COCHRAN, PH.D. SENIOR SCIENTIST, NUCLEAR PROGRAM, AND CHRISTOPHER E. PAINE, DIRECTOR, NUCLEAR PROGRAM, NATURAL RESOURCES DEFENSE COUNCIL, INC.

I. Introduction

Mr. Chairman and members of the Committee, thank you for providing the Natural Resources Defense Council (NRDC) the opportunity to present its views on several current issues related to nuclear energy. NRDC is a national, non-profit organization of scientists, lawyers, and environmental specialists, dedicated to protecting public health and the environment. Founded in 1970, NRDC serves more than 1.2 million members and supporters with offices in New York, Washington, D.C., Los Angeles, San Francisco, Chicago and Beijing.

Our testimony focuses on three issues: a) whether additional federal loan guarantees should be provided to construct new nuclear power plants; b) whether the United States should engage in reprocessing of spent nuclear fuel; and c) whether Congress should intervene in the Nuclear Regulatory Commission's proposed rulemakings on temporary storage of spent fuel and so-called "waste confidence," that is, whether sufficient confidence exists today in our long-term ability to isolate

spent fuel from the biosphere that we can responsibly license new reactors that will add to the nuclear waste burden.[1]

II. Summary of Recommendations

A. Loan Guarantees.—Congress should not provide additional loan guarantees to construct new nuclear plants. Sufficient nuclear loan guarantee authority already exists to accomplish the legitimate public purpose that is involved here. Let us define here what we believe to be the legitimate purpose of loan guarantees—they are intended to shift much of the downside financial risk involved in the initial commercial deployment of new or significantly improved low-carbon energy technologies from private interests to federal taxpayers.

Since the underlying light-water reactor technology to be supported by these guarantees has been around for 45 years, has been the prior recipient of many tens of billions of dollars in government support, and already accounts for 20% of U.S. grid-connected power generation, the technology innovation case for nuclear loan guarantee support is weak, and at best, a very narrow one. To avoid serious and lasting distortion of the U.S. energy marketplace and an economically inefficient decarbonization effort, nuclear loan guarantees should be limited to the lead units of new nuclear plant designs, not previously deployed in the United States or in similar markets abroad with comparable regulatory requirements. These designs must incorporate substantial design innovations promising improved safety, increased operating efficiencies, significantly reduced capital costs, and lower environmental impacts.

In our view, few if any of the Gen III + reactors being proposed today plausibly meet this description, but if any of them do, it could only be the lead units of new passive safety, smaller footprint, less capital intensive designs that have not yet been deployed elsewhere. Fitting that description currently are the AP-1000 and the Economic Simplified Boiling Water Reactor (ESBWR), and possibly later the Very High-Temperature Gas-Cooled Reactor (VHTGR), now in the early stages of development by the Department of Energy (DOE).

But even here, we find that there are currently three regulated utilities, each proposing to add two AP1000 units to their respective rate bases, which do not appear to require loan guarantees for financing, or at least full loan guarantee coverage at 80% of total project cost. We believe that the $18.5 billion is already sufficient to support construction of more than just the lead units of the innovative standardized reactor designs currently available to the U.S. market, and therefore no additional loan guarantee authority is needed.

More loan guarantee support to underwrite the U.S. market penetration of additional designs, already deployed or under construction in foreign markets, would only further distort the energy marketplace and undermine the goal of design standardization, which is a widely shared objective of the DOE, Nuclear Regulatory Commission (NRC), nuclear industry and others concerned about the future effectiveness of the NRC's safety regulation.

Federal loan guarantees should not be abused to insulate an entire industry from competition with a host of new energy technologies that promise comprehensive environmental and social benefits. Unlike improvements in efficiency and renewable technologies, nuclear power is a decarbonization solution packaged with a host of non-carbon environmental, security, and waste problems. For these reasons, nuclear power should not be considered for inclusion in any "Renewable Electricity Standard" Congress may legislate.

B. Spent Fuel Reprocessing.—The federal government should not encourage or support commercial spent fuel reprocessing. Putting aside for the moment the serious proliferation and security concerns involved in any future global shift toward reprocessing, it's clear that combating climate change is an urgent task that requires near term investments yielding huge decarbonization dividends on a 5 to 20 year timescale. For thermal reactors, the closed fuel cycle (spent fuel reprocessing and recycling plutonium) is unlikely ever to be less costly than the once-through fuel cycle, even assuming significant carbon controls. But setting aside such near-term cost barriers, commercial viability for a closed fuel cycle employing fast reactors is an even longer-term proposition. So even fervent advocates of nuclear power need to put the reprocessing agenda aside for a few decades, and focus on swiftly deploying and improving the low-carbon energy solutions.

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[1] NRC, Consideration of Environmental Impacts of Temporary Storage of Spent Fuel After Cessation of Reactor Operation (hereinafter "Proposed Temporary Storage Rule") 73 Fed. Reg. 59547 (October 9, 2008), and Waste Confidence Decision Update, (hereinafter "Proposed Waste Confidence Rule") NRC, 73 Fed. Reg. 59551 (October 9, 2008).

Think about it. In pursuit of closing the fuel cycle, the U.S. government could easily spend on the order of $150 billion over 15 years just to get to the starting line of large-scale commercialization. But all that spending will not yield one additional megawatt of low-carbon electricity beyond what could be obtained by sticking with the current once-through cycle, much less by investing that $150 billion in renewable and efficient energy technologies. Spent-fuel reprocessing, plutonium recycle, and fast reactor waste transmutation are currently uneconomical, higher-risk, 100-year answers to an urgent climate question that now requires low-risk 5 to 20 year solutions. For now, Congress and the new Administration should terminate funding for the Global Nuclear Energy Partnership (GNEP) and its associated efforts to close the nuclear fuel cycle and introduce fast burner reactors in the United States.

At any point along the way, Mr. Chairman, we can revisit this issue to assess whether there may be truly disruptive innovations in nuclear technology that would alter this negative assessment, and induce us to view closing the fuel cycle as a more cost-effective pathway to decarbonization than the host of cheaper alternatives we have available to us today.

C. Nuclear Waste Disposal.—As the political sun sets on the proposed Yucca Mountain project, the federal government needs to begin identifying alternative geological disposal sites for the country's nuclear waste. Congress should initiate a search for a new geologic repository site for disposal of spent fuel, and insure that adequate federal funding is available to retain the technical community associated with the Yucca Mountain project, so that this expertise will be available to assess and develop new proposed geological waste disposal sites. The Congress should not interfere in the NRC's ongoing Waste Confidence and Temporary Storage rulemakings, and let this regulatory body attempt to fulfill its independent regulatory mandate.

III. Detailed Observations

A. Loan Guarantees—Congress should not further subsidize the construction of new nuclear power plants and not provide additional loan guarantees for this purpose

In the United States existing nuclear power plants operate efficiently and are profitable either because ratepayers long ago paid the piper for their stranded capital costs, or these assets were heavily discounted when corporate ownership changed in the 1990's and now are carried on the books of the new owners at a small fraction of their original asset value. The domestic nuclear power industry, however, is confronting two big economic dilemmas with respect to new nuclear plants. New plants remain uneconomical when compared to other electricity generating technologies and improvements in end-use efficiency; and the unit costs of new nuclear plants are so high that they are difficult to finance in the private capital markets, especially today.

As a purely commercial proposition, when stripped of all the various forms of federal and state subsidies, new nuclear plants are likely to remain non-competitive with other forms of baseload generation in most areas of the country until the price of carbon emissions exceeds $50 per ton of carbon dioxide. We note, however, that efficiency and many renewable sources are competitive with nuclear now and will only become more so. To bridge this gap, the nuclear industry, through its congressional boosters, has already received production tax credits for the first 6,000 megawatts of new capacity, licensing cost sharing with DOE, "regulatory risk" insurance against delays in construction, and to date some $18.6 billion in federal loan authority to support the construction of new plants. In addition, most new reactor projects are benefitting from additional subsidies and incentives, such as tax abatements and worker training programs, offered by state and county governments.

Now the industry is returning to Congress for yet more support, essentially stipulating that nuclear power "must be part of the energy mix" needed to mitigate climate change and to provide for jobs under the economic stimulus plan. We should reject this categorical imperative, command economy type approach. It reminds us of the mindset we used to encounter in Minatom, the old Soviet Ministry of Atomic Energy. The economically efficient way to mitigate climate change is to internalize the cost of carbon emissions through a declining cap-and-trade program, which NRDC strongly supports.

This Committee should reject any broader attempt to use loan guarantees to recapitalize a technically mature industry, or to shift the overall terms of trade in the electricity marketplace in favor of nuclear power. This runs a serious risk of misdirecting investment capital away from commercialization of low-carbon energy technologies that are cheaper, cleaner, and more versatile than currently available nuclear power plants.

Shifting the overall terms of energy commerce in favor of low-carbon solutions, nuclear power included, is the task of a climate bill, not the federal loan guarantee program. At best, federal loan guarantees should be construed as bridging the gap between successful prototype development and a foothold in the commercial marketplace, by spreading the risk of the initial capital investments required to bring a new technology to commercial scale.

But federal loan guarantees should not be abused to insulate an entire industry from competition with a host of new energy technologies that promise comprehensive environmental and social benefits. Unlike improvements in efficiency and renewable technologies, nuclear power is a decarbonization solution packaged with a host of non-carbon environmental, security, and waste problems. For these reasons, nuclear power should not be considered for inclusion in any "Renewable Electricity Standard" Congress may legislate.

In sum, the economically inefficient way to mitigate climate change is to broadly subsidize deployment of currently available nuclear power plant technologies. This will crowd out or slow investment in improved energy efficiency, utility-scale renewable electricity supply, and decentralized smart-grid technologies that can mitigate climate change in less time, with less cost and risk. If Congress is unwilling or unable politically to let a climate bill do the work of sorting out the most cost-effective low-carbon energy technologies, one possible way to mitigate economic inefficiency would be to closely couple any additional federal loan guarantees for nuclear with utility commitments to phase out existing coal capacity, such that future electricity demand growth in the affected service area or regional grid must be met in the first instance by large improvements in less costly energy efficiency, and by the development of renewable sources having environmental impacts and a marginal cost of generation less than nuclear power.

The idea that the nuclear and coal dependent Southeastern region of the United States is without renewable resources worthy of development is a gross distortion that needs to be dispelled. The region has vast distributed potential for photo-voltaic solar development, waste-heat cogeneration, bio-gasification, small hydro, and offshore wind. Above all, with the highest rates in the nation of energy consumption per unit of economic output, the region has a huge energy efficiency resource that can be tapped at far less cost than nuclear. The fact that the dominant utilities and electricity grid in that region are not currently structured to take advantage of these resources does not mean that they do not exist.

We should not use loan guarantees, or any other federal subsidies, to promote the economically inefficient use of nuclear power ahead of low-carbon energy alternatives that will be available sooner, at lesser cost, and with fewer environmental impacts. Under a well designed cap and trade system with competitive open access to the transmission and distribution grid, if nuclear power is needed for decarbonization, the marketplace for low-carbon energy will get around to demanding more of it, but not before it has exhausted the potential of other available energy resources (including all cost-effective avenues for extracting energy savings from improvements in efficiency) that can displace CO_2 at a lower cost per ton than nuclear power.

An appropriate role for direct federal support of low-carbon energy is to underwrite research, development, and demonstration of meritorious new technologies that are unlikely to be developed by private industry acting alone, either because the return on the investment is too distant or because the investment risks are too high. Alternatively, society may reap benefits by using production or investment tax credits to more rapidly expand the market for beneficial emerging technologies, thereby helping to driving down unit costs of production to a level that allows the technology to become self-sustaining in the marketplace.

Further subsidization of new nuclear power plants does not meet either of these criteria. The first 6,000 megawatts of nuclear new-build capacity are already covered by a production tax credit comparable to wind, and sufficient loan guarantee authority ($18.5 billion) has already been made available to support construction of the first 'new' Gen TIT+ reactor designs proposed for the U.S. market—the Toshiba-Westinghouse AP1000 and the GE-Hitachi ESBWR. All other reactor designs proposed for construction in the United States either don't qualify as innovative, have already been constructed elsewhere, or both.

Furthermore, loan guarantees are not essential for nuclear plants currently being developed by regulated utilities as evidenced by Progress Energy's efforts to build two new units in Levy County, Florida, Georgia Power's efforts to build two units (Alvin W. Vogle Units 3 and 4), and South Carolina Electric & Gas's efforts to build two units (Virgil C. Summer Units 2 and 3). All six of these proposed units are AP1000 designs.

Finally, as NRC Chairman Dale E. Klein noted last week, the "excessive exuberance" for nuclear power has declined because of the global credit and economic crisis. The current economic recession has reduced the projected demand for electricity and there is a reduced need to build new base-load electricity generating capacity.

B. Reprocessing—The Federal Government should not encourage or support commercial spent fuel reprocessing

Reprocessing of commercial spent fuel, as it is practiced today in France, Russia and Japan offers no advantages and numerous disadvantages over continuing to rely on the once-through nuclear fuel cycle as practiced in the United States and most countries with nuclear power plants. The trend in recent years has been for more countries to abandon reprocessing than to initiate reprocessing. Relative to the existing open fuel cycle, the use of a closed or partially closed mixed-uranium and plutonium oxide (MOX) fuel cycle in thermal reactors has proven to be more costly and less safe. It leads to greater routine releases of radioactivity into the environment, greater worker exposures to radiation, larger inventories of nuclear waste that must be managed, and it doesn't appreciably reduce the geologic repository requirements for spent fuel or high-level nuclear waste.

Because reprocessing as it is practiced today does not appreciably reduce repository requirements it is not an alternative to Yucca Mountain. Should GNEP's advanced reprocessing technologies—essential to the success of the GNEP vision—prove technically feasible, they are unlikely to significantly impact repository requirements, because the fast reactors required for efficient waste transmutation are likely to remain more costly and less reliable than conventional thermal reactors, and hence will not be commercially deployed in sufficient numbers to effect the desired reductions.

The GNEP vision of burning the long-lived actinides, requires that some 30 to 40 percent of all reactor capacity be supplied by fast reactors. In other words, for every 100 thermal reactors of the type used throughout the United States today, some 40 to 75 new fast reactors of similar capacity would have to be built. The commercial use of large numbers of fast reactors for actinide burning is unlikely to occur because—to borrow observations made by U.S. Navy Admiral Hyman Rickover more than 50 years ago that remain true today—fast reactors have proven to be "expensive to build, complex to operate, susceptible to prolonged shutdown as a result of even minor malfunctions, and difficult and time-consuming to repair."

The development of fast reactors to breed plutonium failed in the United States, the United Kingdom, France, Germany, Italy, and Japan. We would argue it failed in the Soviet Union despite the fact that the Soviets operated two commercial-size fast breeder plants, BN-350 (now shut down in Kazakhstan) and BN-600 (still operational in Russia), because the Soviet Union and Russia never successfully closed the fuel cycle and thus never operated these plants using MOX fuel.

Moreover, the advanced reprocessing technologies are even more costly than the conventional PUREX method and produce even larger inventories of intermediate and low-level nuclear wastes.

