

## Table of Contents

U.S. Senate	Date: Thursday, April 21, 2016
Committee on Environment and Public Works	Washington, D.C.
STATEMENT OF:	PAGE:
THE HONORABLE SHELLEY MOORE CAPITO, A UNITED STATES SENATOR FROM THE STATE OF WEST VIRGINIA	3
THE HONORABLE TOM CARPER, A UNITED STATES SENATOR FROM THE STATE OF DELAWARE	6
THE HONORABLE CORY BOOKER, A UNITED STATES SENATOR FROM THE STATE OF NEW JERSEY	12
THE HONORABLE MIKE CRAPO, A UNITED STATES SENATOR FROM THE STATE OF IDAHO	16
THE HONORABLE SHELDON WHITEHOUSE, A UNITED STATES SENATOR FROM THE STATE OF RHODE ISLAND	20
CHRISTINA A. BACK, DIVISION DIRECTOR, GENERAL ATOMICS INERTIAL FUSION AND ADVANCED FISSION	24
ASHLEY E. FINAN, POLICY DIRECTOR, NUCLEAR INNOVATION ALLIANCE	29
MARIA KORSNICK, CHIEF OPERATING OFFICER, NUCLEAR ENERGY INSTITUTE	34
EDWIN LYMAN, SENIOR SCIENTIST, UNION OF CONCERNED SCIENTISTS GLOBAL SECURITY PROGRAM	39
VICTOR MCCREE, EXECUTIVE DIRECTOR OF OPERATIONS, NUCLEAR REGULATORY COMMISSION	45
THE HONORABLE JEFFREY S. MERRIFIELD, CHAIRMAN, U.S. NUCLEAR INFRASTRUCTURE COUNCIL ADVANCED REACTORS TASK FORCE	50

ENABLING ADVANCED REACTORS AND A LEGISLATIVE HEARING ON S. 2795,  
THE NUCLEAR ENERGY INNOVATION AND MODERNIZATION ACT

THURSDAY, APRIL 21, 2016

U.S. SENATE

Committee on Environment and Public Works

Subcommittee on Clean Air and Nuclear Safety

Washington, D.C.

The subcommittee met, pursuant to notice, at 9:45 a.m. in room 406, Dirksen Senate Building, the Honorable Shelley Moore Capito [chairwoman of the subcommittee] presiding.

Present: Senators Capito, Crapo, Wicker, Fischer, Inhofe, Carper, Whitehouse, Markey and Booker.

STATEMENT OF THE HONORABLE SHELLEY MOORE CAPITO, A UNITED STATES  
SENATOR FROM THE STATE OF WEST VIRGINIA

Senator Capito. I would like to welcome all of our witnesses today, but a particular welcome to an alumnus of this committee, Mr. Merrifield, who told me he began here in 1986. I appreciate your returning.

Each witness has been asked to give a five-minute oral statement and then take questions.

We are here to examine an exciting topic: advanced nuclear reactors. I would like to thank Senator Carper because I know he has a great interest in this. While nuclear issues may be somewhat new to me, I am learning that these technologies have the potential to make great strides in advancing nuclear technology.

This is a topic many of us are very interested in because nuclear energy is an essential component of our all-of-the-above energy strategy. Our current nuclear plants provide clean, safe, reliable, and affordable energy to power our economy while providing thousands of jobs and millions of dollars in benefits to local communities.

They have made vital contributions to our energy security for years, but we need to look forward to what comes next. Advanced reactors have the potential to be cleaner, safer, and more secure.

One purpose for this hearing is to better understand these technologies and the barriers to their development as commercial energy sources. The other purpose of this hearing is to examine S. 2795, the Nuclear Energy Innovation and Modernization Act, introduced last week by my colleagues, Senators Inhofe, Booker, Whitehouse, and Crapo. S. 2975 directs the NRC to develop a regulatory framework under which license applications for a variety of technologies can be reviewed, in keeping with the NRC's safety and security mission.

The NRC's existing regulations were designed around one technology and are not well-suited to the innovations that are underway. This is clearly an issue our committee needs to address and I am glad my colleagues have come forward with a solution.

Efficient and timely decision-making at the NRC is crucial for our existing plants and for emerging technologies. The bill modernizes the NRC's budget and fee structure to ensure funds are available to complete reviews that the existing industry needs to remain economically competitive and that will also allow emerging technologies to grow.

The NRC's safety and security mission is a vital one, but must be accomplished efficiently and with fiscal discipline. According to the NRC's Principles of Good Regulation, the American taxpayer, the rate-paying consumer, and licensees are

all entitled to the best possible management and administration of regulatory activities.

This bill aligns with that principle and I thank my colleagues for their hard work and bipartisanship to advance innovative new energy technologies. These are technologies where our Nation should lead the way, not just for our energy security but also in the interest of national security. Only by leading can we hope to advance our nonproliferation goals.

With that, I am eager to hear Senator Carper's remarks and those of our witnesses.

Senator Carper?

[The prepared statement of Senator Capito follows:]

STATEMENT OF THE HONORABLE TOM CARPER, A UNITED STATES SENATOR  
FROM THE STATE OF DELAWARE

Senator Carper. Thank you, Madam Chairman.

Thanks for letting me be your wing man. It is good to be here with all our colleagues, particularly with Senator Inhofe and Senator Crapo who have a huge interest and a lot of expertise in these issues.

I want to welcome each of you. It is nice to see one of you again for many years now, have a chance to welcome back others and to meet some of you for the first time.

When our Country began exploring nuclear power I think it was more than 60 years ago. I do not know how many had much of an idea how important this technology could be to the future of our Nation's energy supply. Serious incidents in places like Chernobyl, Three Mile Island and Fukushima caused a number of people, both at home and around the world, to question the viability of nuclear power but I think support for this clean, reliable technology has begun to grow again in recent years.

Given that development, Congress has an important role to play in ensuring that our Nation invests wisely in nuclear while at the same time maintaining our focus on safety. Many Americans may be unaware that nuclear technology was actually invented in the United States. In fact, for a number of years, our Nation led the world in nuclear manufacturing, construction

and production.

The jobs and the economic benefit of this growth stayed here at home for the most part. Unfortunately, this is no longer the case. Many nuclear components are now only available from our international economic competitors, including the French, South Koreans, Japanese and now the Chinese.

While the United States continues to have more nuclear power plants than any other country, other nations, China in particular, are gaining quickly. At the same time, our Country's nuclear reactors are getting older and many will need to be replaced in the years to come.

Some people believe that our Nation's nuclear success story may be winding down. But I believe that like a distance runner, nuclear power in America is just getting its second wind. Albert Einstein used to say with adversity lies opportunity. He was right then and he is right today.

While this industry has faced a good deal of adversity in recent years, there appears to be a fair amount of opportunity ahead of it now. If we are smart, we will seize the day and begin to replace our aging nuclear reactors with new ones in the years ahead that are safer, produce less spent fuel and are less expensive to build and operate.

If we are smart about it, I foresee an opportunity to develop and build the next generation of nuclear reactors on

American soil. I foresee a chance to have some of our closed manufacturing plants reopen, construction crews will be called back to work and colleges will face a new demand from industry for skilled nuclear technicians.

In short, I foresee an opportunity for the United States to once again lead the world in nuclear technology. Today's hearing is about how we seize this opportunity. Decisions we make today will impact what types of nuclear reactors will be operating in this Country 10, 20 even 50 years from now.

Fortunately, there has been good progress of late and we are beginning to deploy new nuclear technology. Several years ago, the NRC approved construction to build four new reactors in Georgia and South Carolina that will incorporate some of the most up-to-date safety technology.

Construction of these new reactors is creating thousands of new jobs for the economies in those States. It is becoming increasingly likely that small modular reactors will become a reality in this Nation with the first reactors expected to become operational within the next decade. This is an encouraging start but I know we can and need to do better.