The closed fuel cycle technologies required by GNEP pose greater proliferation risks than the once-through fuel cycle. Even though GNEP's ambitious vision of deploying new reprocessing plants and fast reactors in large numbers will surely fail to materialize, the partnership's research program will encourage the development in non-weapon states of research facilities well suited for plutonium recovery, i.e., small hot cells and even larger reprocessing centers, as well as the training of experts in plutonium chemistry and metallurgy, all of which pose grave proliferation risks. It is for this reason that we advocate terminating the GNEP research on advanced reprocessing technologies.

For now, Congress and the new Administration should terminate funding for the GNEP and its associated efforts to close the nuclear fuel cycle and introduce fast burner reactors in the United States. This leaves the question of what level of long-term DOE research funding is appropriate to explore advanced nuclear fuel recycling technologies.

We hold the view that even substantial research spending in this area is unlikely to lead to disruptive nuclear technology breakthroughs that actually meet the stated goals of the research—cost-effective and non-proliferative techniques for reprocessing, recycling and transmuting plutonium-based fuels. And while the proliferation risks of this cooperative international research would be ongoing and tangible, we and many others in the nonproliferation community believe that shutting down the current U.S. plutonium recycle research effort, and any support it extends to foreign efforts, is the wisest course, at least until such time as the latent nuclear proliferation risk in the world is much better controlled than it is today.

Others, including Energy Secretary Steven Chu, appear to believe that some level of ongoing advanced fuel cycle research is appropriate and has some chance of yielding the desired disruptive nuclear technology breakthrough, if pursued for perhaps a decade or more. History has not been very kind to this view, but the plutonium fuel cycle community is a lot like the fusion energy community in this respect—hope springs eternal as long as federal research dollars are within reach.

So weighing these contrasting glass-half-full and glass half-empty perspectives, Mr. Chairman, you might conclude that some modest long-term research program, geared to narrowing the technical and cost uncertainties surrounding the toughest unresolved technical, economic, safeguards, and proliferation issues, would be an appropriate and prudent middle path to pursue with respect to closing the fuel cycle. We would emphasize that even more important than the particular choice of technology is a better understanding of the requirements for the international institutional setting in which a large-scale fast reactor roll-out would be attempted. This, more than the technology, is the long pole in the closed fuel cycle tent. If one is serious about wanting to minimize the risks of proliferation, one is more or less driven to consider some form of international ownership and control over nuclear fuel cycle facilities, and this is likely to prove just as demanding a task as the development of more "proliferation resistant" strains of reprocessing. We also note that absent such an international structure for closely regulating the closed fuel cycle, we are unlikely ever to transition to a world free of nuclear weapons.

C. Congress should not interfere in the NRC's ongoing Waste Confidence and Temporary Storage rulemakings

The issue of whether and how the availability of permanent geologic disposal should factor into the NRC licensing of commercial nuclear power plants has been with us for decades. A compromise on how the issue would be addressed in a scientific and publicly acceptable manner was reached nearly twenty five years ago and the basic framework of that compromise has not changed substantially over the years.

To make a long story short, in June of 1977, the NRC denied a NRDC petition that forced the question of whether there should be a rulemaking proceeding to determine whether high-level radioactive wastes generated in nuclear power reactors can be permanently disposed of without undue risk to public health and safety. NRDC then petitioned the United States Court of Appeals for the Second Circuit to review the NRC decision. The D.C. Circuit remanded the matter to the NRC for further proceedings to determine whether there was reasonable assurance that a permanent disposal facility will be found. This and a related case gave rise to the NRC's "waste confidence" rulemaking. The NRC issued a set of findings in 1984 and subsequently revised them in 1990, and reaffirmed them in 1999. The NRC is now revisiting the issue.

The resolution of this issue properly remains with the NRC which was established to address health and safety issues associated with civil use of atomic energy. We would caution against intervention into this ongoing NRC decision-making process. It may be instructive to remind ourselves that the current failure to develop a geologic disposal facility for high level radioactive waste and spent fuel is due in large part to interventions by Congress subsequent to the passage of the Nuclear Waste Policy Act of 1982.

The CHAIRMAN. Thank you both very much for your testimony.

Mr. Fertel, I gather from your testimony you think the top priority for the nuclear power industry, as far as legislation might be concerned, would be fixing this loan guarantee program, getting this in a form that it is able to assist all of those that would like to go forward and construct these facilities. Is that an accurate understanding?

Mr. FERTEL. That is accurate, Mr. Chairman.

The CHAIRMAN. Dr. Cochran has made the argument that these loan guarantees should be limited to the lead units of new nuclear plant designs and not made available to subsequent units that employ designs that have already been built. What is your response to that?

Mr. FERTEL. My response is quite straightforward on that, sir. As a Nation, we are looking to radically change our electricity supply system. We are looking to go to much lower carbon footprints for

everything. We talk about smart grid. We are clearly moving toward renewables. We need to do more efficiency.

There is no silver bullet. We basically need a portfolio that does all of these things very effectively, and the only large proven baseload source of electricity that doesn't emit carbon is nuclear. The reality is that if we are going to go to a low-carbon footprint across our electricity system, it won't happen in 5 years, as Tom is saying. It will take us much longer.

But to do that, we are going to have to finance large projects, and there is advantage from a public policy standpoint to loan guarantees, which I will explain. If I leverage—if I am a merchant plant in a State that actually has deregulated, I would actually leverage more debt to equity. If I had loan guarantees, I would be able to do that.

That reduces the cost of electricity to our customers. So it helps there. It helps us deploy quicker, whether it is nuclear or renewables or anything else.

The third thing right now in title XVII, the way you wrote it, sir, we actually pay the Government for the loan guarantees. It is not a gift. You actually get money for it. The companies want to deploy nuclear and they will ultimately maybe get financing in the open market, but in our economic situation today, you are not going to get a lot of financing for anything.

So it is good public policy, in our opinion, if you are trying to move our electricity system in a different way and moderate the impact on customers.

The CHAIRMAN. Let me ask a question about this reprocessing. Is there any interest on the part of private companies, Mr. Fertel, as far as you know, in building fast reactors or reprocessing plants with private capital? Is there any move to do that?

Mr. FERTEL. There is clearly interest by a couple of the prime movers in that area over the last couple of years because of the Bush Administration discussing of GNEP, and they have been looking at it as a business case. Where I agree with Tom is it won't happen fast, and it doesn't have to happen fast.

But we do need to look at what we should do if we do want to close the fuel cycle in this country, and I think Tom may be wrong in his premise that the rest of the world won't continue to look at reprocessing. If we want to influence them on technology, on safety, on environmental, and on nonproliferation issues, you can't do it when you say we don't care to do it, and we think you shouldn't. You have to engage.

The CHAIRMAN. Dr. Cochran, let me ask you about this NRC waste confidence rulemaking. You suggest that Congress stay out of that. Do you believe, in light of the current state of the repository program, that the NRC can reasonably expect a repository to be available even in this timeframe of 50 to 60 years after the 60-year operating life of a reactor?

Mr. COCHRAN. I believe that is such a long time that I don't think any answer would be meaningful. First of all, half the nuclear power plants have extended their licenses for 60 years. The other half are expected to apply and extend their licenses. They are already beginning to think about a second extension to 80 years,

and then you add on another 50 to 60 years beyond that, you are well beyond 100 years into the future.

Now do I have confidence that we will find a solution within the next 100 years? Let us review the history. Yucca Mountain is not the first failure to find a solution to the spent fuel or high-level waste disposal. It is actually the third failure in the last 50 years.

The first failure, you recall, was efforts by the AEC to dispose of high-level waste at Lyons, Kansas, in a salt repository. When that program was terminated because the site proved to be less attractive than initially thought, the newly formed ERDA/Department of Energy proposed—this was, I think, during the Carter Administration—a retrievable surface storage facility solution, where we would gather up all the fuel and on an interim basis store it in one large central pool or pools.

That proposal was also shot down and abandoned, and that led to the nuclear—development of a new alternative and the passage of the Nuclear Waste Policy Act of 1982. In that case, we supported that act. It set up a beautiful system where one Federal agency, the Department of Energy, was to go out and find the best sites in the Nation and narrow it down to two.

A second Federal agency, the EPA, was to independently develop criteria for safe disposal of the waste in the repository. The third Federal agency, the Nuclear Regulatory Commission, would make the decision.

In the intervening years, the Department of Energy and the Congress corrupted the site selection process, and it led to singling out Yucca Mountain. In the intervening years, the EPA took decades to finalize the criteria, and they corrupted that process as well. So, you have ended up with now a political solution that is essentially eliminating Yucca.

Will that happen again? Perhaps. I think it is incumbent upon us—because the large inventories of spent fuel exist and geologic disposal is still the best solution for long-term disposal of this material, it is incumbent upon us to immediately start to identify new geologic repositories. We are going to lose a couple of decades if we simply cutoff the funding for the technical people who know this issue best so that they are not around to help us engage in identifying the best options under plan B.

The CHAIRMAN. Thank you very much.

Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman.

Interesting panel. Very seldom do we have just two, and really, you couldn't be on——

Mr. FERTEL. So close together, right?

[Laughter.]

Senator MURKOWSKI. So close together. That is right. Anyway, it has been interesting hearing the comments from both of you.

Mr. Fertel, first to you, you have—we all recognize that the number of applications that Department of Energy has received for the loan guarantees far exceeds, $93 billion as opposed to the $18.5 billion that is currently available and limited to.

What does NEI believe that the authorized loan volume needs to be in order to get the nuclear industry reestablished?

Mr. FERTEL. That is an excellent question, Senator, and we are trying to get a better handle. I mean, you have an indication by just what was filed.

Senator MURKOWSKI. Right.

Mr. FERTEL. Which is $93 billion by the 10. You shouldn't look at that as 10 plants. We are not privy to what they filed, but I am sure there are multiple units in those filings. It is not 10 applications, 10 single units.

I think the difference, again, is that the program that the 2005 act put in place was a program that Tom described very well. It was to jumpstart some new technologies.

I think the situation is a structural problem that we are trying to address, which is the ability of our Nation to privately finance large projects and particularly when the companies are the size of our electric utilities. They are not the size of Electricite de France or some of the German companies, which are almost 10 times at times the size of some of our companies that you can't finance as easily or at all in some cases.

So Government intervention to support it actually has merit. Right now, the program is $111 billion, of which $18.5 billion is for nuclear. The rest goes to renewables and other technology.

So we ought to be clear. Nuclear is not running away with the bulk of the money in the current program, but I think you have an indication from what has been filed.

Senator MURKOWSKI. You made a statement that I want to follow up with because I made the suggestion at a hearing that we had last week that the Administration's actions with regard to Yucca could be viewed as a disincentive to those in the industry to pursue new applications to advance this nuclear renaissance that we have been talking about.

You have suggested here this morning that you don't think that that is necessarily the case, and I appreciate that. But let me ask you this. If, in fact, we do not get a strong signal from the Administration that they believe—let us say that they trend toward Dr. Cochran's view that, in fact, the loan guarantees are perhaps not that necessary or perhaps we do not need to increase the amount.

You have that message coupled with the message on Yucca. What does that do to the growth of the industry?

Mr. FERTEL. Yes, I think it immediately causes some of the companies to slow down because they can't finance some without loan guarantees. You would probably lose the merchant plants just as a business decision.

I think that in other boardrooms, you would have the board of directors sitting and saying, "Well, where is the Administration on this, and what do we do?" So I think, clearly, the combination would have to slow down any deployment of new nuclear.

My comment on the waste issue is that you always had the possibility, and Chairman Klein referred to it, of Yucca not getting licensed. We think that there is great technical stuff and they have worked so hard and they have worked so long, but that was always a possibility. You would then have to go find another location.

So that was always out there. As the chairman said, they will make sure you manage safely and securely the used fuel onsite or at any other location we put it. So we would say you could go for-

ward if it was just waste, as long as there is an effort by our country to do something.

With Senator Bingaman back in his question to Tom about waste confidence, let me just add maybe a perspective on waste confidence that you don't usually hear. The reason NRC has the waste confidence rulemaking is because of NEPA. It is to allow them to deal with the issue of waste, which is an environmental issue as well as a safety issue under NEPA.

This is a personal opinion. We have a law. We may not be implementing it very effectively, but it is the law. It would seem to me that if the Federal Government passes a law that says we are going to ultimately deal with waste—Tom is right—eventually, we should ultimately deal with the waste.

I am not sure they should litigate that either through a waste confidence rulemaking or through individual proceedings in regulatory. I think you could legislatively say you have waste confidence because otherwise you don't believe our Government will ever implement what it says it is going to do.

Now I think NRC is accommodating the process very well by doing a very robust rulemaking and then relying on it. But that is why they have to deal with it, because of NEPA.

Senator MURKOWSKI. My time has expired. But if I may, Mr. Chairman, just one question of Dr. Cochran?

Because you have very clearly articulated your perspective that we should not expand the nuclear loan guarantee program, we should not pursue the spent fuel reprocessing. You have seen the President's blueprint in terms of the goals that he is looking to for climate change and reduction in emissions. He is looking for an 83 percent reduction in emissions by 2050. That is pretty aggressive.

Do you believe that we can achieve the goals that he is setting out without nuclear?

Mr. COCHRAN. First of all, we have nuclear. We have 104 plants. They have been increasing their capacity factor and their capacity, and there will be more nuclear plants. So nuclear is in the mix, and nuclear is here to stay.

Senator MURKOWSKI. But when you say that, I want to follow on the question that I asked to Mr. Fertel.

Mr. COCHRAN. I want to finish my answer.

Senator MURKOWSKI. If, in fact, we do not have an increase, if we just stay at our 104, can we get there from here?

Mr. COCHRAN. Let us put in place the policies that will achieve a priority objective, which is to mitigate climate change. The economically efficient, most efficient way to do that is to treat carbon as you would any other pollutant.

So, the highest priority is to get Federal legislation to implement a cap and trade program on carbon, a meaningful cap and trade program. We should solve the climate issue by dealing with the pollutant, not by going out and subsidizing your favorite technologies.

There is a role for Federal subsidies. There is a role for loan guarantees.

Senator MURKOWSKI. That is clearly what we are doing.

Dr. COCHRAN. But it is not to, as Mr. Fertel wants to do, provide unlimited loan guarantees to all the nuclear plant owners and op-

erators that come to the table and want to build a new nuclear plant. Now——

Senator MURKOWSKI. So could we——

Mr. COCHRAN. Wait just a minute.

Senator MURKOWSKI. I still want to get back to my question, which is can we achieve the level of reductions that the President is looking for, given what we have with our current nuclear capacity?

Mr. COCHRAN. NRDC thinks we can, but more importantly, we ought to put in place the policies that get us there the quickest, most safely, and at the least cost to the Federal Government. Our concern is that providing these unlimited loan guarantees to the nuclear energy industry will ultimately reduce the efforts to deploy technologies that can provide carbon offsets more cheaply and more quickly.

Now let me—let us just take—first of all, let us recognize that the loan guarantees are not needed for those utilities that are regulated because they can go to the PUCs and get money provided through increased rates and finance these plants.

He mentioned that it would likely eliminate or reduce the number of merchant plants we build. Well, let us take a case. Let us take the business model for Calvert Cliffs plant right down the street.

Calvert Cliffs is a proposal by UniStar, which ultimately is a proposal by the French government because UniStar is a joint venture between Constellation Energy and Electricite de France, and Electricite de France just bought half of Constellation Energy. Electricite de France is owned, 85 or higher percent, by the French government.

They want to build a French plant, EPR, which is built by AREVA, owned by the French——

Senator MURKOWSKI. Dr. Cochran, I am——

Mr. COCHRAN [continuing]. Government.

Senator MURKOWSKI [continuing]. Double over my time here. I am 5 minutes over, and I am not quite sure where you are going.

Mr. COCHRAN. I am not sure I am not over my time, but let me finish my point.

Senator MURKOWSKI. You are over your time. Where you are going is——

Mr. COCHRAN. Where I am going is——

Senator MURKOWSKI [continuing]. Really inconceivable.

Mr. COCHRAN [continuing]. That your loan guarantees, you have got to go to your constituents and the constituents in New Mexico and say we want to tax homeowners, families, so that we can provide insurance to the French government so that through Electricite de France they can enter the American market, sell electricity below cost so the consumers in Washington, DC., and Baltimore don't have to provide energy efficiency, and they can make a profit by selling nuclear energy below cost.

I think that is a bad model for solving climate. It is a bad model—it is a bad business model for having efficient nuclear power plants.

Senator MURKOWSKI. I think where the Natural Resources Defense Council is coming is they do not believe that nuclear should

be any part of the solution for this country, and I am disappointed with your response.

Thank you, Mr. Chairman.

Mr. COCHRAN. Senator, the highest priority program of the Natural Resources Defense Council is to achieve Federal legislation that will cap carbon emissions. This happens to be the single most important Federal policy that would help the nuclear industry.

The second most important Federal policy that could help the nuclear industry would be to encourage the development and deployment of plug-in hybrids and electric vehicles. This is also a priority of our organization. So don't tell me——

Senator MURKOWSKI. We will work with you on that.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Udall.

Senator UDALL. Thank you, Mr. Chairman.

This previous interchange is informative and entertaining enough, I am tempted to yield my 5 minutes to Senator Murkowski and——

[Laughter.]

Senator UDALL [continuing]. We will continue the discussion. I do think my colleague from Alaska is on to an important line of questioning, and I think it is, in many ways, why this hearing was held today.

Dr. Cochran, thank you for your passion and your interest and the time you dedicate to understanding nuclear power. I did want to return to you for some additional comments.

But Mr. Fertel, in the interest of fairness, I would like to hear your thoughts on loan guarantees and once again give you a couple of minutes to talk about why you think this is important.

Mr. FERTEL. Thank you, Senator Udall.

Again, I think going—not to rebuke, but some of Tom's points. First of all, the loan guarantees, the citizens of Colorado and the taxpayers of New Mexico or Alaska or Alabama are not paying any money for the loan guarantees that we get. We are paying the Government money for the loan guarantees that we get, and then we are producing cheaper electricity with it.

To be honest, on Tom's sort of attack on the French, I don't want to defend the French, but AREVA is in the process right now of building a facility in Norfolk, Virginia, that is going to employ 500 people, that is going to build equipment for the EPR that would be built in this country. Their facilities in Lynchburg have hired probably more than 500 people in the last couple of years, and the people that will build the plant in this country will be unionized people that they have signed a contract with to build in Maryland.

So I think we need to maybe not throw as many stones at some of what is going on. First, it is a global marketplace, and second, the building is going to come here and the electricity will be here.

We think loan guarantees are a good public policy. We think that they allow for a more effective deployment of clean technologies. As I said, there is $111 billion in the loan guarantee program now, of which $20.5 billion is nuclear. So I don't know if Tom thinks they should take out the other $90 billion that goes to renewables and

other things, too? We don't. We think they should get it if they need it. We don't imagine how they can spend it.

It helps us reduce the cost of electricity. It helps us deploy low-carbon technologies quicker than we could without them because of the size of some of our projects in particular, but others that are having trouble. We think that the Government actually gets money back for it.

So we see it as a good public policy. We see it as something that achieves the end goals we want. I agree with Tom that if we do a climate bill with cap and trade or whatever form it takes, it will also have an impact on the technology decisions.

The answer, Senator, is we need all the technologies we can use. How we deploy them depends upon the policies we set.

Senator UDALL. Is it fair to say that when Dr. Cochran talked about his concern that the loan program was initially framed to promote these new cutting-edge technologies, these more modular units that we are now hearing that we ought to expand those loan guarantees to the more mature technologies, is that because of the marketplace and the——

Mr. FERTEL. That is exactly right, Senator.

Senator UDALL [continuing]. Stresses there?

Mr. FERTEL. Yes, we actually agree that when Senator Bingaman and the committee passed the 2005 act, its intent was different. It is still a valid thing to look at and to do. But the financing and structural problems that we have in deploying the bulk of technologies we need actually needs more help than what the original program was intended to do.

Yes, sir. That is correct.

Senator UDALL. Dr. Cochran, in the interest of fairness, would you care to comment?

Mr. COCHRAN. The renewable industry, as I understand it, was not seeking loan guarantees prior to the financial meltdown. Now the Congress, in its wisdom, has put in large amounts of loan guarantees to reflect the difficulty of immediate financing following the financial meltdown.

It is my view that the loan guarantees should be limited to application of the new innovative energy technologies, and once the technology has gone above, say, 5 percent of the market, you shouldn't continue them. You don't need to continue them.

The economically efficient way to solve the climate problem is through a cap, a carbon cap. It is not through a loan guarantee program. There is nothing in the loan guarantee program from preventing utilities from, let us say, shutting down a gas-fired plant rather than a coal plant. So, we lose half the benefits, the carbon benefits, if they are going to shut down some other technology rather than the plants that emit the most CO_2.

So I think the economically efficient way to address that CO_2 problem is cap CO_2 and put a price on it. Let these guys compete in the marketplace, and your job ought to be to eliminate all these Government subsidies rather than load them up.

There are legitimate reasons to subsidize new energy technologies. One is to do R&D on long lead-time technologies that are valuable to society or technologies that are high risk that the industry won't provide the R&D.

The second is to lower initial costs by creating a market and introducing technologies, building a marketplace and reducing the costs in that manner. Beyond that, the Government ought to get out of the business and let the marketplace work.

Senator UDALL. Thank you. My time has expired.

That is certainly the mission of this committee and the Senate of the United States is to not advantage one technology over another technology. Easy to say. Harder to do.

I am glad Senator Murkowski and Senator Bingaman are leading the charge so that we find our way to that goal.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Sessions.

Senator SESSIONS. Thank you.

We are certainly advantaging one technology over another in that we are giving direct substantial subsidies for wind and also talking about mandating a certain amount of it.

Whereas, all the nuclear power industry who, if we can get it going again, will produce far more clean baseload power with no emissions is a loan guarantee, which I suppose, Mr. Fertel, you intend to pay back?

Mr. FERTEL. We not only pay it back, but we need to pay for it. I mean, Tom uses "subsidy" as a sort of throw-away line, and usually a subsidy means you are getting it for free. For our loan guarantees, we actually have to pay the Government to get it, and then, of course, we pay it back. So——

Mr. COCHRAN. There were more nuclear plants canceled than built in the United States. Mr. Fertel believes that there is no risk associated with the construction of these nuclear plants, and therefore, the Government is not at risk.

Senator SESSIONS. Mr. Cochran, we know the history of that, and it is one of the dark days in this country that those plants were stopped. I am telling you, if we had gone forward with nuclear power, we wouldn't have to be depending on France today for certain technologies. You and some of your colleagues are the reason that happened.

It has damaged our emissions, increased the CO_2 in the atmosphere, and if we don't build—tell me how many plants, Mr. Fertel, we need to build to just keep our electricity by nuclear power at 20 percent in America today?

Mr. FERTEL. Our estimate right now is if we built 26, which is 34,000 megawatts, by 2030, we would stay at 20 percent in 2030.

Senator SESSIONS. This is—I just saw an MSNBC poll. Sixty-seven percent of Americans are in support of building more nuclear plants. Now the Administration has talked about it. Dr. Chu is a nuclear physicist. He has been cooperative and talking somewhat positive. But Mr. Chairman, I am not seeing any action yet.

I know our bill that you are working and Senator Murkowski has got a lot of good things in it, but I don't see anything in it would help us with nuclear much. So I hope we can do some things that signal that Congress is supportive. I am just sorry to be upset about that.

I am looking, in Alabama, at the Bellefonte plant, they put $4 billion in it, TVA did, 25 years ago. It is the fundamental reason

TVA has a large debt today, $4 billion with no income for 30 years nearly. They want to restart it. They are going to commence soon to restart that plant.

How much better would the environment be and how much better would TVA's bottom line be had that plant been completed and not stopped?

With regard to the—hopefully, we won't have an RPS renewable standards, but it strikes me, Mr. Fertel, that if required renewable standards are made, the purpose of renewable portfolio is reduce CO_2 emissions, shouldn't there be some credit for a utility that is spending billions of dollars over 6 years to get a massive reduction of CO_2?

Shouldn't they be given some credit as opposed to somebody that was able to get some renewable in the interim, and should these utilities be required to pay fines when, in the long run, they will reduce CO_2 far more?

Mr. FERTEL. Obviously, we think that nuclear's significant role in reducing CO_2 emissions should be recognized in some way, as Congress looks at both the climate bill and as it also looks at any sort of electricity standards. But I have confidence that the chairman and the ranking member and the members of this committee will try and work together to figure out the best way to do that.

We think renewables have a role. We think efficiency has a major role. Obviously, if we can get coal—the carbon capture and storage, coal will continue to play a role. If we don't do that, the rest of what we do may not matter because the rest of the world will build lots of coal.

So we see everything having a role, and where I differ with Tom, where he says let the marketplace decide, he doesn't really do that because he knows which ones he wants. What I would say is that the marketplace will help you decide where you go with what, but this whole discussion on carbon, while important, you actually want to produce electricity, too.

We need to make sure that we are producing electricity, and one of the reasons we think that you need to deal with the structural problem is that you really can't build quick enough electricity plants, and we won't build, no matter how much we think we will, a smart grid in the next 5 years. We may not define a smart grid in the next 5 years.

So we really need to go about this smart as a Nation and not pick winners or losers, but not decrease our options by doing things that makes it harder to deploy the technologies we know work.

Senator SESSIONS. Just briefly, one of the things, Mr. Fertel, that I think nuclear power provides us is an opportunity for smart meters, where in off-peak hours, you can utilize the baseload nuclear power. Is that a positive factor for the public and the environment?

Mr. FERTEL. It is a positive factor there. It is a positive factor what Tom said about plug-in hybrids.

Senator SESSIONS. I agree.

Mr. FERTEL. It would be a really good time to be charging your hybrid overnight when the nuclear plant is working and producing electricity at the low numbers that Senator Landrieu mentioned from an operating standpoint.

Senator SESSIONS. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Let me just ask you one more question, Dr. Cochran. Is it your view that the NRC should go ahead with licensing new reactors before Congress comes up with a solution to the nuclear waste problem? I mean, if Yucca Mountain is not going to be the solution, do you see that as an impediment to the NRC going ahead and granting applications or granting licenses?

Mr. COCHRAN. I don't see that as an immediate impediment. But there is a rulemaking process ongoing before the Nuclear Regulatory Commission to resolve that issue and to address the environmental issues that Mr. Fertel raised, which are part of that rulemaking process.

I think the proper way to deal with that issue is for the NRC to complete that rulemaking, to go back and revise the environmental assessments that are assumed for all nuclear power plants—is going to be zero emissions associated with a geologic repository and that the repository is going to be in some salt deposit somewhere—and do that in an orderly, proper rulemaking procedure where the public can engage on those issues.

The CHAIRMAN. That concludes my questions.

Senator Murkowski, do you have any other questions?

Thank you both very much. I think it has been a useful hearing. Thank you.

[Whereupon, at 11:35 a.m., the hearing was adjourned.]

[The following statement was received for the record.]

STATEMENT OF DEBORAH DEAL BLACKWELL, VICE PRESIDENT, LICENSING & PUBLIC POLICY HYPERION POWER GENERATION, INC.

The Committee's interest in nuclear energy development is appreciated. It is no secret that nuclear must be part of the "mix" of energy generating tools for the future of the United States and the world. Clean, emission-free energy from nuclear power plants can provide the baseload power today that is required and that wind, solar and hydro will probably not be able to supply for decades.

And, the people of the United States are ready to accept more nuclear power. This year's Gallup Environment Poll has found new high levels of support. Seventy-five percent of Americans whose total annual household incomes are at least $75,000 favor using nuclear power to produce electricity in the United States. With all income levels factored in, 59% now favor the use of nuclear power. A global survey just released from Accenture reveals that more than two-thirds of people around the world believe that their countries should start using or increase their use of nuclear power

However, little attention has been paid to a key development in the nuclear industry—small, modular nuclear power reactors (SMRs). SMRS solve many of the problems of large-scale nuclear power plants. According to an independent report by the Wall Street Journal, each of the next traditional-sized new nuclear power plants will cost $6 billion to as much as $12 billion, and they will take as long as 12 years to build and license.

Clearly financing of such expensive projects is going to continue to be a problem. The loan guarantees approved by you and your colleagues are welcome and appreciated. But, they will only assist in the building of perhaps three or four traditionally large-scale plants. As you realize, four additional nuclear plants will not meet the burgeoning need for baseload power in this country.

The answer may well lie in the development of SMRs. There are less than a handful of companies developing SMRS that have been identified by the Nuclear Regulatory Commission as upcoming license applicants. And, there is only one wholly-American owned and operated private company that is developing for global commercialization, a small nuclear power reactor for distributed power from the U.S. Department of Energy and that is Hyperion Power Generation. The company's SMR was invented at Los Alamos National Laboratory. It has been licensed to Hyperion through the lab's technology transfer program.

Providing 70 MW thermal power (27 to 30 MW of electric), each stand-alone proliferation-resistant Hyperion Power Module provides enough power for 22,000 average American-style homes or the industrial equivalent, for a capital investment of only $25 to $30 million per module. (Modules can be teamed for greater output.) The HPM, with its small amount of low-enriched fuel, makes the benefits of nuclear power available almost anywhere in the world without a multi-billion dollar investment. And, as the HPM will be mass produced in an American factory and is only 1.5 meters wide by 2 meters tall, the time from purchase to installation can be only a matter of months—not years, depending on the site.

Because the HPM is transportable, the design provides a desirable solution for emergency response and U.S. military installation use, among many others. Attached is a more in-depth discussion of the Hyperion Power Module and its global applications.

Thank you for your attention. We appreciate the Committee's interest in our national energy security and in its commitment to increasing U.S. economic security through technical innovation and small business development.

ATTACHMENT.—THE HYPERION POWER MODULE (HPM)

Perhaps the most important component of U.S. infrastructure is its system for generating and distributing electric power. Supplied by conventional centralized power plants and transmitted often hundreds of miles by an aging grid system, electricity is the lifeline of the country. Terrorism aside, the system is frightfully vulnerable due to normal wear and tear and simple accidents, as evidenced by the blackout several years ago in the Northeast. In addition to replacing or providing backup for the existing infrastructure, the amount of electricity needed for residential, commercial, industrial and military use is growing at an unprecedented pace.

While solar, wind and hydropower technologies can deliver peak power, they will not be able to deliver reliable baseload power—the electricity that is needed 24 hours a day, seven days a week, to run the world's infrastructure for schools, homes, government, commercial, and industrial purposes. Nuclear energy is the only viable baseload power solution for the rest of the 21st century.

But nuclear power in its current configuration cannot meet global needs now or in the future.