I have also heard from U.S. businesses who believe that we can do better. Over 50 companies are investing in next generation nuclear technologies. Today, we are going to hear directly from a company that is making some of those

investments.

As these companies make advances in technology, we need to make sure that our regulatory framework can keep pace. The NRC is considered the world's gold standard of nuclear regulatory agencies. However, as science and technology evolve, so must the NRC.

In closing, let me say I believe that government in this Country has a number of roles to play. I am sure you agree. Among them, few are as important as helping to create a nurturing environment for job creation and job preservation. That includes making sure that we have affordable, dependable energy, that we produce it safely in this Country, and in ways that diminish the threat of climate change rather than increasing it.

Advances in nuclear energy can help us attain that more nurturing environment and provide a more promising future for our Nation, for its people and for our planet. I hope we will learn today about the roles the NRC and other agencies need to play if that promising future is to be realized.

Thank you, Madam Chair.

[The prepared statement of Senator Carper follows:]

Senator Capito. Thank you.

With that, I think the Chairman has requested time.

Senator Inhofe. Just unanimous consent that my statement be placed in the record.

Senator Capito. Without objection, so ordered.

[The prepared statement of Senator Inhofe follows:]

Senator Capito. Again, I would like to thank the witnesses and welcome you to give a five minute statement. Your full testimony has been submitted for the record. Then we will go through a round of questioning.

Senator Booker, I understand you would like to make a comment about the bill in advance of the testimony.

STATEMENT OF THE HONORABLE CORY BOOKER, A UNITED STATES SENATOR  
FROM THE STATE OF NEW JERSEY

Senator Booker. I am very grateful, Madam Chairman, for this opportunity and thank you for giving me a chance to say a few words.

I am a Senator today with no name or a Senator whose name shall not be mentioned.

Again, thank you, Chairman Capito. I want to thank Senators Inhofe, Whitehouse and Crapo for their partnership on this really important bill.

American leadership on nuclear energy is absolutely critical. The historic Paris Climate Agreement set ambitious goals to target and limit global warming to 1.5 centigrade above pre-industrial levels. However, scientists agree that even if all countries meet their commitments under this pact, we are not on track to meet these ambitious targets, not even close. Meeting the rising global demand for energy while simultaneously slashing carbon emissions presents a very difficult challenge for this generation.

Think about this. By 2050, meeting the Paris targets would require us to cut emissions by up to 70 percent while producing 70 percent more electricity. That is an incredibly difficult thing to do, to produce 70 percent more electricity than we do today while at the same time emitting 70 percent less carbon.

I am a big believer in energy efficiency and renewable energy. I fought with other Senators to expand the tax credits last year for renewable, but in order to avert the worst effects of climate change, we do not see any way around the idea that we must substantially increase our nuclear energy capacity in the coming decades. We have no choice but to increase nuclear capacity.

Nuclear energy, which provides a critical baseload power, currently comprises more than 60 percent of our Nation's carbon free electricity generation. Right now in the United States we have five new reactors under construction, the first new commercial units in 30 years, but several existing reactors have already been shutdown prematurely and many more are at risk.

We need to make sure that we see dozens of more private sector companies beginning to move into this area and help to produce an environment where they are making their billion dollars of investment.

We desperately need sound, long term government policies that will support our existing fleet and also support a sustained commitment by the private sector to advance nuclear reactors that can be commercialized in the future.

This bill, S. 2795, takes several positive, bipartisan steps in that direction. First, the bill would direct NRC to develop new staged licensing processes for advanced nuclear

reactors. Second, the bill would, over longer terms, put in place, new technology, inclusive regulatory framework and would make licensing of advanced nuclear more efficient, flexible and predictable while maintaining the NRC's safety and security missions.

Third, the bill would authorize a new cost sharing grant program at the Department of Energy that would help the first advanced reactor projects that move forward to pay for some of the licensing costs at NRC.

This bill would place a cap on the annual fees that existing nuclear reactors pay to the NRC. While this cap may never be hit, putting it in place will provide certainty and protection for the existing fleet.

This is a critical challenge we have in our Nation right now, making sure we are meeting our energy needs, dealing with the realities of climate change and empowering business and innovation.

I am very happy to have worked in a bipartisan fashion on what is a solid bill that will help us to take a step forward.

Thank you, Chairman, for providing me this opportunity to make an introduction to the bill. I look forward to hearing from all of our witnesses.

[The prepared statement of Senator Booker follows:]

Senator Capito. Thank you.

Senator Inhofe. Just a ten-second response. Let me assure you that while we enjoy this bill, we are co-sponsoring the bill, it has nothing to do with global warming. The disaster you will see tomorrow of what they call Earth Day in New York is an embarrassment. The President is not even going there for it.

My motivation on this is when I say all of the above to save this Country, all energy, it includes nuclear. Thank you.

Senator Capito. Thank you.

Another bill sponsor, Senator Crapo, would like to make an introduction to the bill and make some comments.

STATEMENT OF THE HONORABLE MIKE CRAPO, A UNITED STATES SENATOR  
FROM THE STATE OF IDAHO

Senator Crapo. Thank you, Madam Chairman. I appreciate the opportunity to be here today.

Senators Inhofe, Whitehouse, Booker and I have introduced legislation to ensure the NRC will be ready to license advanced reactor designs as companies are ready to commercialize them.

We have undertaken a deep dive into the inner workings of the Commission. Through hearings and discussions with officials and stakeholders, we have developed a plan that will help modernize the Commission and enable it to stay abreast of reactor design advancements in the nuclear industry.

Our bill, the Nuclear Energy Innovation and Modernization Act, NEIMA, increases transparency and accountability in the NRC's budget and fee structure through modernizing reforms based on years of EPW oversight efforts.

The measure also directs the agency to develop a technology inclusive regulatory framework enabling the Commission to review a diverse set of advanced reactor technologies. NEIMA's improvements bring a great deal of transparency and accountability to the NRC.

We want the Commission to make changes that allow stakeholders of various backgrounds and motivations to look at the Commission's actions and understand what it is doing.

In particular, the agency must be more transparent in its budgeting and fee process. This is especially true regarding the Commission overhead costs. When the NRC talks about overhead costs, it refers to activities that may be categorized as corporate support, office support and mission indirect.

At this point, our bill only captures one portion of these overhead costs, the corporate support costs, because that is the only portion of the overhead costs that we can get the NRC to clearly label and define. The NRC must endeavor to make its budgeting information more transparent and accessible.

Some amount of overhead is necessary for all organizations. Nonetheless, the NRC needs to be able to clearly account for its overhead costs and for the way it uses fees from licenses to support these costs. Clear and transparent budget processes are required for effective oversight. This is something I look forward to working with my fellow EPA colleagues on, both in this bill and in beyond.

Finally, it is imperative that we licensing process for advanced reactors is transparent and takes into account past lessons learned. NEIMA enables the NRC to create a technology inclusive regulatory framework. By creating a technology inclusive framework, we are enabling the NRC to review and license any advanced reactor design that it considers to be safe and secure.

We are not forcing the NRC to pick winners and losers among reactor designs by forcing it to allocate resources on one type of reactor or design. As a whole, NEIMA provides important transparency and accountability improvements across the NRC and improves the communication between various stakeholder groups and the agency.

Enabling better transparency, accountability and communication are critical to ensuring the NRC remains the world's preeminent safety and security regulator. Such improvements also provide more stability and predictability in the industry and among stakeholder groups.

Increasing the NRC's ability to be transparent and accountable will increase its ability to perform its safety mission and share information with all stakeholder groups.

Thank you very much, Madam Chairman.

[The prepared statement of Senator Crapo follows:]

Senator Capito. We would like to go to the witnesses but I understand the original sponsor, Senator Whitehouse, has some comments.