Conventional nuclear power reactor plants, designed to serve large regions, cost billions of dollars to construct. A recent article in the Wall Street Journal forecast that the next new nuclear plant would end up costing $12 billion and take 15 years to license and build. The national and global economy will not be able to support such investment in time or funds. Conventional plants cannot be financed and built fast enough to meet the growing demand for energy.

Now, for the first time, the advantages of nuclear power—efficient, cheaper, and non-polluting with no greenhouse gas emissions—are available in a significantly smaller, less capital intensive, less complex package. The small modular reactor (SMR) for "distributed generation" can have an impact on electricity needs and a place in the history of mankind's accomplishments that far exceeds its metaphoric miniature version—the common battery. Distributed generation systems generate electricity from many small energy sources instead of one large, vulnerable and capital-intensive site. They reduce the size and number of power lines that must be constructed. And, they reduce the amount of energy lost in transmitting electricity because the electricity is generated very near where it is used. An aesthetic and environmental improvement, distributed generation also makes widespread outages less likely regardless of cause.

Designed to provide distributed power, SMRs can be manufactured at a single location and shipped wherever they are needed. They provide essential power to even the most remote locations without designing and building individual, massive, and costly conventional power plants. The only U.S. small modular power reactor (SMR) design feasible for deployment within the next five years is the Hyperion Power Module (HPM).

American Innovation, American Jobs, the Hyperion Opportunity

The HPM was invented at Los Alamos National Laboratory. Through the U.S. government's technology transfer initiative, the exclusive license to develop and commercialize the invention was granted to Los Alamos, New Mexico-based Hyperion Power Generation, Inc. (HPG). The company has now retained the nation's top nuclear power design and engineering teams, including staff from U.S. federal laboratories and industry, to further develop the reactor. HPG will also partner with industrial leaders for the production, operation, and maintenance of the HPM. Hyperion Power Generation, Inc. is a small business totally owned and operated by

U.S. citizens, and is the only U.S. owned and controlled small reactor design firm in the world.

In addition to generating income for the labs involved in the project, Hyperion Power Generation can stimulate both short and long-term jobs in the private sector. Construction of a U.S. manufacturing facility will involve a variety of building trades. Long-term, the factory will ensure a wide variety of positions ranging from assembly, forging and security, to quality assurance, testing and management. Additionally many jobs would be created and ensured for complementary technology and manufacturing companies both new and currently existing. Already, over $7 billion worth of HPMs are in the company's "sales pipeline." The company expects to produce at least 2,000 units in the first ten years of operation and a great number of those will be sold before the factory is open. This early enthusiasm for the product is a clear indication of the product's coming success and contribution to future U.S. employment.

Applications for the Hyperion Power Module

Generating nearly 70 megawatts* of thermal energy and from 27 to 30 megawatts of electrical energy, the HPM is the world's first small transportable reactor, taking advantage of the natural laws of chemistry and physics and leveraging all of the engineering and technology advancements made over the last fifty years.

The HPM was initially created in response to the need for an efficient source of steam to power equipment for removal of fossil fuels from oil sands and shale. Thus far, retorting and processing equipment cost an unacceptable amount of the very resource that is being accessed and the HPM was created to eliminate that unsatisfactory paradigm. Using hydrocarbons to recover heavy hydrocarbons is inefficient and unnecessary.

However, Hyperion Power Generation's small modular, self-stabilizing reactor (the HPM) offers such attractive advantages that it could alter the manner in which nuclear energy is harnessed for generating electricity and creating industrial steam. As such, the possible applications for the technology are enormous. Meeting all the nonproliferation criteria of the Global Nuclear Energy Partnership (GNEP), the HPM is appropriate anywhere cost, safety and security is of concern.

There are five main areas of application for the HPM:

- Distributed "baseload" power for urban and rural communities
- Quickly installed back-up and emergency power for disaster areas
- Military bases (independent, baseload power)
- Oil & gas recovery and refining, including in oil sands and shale recovery
- Remote communities lacking accessibility to a source of electrical generation.

Energy Savings Around the Globe

A key design objective of the HPM is the ability to produce electricity anywhere in the world for less than 10 cents a kilowatt hour. As an example, the costs of the HPM for use in heavy oil recovery have been estimated to save over $1 billion dollars a year, for a single, high-power application when compared with the present cost of using natural gas. The estimate is based on the projected 5-year life of the HPM reactors, and includes the cost of refueling and waste handling. The savings come from the higher energy content of nuclear fuel and the low personnel costs for operating the HPM. The inherent safety of the HPM's core, coming from its chemistry-based self-control, minimizes the human oversight needed for operation. The compact design permits staged introduction of the new power source to any application and the low unit costs reduce financial risk, both for the initial demonstration programs and for final deployment. Furthermore, the compact design and "walk-away" safety can permit, for the first time, the distributed production of power from nuclear sources.

The compact nature and inherent safety opens the possibility for low cost mass production and operation of HPM reactors. The overnight capital costs and the operating costs for this device have been estimated and found to be very attractive. The capital costs were estimated by an expert in the nuclear industry and found to be $1,400 per kW of electricity, which compares favorably with an estimate of $4,500 for the same electrical production but from gigawatt scale installations. The operating costs for thermal power steam production have been estimated to be $3 per million BTU, costs that are not only lower than natural gas but also more stable—all without CO_2, nor NO_X nor SO_X emissions.

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*While individual HPM units produce 70WM thermal power, the units can be "ganged" for even greater energy output.

Summary of Unique Advantages of the HPM:

- ransportable baseload power source
- Installed within a day or so once minimal site prep is performed
- Substantial power—enough power for an entire community infrastructure (20,000 homes)
- Reliable, continuous power—enough for five to eight years depending upon demand
- No refueling on site
- No maintenance of heat source
- Only small area required for sighting
- Attractive costs and low investment

Technical Overview

The Hyperion Power Module (HPM) was specifically designed to avoid the high construction costs and uncertainties associated with traditional reactor technology. Each unit will generate approximately 27 megawatts of electrical power. A one and one-half meter diameter core, without internal mechanical moving parts, permits the reactor to be sealed at the factory, sited underground, and eventually returned to the factory for fuel recycling and refueling after a useful life of five to seven years.

The HPM has the following attributes:

- Single-unit, sealed construction and dispersed, underground siting also provides anti-tampering protection.
- The inherent simplicity and compactness of the design will enable mass production of Hyperion modules as turnkey devices.
- The modest size of the modules greatly reduces the financial investment risk in both the development and the eventual deployment of the reactors.
- Mass-production and the minimal required operational oversight make the Hyperion reactor economically competitive and attractive for new and distributed power production deployment, and could substantially contribute to national energy independence.

The physical characteristics of uranium hydride, a combined fuel and neutron energy moderator, are ideal for the generation of safe nuclear power. The reactor operates at an optimum temperature of 550°C. At 550°C, the dissociation pressure for the hydrogen above the hydride is approximately eight atmospheres, which permits easy transportation of the gas without presenting significant high-pressure risk. The temperature-driven mobility of the hydrogen contained in the hydride can change the moderation, and therefore the reactor criticality, making the HPM reactor self-regulating and passively safe.

The hydrogen forced out of the core during any over-temperature excursion reduces the neutron energy moderation necessary for nuclear criticality. The Hyperion Power Module is inherently fail-safe, since any temperature increase from excess activity immediately reduces the criticality parameters and thus the power production. The consequent power reduction causes the temperature to decrease and that temperature decrease eventually reverses the process, resulting in relaxation oscillations that quickly damp out to steady-state operation.

History of the Fuel & Technology

Hydride materials have long been recognized as possible controls for self-regulating nuclear reactors. In addition, uranium hydride was demonstrated to be a successful reactor fuel very early in the nuclear era, although the hydride was cast into blocks using a polymeric binder to prevent the hydrogen from escaping. This binding of the fuel precluded any observation of the self-regulation characteristics inherent to the material.

While the science of the Hyperion reactor has been around for this long time, it has not been implemented because the conditions for self-regulation had not been explored and the limits on those conditions delineated. We have now performed the critical modeling and thereby discovered the critical feature and design criteria for exploiting the safety and self-regulation advantages of hydride materials within the reactor that make a hydride reactor practical for construction and deployment.

Hyperion is proposing a new concept for an inherently safe nuclear power source that is self-stabilizing and requires no moving mechanical components. The modest size of the modules reduces the financial investment risk for both development and deployment. The potential for mass-production and the minimal operational oversight make these reactors economically attractive for new and dispersed power production deployment.

In Conclusion

Transportable and buried safely underground out of sight, HPMs, with their small size, but mighty power, and virtually maintenance-and proliferation-free design, offer the long-awaited solution to our country's desire for increased national security through independent and robust distributed power systems.

Hyperion will seek a design certification from the U.S. Nuclear Regulatory Commission. The company expects its first installation to go live in late 2013.

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

RESPONSES OF DALE E. KLEIN TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. The increased interest in new reactor licensing over the last few years has put the NRC in the position of certifying new reactors while at the same time reviewing license applications.

Do you see any issues with this fact in terms of continuing to maintain the safety of new reactor construction or maintaining public involvement in the process?

Answer. The NRC has long sought standardization of nuclear power plant designs, and the enhanced safety and licensing reform that standardization could make possible. The NRC's licensing process, regulation (Part 52 to title 10 of the Code of Federal Regulations), provides a predictable licensing process, including certification of new nuclear plant designs. This process reflects decades of experience and research involving reactor design and operation. The design certification process provides for early public participation and resolution of safety issues prior to an application to construct a nuclear power plant.

NRC approval of each standard design is formalized via a specific design certification rulemaking. This process allows the public to review and comment on the designs up front, before anyone builds a plant of this design. NRC design certification fully resolves safety issues associated with the design.

A specific provision of Part 52 allows applicants to reference a certified design that has been docketed but not approved. Thus, although the Commission anticipated that applicants would first seek to have designs certified before submitting combined license (COL) applications that reference those designs, the NRC's regulations, nonetheless, allow an applicant—at its own risk—to submit a COL application that does not reference a certified design. The Commission's Policy Statement on the Conduct of New Reactor Licensing Proceedings addresses this very situation and its effect on public participation in COL adjudications. The Commission determined that issues concerning a design certification application should be resolved in the design certification rulemaking and not in a COL proceeding. When an issue is raised in a COL proceeding that challenges information in the design certification rulemaking, under NRC processes, that issue should be referred to the staff for consideration in the design certification rulemaking. This makes the process more effective and efficient by allowing the NRC review and a public COL hearing to focus on remaining issues related to plant ownership, design issues not resolved earlier, and organization and operational programs. Granting a COL signifies resolution of all safety issues associated with the plant. The new licensing process affords multiple opportunities for public participation in the process.

With respect to maintaining the safety of not only new reactor construction but the operating reactors as well, the NRC reorganized the Office of Nuclear Reactor Regulation to create an Office of New Reactors to ensure effective oversight of operating nuclear power plants and prepare for the industry's interest in licensing and building new nuclear power plants in the near term. The agency also added a new organizational unit, headed by a Deputy Regional Administrator for Construction in its Atlanta office, to oversee inspections related to expected new construction of nuclear facilities. These changes will ensure we maintain our focus on the safe and secure operation of existing nuclear power plants, while enhancing our effectiveness in processing the anticipated new plant licensing workload.

Question 2. The NRC has recently proposed changes to the 1990 Waste Confidence Decision that would base this decision on the probable availability of a deep geologic repository for wastes within 60 years of the end of any reactor's operating license. Recently the Administration has made it clear that although it intends to continue to support the Yucca Mountain license review, it does not intend to open the repository.

In light of the proposed waste confidence decision changes do you feel the Administration's position will impact the NRC's ability to grant new reactor licenses or extend current licenses?

Answer. As published in the *Federal Register* on October 9, 2008, the Commission sought public comment on proposed revisions to two elements of its 1990 waste confidence findings, one of which would potentially alter the date when a geologic repository may be expected to be available. The public comment period closed on February 6, 2009. NRC staff will review these comments and prepare a recommendation for a final rule to be presented to the Commission for action later this year.

The proposed revision issued for public comment would predict that repository capacity will be available within 50 to 60 years beyond the licensed operation of all reactors and would affirms the Commission's confidence that spent fuel can be safely stored for at least 60 years beyond the operating license. Changes to existing U.S. policies—or revisions to strategies—for the long-term management of high-level waste, should any be adopted, would be considerations as the Commission deliberates its waste confidence findings.

Responses of Dale E. Klein to Questions From Senator Cantwell

Question 1a. While nuclear power has proven to be a reliable way to generate greenhouse gas emissions free electricity—including about 10% of the power in Washington state—there seems to be continued doubt about the economic viability of any new reactor plants.

Given the current credit crisis, tightness in the supply chain, lack of skilled craft and sub-suppliers, among other challenges, how many nuclear plants do you think can be built in the U.S. in the next decade?

Answer. NRC agrees there am challenges; however, as a safety regulator engaged in the process of reviewing combined license applications, it would be inappropriate for the NRC to speculate on the number of nuclear plants that will be built in the next decade. To date, the NRC has received 17 combined license applications for 26 units. Part of the review process for a combined license application includes a review of the applicant's financial qualifications to carry out the licensed activities. For an application to be approved, the NRC must have reasonable assurance that the applicant possesses or can obtain the funds necessary to cover estimated construction costs, related fuel cycle costs, and provide decommissioning funding assurance. An applicant must also demonstrate that it possesses or can obtain the funds necessary to cover the costs of operation for the period of the license. If the NRC approves the application and issues a license, the decision to construct the facility is the licensee's business decision.

Supply chain issues, lack of skilled craft and sub-suppliers are among the challenges the NRC is anticipating and our inspection program is being developed to assure quality is maintained if construction moves forward.

Question 1b. Is it accurate that only about four or five U.S. utilities even have the financial capacity to build a two-unit nuclear plant?

Answer. Of the 17 combined license applications that the NRC has received to date, nine utilities have submitted applications for two-unit nuclear power plants. These applications are still under review, including the financial qualifications review. The utilities are: Tennessee Valley Authority, Luminant Generation Company, LLC, Progress Energy Florida, Inc., Progress Energy Carolinas, Inc., South Texas Project Nuclear Operating Company, Exelon Nuclear Texas Holdings, LLC, Duke Energy, South Carolina Electric & Gas, and Southern Nuclear Operating Company.Senator Maria Cantwell to Chairman Dale Klein

Question 5a. I understand the NRC is currently considering applications that reference five different reactor designs and the industry is expected to submit additional designs for NRC review and approval. But in a speech last week, NRC Commissioner Jaczko characterized current new reactor licensing as "a situation where we have incomplete designs and less than high quality applications submitted for review." And pointed out that "today, almost a fifth (3 of 17) of the combined operating license applications we have received are on hold at the request of the applicants themselves."

If one of the factors leading to the massive nuclear construction costs overruns in the 1970s and 1980s was the lack of standardization among reactor designs at the time, what is the NRC doing to ensure that only a limited number of the safest and most cost-effective advanced technologies are approved?

Answer. The NRC's licensing process for new reactors (10 CFR Part 52) evolved from 30 years of lessons learned in licensing today's 104 operating commercial reactors, and is expected to make the licensing review process more effective and efficient. Under the Part 52 licensing process, the NRC established regulatory require-

ments for Design Certifications. The design certification process allows an applicant to obtain approval of a nuclear reactor design, independent of an application to construct or operate a plant. During the design certification review, the NRC reviews the safety issues associated with the proposed nuclear power plant design. Because the certification of a reactor design requires rulemaking, the issues addressed and resolved in the certification process have a high degree of regulatory finality. A design certification is valid for 15 years from the date of issuance, but can be renewed for an additional 10 to 15 years. Any applicant can reference a certified design in a combined license application, which addresses site-specific design features and environmental impacts. This newer licensing process resolves design issues early in the process before construction begins, reduces regulatory uncertainty, and encourages the standardization of reactor technology within the U.S.

The NRC's reactor licensing process under Part 52 permits an applicant to submit an application which references a reactor design that is not yet certified. If an applicant selects a reactor design that has not yet been certified, however, then the design certification rulemaking is conducted concurrent with the combined license review. The applicant assumes the likely risk that this will result in a more resource-intensive review process compared to a combined license application that references an already-certified design.

Question 5b. Is there anything Congress can do to support more plant design standardization? For example, should we make nuclear financing contingent on one or two standardized designs?

Answer. The NRC believes that the current NRC licensing process provides sufficient incentive for applicants to use standardized designs while not constraining innovation or continued improvements to reactor technology. In general, applicants for new reactor combined licenses are choosing among the 5 designs currently under review on the basis of their power planning needs, their experiences with reactor technologies already in their reactor fleets, and other economic and business considerations that the individual applicants are best equipped to address.

RESPONSE OF GREGORY B. JACZKO TO QUESTION FROM SENATOR CANTWELL

Question 5a. I understand the NRC is currently considering applications that reference five different reactor designs and the industry is expected to submit additional designs for NRC review and approval. But in a speech last week, NRC Commissioner Jaczko characterized current new reactor licensing as a situation where we have incomplete designs and less than high quality applications submitted for review." And pointed out that "today, almost a fifth (3 of 17) of the combined operating license applications we have received are on hold at the request of the applicants themselves."

If one of the factors leading to the massive nuclear construction costs overruns in the 1970s and 1980s was the lack of standardization among reactor designs at the time, what is the NRC doing to ensure that only a limited number of the safest and most cost-effective advanced technologies are approved?

Answer. Standardization is important. From the regulatory perspective, it is technically an efficiency issue and not a safety issue, but it is crucial to an effective and predictable license review process.

Standardization does not necessarily mean moving forward with only one new design. Having some diversity is beneficial so that any generic safety issues that may be discovered in the future will not affect all plants simultaneously. However, we are now looking at the possibility of applications to build more than six unique new designs, including the potential of two separate versions of the Advanced Boiling Water Reactor and small modular light water reactors. We have approached an unnecessary and inefficient number of reactor designs to review and potentially regulate. Such a situation would only make the NRC's application review and potential oversight work more complicated.

There has been recognition on the part of the industry that standardization is important, Applicants have developed a set of working groups around specific designs. Vendors and applicants are working together to ensure applications are as uniform and consistent as possible. The NRC has attempted to encourage applicants to continue their coordination and to provide high quality applications for the agency's review if they desire a predictable license review schedule.

The NRC is committed to thoroughly review each license application and provide oversight of operating reactors to ensure the Atomic Energy Act standard of "a reasonable assurance of adequate protection'. is met. Without additional standardization, however, the Nuclear Regulatory Commission may ultimately be challenged to

secure and manage the resources necessary to conduct licensing reviews and regulate a large number of diverse new reactors if they are approved and built.

Question 5b. Is there anything Congress can do to support more plant design standardization? For example, should we make nuclear financing contingent on one or two standardized designs?

Answer. There are a couple of steps the Congress could take if it wanted to support additional requirements for nuclear reactor standardization. It could provide additional guidance to the NRC about how to prioritize its resources. It could also restrict the use of financial incentives to a finite number of designs.

RESPONSES OF DALE E. KLEIN TO QUESTIONS FROM SENATOR BARRASSO

Question 1. Chairman Klein, can I have an update on the in-situ recovery General Environmental Impact Statement (GEIS)? As you know, the prompt resolution of the GEIS will allow several Wyoming uranium production operators to move forward on their In-situ Recovery (ISR) permit applications.

Answer. The NRC expects to issue the final GEIS by June 2009. The final GEIS addresses approximately 2200 comments received on the draft GEIS, which was issued for public comment on July 28, 2008. These comments were received from federal, state, and local agencies, the uranium mining industry, advocacy groups, and interested members of the public. The purpose of the GEIS is to provide a starting point for NRC's environmental reviews of applications to obtain, renew, or amend NRC licenses for in-situ recovery (ISR) uranium recovery facilities, in accordance with NRC's NEPAimplementing regulations at 10 CFR Part 51. Each site's environmental characteristics will be evaluated specifically in a supplemental environmental impact statement that addresses issues not covered by the GEIS. It is expected that the GEIS will improve the efficiency of NRC review of ISR applications.

The NRC is currently reviewing five license applications for new ISR facilities in Wyoming. The NRC has been using the draft GEIS in the environmental reviews for these applications. The NRC expects to make its licensing decision on each application within the two-year schedule it provided to the applicants at the start of NRC's review—This schedule is dependent on the timing and quality of each applicant's submittals, the response to NRC requests for additional information, and on the availability of sufficient resources.

Question 2. The Wyoming Bureau of Land Management (BLM) is currently not recognizing NRC's primacy over regulating ISR sites in Wyoming and is requiring their own Environmental Assessments and/or Environmental Impact Statements for ISR projects already licensed by the NRC.

What progress has been made by the NRC towards signing a Memorandum of Understanding or similar document between the NRC and the BLM?

Answer. The NRC and the BLM initiated discussions regarding formal cooperation in September 2008, which has resulted in a draft Memorandum of Understanding (MOU). Several meetings have occurred to discuss the structure and content of the MOU including the roles and responsibilities of each agency and the process by which information on environmental impacts wouid be shared between the agencies. It is anticipated that the MOU will be finalized before the end of summer 2009.

The NRC and BLM have agreed to share information to increase efficiency and avoid duplication of efforts—Timing differences in the availability of environmental information will likely preclude developing one environmental document that can be used by both agencies. In many cases, the BLM is required to complete an environmental analysis on the potential impacts of exploratory drilling, an activity that is not within the NRC's jurisdiction. Therefore, BLM begins its environmental review before the applicant applies to the NRC for a license.

NRC's National Environmental Policy Act analysis, in comparison, begins when a company's application for a sou'ce materials license for uranium recovery is accepted for docketing. Further, given the different applicable legislation, the different agencies' missions and the resultant differing decisions stemming from the agencies' environmental evaluations, the content of the two documents may necessarily differ. Nevertheless, coordination and communication between the two agencies will allow the environmental documents prepared by the two agencies to be tiered or to have information incorporated by reference.

The NRC continues to work closely with the individual BLM field offices in Wyoming (without a formal MOU) on the uranium recovery applications that have been received, accepted, and for which environmental documentation is being prepared. Information is being shared on a regular basis, including NRC requests to the applicants for additional information to support an environmental analysis, and notices

submitted by the applicant to the BLM for exploratory and confirmatory drilling on the site. In addition, BLM field office personnel give NRC staff regular updates on applicant activity on the uranium recovery sites.

NRC and BLM will continue to communicate with industry to improve understanding of both agencies' processes, which should help facilitate applicants' planning process.

Question 3. I have a question regarding the infrastructure needs in the domestic uranium production industry. Do you agree there is an urgent need for new milling capacity for domestic conventional uranium mining projects? What is NRC doing to promote or assist in the licensing of such milling facilities?

Answer. As a health and safety regulator, it would be inappropriate to comment on whether there is a need for new milling capacity for domestic conventional uranium mining projects. The need for domestic uranium milling capacity is generally reflected in the price of uranium. Both spot prices and long-term prices are substantially higher than they have been over the past decade and beyond, reflecting a gap between supply and demand. As a result, new applicants have emerged to fill this gap. Countries like the United Kingdom, China, India, and Russia are planning significant expansions of nuclear energy; other nations are also planning new reactors. Many new reactors are under construction today throughout the world. U.S. companies are considering or planning to build up to 33 new reactors. Building all of these reactors would likely put substantial pressure on current uranium supplies.

The NRC's mission is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials to ensure adequate protection of public health and safety, promote common defense and security, and protect the environment. Under this mandate, the NRC does not promote nuclear projects, but provides the regulatory framework to enable the safe use of radioactive material. In its uranium recovery program, the NRC regulates the construction, operation, and decommissioning of conventional and heap leach uranium mills and in-situ recovery operations, but does not regulate conventional uranium mining.

The NRC licensing process is designed to be efficient, effective, and stable. In that regard, we have updated regulatory guidance for licensing new facilities, held a new licensing workshop with prospective licensees to guide them through the licensing process, committed to meet with applicants throughout the licensing process, and implemented operational metrics that ensure that NRC's licensing activities are completed in a transparent and timely manner.

The NRC is nearing completion of a Generic Environmental Impact Statement addressing common issues for environmental reviews of ISR facilities to allow a more efficient environmental review process. The NRC has also increased its coordination with the State of Wyoming, the Bureau of Land Management, the U,S. Forest Service, and Indian Tribes to enhance efficiency and maintain consistency for regulatory actions and to effectively engage our stakeholders in NRC's regulatory process. In addition, NRC co-sponsors an annual uranium recovery workshop in Denver, Colorado with the National Mining Association to discuss licensing issues and other uranium recovery topics of interest. Over 250 attendees participated in the last workshop.

Response of Dale E. Klein to Question From Senator Landrieu

Question 1. Would you outline for me, and I will share it with the members of the committee, the significant differences in design or licensing requirements between the U.S. and other countries, that perhaps we could learn a little bit more about the way they are doing it and improve our system here?

Answer. The regulatory licensing process used by the countries currently involved with the review and construction of new nuclear power plants is similar to the original, 10 CFR part 50, NRC licensing process. This process uses a two-step licensing process. After the regulator is satisfied that the design selected by the applicant meets established safety criteria, the regulator issues a construction permit. The level of inspection effort during construction varies from country to country but once construction is completed and startup testing and preoperational testing are successful, the r egulator will issue an operating license. This process allows for construction for new designs to start before the vendor completes the design process and before the regulator has an opportunity to complete a full design review. The NRC is currently implementing a one-step licensing process in which we complete a design review before issuing a license to begin construction.

The NRC is participating in international initiatives, through bilateral and multilateral agreements among regulators, and through programs facilitated by international organizations such as the International Atomic Energy Agency and Nuclear Energy Agency, which are designed to better understand each other's regulatory

regulatory requirements and increase multi-national convergence of codes, standards and safety goals. One example is the Multinational Design Evaluation Program—a program that includes 10 countries that are currently in the process of reviewing designs similar to those that the NRC is reviewing. Significant progress is being made on the overall MDEP goals of increased cooperation and enhanced convergence of requirements and practices. Particularly noteworthy accomplishmnets include: performance of the first joint vendor inspection, establishment of the MDEP library, development of common positions in the area of digial instrumentation and controls, and development of a comparison table which will identify the similarities and differences between the Korean, Japanese, and French codes for class I pressure vessels as the compare to the ASME code. MDEP has developed a process for identifying common positions on specific issues among the member countries which may be based on existing standards, national regulatory guidance, best practices, and group inputs. NCR is using this program, and other vehicles, to better understand the other regulators' processes so that we can cooperate with them on design reviews with the goal of making our reviews more efficient and effective.

RESPONSES OF THOMAS B. COCHRAN TO QUESTIONS FROM SENATOR CANTWELL

Question 2a. What are utilities estimating the per kilowatt cost of constructing a new nuclear power plant?

(b) How long will it take to build a plant once its license is approved?

(c) I understand that AREV A's experience building one of their new standardized plants in Finland has not been ideal. What can we learn from that project that can inform the current debate on whether to construct new nuclear plants today?

(d) Given the other clean energy alternatives out there and the need to quickly build more capacity to meet growing electricity demand, what is the business case for a utility to build a new nuclear plant? How do the costs of new reactors compare with projected costs for wind or solar facilities in the decade it will likely take to get a new nuke plant up and running?

Answer. (a) The best recent public estimates of the cost of construction of new nuclear plants in the United States are those that have been presented to public utility commissions associated with: the proposal by Progress Energy to build two API000 plants (Units 1 & 2) at a new site in Levy County, Florida; the proposal by Georgia Power, a unit of Southern Company, to build two API000 plants (Units 3 & 4) at the existing Alvin W. Vogtle Nuclear Power Station in Georgia; and the proposal by South Carolina Light and Gas to build two APlOOO plants (Units 2 & 3)at the existing Virgil C. Summer Nuclear Power Station. The estimated plant "overnight costs," i.e., construction cost before borrowing charges, allowances for inflation and real cost growth during construction, and other owner's costs, are in the range of $3,000 to $6,000 per kilowatt, where the upper end of this range includes the cost of new transmission lines and facilities. New nuclear plant cost estimates are a moving target given that the best estimates of the costs of new nuclear plants have doubled over the past five or six years.

(b) If a license for a new plant is approved, it would likely take from four to six years to construct the reactor and perhaps another year before it is fully operational. The nuclear industry is in a better position than NRDC to estimate the actual time of construction.

(c) Construction of AREVA's new Evolutionary Pressurized Water Reactor (EPR) at the Olkiluoto nuclear site in Finland began in August 12,2005, but has already fallen three years behind schedule to 2012, after safety and quality-assurance problems with the piping, containment liner and concrete base slab were discovered. This has put the Finnish EPR 50 percent over budget with a current estimated cost of at least $6.7 billion.

AREVA's partner Siemens has pulled out of the project, leaving AREVA to buyout Siemens' share at an estimated cost to AREVA of $2.6 billion.

Construction of a second EPR, at Flamanville, France, began December 3, 2007, and the construction period was estimated to be 54 months but has encountered problems. Construction of this plant is being managed by Electricite de France (EdF). In the summer of 2008, Autorite de Surete Nucleaire (ASN), the French nuclear safety authority, shut down the construction site due to safety concerns about technical and quality-control problems with the reinforced steel used in the concrete base. ASN's action followed a series of letters from the agency to Flamanville's construction manager. In the letters, ASN inspectors highlighted a range of problems including nonconformities in the pinning of the steel framework of the concrete base slab, incorrectly positioned reinforcements and inadequacy of technical inspection by both the construction companies and EdF. Inspectors also uncovered inconsistencies

between the blueprint for reinforcement work and the plan for its practical implementation. They noted incorrect composition of concrete that could lead to cracks and rapid deterioration in sea-air conditions. Concrete samples were also not collected properly, according to ASN. Cracks have already been observed at part of the base slab beneath the reactor building. The supplier of the steel containment liner reportedly lacks the necessary qualifications. Fabrication of the liner was continuing despite quality failures demonstrating the lack of competence of the supplier. As a result, one quarter of the welds of the steel liner in the reactor containment building were deficient. [WISE, "Flamanville EPR Construction Suspended, "Nuclear Monitor, June 5, 2008].

EdF insists the Flamanville EPR will open on schedule in 2012, despite news reports that put the project nine months behind schedule after just nine months of construction. In early March 2009, EdF ran afoul of the European Commission, which raided the company's offices, suspecting EdF of antitrust violations and illegal price hikes.

(d) Commercial nuclear power plants are not a "clean energy alternative." In light of the potential for improvements in energy efficiency and the recent downturn in the economy, we do not see a "need to quickly build more capacity to meet growing electricity demand."