STATEMENT OF THE HONORABLE SHELDON WHITEHOUSE, A UNITED STATES  
SENATOR FROM THE STATE OF RHODE ISLAND

Senator Whitehouse. Thank you, Madam Chairman.

Let me first thank Chairman Inhofe, Senators Crapo and Booker for the work we have done together to try to streamline this process.

The sense that I have and that brought me to this conversation is that the approval process at NRC is an obstacle course that is designed for a particular type of technology but is not well suited to technologies that are not that technology.

Indeed, the irrelevancy, as I think someone mentioned to me, is two plus two equal cheese. It just does not fit or make sense at all.

We do have new technologies that are emerging. They have enormous promise for a carbon constrained world. We, in America, have done a lot of the leadership design for them but if we cannot get them through a process to where they are actually creating electrons, then we have not done ourselves any good. I look forward to pursuing this.

I would add two brief points. One is that it should remain, I think, a very high priority goal of this committee and this process to continue to point towards ways to reuse spent nuclear fuel.

Some of these technologies hold out at least the promise of

taking the enormous stockpile of what is now dangerous nuclear waste, for which we have no means of disposal and which will be very expensive to deal with, and repurpose that into, as one person told me, potentially trillions of dollars of virtually free power. That, I think, needs to be a significant subordinate goal as we go forward in this process.

The last thing I will say is that I think it is a tragedy that we are losing some of our nuclear facilities to an economic problem, that there is no payment for their carbon free power. If a nuclear plant is not safe, then I am the first person to want to shut it down yesterday.

However, if the only reason it is being shutdown is because it cannot compete economically with a natural gas plant, and the only reason it cannot compete economically with a natural gas plant is because it gets no benefit for being carbon free when across the Country through our corporate world, throughout our government, we recognize there is actual value to being carbon free, then we are artificially damaging an industry that should be doing better.

We need to figure out a way to make sure there is, in fact, a payment to this industry for the carbon-free value of the electrons they produce.

With that, I will close my comments.

I again thank my colleagues on this bill for their

leadership. I am delighted to be working with them.

[The prepared statement of Senator Whitehouse follows:]

Senator Capito. Thank you.

We will proceed to the witnesses. I am going to begin on my left with Dr. Christina A. Back, Division Director of General Atomics Inertial Fusion and Advanced Fission. Welcome.

STATEMENT OF CHRISTINA A. BACK, DIVISION DIRECTOR, GENERAL  
ATOMICS INERTIAL FUSION AND ADVANCED FISSION

Ms. Back. I would like to thank Chairman Capito and Ranking Member Carper for holding this hearing, and Chairman Inhofe, Senators Crapo, Whitehouse and Booker for their legislation. Also, thanks to my home State Senator, Ranking Member Boxer.

My name is Christina Back and I am the Vice President of Nuclear Technologies and Materials at General Atomics. General Atomics is a privately held company with over 60 years of experience in nuclear energy, one where we continuously push the technological envelope.

I was asked to describe what nuclear reactors are and what we believe may be appropriate issues for you to consider when developing public policy for encouraging the development of new reactors. We believe advanced reactors are vital to making nuclear power, economically competitive and vital to reversing the current decline of the nuclear industry.

In order to be helpful to the committee's efforts, I would like to start by noting that the term advanced reactors is somewhat loosely used. Some people consider them to be non-light water reactors, while others mean new light water reactors.

We believe an advanced reactor concept is one whose design

is guided by the four core principles that help ensure economic success. These principles are to produce significantly cheap electricity, to be safer, to produce significantly less waste, and reduce proliferation risk. We believe every worthy reactor concept must address these four core principles jointly if it is to be an advanced reactor. It is not sufficient to excel in just one with disregard to the others.

I would like to discuss GA's reactor concept. This is one of many of the advanced reactor concepts referred to before. GA has a concept which is an energy multiplier module or EM<sup>2</sup>. As a way of illustrating what advanced can mean, I would like to discuss this reactor.

GA chose to employ innovative design and engineered materials to meet the four core principles. What makes it compelling to think about nuclear reactors and advanced reactors now is that in the last 30 years, scientists have made unprecedented advances in understanding materials.

We at GA know how to manipulate these materials and are trying to revitalize the nuclear industry with them. Now let us consider each of the principles I mentioned.

First is cost. The drive to make a cheaper reactor led us to design a much smaller reactor that would produce up to 60 percent more power than today's reactor from the same amount of heat.

Second is safety. For a radical improvement in safety, EM<sup>2</sup> uses engineered, ceramic materials to hold the fuel that work in intense radiation and withstands more than two times higher temperatures than current reactor materials today. They would not be subject to failure like those in Fukushima.

Third is waste. EM<sup>2</sup> will reduce the amount of waste by at least 80 percent. The reactor can also use spent light water reactor waste as fuel, thus turning this waste into energy.

Fourth is nonproliferation. EM<sup>2</sup> keeps the fuel in the reactor for 30 years without the need for refueling or repositioning the fuel rods. This means we access the core once, much less than the 20 times the current reactors need for existing refueling. We calculate that EM<sup>2</sup> will produce power at approximately 40 percent lower costs than today's reactors and be passively safe.

As for any new reactor design, this one will require extensive interactions with the NRC and we think involving the NRC early in this process is important to inform the design for a safer reactor. Radically new concepts require upfront investment involving risk. Some of these investments may not pay off and even those that are successful could take up to ten years to produce revenue.

While GA has already invested \$40 million in EM<sup>2</sup>, it is hard to divert scarce dollars from R&D to NRC considerations at this

early point in time. If this committee's objective is to stimulate the development of new advanced reactors, hopefully as we have defined and outlined here, we suggest that it would be relatively inexpensive to involve the NRC early in the consultations with potentially very high impact.

We suggest the committee consider authorizing the appropriation of \$5 million at first to provide NRC services to developers of advanced reactors and perhaps with a relatively low cost share of say 3 percent. The NRC is important and necessary for ensuring nuclear power is safe. Therefore, it plays a critical role in nuclear power innovation.

In closing, I would like to say right now is a very exciting time in nuclear energy. I love that I get to put science in practice and engage the next generation of scientists and engineers and help meet the Nation's energy needs by creating a new, innovative way to produce clean and safe power.

Thank you for the efforts of this committee. Thank you for the opportunity to speak to you. I would be pleased to answer questions.

[The prepared statement of Ms. Back follows:]

Senator Capito. Thank you.

Our next witness is Dr. Ashley E. Finan, Policy Director,  
Clean Air Task Force, Advanced Energy Systems. Welcome.

STATEMENT OF ASHLEY E. FINAN, POLICY DIRECTOR, NUCLEAR  
INNOVATION ALLIANCE

Ms. Finan. Chairman Capito, Ranking Member Carper, and distinguished members of this subcommittee, thank you for holding this hearing and for giving me the opportunity to testify.

My name is Ashley Finan and I am Policy Director for the Nuclear Innovation Alliance, NIA, a non-profit organization dedicated to leading advanced nuclear energy innovation.

The NIA was established by a cross-cutting group who believe that advanced nuclear energy is needed to ensure a better future. This group includes innovators, academics, environmental organizations, industry groups and other experts and stakeholders.

The world will double or triple its energy demand in 30 years, driven by a growing middle class in the developing world and the need to bring electricity to 1.4 billion people who lack it today. At the same time, many analyses point to the pressing need to reduce global carbon emissions by 80 percent or more by 2050 if we are to avoid the worst impacts of climate change. A more rapid expansion of nuclear power is an essential part of the solution.

In the United States and elsewhere, dozens of innovative start-up companies and other stakeholders are pioneering designs

that promise to lower risk and cost, and reduce deployment barriers, but the transition from design to commercialization and deployment, both in the US and globally, has been slow.

Current NRC regulation confronts the licensing of advanced technologies with two major challenges. First, NRC design certification or approval calls for enormous front-loaded investment during a protracted development and licensing phase, without a staged structure to provide applicants with clear, early feedback on an agreed schedule.

Second, current regulation primarily evolved to oversee light water reactor technologies. It must be adapted to the features and performance characteristics of advanced reactors, which rely on substantially different fuels, cooling systems, and safety strategies, and require novel operating strategies.

Over the past two years, the NIA has been developing strategies to facilitate the efficient, cost-effective, and predictable licensing of advanced nuclear power plants in the United States. These strategies are based on consultations with nuclear innovators, safety experts, regulators and investors, key stakeholders of the nuclear industry.

We compiled the results of our work into a report called *Enabling Nuclear Innovation: Strategies for Advanced Reactor Licensing*, which was issued on April 12. The report has been provided to the committee, and is available to the public on the

NIA website. It discusses in much greater detail the points that I am touching on today.

To address the LWR-centric nature of the current regulations, a more technology-inclusive approach is needed. A risk-informed, performance-based licensing approach will allow the NRC to review a diverse set of advanced reactor technologies.

This would incorporate both modern methods of risk assessment and traditional deterministic approaches to provide an exhaustive safety review. S. 2795 provides for the NRC to do work in this area without impacting the costs incurred to the existing plants.

To illustrate the investment challenge, I would like to direct your attention to Figure 1. This shows schematically the risk/investment profile of nuclear energy projects relative to the licensing process today, and the large monetary and temporal hurdle of obtaining design approval.

Figure 2 illustrates a staged approach that provides interim feedback and opportunities for risk reduction. It better aligns with private sector development of innovative technology using a licensing project plan, topical reports, and other mechanisms. It can provide clear and early feedback to investors and developers through a statement of licensing feasibility process. This approach maintains the rigor and high

standards of the NRC, and facilitates the development of advanced nuclear technology that produces less waste, or even consumes it.

S. 2795 authorizes the NRC to do the crucial work to develop and implement this staged licensing process with dedicated funding. This is important for two reasons. It helps the NRC to develop the rigorous, technology-inclusive regulatory infrastructure to support the review of advanced nuclear energy technologies.

Significantly, it does this without diluting funds used to regulate operating plants. It also allows for immediate adjustments that will provide a more efficient, predictable, and effective process.

Thank you for this opportunity to testify. S. 2795 is needed to enable progress and advance nuclear energy.

I would be pleased to respond to any questions you might have today or in the future.

[The prepared statement of Ms. Finan follows:]

Senator Capito. Thank you.

Our next witness is Maria Korsnick, Chief Operating Officer of the Nuclear Energy Institute. Welcome.

STATEMENT OF MARIA KORSNICK, CHIEF OPERATING OFFICER, NUCLEAR  
ENERGY INSTITUTE

Ms. Korsnick. Thank you very much, Chairman Capito.

On behalf of the commercial nuclear energy industry, I want to thank the committee for considering S. 2795. Introduction of this bill is particularly well timed.

Nuclear energy makes a significant contribution to our clean air quality, the reliability of our electricity supply and our national security. Yet, regulatory inefficiency and costs are constraining our use of this valuable national resource. If not addressed in the very near term, those issues will impede deployment of even more innovative reactor technologies here and around the world.

Despite NRC's effort to reduce its budget and right size the agency, fees continue to be excessive and the limitations of the mandated 90 percent fee rule create fundamental structural problems. The NRC's budget continues to hover at approximately \$1 billion a year, despite significant declines in its workload as plants have shutdown. In particular, according to Ernst & Young, the NRC spends 37 percent of its budget on support costs. That is more than 10 percent higher than some of its peer agencies.

Because the NRC must collect 90 percent of its budget from licensees and the NRC's budget has not correspondingly declined,

remaining licensees are responsible for paying these higher annual fees. With several recent premature shutdowns and additional reactors decommissioning in the coming years, the current fee structure virtually guarantees that remaining licensees will continue to bear even higher annual fees.

The cost of licensing actions also continues to increase well beyond the cost of living. For example, since 2000, the NRC review fees at license renewals have been an eight fold increase in review costs.

Objectively, one would expect a decrease based on efficiencies gained in the review process. This is particularly notable as we look ahead and want second license renewal for some of our plants. These illustrate that a fundamental change to the NRC fee recovery structure is needed. S. 2795 repeals the 90 percent fee recovery requirement and replaces it with a much more rational approach.

It requires the NRC to expressly identify annual expenditures anticipated for licensing and other activities requested by applicants. The legislation would also help drive greater efficiency in the NRC's operations.

In turn, it would drive down annual fees by limiting corporate support percentages, although we do recommend that the cap be lower than the 28 percent level proposed by this legislation. Complementing the limit on corporate support, the

bill would cap annual fees for operating power reactors at the fiscal year 2015 level. We also recommend that it apply to all licensees so non-reactor licensees as well.

S. 2795 also affirms Congress' view that this Country can and in fact, should, be a leader in advanced reactor technology. The bill effectively directs the NRC to think differently about reactor licensing.

It requires that the NRC's regulatory regime accommodate large light water reactors as it does today, small light water modular reactors and advanced non-light water reactors, in short, an all of the above approach.

The bill's call for a technology inclusive licensing framework, use of a risk informed performance-based licensing technique and a staged licensing process will, in fact, be a good and helpful step forward. Developers will be able to demonstrate progress to investors in this first of a kind project, thus obtaining necessary capital resources as they achieve milestones.

Too often we hear from our members that regulatory uncertainty is the greatest impediment to new plant deployment in the United States. S. 2795 tackles top line issues now standing in the way of innovation.

In sum, we must be thoughtful and deliberate in the way we plan for advanced reactor technologies, but we must also begin

today if we are to meet the potentially enormous demand by 2030 for U.S. technology not only here but in the international market.

Senators Inhofe, Crapo, Whitehouse and Booker, on behalf of the industry, I want to thank you very much for taking a strong leadership role. NEI supports S. 2795 and we look forward to continuing to work with you and your staffs as it progresses through Congress. I hope it is enacted expeditiously.

Thank you very much.

[The prepared statement of Ms. Korsnick follows:]

Senator Capito. Thank you.

Our next witness is Dr. Edwin Lyman, Senior Scientist,  
Union of Concerned Scientists Global Security Program. Welcome.

STATEMENT OF EDWIN LYMAN, SENIOR SCIENTIST, UNION OF CONCERNED  
SCIENTISTS GLOBAL SECURITY PROGRAM

Mr. Lyman. Thank you, Chairman Capito, Ranking Member Carper and distinguished members of the subcommittee.

My name is Edwin Lyman. I am a senior scientist at the Union of Concerned Scientists. On behalf of my organization, I would like to thank you for the opportunity to provide testimony on this very important subject, nuclear energy innovation and the critical role of effective regulation to ensure nuclear safety and security.

UCS is neither pro nor anti-nuclear power. We are a nuclear safety watchdog and we work to ensure that U.S. reactors are adequately safe both from accidents and secure from terrorist attacks. Our position on nuclear power is not ideological but pragmatic. We do believe nuclear power could have a role to play in helping to mitigate the threat of climate change but this really can only happen if nuclear power is sufficiently safe and secure.

That means if nuclear power is to grow, then there must be a corresponding increase in safety and security. Otherwise the risk to public health and the environment will increase. Nuclear power could take itself out of the running if there is another event like the March 2011 Fukushima Daiichi disaster.

Just over five years ago, Japan was a world leader in

nuclear energy, with over 50 operating nuclear power, but its nuclear establishment was too complacent about the dangers their reactors faced. Today, only two of those reactors are running and a battle is raging in the courts over the restart of two others. The United States needs to do everything it can to avoid repeating Japan's mistakes.

Therefore, Congress must ensure that the Nuclear Regulatory Commission continues to serve as a thorough and rigorously independent regulator for overseeing both the operation of existing plants and the licensing of new ones.