In any event, the cost of new nuclear plants and other supply alternatives will vary from site to site and over time. Before committing to build a new nuclear power plant a utility or energy generating company should, among other considerations, be required by the public utility commission to demonstrate that the projected energy need cannot be met by an integrated portfolio of alternatives that has a lower average delivered cost to the customer. The mix of alternatives should include improvements in energy efficiency, matched with renewables firmed by natural gas and distributed sources of industrial waste-heat cogeneration. Estimates of the cost of fossil-fueled alternatives should be based upon meeting effective constraints on carbon emissions, and nuclear electricity costs should be assessed without assuming that they will be paid down by federal, state and local government subsidies and federal loan guarantees, and should include charges that cover the full cost of storing and disposing of spent nuclear fuel.

To us the most important public policy issue with respect to nuclear financing is not what the plants will ultimately cost-the honest answer today is nobody really knows-but who should bear the financial risk of such large and costly nuclear projects. The best science and engineering available suggests that we are not close to the point of exhausting the cost-effective decarbonization potential available from a wide range of renewable energy and efficiency technologies that are cleaner, intrinsically less hazardous than nuclear power and can be deployed more quickly. Basic considerations of economic logic and sound public investment suggest that we turn our attention first to exploiting the full potential of these more benign energy sources where it is economical to do so, and turn to nuclear at the point when the marginal cost of adding another megawatt of efficiency savings, wind, biogas, or solar exceeds the true life cycle cost to society of adding a megawatt of nuclear power.

The public policy justification for taxpayers to bear the downside economic risks of private investments in costly new nuclear plants that, from a technical standpoint, do not differ significantly from existing nuclear power technology, and show no likelihood of delivering lower costs to electricity consumers and ratepayers, is highly dubious in our view. On the one hand, there are a host of rapidly evolving clean energy and efficiency technologies that have low current market penetration and enormous decarbonizing potential. On the other hand, we have a mature nuclear power industry with a 20 percent market share demanding public support for massive reactor investments that in many regulated electricity markets will likely displace, not dirty cheap existing coal-fired generation, but relatively cleaner new natural gas capacity and potentially cheaper distributed generation from biomass, biogas, waste-heat cogeneration, wind, and PV solar.

If the utilities and merchant companies seeking to deploy new nuclear units are truly convinced of their economic viability, and are merely concerned that the first-of-a kind project execution risk for their own particular project could undermine their individual balance sheets, then the appropriate solution is more widespread private cross-ownership of the initial tranche of reactor projects, so that several companies share the risk of each individual project. The solution is not to load the downside economic risk of a historically noncompetitive industry onto taxpayers, while reserving the risk-reduced economic upside for highly leveraged limited liability corporations with only 20 percent equity invested from one or a few private owners.

Bottom line on cost: Let the $18.5 billion in loan guarantee authority already provided by Congress do what it was originally designed to do: reduce the economic risk of deploying the first two or three "first-of-a kind" units of innovative reactor designs new to the American market. If these initial projects vindicate the economic potential of new Gen 3+ nuclear power plants, then presumably there will be no need for further government support. If they do not provide such evidence of viability, then presumably both industry and government will look to other generating technologies in the near term, and focus on a program for developing a more cost-effective nuclear reactor candidate for deployment in 2025 and beyond. Either way, enlargement of the nuclear loan guarantee program is not needed now, and could even be harmful by handing a position in the market to nuclear power technologies and projects that do not deserve to be there based on their intrinsic levels of performance. Either ratepayers or taxpayers will be forced to make up the difference.

Question 3. As you know, Congress authorized DOE to guarantee loans that support early commercial use of advanced technologies if there was a reasonable prospect of repayment. And currently, $18.5 billion of the allotted $38.5 billion for the loan guarantee program is earmarked for nuclear power projects. But the GAO has since estimated that the average risk of default for DOE loan guarantees could be 50 percent or higher and Wall Street has put the industry on notice that it won't provide loans without a complete underwriting by the federal government.

Do you agree with GAO's assessment of the average risk of default for new nuclear plants? If you disagree please detail your objections to their analysis and provide your estimate of the average risk of default for the 17 pending nuclear plant applications. Given your estimate, please quantify the likely cost to the US Treasury of those defaults.

Do you support the Energy Department pursuing non-cash equity such as land or other assets as part of a loan guarantee package?

Answer. We do not have independent information to determine the validity of the GAO assessment of the probability of default for new nuclear plants. In the United States there were 110 operational nuclear power plants in 1990 and 104 operational plants today. According to our records, more than 130 proposed U.S. power reactors were cancelled before becoming operational. Of these cancelled reactors, many were cancelled before construction. We have identified one reactor that was cancelled after construction was completed. We have identified another 20 reactors that were cancelled during construction. And we have identified yet another 22 reactors that were cancelled after a construction permit was issued. While these data suggest that the future default rate could be high, we are not in a position to judge the relevance of this historical information for estimating future default rates. One reason to expect a lower default rate is precisely because of this financial train wreck that ended the first nuclear build-out. People have presumably learned from this experience and would not rush headlong into risking large sums without due diligence and more careful sharing of the risks between reactor vendors, constructors, and owners.

Equally important, the global economy is in recession because bank and other financial institutions bundled toxic assets with less risky assets in order to remove or lessen the risks associated with the higher risk loans. Surely we have learned that separating the risk of investments from the investments themselves carries a significant risk.

In short, for the reasons outlined in our testimony, we do not support Federal loan guarantees for the construction of new nuclear power plants in any form.

Question 4. When the loan guarantee program was created in the 2005 Energy and Policy Act it was intended to promote a small number projects for new and innovative energy sources that did not have the proven track record necessary for Wall Street financing.

Please describe how the 17 projects that have applied to the DOE loan guarantee program to date employ "new and innovative" technology relative to the 104 nuclear power plants up and running today.

Answer. Some of the proposed reactor designs are not new or innovative. The ABWR, for example, is an old design although none are operating in the United States today. General Electric submitted the Standard Design Certification Application for the ABWR to the U.S. Nuclear Regulatory Commission (NRC) in piecemeal format from September 29, 1987, through March 31, 1989. The NRC issued a final rule certifying the ABWR design on May 12, 1997. Two ABWR in Japan, Kashiwazaki Kariwa Units 6 and 7, began construction in September 1991 and February 1992, and became operational in 1996 and 1997, respectively. Both were then shut down as a consequence of the earthquake near the site on July 16, 2007. Three additional ABWRs are under construction, two in Taiwan and one in Japan.

AREV A claims the USEPR is safer than previous PWRs built in France, but AREV A also claims the EPR is "a mature design based on familiar technology."

The French government owns 93 percent of the stock in AREV A, which is the vendor of the USEPR. The French government is also the principal investor in Electricite de France (EdF) which proposes through a joint venture (Unistar Nuclear) with Constallation Energy (partially owned by EdF) to build a USEPR at the Calvert Cliffs Nuclear Power Station in Maryland. If built EdF would own about one-half of the new unit. It makes no sense for U.S. taxpayers to subsidize the construction of a French plant whose majority owner will be EdF, the French government electricity monopoly, or guarantee the French government's investment risks in these plants through U.S. taxpayer-backed loan guarantees. If the French government wishes to insure EdF against the risks of investing in the U.S. nuclear power market, in the same way that the Overseas Private Investment Corporation (OPIC) reduces risks for U.S. investors making overseas investments, the French government is welcome to do so, but there is no reason why U.S. taxpayers should assume the vast share of the economic risk of helping a foreign state-owned company to penetrate the U.S. nuclear electricity market, and drive up their electricity costs in the process. This outcome makes no economic or political sense.

RESPONSE OF THOMAS B. COCHRAN TO QUESTION FROM SENATOR MURKOWSKI

Question 1. In your written testimony you refer to the political sun setting on the Yucca Mountain project and argue that the Congress should initiate a search for a new geologic repository site for spent nuclear fuel.

Given that the Department of Energy conducted such a study in the early 1980s why is the NRDC confident that such a study would yield substantially different results today?

Why is it reasonable to assume that any site selected would avoid the same political fate as the Yucca Mountain repository?

Answer. The site selection process for two geologic repositories as required by the Nuclear Waste Policy Act of 1982 (NWPA of 1982) was corrupted. First, the Department of Energy (DOE), in its initial selection of candidate media and sites for a repository, showed a preference for sites on DOE and other federal lands. Then, the U.S. Congress short-circuited the site selection process by choosing the single Yucca Mountain site for development as a repository.

Before initiating a new site selection process, Congress and the Administration should seek an independent study, followed by Congressional hearings, to fully understand what went wrong in the site selection process of the 1980s and then put in place safeguards to prevent repetition of previous mistakes. If something along these lines is not done, NRDC would not have confidence that a new search would yield results different from the failed efforts to site a repository at Lyons, Kansas or at the Yucca Mountain site in Nevada.

RESPONSE OF MARVIN S. FERTEL TO QUESTION FROM SENATOR MURKOWSKI

Question 1. Over the last twenty years the nuclear utilities have achieved a remarkable level of operational efficiency and worker safety that is far better than the industrial sector in general and rivals that of the financial industry. You referred to a number of statistics in your testimony. The industry will require thousands of new workers all across the country to construct and operate just the new reactors that have already submitted license applications to the NRC.

In NEI's view what is the best way to perpetuate the nuclear industry's commendable safety culture as we go through the coming expansion?

Answer. There are many ways by which the nuclear industry will perpetuate the high levels of safety performance. First, all companies are implementing knowledge transfer and retention programs to ensure that the experience gained over the first 3,000 reactor operating years is maintained. These programs include formal interviews and documentation from experienced personnel as well as mentoring programs for younger employees. Second, the industry is continuing to expand its training programs by partnering with many universities and community colleges to ensure there is a steady pipeline of qualified personnel. Finally, and perhaps most importantly, the industry will continue to do what it does best—learn from operational events and benchmark the best practices in the world as it strives for continuous improvement.

RESPONSES OF MARVIN S. FERTEL TO QUESTIONS FROM SENATOR CANTWELL

Question 1a. While nuclear power has proven to be a reliable way to generate greenhouse gas emissions free electricity—including about 10% of the power in

Washington State—there seems to be continued doubt about the economic viability of any new nuclear plants.

Given the current credit crisis, tightness in the supply chain, lack of skilled craft and sub-suppliers, among other challenges, how many nuclear plants do you think can be built in the U.S. in the next decade?

Answer. Despite the current economic crisis, nuclear energy is one of the few bright spots in the U.S. economy—expanding rather than contracting, creating thousands of jobs over the past few years. Over the last several years, the nuclear industry has invested over $4 billion in new nuclear plant development, and plans to invest approximately $8 billion more to be in a position to start construction in 2011-2012.

In the nuclear sector, there are signs that U.S. manufacturing capability is being rebuilt. In North Carolina, Indiana, Pennsylvania, Virginia, Tennessee, Louisiana, Ohio and New Mexico, among other states, U.S. companies are adding to design and engineering staff, expanding their capability to manufacture nuclear-grade components, or building new manufacturing facilities and fuel facilities -partly in preparation for new reactor construction in the United States, partly to serve the growing world market.

Last year, for example, AREVA and Northrop Grumman Shipbuilding formed a joint venture to build a new manufacturing and engineering facility in Newport News, VA. This $360-million facility will manufacture heavy components, such as reactor vessels, steam generators and pressurizers. Global Modular Solutions, a joint venture of Shaw Group and Westinghouse, is building a fabrication facility at the Port of Lake Charles to produce structural, piping and equipment modules for new nuclear plants using the Westinghouse AP1000 technology. In New Mexico, LES is well along with construction of a $3-billion uranium enrichment facility, scheduled to begin production this year. Even for ultra-heavy forgings, Japan Steel Works is expanding capacity, and companies in South Korea, France and Great Britain are planning new facilities.

Although progress in rebuilding the supply chain is encouraging, federal government policy could accelerate the process of creating new jobs and generating economic growth. Specifically, the expansion and extension of investment tax credits for investments in manufacturing provided in the stimulus would ensure continued expansion of the U.S. nuclear supply chain and help restore U.S. leadership in this sector.

Electric utilities have created 42 partnerships with community colleges to train the next generation of nuclear workers. The industry is developing standardized, uniform curricula to ensure that graduates will be eligible to work at any nuclear plant. Sixteen states have developed programs to promote skilled craft development. Enrollment in nuclear engineering programs has increased over 500 percent since 1999. Grant programs from the NRC, the Department of Energy, the Department of Labor and the Department of Defense for education and training are having a major impact on increasing our trained workforce.

As with the nuclear supply chain, targeted tax credits to encourage companies to invest in apprenticeship programs and other work force development would accelerate job creation and training in the nuclear energy sector.

The supply chain and work force are responding to the opportunities offered by the expansion of nuclear energy. Access to financing in the current credit markets, however, is a potential constraint.

The United States faces a significant challenge—financing large-scale deployment of clean energy technologies, modernizing the U.S. electric power supply and delivery system, and reducing carbon emissions. This is estimated to require investment of $1.5-2.0 trillion between 2010 and 2030.

The omnibus appropriations legislation for FY 2008 and FY2009 authorizes $38.5 billion in loan volume for the loan guarantee program—$18.5 billion for nuclear power projects, $2 billion for uranium enrichment projects, and the balance for advanced coal, renewable energy and energy efficiency projects.

DOE has issued solicitations inviting loan guarantee applications for all these technologies and, in all cases the available loan volume is significantly oversubscribed. For example, the initial nuclear power solicitation resulted in requests from 14 projects seeking $122 billion in loan guarantees, with only $18.5 billion available. NEI understands that 10 nuclear power projects submitted Part II loan guarantee applications, which represented $93.2 billion in loan volume. Two enrichment projects submitted Part II applications, seeking $4.8 billion in loan guarantees, with only $2 billion available. NEI also understands that the solicitation for innovative coal projects resulted in requests for $17.4 billion in loan volume, more than twice the $8 billion available. The recent stimulus package added an additional $60 billion

in loan volume to the existing allocation of $10 billion for renewable technologies and transmission projects to assist with financing constraints.

It is, therefore, essential that limitations on loan volume—if necessary at all in a program where project sponsors pay the credit subsidy cost—should be commensurate with the size, number and financing needs of the projects. In the case of nuclear power, with projects costs between $6 billion and $8 billion, $18.5 billion is not sufficient.

The scale of the challenge requires a broader financing platform than the program envisioned by title XVII. An effective, long-term financing platform is necessary to ensure deployment of clean energy technologies in the numbers required, and to accelerate the flow of private capital to clean technology deployment.

Safety-related construction of the first new nuclear plants will start in 2012, and NEI expects four to eight new nuclear plants in commercial operation in 2016 or so. The exact number will, of course, depend on many factors—U.S. economic growth, forward prices in electricity markets, capital costs of all baseload electric technologies, commodity costs, environmental compliance costs for fossil-fueled generating capacity, natural gas prices, growth in electricity demand, availability of federal and state support for financing and investment recovery, and more. We expect construction of those first plants will proceed on schedule, within budget estimates, and without licensing difficulties, and a second wave will be under construction as the first wave reaches commercial operation.

To increase nuclear energy's contribution to 2050 climate goals, build rates of 4-6 plants per year must be achieved. This was possible in the 1970s and 1980s even with the old licensing process and lack of standardization. With standardized designs and improved construction techniques, this accelerated deployment is feasible after the first wave of plants is constructed.