We believe the most efficient and cost-effective way to enhance reactor safety and security in the near-term is making evolutionary improvements in current designs and strengthening regulatory oversight, but we do acknowledge new and novel reactor technologies have the potential to achieve these goals in the longer term.

However, experience has shown that there are no quick or easy fixes to make nuclear power safer. Although each new reactor type has advocates who make claims about the benefits of their preferred designs for improving safety, proliferation resistance or economic competitiveness, such assertions rarely stand up to scrutiny. Reality is a lot messier.

Given the proliferation of new reactor designs and the massive investment needed to commercialize just one of them,

private and public investment in nuclear development should be focused on those concepts that have the greatest chance of meeting goals for enhanced safety, security, proliferation resistance, and economic viability. Cutting through the hype and identifying the best prospects is a major challenge.

For this reason, a thorough and independent technical peer review process needs to be part of any government program that provides support to new nuclear projects, whether at the national labs or in the private sector.

Now I would like to focus my remarks on the matter at hand, S. 2795. Fundamentally, UCS believes that the NRC's regulations and procedures governing both operating plants and new plants are not strong enough today to achieve the level of safety and security needed in the post-Fukushima era.

Correspondingly, we do not agree with the notion that the NRC's licensing processes for advanced reactors are too stringent and need to be weakened to facilitate deployment. Some argue that the NRC's regulations impede U.S. competitiveness allowing other countries like China to get ahead of us. We think the opposite is true, the reputation of the NRC for being a gold standard, as Senator Carper pointed out, is a good brand.

The NRC's reputation for rigorous safety reviews only enhances that brand. We do not think we should be engaged with

China and other countries in a regulatory race to the bottom just to secure customers.

We believe that the focus of the bill on NRC licensing is misplaced and will do little to facilitate the deployment of advanced reactors in the United States. The NRC licensing process may be a convenient target, but we think the NRC is being scapegoated for the far more formidable institutional barriers.

These barriers include a lack of support for government-funded energy R&D; the enormously high cost and long time needed for commercializing any advanced reactor; the lack of utility interest in making those investments; and the failure of nuclear power entrepreneurs to put any significant money into the projects they espouse.

We do not think the NRC's licensing process is a significant factor in inhibiting advanced reactor deployment. As a result, we do not think that the prescriptions in S. 2795 are the problem. The problem is the cost and difficulty of obtaining the analyses and experimental data sufficient to satisfy the regulatory requirements ensuring the reactors can be licensed and safely operated. This is the fundamental issue we think Congress needs to address.

In summary, we think the legislation is premature. We would offer that the National Academy of Sciences first review

the systemic obstacles to licensing and deployment of advanced reactors, including all the issues we mentioned and whether the specific prescriptions in changing NRC regulations would be efficient and effective in achieving these goals.

In conclusion, the future of nuclear power depends crucially on the NRC's credibility as an effective regulator, so we think Congress should reject any attempt to short circuit NRC safety reviews and help ensure that oversight and licensing will result in clear improvements in safe and secure operations.

Thank you for your attention.

[The prepared statement of Mr. Lyman follows:]

Senator Capito. Thank you.

Our next witness is Mr. Victor McCree, Executive Director of Operations, Nuclear Regulatory Commission. Welcome.

STATEMENT OF VICTOR MCCREE, EXECUTIVE DIRECTOR OF OPERATIONS,  
NUCLEAR REGULATORY COMMISSION

Mr. McCree. Thank you and good morning.

Chairman Capito, Ranking Member Carper, and distinguished members of the subcommittee, I appreciate the opportunity to testify this morning. I appear before you today representing the technical staff of the U.S. Nuclear Regulatory Commission.

I plan to briefly discuss the NRC's current and planned activities to prepare to review an application for an advanced non-light-water reactor design and to offer NRC staff views on S. 2795, the Nuclear Energy Innovation and Modernization Act.

A number of advanced non-light-water reactor designs that employ innovative design features are under development. The NRC has the necessary licensing and oversight authority over commercial advanced reactors and is ready to work with the potential applicants to prepare for and review applications for these reactors. However, the NRC is also considering the extent to which enhancements to the existing licensing framework could increase the efficiency, timeliness and predictability of our safety and environmental reviews.

Our objectives for the activities I will discuss with you today is to strategically prepare for non-light-water reactor applications commensurate with the development of vendor and industry plans. However, our overall goal is to create a more

effective, efficient, clear and predictable licensing process for advanced reactor safety reviews.

With this in mind and within available resources, the NRC staff is pursuing a multipart strategy to prepare for our review of non-light-water reactor technologies. The President's fiscal year 2017 budget request includes \$5 million in non-fee recoverable activities to execute this strategy. If Congress appropriates this funding, it will be used to facilitate the NRC's preparation to undertake efficient and effective safety reviews of advanced reactor technologies.

We plan to pursue activities in three primary areas: licensing infrastructure; technical preparation; and stakeholder outreach.

First, within licensing infrastructure activities, we will optimize the regulatory framework and licensing process for advanced reactor safety reviews.

Second, our technical preparation activities will evaluate, clarify and resolve critical technical and policy issues that need to be addressed for effective, efficient advanced reactor safety reviews.

Finally, we will expand upon our outreach activities to proactively engage key stakeholders to ensure all parties will be ready to proceed in the development and review of new reactor designs.

Our strategy reflects insights we have gained from many years of interaction with the Department of Energy and the non-light-water reactor community. We believe this strategy will enable the resolution of novel policy issues and lead to the development of design criteria, regulatory guidance and industry codes and standards for non-light-water reactor designs.

By enhancing the efficiency and effectiveness of non-light-water reactor reviews, this strategy will reduce uncertainty and business risk.

The NRC's Advanced Reactor Program is one of several topics addressed in S. 2795. Consistent with my role as the NRC's Executive Director for Operations, my comments represent the NRC staff's assessment of factual issues associated with a draft version of the bill.

Based on our preliminary review, the bill would require the NRC to undertake a number of activities related to developing plans, strategies and rulemaking associated with the licensing of advanced reactors and of research and test reactors and report on those to Congress. Significant time and resources would be required over several years to implement the full range of additional activities described in the bill, particularly with regard to the rulemaking required by the bill.

Another area covered by the bill is performance and reporting. These provisions would require the NRC to develop

performance metrics and milestone schedules for any activity requested by a licensee or applicant and to report to Congress for certain delays.

This would require NRC to develop performance metrics and milestone schedules for many activities beyond those for which such metrics and milestones are currently prepared. We believe we currently have appropriate performance metrics to provide the desired outcome.

These measures recognize the need to adapt to schedule changes that may arise to an applicant, licensee or NRC performance and account for emerging safety or security issues, changes in licensee plans and so forth. As written, the proposed requirements may limit NRC's flexibility in this area.

In closing, I welcome the committee's interest in and ideas for enhancing the NRC's performance and the success of our mission.

Chairman Capito, Ranking Member Carper and distinguished members of the subcommittee, this concludes my formal remarks. I thank you for the opportunity to appear before you and would be pleased to respond to your questions.

[The prepared statement of Mr. McCree follows:]

Senator Capito. Thank you.

Our final witness is the Honorable Jeffrey S. Merrifield,  
Chairman, USNIC Advanced Reactor Task Force. Welcome.

STATEMENT OF THE HONORABLE JEFFREY S. MERRIFIELD, CHAIRMAN, U.S.  
NUCLEAR INFRASTRUCTURE COUNCIL ADVANCED REACTORS TASK FORCE

Mr. Merrifield. Chairman Capito, thank you very much.

It is indeed a pleasure to be here today before a committee on which I used to work as a counsel, and on which I testified on many occasions as an NRC Commissioner.

I am appearing here today in my role as Chairman of the U.S. Nuclear Infrastructure Council Advanced Reactors Task Force, although my full time occupation is as an attorney and partner with the Pillsbury law firm.