Question 1b. Is it accurate that only about four or five utilities even have the financial capacity to build a two-unit nuclear plant?

Answer. It is accurate to say that most utilities will have difficulties building a two unit site without support from the federal loan guarantee program, support from state regulators (such as construction work in progress), or both. Several projects also involve partnerships to spread the costs and risk.

Unlike the many consolidated government owned foreign utilities and the large oil and gas companies, U.S. electric power sector consists of many relatively small companies, which do not have the size, financing capability or financial strength to finance power projects of this scale on their own, in the numbers required. Federal loan guarantees offset the disparity in scale between project size and company size. Loan guarantees allow the companies to use project-finance-type structures and to employ higher leverage in the project's capital structure. These benefits flow to the economy by allowing the rapid deployment of clean generating technologies at a lower cost to consumers. The recent stimulus bill recognized the need to provide access to low-cost capital to encourage rapid deployment of renewable energy projects. Similar support is required for nuclear energy since, in many cases, new nuclear plants and renewable energy projects are built by the same utilities.

Question 2. What are utilities estimating the per kilowatt cost of constructing a new nuclear power plant?

Answer. The per kilowatt cost of a new nuclear plant will depend on the size of the units and infrastructure required at a given facility location. However, an evaluation by the Brattle Group conducted for the state of Connecticut showed a cost of 8.34 cents per kilowatt hour for a base case. This study showed that new nuclear was the least expensive option with the exception of combined cycle natural gas with no carbon controls. If a carbon tax is imposed, nuclear will likely be the least expensive baseload electricity.

	Overnight capital cost (2008 $/kW)	Electricity cost (c/kWh)
nuclear	4038	8.34
supercritical coal	2214	8.65
supercritical coal + CCS	4037	14.19
IGCC	2567	9.22

	Overnight capital cost (2008 $/kW)	Electricity cost (c/kWh)
IGCC + CCS	3387	12.45
gas combined cycle	869	7.60
gas combined cycle + CCS	1558	10.31

CCS = carbon capture and sequestration

IGCC = integrated gasification combined cycle

Figure 1. Comparison of electricity generation technology capital and electricity costs from "Integrated Resource Plan for Connecticut," The Brattle Group, January 2008

Similarly, Florida Power and Light, Florida Progress, Southern Company, and SCANA demonstrated new nuclear's competitive busbar cost. These costs were presented in the financial modeling that supported their requests in the past two years to their respective state public service commissions (PSCs) for "determinations of need" for new reactors. For instance, FP&L modeled nine different scenarios. The only scenario in which nuclear was not preferred was a world in which natural gas prices were unrealistically low and there was no price on carbon. The Florida, Georgia, and South Carolina PSCs have approved these new nuclear plant projects.

Question 2a. How long will it take to build a plant once its license is approved?

Answer. The timeline to build a new plant once a license is approved by the NRC is estimated at roughly 60 months for the first plants in the U.S. However, once the process has been tested, foreign experience shows that with standard designs, the timeline can be significantly shortened. As an example, the Japanese have demonstrated that they can build an Advanced Boiling Water Reactor in less than 39 months from the first safety related concrete pour until the unit is synched to the grid while meeting budget goals.

Question 2b. I understand that AREVA's experience building one of their new standardized plants in Finland has not been ideal. What can we learn from that project that can inform the current debate on whether to construct new nuclear plants today?

Answer. The schedule delays and cost overruns at Areva's Olkiluoto Unit 3 project in Finland are due to deficient project management, according to a report by the Finnish regulator. These project management deficiencies are similar to those that helped cause delays in nuclear power plant construction during the 1970s and 1980s.

However, the root causes of these construction delays are now well-understood. Over the last several years, industry teams have conducted systematic assessments of what caused construction delays, and developed a detailed inventory of lessons-learned that are shared industry-wide. The industry also undertook a comprehensive project to benchmark major maintenance and upgrade projects at operating plants, to identify the characteristics of successful project management. Based on this research and analysis, the industry then developed project management strategies and techniques intended to ensure completion of major projects on time and within budget.

Largely as a result, the nuclear industry, including the U.S. nuclear industry, has performed major projects efficiently and without delay-ranging from $400 million material upgrades such as the Fort Calhoun refurbishment, to the $1.8 billion plant restart at Browns Ferry Unit 1, to refueling outages averaging 37 days industry-wide.

Recent construction and operational experience demonstrates that an experienced project management team, with effective quality assurance and corrective action programs, and with detailed design completed before the start of major construction, can complete projects on budget and on schedule.

Question 2c. Given the other clean energy alternatives out there and the need to quickly build more capacity to meet growing electricity demand, what is the business case for a utility to build a new nuclear plant?

Answer. Nuclear energy provides base load electricity that can be widely deployed and has a capacity factor in the ninety percent range. In addition, a single new nuclear plant typically provides between 1,000 and 1,700 megawatts of generation which allows fewer plants to deliver significant increases in electricity to the grid.

As discussed earlier in this response, two utilities in Florida have had certificates of need approved by the state public utilities commission based on nuclear providing the lowest cost option for rate payers. Similar decisions have been made in South Carolina and Georgia in support of building new nuclear units.

Seventeen companies have applications under NRC review for twenty-six new nuclear plants to ensure that they preserve the option for nuclear generation as demand grows. It is anticipated based on the efficiencies in the new licensing process and new construction techniques for standard designs that the timeline to build a new plant will be gradually trimmed to seven years once the first wave of new plants is licensed and constructed.

Question 2d. How do the costs of new reactors compare with projected costs for wind or solar facilities in the decade it will likely take to get a new nuke plant up and running?

Answer. It is difficult to predict the costs for wind or solar facilities in the future. The costs of these projects tend to be site specific depending on the natural resources available. In addition to the costs of the generating capacity, solar and wind technologies typically require transmission upgrades and back-up electricity sources such as a combined cycle natural gas plant.

Predominantly independent assessments of how to reduce U.S. electric sector CO_2 emissions—by the International Energy Agency, McKinsey and Company, Cambridge Energy Research Associates, Pacific Northwest National Laboratory, the Energy Information Administration, the Environmental Protection Agency, the Electric Power Research Institute and others—show that there is no single technology that can slow and reverse increases in CO_2 emissions. A portfolio of technologies and approaches will be required, and that portfolio must include more nuclear power as well as aggressive pursuit of energy efficiency and equally aggressive expansion of renewable energy, advanced coal-based technologies, plug-in hybrid electric vehicles and distributed resources.

Recent analysis by the Electric Power Research Institute (EPRI) suggests that nuclear will be the low cost generating option going forward as carbon taxes are imposed. As shown on the graph in Figure 2*, the costs of non-greenhouse gas emitting technologies are constant while the costs of natural gas combined cycle (NGCC) and coal without carbon capture and sequestration (CCS) climb as the carbon tax increases on the x-axis.

As discussed in previous answers, analyses by several other parties also indicate that new nuclear plants will be a competitive source of baseload power. Deployment of a combination of technologies will be the best path forward to meet our climate change goals in the most expeditious and economic manner.

Question 3. As you know, Congress authorized DOE to guarantee loans that support early commercial use of advanced technologies if there was a reasonable prospect of repayment. And currently, $18.5 billion of the allotted $38.5 billion for the loan guarantee program is earmarked for nuclear power projects. But the GAO has since estimated that the risk of default for DOE loan guarantees could be 50 percent or higher and Wall Street has put the industry on notice that it won't provide loans without a complete underwriting by the federal government.

Do you agree with GAO's assessment of the average risk of default for new nuclear plants? If you disagree please detail your objections to their analysis and provide your estimate of the average risk of default for the 17 pending nuclear plant applications. Given your estimate, please quantify the likely cost to the U.S. Treasury of those defaults.

Answer. No, NEI does not agree with the assessment cited. The reference to the default rate is unsupported and is misleading.

On page 20 of its July 2008 report[1], the GAO estimates that the loss rate (the product of default rate times recovery rate) would be over 25 percent. The report says this rate was calculated using the assumptions included in the fiscal year 2009 president's budget. A footnote references Table 6 of the Federal Credit Supplement, Fiscal Year 2009. In that document, a default rate of 50.85 percent and a recovery rate of 50 percent were assumed for the entire loan guarantee program. Furthermore, as Note 4 in Table 6 explains, these rates are "[a]ssumptions reflect[ing] an illustrative example for informational purposes only. The assumptions will be determined at the time of execution, and will reflect the actual terms and conditions of the loan and guarantee contracts." Thus, the cited basis for the GAO's assumed default rate of more than 50 percent recognizes that the actual default rate and recovery rate to be used in estimating loss rate must be based on the details of individual

* Figure 2 has been retained in committee files.

[1] "Department of Energy: New Loan Guarantee Program Should Complete Activities Necessary for Effective and Accountable Program Management", GAO-08-750, July 2008.

projects and deals. It is unlikely that a single value (50.85 percent) chosen to be illustrative of the entire pool of guaranteed projects would be representative of a specific portion of that pool (e.g., the nuclear power projects) with its particular risks and characteristics.

Similarly, a CBO estimate of 50% default probability is also an unsupported assumption. The CBO language dates back to a 2003 analysis of S.14, the Energy Policy Act of 2003, which was considered (but never passed) during the 108th Congress. The loan guarantee program in the 2003 legislation bore no resemblance to the loan guarantee program in the 2005 Energy Policy Act. The 2003 program was nuclear-specific, not technology-neutral. It did not require project sponsors to pay the credit subsidy cost, and thus did not have the significant fiscal discipline associated with title XVII. The CBO "analysis" simply asserted that there will be a 50 percent default probability, with no modeling or financial analysis to support that assertion.

The Nuclear Energy Institute believes that the nuclear projects now undergoing NRC licensing review will not present any risk of default to the DOE loan guarantee program. These projects have been structured and are being managed in ways designed to minimize risks.

The federal government uses loan guarantees widely to ensure investment in critical national needs, including shipbuilding, transportation infrastructure, exports of U.S. goods and services, affordable housing, and many other purposes. The federal government successfully manages a loan guarantee portfolio of $1.1 trillion. A disciplined process is used to ensure that the taxpayers' interests are protected before federal agencies issue loan guarantees. The Department of Energy will use a similar process for its loan guarantee program.

The title XVII loan guarantee program evaluation process includes financial analysis, due diligence and underwriting performed by expert outside financial, technical and legal advisors (whose fees and expenses are paid by the companies developing the projects) to assist in the underwriting, negotiation, documentation, and monitoring of the projects. The strength and credit worthiness of the project can be measured by indicators (widely used by investment banks and rating agencies) such as the credit rating of the project sponsor, project capital structure, project cash flow, strength of power purchase agreements, borrower's exposure to market and commodity risks, management and operator experience, etc. Projects that do not meet defined metrics will not be approved for loan guarantees.

In the case of new nuclear power projects, the companies will have significant shareholder equity ($1 billion or more per project) at risk. This equity is in a "first-loss" position—i.e., the company forfeits that equity in the event of default. For most electric companies, such a loss would be unsustainable. The significant amount of money at risk imposes a high level of discipline on investment decisions. As a result, the companies seeking loan guarantees for nuclear power plants have a powerful incentive to ensure that projects are properly developed, constructed, operated and maintained to achieve commercial success. The federal government's interest and the company's interest are completely aligned. Like the federal government, the nuclear companies wish to avoid default at all costs.

The energy loan guarantee program is self-financing: There is no cost to the taxpayer. The 1990 Federal Credit Reform Act created a standardized way of accounting for loan guarantee programs in the federal budget. Federal agencies that provide loan guarantees are required to calculate a "cost," following standardized protocols. In most loan guarantee programs, this cost appears in the federal budget as an appropriated amount. The energy loan guarantee program took a different and innovative approach. The Department of Energy cannot issue a loan guarantee unless the company receiving the loan guarantee has paid the cost of the guarantee and all administrative fees and costs incurred by the agency in administering the program.

Based on the above, NEI believes that the nuclear projects subject to the loan guarantee program will cost the U.S. Treasury nothing and will actually return a profit to the Treasury through the payment of credit subsidy fees.

Question 3a. Do you support the Energy Department pursuing non-cash equity such as land or other assets as part of a loan guarantee package?

Answer. Yes. NEI believes that non-cash project assets, such as land, should be allowed as part of the project sponsor's equity contribution.

Question 4. When the loan guarantee program was created in the 2005 Energy Policy Act it was intended to promote a small number of projects for new and innovative energy sources that did not have the proven track record necessary for Wall Street financing.

Please describe how the 17 projects that have applied to the DOE loan guarantee program to date employ "new and innovative" technology relative to the 104 nuclear power plants up and running today.

Answer. The 17 applicants that originally applied to the loan guarantee program are planning to construct and operate advanced nuclear power facilities employing passive and evolutionary design features. These features are new and innovative when compared to the existing 104 operating reactors that provide 20 percent of the country's electricity. Although several projects are under consideration, the nuclear power facility proposed by each is one of five standardized designs that is or will be certified by the NRC.

A key example of the use of new and innovative technology is in the area of instrumentation and control. Most of the operating reactors today use hard wired point-to-point control room to field monitoring and control systems. In simple terms this means there is one wire per function or ~30-50,000 wires coming from the field to the plant control room. The new reactors are designed with three-layer instrumentation and control system that uses extensive multiplexing and fiber optics. Single multiplexer units can generally handle 300 to 400 signals. Fiber optics allows the plant operator to interface with all screens, peripherals and alarms.

Also, many of the new reactors designs are utilizing modular construction. These modules are rail shippable, which allows construction to take place in a controlled environment and then shipped to the construction site. Advances in 3D computer modeling play a significant role in this modular construction approach. This approach reduces construction time and ensures efficient use of field manpower.

Two of the five new plant technologies achieve enhanced safety through incorporation of passive or inherent safety features. These features require no active controls or operational intervention to avoid accidents in the event of malfunction, and may rely on gravity, natural convection or resistance to high temperatures. Traditional reactor safety systems are 'active' in the sense that they involve electrical or mechanical operation on command. Inherent or full passive safety depends only on physical phenomena such as convection, gravity or resistance to high temperatures, not on functioning of engineered components. There is no need for active equipment such as pumps, fans, and other rotating machinery.

In addition to advanced instrumentation and control systems, all five new reactors benefit from:

- Use of NRC-approved probabilistic risk assessments that show the likelihood of a release of radiation is significantly below that of operating facilities and well below the NRC safety goals.
- Enhanced protection from fires through physical separation of equipment and cables and redundancy in safety systems
- Enhanced protection against aircraft impacts
- Fewer valves, less piping, less control cabling, and fewer pumps than the existing operating fleet based on lessons learned from over 30 years of experience with commercial operation

Question 5a. I understand the NRC is currently considering applications that reference five different reactor designs and the industry is expected to submit additional designs for NRC review and approval. But in a speech last week, NRC Commissioner Jaczko characterized current new reactor licensing as "a situation where we have incomplete designs and less than high quality applications submitted for review," and pointed out that "today, almost a fifth (3 of 17) of the combined operating license applications we have received are on hold at the request of the applicants themselves."

If one of the factors leading to the massive nuclear construction cost overruns in the 1970's and 1980's was the lack of standardization among reactor designs at the time, what is the NRC doing to ensure that only a limited number of the safest and most cost effective advanced technologies are approved?

Answer. It is important to remember that many of the plants constructed in the 1970's and 1980's were built and commissioned under the most unforgiving conditions.

The defining event for the 1980s-vintage plants was the accident at the Three Mile Island nuclear power plant in 1979. After that accident, nuclear power plants-both operating plants and those under construction—were engulfed in new regulatory requirements imposed by the Nuclear Regulatory Commission. The changing requirements forced extensive redesign and rework at nuclear units under construction. This stretched out construction schedules and—to make matters worse—the delays coincided with a lengthy period of double-digit inflation and national economic distress. All this combined to drive up the cost of these nuclear units to several times the original cost estimates. For some of these nuclear plants, half the total cost was interest on debt raised to finance construction.

The 104 nuclear power plants now supplying about 20 percent of U.S. electricity also were built under a two-step licensing system. Under this system, electric utili-

ties had to secure two permits-one to build a nuclear power plant, a second to operate it. Many companies started construction before design and engineering was complete. In fact, in many cases, the design/engineering work had barely started.

This "design as you go" approach led to big problems. The Nuclear Regulatory Commission (NRC) obviously could not finish its review and approval of the plant design until the plant was built and the power company requested an operating license.

Even before the accident at Three Mile Island, requests for operating licenses were complex and contentious. After the accident, they became even more difficult. The reviews, conducted by licensing boards, were formal adjudicatory proceedings with all the trappings of a courtroom trial-discovery, cross-examination and the like. They were typically lengthy, bitterly contested, divisive events. And they caused delays in plant operation, which added hundreds of millions of dollars to the cost.

Based on that experience, the electric power industry resolved that future nuclear power plants would be fully designed before construction began. Never again would electric utilities start building a nuclear power plant that was only partly designed, or do extensive design and engineering work during construction. The change in design philosophy was accompanied by a complete overhaul of the licensing system, which was ratified by Congress in the Energy Policy Act of 1992.

The new licensing process delineated in 10 CFR Part 52 allows nuclear power plant designers to submit their designs to the NRC for "certification." When a design is certified, electric utilities can order that plant, confident that design and safety issues have been resolved.

The new process also lets a company request a combined license to build and operate a new nuclear unit. As long as the design is pre-approved, and as long as the plant is built to pre-approved specifications (and the Nuclear Regulatory Commission will be on-site, checking to make sure that it is), then the power company can start the plant up when construction is complete—assuming of course, that no new safety issues have emerged.

Taken together, the new design philosophy and the new licensing system ensure that the major licensing issues—design, safety, siting and public concerns—will be settled up front before a company starts building a nuclear power plant and puts billions of dollars at risk.

In summary, the conditions that led to large cost increases for some operating nuclear power plants no longer exist. Past experience is useful in identifying the weaknesses in the regulatory process and fixing those weaknesses. Past experience does not, however, provide useful guidance as to the cost of nuclear power plants that will be built in the future, or the length of time it will take to build them.

Regarding design certifications, the NRC's statutory responsibility is to ensure the designs are safe. As noted in their policy statement on regulation of new reactors, the Commission expects, as a minimum, at least the same degree of protection of the environment and public health and safety and the common defense and security that is required for current generation light-water reactors. Furthermore, the Commission expects that advanced reactors will provide enhanced margins of safety and/or use simplified, inherent, passive, or other innovative means to accomplish their safety and security functions. How many designs are ultimately certified and whether those designs are cost effective is not for NRC to decide. The market place will make that determination.

The industry agrees that reviewing the design certifications and COL applications in parallel is not ideal, but is necessary for the first wave of applications. The NRC has completed acceptance reviews formally accepted (docketed) all of the design certifications and COL applications submitted by the industry to date. The NRC has provided review schedules to applicants and has been successfully meeting early milestones which is another indication that the applications are complete.

The long lead times for these new nuclear projects allow the sponsors to make adjustments as market conditions change. A limited number of applicants have placed their NRC reviews on hold pending resolution of business issues. The NRC has requested notifications from applicants as soon as possible if there are changes in the content or schedule for applications to support the NRC's work load management efforts. The NRC and industry are working to prioritize the review activities to ensure project sponsors will be able to meet their online need dates for power. Note that all review activities are paid for by project sponsors through hourly billing by the NRC.

Question 5b. Is there anything Congress can do to support more plant design standardization? For example, should we make nuclear financing contingent on one or two standardized designs?

Answer. Presently three standardized designs and one design certification amendment are under review by the Nuclear Regulatory Commission. The Department of

Energy's Nuclear Power 2010 program plays a critical role in supporting the design and licensing activities needed for the NRC to complete its reviews of two standardized designs. Congressional support of funding for this program in fiscal year 2010 would be beneficial.

As discussed above, standardized designs serve a function in reducing risks before a project sponsor proceeds with construction. Financing for construction activities should not be tied to a limited number of designs as the major construction risks related to design certainty will already be addressed at that point.

RESPONSE OF MARVIN S. FERTEL TO QUESTION FROM SENATOR SHAHEEN

Question 1a. As you know the Energy Policy Act of 2005 authorized the Secretary of Energy to guarantee loans for up to 80% of construction costs for energy projects that reduce greenhouse gas emissions, including new nuclear facilities. Last June, DOE solicited applications for guarantees of loans totaling up to $18.5 billion. The DOE now has received 17 applications for 26 new reactors seeking guarantees for a total of $122 billion in loans, which it is now evaluating.

How many reactors do you think the current amount of funding that is available for loan guarantees, $18.5 billion, will cover?

Answer. It is difficult to predict how many new nuclear power plants will be built with the $18.5 billion in federal loan guarantees currently authorized. Some projects have multiple co-owners, and it is possible that not all co-owners will choose to avail themselves of the loan guarantee program. Some projects will receive partial support from the government export credit agencies of France and Japan, which testifies to the degree of confidence the French and Japanese governments have in nuclear power. Such co-financing will leverage the $18.5 billion in existing loan guarantee authority and, as a result, it may cover 3-4 projects.

Certainly, the $18.5 billion in existing loan guarantee authority will not cover all the projects that filed Part I loan guarantee applications with the Department of Energy. DOE originally received loan guarantee applications from 17 companies for 21 new reactors, with an aggregate loan volume loan volume of $122 billion and total project costs of $188 billion. Those applications represent 28,800 megawatts of carbon-free generating capacity and would, NEI estimates, avoid 183 million metric tons per year of CO_2, 124,000 tons of NO_X, and 348,000 tons of SO_2 (based on a 90% capacity factor).

Question 1b. In your opinion, how many new reactors will be necessary for economies of scale to begin to kick in and the costs of each reactor begin to come down, making it easier to secure financing?

Answer. International experience proves that each consecutive construction project using a standard design will benefit from efficiencies learned from the first. Particularly in the U.S. where the reactor designer and architect/engineers are teamed for construction, this will be the case.

The United States faces a significant challenge—financing large-scale deployment of clean energy technologies, modernizing the U.S. electric power supply and delivery system, and reducing carbon emissions. This is estimated to require investment of $1.5-2.0 trillion between 2010 and 2030.

The omnibus appropriations legislation for FY 2008 and FY2009 authorizes $38.5 billion in loan volume for the loan guarantee program—$18.5 billion for nuclear power projects, $2 billion for uranium enrichment projects, and the balance for advanced coal, renewable energy and energy efficiency projects.

DOE has issued solicitations inviting loan guarantee applications for all these technologies and, in all cases the available loan volume is significantly oversubscribed. For example, NEI understands that 10 nuclear power projects submitted Part II loan guarantee applications, which represented $93.2 billion in loan volume. Two enrichment projects submitted Part II applications, seeking $4.8 billion in loan guarantees, with only $2 billion available. NEI also understands that the solicitation for innovative coal projects resulted in requests for $17.4 billion in loan volume, more than twice the $8 billion available. The recent stimulus package added an additional $60 billion in loan volume to the existing allocation of $10 billion for renewable technologies and transmission projects to assist with financing constraints.

It is, therefore, essential that limitations on loan volume—if necessary at all in a program where project sponsors pay the credit subsidy cost—should be commensurate with the size, number and financing needs of the projects. In the case of nuclear power, with projects costs between $6 billion and $8 billion, $18.5 billion is not sufficient.

The scale of the challenge requires a broader financing platform than the program envisioned by title XVII. An effective, long-term financing platform is necessary to

ensure deployment of clean energy technologies in the numbers required, and to accelerate the flow of private capital to clean technology deployment.

During the 110th Congress, Senator Bingaman introduced legislation to create a 21st Century Energy Deployment Corporation. Senator Domenici, ranking member of this committee during the last Congress, introduced legislation to create a Clean Energy Bank. Both proposals address aspects of the financing challenge facing the United States and its electric power industry.

NEI believes that the existing title XVII program and the DOE Loan Guarantee Program Office, operating under workable rules, could serve as a foundation on which to build a larger, independent financing institution within the Department of Energy. There is precedent for such independent entities, equipped with all the resources necessary to accomplish their missions, in the Federal Energy Regulatory Commission and the Energy Information Administration. This approach could have significant advantages:

- An independent clean energy financing authority within DOE could take advantage of technical resources available within the Department, to supplement its due diligence on prospective projects and to identify promising technologies emerging from the research, development and demonstration pipeline that might be candidates for loan guarantee support to enable and speed deployment.
- An independent entity within DOE would have the resources necessary to implement its mission effectively, including its own legal and financial advisers with the training and experience necessary for a financing organization. Providing the independent entity with its own resources would eliminate the difficulties encountered during implementation of the title XVII program.
- Programmatic oversight in Congress would remain with the Energy Committees, which have significantly more experience with energy policy challenges, and in structuring the institutions necessary to address those challenges.

RESPONSES OF MARVIN S. FERTEL TO QUESTIONS FROM SENATOR STABENOW

Question 1. Retooling Plants. In your testimony, you emphasize that the U.S. is ramping up its ability to manufacture nuclear components. This is partly to serve as a growing world market. Do you see any attempts being made to retool existing manufacturing facilities that were once used for other purposes—such as what is happening in Michigan—with manufacturing plants?

Answer. Yes, the U.S. is seeing retooling of existing facilities, development of new facilities and expansion of existing product lines (with augmented quality programs). Some examples include:

Retooling—Precision Custom Components, LLC in York, PA has retooled their existing manufacturing facility with machine tools and other needed equipment to expand into the commercial nuclear industry. PCC provides reactor vessel internals, reactors servicing equipment such as integrated reactor head packages and spent nuclear fuel casks.

Holtec in Turtle Creek, PA added 90,000 square feet to its manufacturing division in a facility that had been an old Westinghouse factory. They manufacture dry fuel storage canisters and high-tech fuel racks for electric utilities in the United States and around the world. With this expansion, Holtec added 75 new jobs last year and has announced plans for 500 new hires in the next three to five years, including manufacturing and welding engineers, production workers and machinists.

Development of New Facilities—Curtiss Wright Flow Control Corporation is building a $62 million, state-of-the-art, multipurpose Large Manufacturing Complex in Cheswick, PA. The nine-story, 48,000-square-foot facility will be used to build commercial nuclear reactor coolant pumps as well as support the production and testing of other new large products.

AREVA and Northrop Grumman Shipbuilding are building a new manufacturing and engineering facility in Newport News, Va., to supply the growing American nuclear energy sector. The 300,000-square-foot facility represents an investment of more than $360 million, and will manufacture heavy components, such as reactor vessels, steam generators and pressurizers. This will result in more than 500 skilled hourly and salaried jobs.

Global Modular Solutions, a joint venture of Shaw Group and Westinghouse, is building a 600,000-square-foot module fabrication facility at the Port of Lake Charles to produce structural, piping and equipment modules for new nuclear plants using the Westinghouse AP1000 technology. The new facility is scheduled open in the summer of 2009 and will employ 1,400 workers or more at full capacity.

Augmenting Quality Programs—In order to supply many nuclear components, it is necessary to have an appropriate quality certification and/or quality program in place that meets the industry standards. One such quality certification is the ASME N-Stamp. Over the past 2 years, the industry has seen a nearly 20 percent increase in the number of N-Stamps held in the U.S. from only 221 in 2007 to 263 today.

The Nuclear Energy Institute has been actively engaging U.S. businesses to encourage them to consider entering the global nuclear supply chain through a series of regional workshops that bring together procurement and supply chain leaders from reactor vendors and engineering, procurement and construction firms with businesses exploring the nuclear market.

In February, NEI conducted our fourth workshop in Chattanooga, Tennessee and nearly 450 people participated. Our next event is scheduled in Detroit on June 4th and will target manufacturers in the Great Lakes Region. Local co-sponsors for this event include the Michigan Chamber of Commerce, the Michigan Minority Business Development Council and the Michigan Manufacturers Association. Nationally, these events are co-sponsored by the U.S. Department of Energy, the National Association of Manufacturers and the Association of Mechanical Engineers.

NEI believes that Congress can help accelerate this retooling and manufacturing expansion by:

- Providing a manufacturing tax credit to allow the development of new facilities or the expansion or retooling of existing manufacturing facilities.
- Providing grants and technical assistance to small and mid-sized business to assist them with putting appropriate nuclear quality programs in place.
- Providing a worker training tax credit to assist with the development of a qualified workforce to support this expansion of nuclear manufacturing capacity.
- Encouraging the export of nuclear products and services by better coordinating federal policy initiatives and actively advocating for the industry.

Question 2. Incentives for Nuclear Manufacturing. When nuclear manufacturing in the U.S. is discussed, a lot of the focus is on heavy manufacturing that not only takes long lead times, but is done overseas. What do you think will be done in the manufacture of non-heavy components for nuclear plants—such as wiring—in the U.S.?

NEI believes that there is substantial opportunity to manufacture both heavy and non-heavy components for nuclear plants in the U.S. In addition to heavy components, the first eight new nuclear plants built in the U.S. may require:

- Over 1,800 miles of cable
- 4,000 to 24,000 nuclear grade valves
- 1,000 to 2,000 pumps
- 30 to 150 miles of nuclear grade piping
- Over 3 million cubic yards of concrete
- Over 700,000 electrical components
- Roughly 500,000 tons of structural and reinforcing steel
- 500 to 1,300 large and small heat exchangers

Many of these components and commodities are produced in the U.S. Yet with the advent of licensing and eventually constructing 26 reactors in the U.S. and potentially 200 overseas, there is an opportunity to significantly expand U.S. manufacturing capacity. Additionally, while there are U.S. manufacturers capable of producing components, many lack the necessary quality programs required to participate in the nuclear market.

A key criteria in selecting the locations of the industry's regional manufacturing outreach workshops (described above) is the current industrial base that exists in the region. In 2008, workshops were held in Columbia, SC, Cleveland, OH and San Antonio, TX to reach out to the existing industrial base for components like valves, pumps, cabling, cable tray, hangers, fasteners, steel, etc. The 2009 program also targets regions of the country with an existing manufacturing base that can be repurposed to support the nuclear industry. As mentioned in the first response, the next event is scheduled in Detroit on June 4th and will target manufacturers in the Great Lakes Region.

Finally, we are seeing growth in the heavy component manufacturing area as well. The Babcock & Wilcox Company has the ability to fabricate heavy components at their facilities and the recent announcement by AREVA and Northrop Grumman Shipbuilding will add additional heavy component manufacturing capacity in the U.S.

NEI believes that the policy recommendations outlined above can help accelerate U.S. industry's entrance into the nuclear market for heavy and non-heavy components.

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