In addition to my full testimony, I would ask that letters from seven advanced reactor developers supporting this legislation be included in the record.

[The referenced information follows:]

Mr. Merrifield. My testimony on S. 2795 will focus on how the NRC conducts its business as well as mixed views regarding the advanced reactor portion of the bill.

NIC applauds the overhead and fee caps within S. 2795 as well as the elements supporting the development and deployment of advanced reactor technologies. On February 22, 2016, NIC issued a framework for advanced reactor licensing modernization white paper which outlined many of the advanced reactor provisions contained in the bill.

While we will suggest a few additional areas for improvement not included in the legislation, we are committed to working with the committee and its staff to promptly move this legislation forward.

When I first became a Commissioner in 1998, the then chairman of this committee, Senator Inhofe, led the way in efforts to oversee NRC. Consistent with maintaining the NRC's mission of protecting people and the environment, the Commission, with the full support of this committee, worked to right size the agency consistent with the level of licensing activities before the NRC.

At that time, the agency had approximately 3,400 employees and within the next few years, we were able to reduce it to about 2,800, principally through attrition yet with no sacrifice to the mission of the agency. Today, the agency faces the same

challenge. I understand and sympathize with the concerns voiced by this committee regarding the size of the agency, the increase in licensing review time and the growth in overhead activities at the agency which is inconsistent with the current number of NRC licensees.

While the NRC has made great strides in right sizing the agency through Project AIM, I believe further reductions can be accomplished while at the same time effectively maintaining safety and inspection activities and improving the timeliness of licensing actions.

I support the provisions of S. 2795 which would limit the overhead of the NRC and place appropriate caps on the growth of agency fees. As was the case when I appeared before this committee over 15 years ago, I believe the amount of fees placed on individual licensees is not appropriate and should not cover inherently governmental functions and overhead.

I believe the fee provisions of S. 2795 appropriately balance the important non-licensee activities which should be borne by general revenues and those licensee activities that should be borne by user fees.

During the past decade, the U.S. has maintained its technology leadership through progressive light water reactor designs including passive Generation III+ reactors currently being deployed in Georgia and South Carolina, as well as small

modular light water nuclear reactors now headed toward deployment.

If the U.S. is to be successful in maintaining its lead in developing and deploying a new advanced reactor fleet in the late 2020s and 2030s, Congress must consider significant new policy changes.

In addition to funding an infrastructure, a modern licensing framework is needed to enable development and deployment of advanced reactor technologies. Currently, the licensing process of the agency is perceived as one of the largest risk factors confronting private developers of advanced reactors.

The proposed licensing process changes envisioned by S. 2795 will help to address this gap. Additionally, Congress should provide additional resources to both NRC and DOE as well as direct them to focus and mobilize their resources and expertise to enable the deployment of advanced reactors.

We believe Section 7 will allow the agency to create a modern, risk informed, technology neutral framework to enable the development of appropriate advanced reactor regulations without passing these costs to the existing utilities or advanced reactor developers.

Advanced reactor technical performance criteria are also critically required to finalize advanced generic design criteria

as well as short term emergency planning and similar requests.

We believe there are two areas where further enhancements are warranted: appropriate funding to reduce the licensing fees borne by advanced reactor developers and a specific pre-licensing review program.

While the NRC is not a promoter of nuclear technologies, it is appropriate for the Commission to engage in early, enhanced dialog with advanced reactor developers. Currently, the NRC has very limited communication with these developers and when it does, it must charge hourly fees, \$268 per hour, per NRC staff member who attends these meetings. As members of the advanced reactor community are early stage and entrepreneurially driven private companies, they lack the resources necessary to finance these activities.

NIC supports Section 9 of the bill regarding the DOE licensing cost share grant program. We believe this is an appropriate development. We would say we think it could be further enhanced by allowing for early stage engagement with the advanced reactor community at no cost with perhaps a 50/50 share in later stages of the licensing process.

Collectively, we believe this will allow the free market to pick winners and losers rather than DOE and the NRC. While Section 7(b) calls for the NRC to "establish stages in the commercial Advanced Nuclear Reactor licensing process," we

believe, and it is generally consistent with our white paper, the bill would be strengthened by incorporating specific language requiring that the NRC provide a pre-licensing design review.

A process which requires the NRC to clearly and promptly articulate where advanced reactor designs do and do not need additional work would enable developers and investors to have a clearer picture of where they stand in meeting NRC requirements.

Finally, we support the elimination of the mandatory hearing requirements contained in Section 8. I would be pleased to discuss my views on this during the question and answer portion.

We believe it is time to make appropriate reforms to the NRC overhead and fee process as well as to modernize the agency's licensing program to spark innovation and enable advanced reactor technologies to achieve their full promise. We believe S. 2795 makes significant progress towards achieving that goal. We are committed to working with this committee towards prompt and successful passage.

Thank you for allowing me to testify today.

[The prepared statement of Mr. Merrifield follows:]

Senator Capito. Thank you. Thank you all very much.

I will begin the questioning asking Mr. McCree what we have heard in the testimony and certainly what is contained in the bill has to do with right sizing the agency in terms of license fees and support.

In 2006, the NRC spent \$208 million on corporate support spending which amounts to 28 percent; you can see it on the chart, of the NRC's budgetary authority. This was at a time when the NRC was regulating more reactors and materials, licensees, with fewer people and resources.

Mr. McCree, I would say, do you recall any impairment of the NRC's safety and security mission in 2006 as a result of this level of corporate support?

Mr. McCree. In response to your question about impairment of our safety and security mission, I would indicate that answer is no.

Senator Capito. Thank you.

I would say if corporate support spending equaled 28 percent of the NRC's budget, the amount would be \$275 million, which is only \$30 million less than what the NRC is expecting on corporate support.

I would ask, in light of the fact that there was more work and more licenses in 2006 with this 28 percent, do you have any reason to believe this amount of corporate spending at the top

part, which would be \$30 million less than what you would expect, could impair the NRC's ability on safety and security?

Mr. McCree. Comparing NRC now to 2006, we are certainly a different agency. While there are about 100 more operating reactors than there were in 2006, there is additional work that we have now that we did not have then with the four AP1000s that we are overseeing as well as completion of oversight of Watts Bar 2. The workload is different than in 2006. Certainly our staff size is different as well.

Senator Capito. Are you saying you think if it were to be right-sized to the 28 percent, there could be some concerns over safety and security?

Mr. McCree. That is not what I am saying. I am simply saying that we are comparing a different agency now in 2016 to 2006. As far as right-sizing, we are taking under Project AIM significant steps to right-size the agency for the work that we have and the work we anticipate in the future.

That right sizing includes right sizing our corporate support area where we have taken significant reductions, about \$30 million in reductions this year, in 2016. Additionally, the Commission just acted on a number of recommendations under the Project AIM re-baselining that will result in additional reductions in 2017.

Several weeks ago, the Chief Financial Officer and I

assigned a tasking for several of our larger corporate support offices to look at additional reductions that we would plan to submit to the Commission in planning for our fiscal year 2018 budget.

As the Chairman noted yesterday in the House hearing, we are not done. The Project AIM right-sizing continues. I do believe the corporate support portion of our budget will continue to go down.

Senator Capito. Ms. Korsnick, you spent a lot of your testimony addressing this issue. Do you have a reaction to what the gentleman testified in answer to my question?

Ms. Korsnick. Yes, and I think I included in my testimony the fact that when we looked at the peer agencies to the Nuclear Regulatory Commission, we would like even more attention paid to those peer agencies which appear to be effective at the corporate support level even less than 28 percent.

The other thing in this fee structure we are very interested in is the way the current bill is structured. It not only asks for the NRC to allocate for certain licensee requests, but that the money needs to be spent on that and on that alone.

Right now, there is the ability to move some money around, if you will, and in fact, move it to corporate support. We would like a stronger fiscal responsibility on that.

Senator Capito. Thank you.

Dr. Back, in your testimony you mentioned the four principles: cost competitiveness, safety, less waste and reducing proliferation risk as your four corners of developing an advanced reactor. I think I am hearing that the NRC would get in on the front end, maybe raise red flags in the beginning of the licensing procedure rather than at the back end where the timelines are leaking and making even incurring more expense.

It would be more helpful to you in order to reach these four benchmarks? Is that a correct assumption?

Ms. Back. Yes, although it is not at the point where the reactor is not performing well. We are looking for input early because the technologies are different, so the way you evaluate the kind of metrics you assess, the safety, cost competitiveness and other factors of the reactor are different.

Senator Capito. At this point in your development, you have had no internal conversations with the NRC on your advanced reactor?

Ms. Back. We have had one conversation because we are allowed one conversation which is free, so to speak, before the hourly rates come up. In our development of the reactor, because of the way it is structured now, it is not well suited for our particular technologies.

When we looked at where we were investing our research dollars versus funds to try and get input from the NRC because

we now it is a long path, there has been a history with NGNP with many white papers without a clear decision.

There is an uncertainty that is very difficult to manage at this early, early stage. That is why a very small investment from NRC funds in the beginning would be very helpful.

Senator Capito. Thank you.

Senator Carper.

Senator Carper. I would be happy to yield to others who may have urgent business to attend to. I will be here for the duration. Is anyone in a tight squeeze right now? If not, who would be next under the early bird rule?

Senator Crapo.

Senator Crapo. Thank you very much, Senator Carper.

Madam Chairman, at this point, we have received 19 letters of support for this legislation. I would like to ask unanimous consent that these letters of support be included in the record.

Senator Capito. Those will be included in the record, without objection.

[The referenced information follows:]

Senator Crapo. Thank you very much.

I would like to direct my first question to you, Mr. McCree. As you know, we have been working very hard to understand the budget of the NRC and its inner workings. There is, in my view, a relative consensus that the NRC budget process is very opaque.

In addition to concerns about fee structure, I am deeply concerned about lack of clarity on how the NRC budgets for its overhead functions. Will you commit to working with my staff and the staffs of other members to provide timely and clear responses to our questions about your overhead functions and your budget requests?

Mr. McCree. Yes, absolutely.

Senator Crapo. I appreciate that. We really need a commitment to provide more detail about how the NRC allocates and spends its resources so that we can more effectively understand how the budget works.

I want to use the rest of my time to talk to the whole panel. I know that is going to be hard in four minutes. The point I want to get at is Dr. Lyman, in his testimony, has two points and many more. One of them was that we should not weaken the NRC regulatory structure. It is the gold standard and we need it to continue to be the gold standard.

I do not view this legislation as weakening the regulatory

structure in any way. I view it as increasing transparency and efficiency. Maybe I will turn to you first, Mr. Merrifield. What is your view of that issue?

Mr. Merrifield. I disagree with Mr. Lyman in that regard. What we are really asking for and what I think this legislation will accomplish is risk informing the regulatory activities of the NRC and tailoring those activities to be appropriate for the licensing of advanced reactor technologies.

This will in no way reduce the level of safety. In fact, arguably, it will allow the agency to appropriately tailor resources to make sure these technologies are regulated in the right way. It will also hopefully have the successful accomplishment of doing it at lower cost which is important as well.

Senator Crapo. The earlier that the agency is involved in the development of the technologies and the understanding of them, the more efficient and effective the regulation can be.

Mr. Merrifield. That is exactly right. I think it would allow much better utilization of resources. I would say a couple things.

One, I think what Mr. McCree's staff really needs to do is elevate, as quickly as possible, many of the generic policymaking decisions that can be made to the Commission and by the Commission to reduce the uncertainty for advanced reactor

technologies.

Secondly, we talked a bit about the fee process. It is very important to provide fee relief in the early stages of the program to allow active discussion between the developers and the NRC.

As discussed by one of the other witnesses, there is a lack of engagement because once you start talking to the NRC besides your initial meeting; the \$268 per hour fee is going to start triggering. That is not good. We really should be encouraging very active discussion between the developers and the NRC right now.

Senator Crapo. Thank you.

I probably only have time for one of the other witnesses. I will turn to Dr. Finan because of your charts.

The other issue that was raised which I focused on is the probably really is not the regulatory system but the fact we cannot get investment at the early stages of the development of these new technologies.

To me that seems to be exactly the point that because of our regulatory structure, at least a big part of that issue is if you do not have the staged development or something like that, which this bill contemplates, you have a situation in which it is very hard to get early investment in these expensive technologies. Could you address that?

Ms. Finan. That is right. I think there are a lot of other challenges to deploying advanced reactors as there are for renewable and carbon capture and other energy options. The investors and innovators have made it very clear that their most immediate and pressing concern is regulatory uncertainty.

I do not think we need to have another study. There have been a lot of studies on that. I would be happy to provide a list of references but climate change is urgent. The private sector is engaged and eager. The time to fix this is really right now.

Senator Crapo. Thank you very much.

My time has expired. It looks like I am now chairing the hearing.

Senator Carper. I think you are doing a great job.

Senator Crapo. [Presiding] I would turn, Senator Booker, to you next.

Senator Booker. Mr. Chairman, thank you for that.

My staff and I were just talking about how incredible your staff has been, not just in working on the bill, but in reaching out to all these groups. The letters you submitted are really a testimony to the kind of inclusion that you have had in this process. Thank you very much.

Ms. Korsnick, in your testimony you make the point that a reduction in the number of existing licensees increases the fee

burden on the remaining licensees. I think we all hope we do not see this rash of additional premature closings within our nuclear fleet. That would be bad for the overall energy picture in the United States.

That said, if we did, can you explain how, under current law, that would impact the reactors that remain and whether this bill would alleviate that scenario?

Ms. Korsnick. In fact, the current bill is structured to alleviate that very concern. As the current structure is in place with the obligation to collect 90 percent of the budget, it is 90 percent of whoever is there to pay.

If those plants close down and are no longer part of that fee structure, then the remaining plants, remaining operating reactors, have to pay that 90 percent bill. Our experience has been, based on the chart you just saw and our experience with the NRC budget historically, the budget has not reduced commensurate with the operating reactors shutting down.

Senator Booker. Thank you.

Dr. Finan, besides the fact you mentioned those two terrible words, climate change, I will forgive you for that, I am into innovation and innovators. I have a problem since I have been two years in the Senate from the FAA to the Patent Office; we do a lot to constrict innovation. In this space, innovation is I think critically important.

The GAO last year did an incredible report that looked at the challenges facing companies attempting to deploy new reactor concepts. In this report, the GAO noted that for first-of-a-kind technologies, the design review costs for these folks can be exceptionally higher than for subsequent projects.

Do you believe this is a real problem as noted in this report? Do you think the DOE matching grant program in the bill can help solve the problem?

Ms. Finan. I agree. I think that is a critical problem for innovators. There is really a need, not only to make sure the costs are under control, but also to make them more predictable so that investors and innovators can plan accordingly. I think the DOE matching program could certainly assist them in that immensely.

Senator Booker. These are innovators who are really critical for advancing nuclear in terms of the safety, in terms of being able to better deal with challenges we have like the waste from current light water reactors as well as deal with problems we have including proliferation of this material, is that correct?

Ms. Finan. That is right. I actually think this is very exciting because in the past nuclear was developed initially for the Navy for submarines. Then it was adapted to land. Today's innovators are really putting a priority on our values today,

those key values being safety, proliferation, cost and all of the other things that nuclear can provide.

I think these new designers and innovators are going to bring that to the table and we need to help them move forward.

Senator Booker. We need to create a government regulatory climate where these folks can flourish and we are not putting undue cost burdens on them, correct?

Ms. Finan. Absolutely.

Senator Booker. Can you expand a bit on your testimony in the little bit of time I have left as to why the existing nuclear framework is really problematic for reactors, a bit more about specifically what is so problematic about the framework?

Ms. Finan. As an analogy, if we looked at our emission standards for vehicles, those are very performance based. They set maximum emission levels. If instead they were prescriptive and required particular catalytic converter technologies, TESLA, with an electric car, would have to come in and seek exemptions to those technology requirements.

For a nuclear reactor, that is much more complex and has a lot more regulation. Those exemptions would be multiplied and have a lot of issues where you need to come in and seek different treatment.

That is something that is a big barrier for new technologies because every time they have to do that, that is an

uncertain process that has not been done before. That uncertainty creates a great problem for investors and innovators.

Senator Booker. I appreciate that.

In the minute I have left, obviously Senators Crapo and Inhofe come at this from a different direction than we do. It is beautiful how we were able to meet and make this a bipartisan bill.

Senator Whitehouse and I, however, come at this with real concerns and fears about overall climate change. There is a massively expanding demand for energy globally which is rapidly expanding as I said in my opening remarks, at a rate that people like me have visions for solar, wind, and battery storage.

There is no way that renewable pace will keep up with the demands we are having. Right now, 60 percent of our clean energy is being produced by nuclear. Do you believe this is a place where we have to actually expand innovation if we are going to deal with the overall problem Senator Whitehouse and I see of climate change?

Ms. Finan. Absolutely. That is very important because this is not just a political issue; it is not even just about climate change or energy security. This is a humanitarian issue. There are a billion-plus people on this earth who do not have electricity. We need to provide that energy. We need to

have all the tools on the table and that has to include nuclear, so I think this is critical work.

Senator Booker. Thank you very much, Dr. Finan.

Senator Crapo. Thank you very much, Senator Booker. It looks like I still have the gavel.

Senator Inhofe.

Senator Inhofe. Confession is good for the soul. I confess that you did a much better job of pointing out something than I did.

The interesting thing about this is there are those on your side whose lives are driven by climate change and those on this side who are realists, but we still agree on this bill. We know this is going to serve everyone's best interest.

I am not sure what all was covered because I had to go down to Armed Services which is one problem we have on this committee. We have nine members on both this committee and Armed Services. Somehow I have never been able to convince John McCain that we are a committee too.

I have a chart. Ms. Korsnick, I want you to look at this. The fees on reactors increased substantially over the last few years. In this bill, we capped the annual fee for operating reactors at the 2015 level based on the most recent fee recovery rule.

This level is very near the all time highest amount that

reflects the post-Fukushima workload. That workload is now declining. We also provide for inflation adjustment.

Ms. Korsnick, do you believe this amount is an appropriate ceiling to ensure the NRC is adequately resourced to execute the safety and security mission?

Ms. Korsnick. Yes. In fact, as you just described, we think fiscal year 2015 is the high water mark, quite frankly, for the agency. We feel, in fact, that it should not need to approach that ceiling.

As you described, some of that workload, in fact, is declining from post-Fukushima and we feel a more efficient agency should be able to operate with a corporate spending more in line with their peer agencies.

Senator Inhofe. Whether or not you would want to reach that cap, it is adequate to take care of what our needs are now?

Ms. Korsnick. It is adequate, yes, Senator.

Senator Inhofe. Under S. 2795, the amount of annual fees the NRC collects would increase when newly operated plants begin to pay their fees or would decrease when reactors close. Do you believe that is an appropriate way to account for increases and decreases?

Ms. Korsnick. Yes, Senator, we do. It obviously speaks directly to workload. We think that is a fair process.

Senator Inhofe. I would agree with that.

When companies decide to close nuclear reactors, do they give the NRC adequate notice such that the NRC can account for the decrease in fees in their budget process?

Ms. Korsnick. We believe so, Senator. The individual plants also need to go through a planning process. They need to inform the regional transmission operator in advance. It is typically a 12 to 18 month timeframe that you are making these types of announcements.

Senator Inhofe. Mr. Merrifield, I think back to when you first started or actually I first chaired this committee, you were then the attorney here. You were not a Commissioner at that time?

Mr. Merrifield. No, I was a counsel to this committee.

Senator Inhofe. You might remember at that time this committee had no oversight for four years.

Mr. Merrifield. That is true. You did a very good job of correcting that problem.

Senator Inhofe. We did correct it. We got busy, set goals and priorities as to when we would be coming in and what we were supposed to be doing. I think that did work.

Mr. Merrifield. It did, Senator.

Senator Inhofe. During your tenure as Commissioner, you led an effort to improve the efficiency of new plant licensing. One of your recommendations was to eliminate the mandatory

hearing, is that true?

Mr. Merrifield. That is true, Senator.

Senator Inhofe. Would you explain what that was all about?

Mr. Merrifield. The mandatory hearing process the agency has right now dates back to the early days of the Atomic Energy Commission. When you look at the legislative history, the reason for its imposition was because the AEC actually approved several reactors with no public involvement whatsoever. The outcry caused Congress to impose a mandatory hearing requirement which was appropriate at the time.

Over the years, with changes under the Administrative Procedures Act and the wide number of opportunities for the public to be involved in the many steps of the licensing process, in my view is, then as it is now, that is an antiquated notion that is no longer necessary.

If there are specific issues, those can be brought up in a contested proceeding that the Commission can go over, but I believe a mandatory hearing is not necessary. Indeed, frankly the requirement right now causes significant staff resources, which ultimately must be borne by a combination of the Federal Government and the licensees, to deal with the mandatory hearing. It would be a significant reduction of fees if that was eliminated.

Senator Inhofe. I have one last question. I would like a

short answer because my time has expired.

I described the lax situation that was there having gone four years. Oversight is important. Do you think since that time we have slipped a little and need to become a bit more forceful in overseeing the NRC?

Mr. Merrifield. As a Commissioner, I welcomed involvement with the committee.

Senator Inhofe. I know you did. You were very helpful.

Mr. Merrifield. It was helpful to us to have our feet held to the fire; it gave us the discipline to make sure we oversaw the agency and its mission. The Commissioners have the responsibility to oversee what Victor McCree and his staff does.

I think further reductions of staffing are appropriate and I think the involvement of this committee in oversight is welcome.

Senator Inhofe. Thank you, Mr. Merrifield.

Senator Crapo. Thank you, Senator Inhofe.

Senator Whitehouse.

Senator Whitehouse. Let me say first how happy I am that the Chairman had a twinkle in his eye when he made that comment about Senator Booker and me.

Second, let me say to Dr. Lyman that it is very much not our intention in this bill to short circuit the safety review of any nuclear facility.

My concern is the review process at the NRC has become so light-water reactor-specific that another technology looking at getting through that obstacle course is facing hazards that have nothing to do with short-or-long circuitedness, but simply not being appropriate to the technology in the same way that if you had to pass a test for how solid the canvas was on the wings of your proposed aircraft when you were actually proposing an aluminum-winged aircraft or where the pilot's goggles needed to be and what they needed to be made of when, in fact, you were proposing a closed cockpit aircraft. It is an issue of relevancy, not of shortcuts.

I would invite you and any other member of the panel who wishes to put in writing some benchmarks for us you think would indicate the departure from moving the regulatory process more towards relevance to new technologies and into simply short circuiting safety because I do not think there is a person who supports this bill who wants to short circuit safety.

It would be helpful to have this conversation in a more specific way about what the red flags might be rather than speaking generally about that.

I worry that we have technologies that effectively are smothered in the crib because they cannot figure out what their regulatory process is going to look like and therefore they cannot raise capital and proceed. There is a big X factor, a

big question mark around the process if you are not a traditional light-water reactor.

That is how I think of the problem. I would be interested in not only your response but everyone else in writing, if you care to make that known.

The last point I will make goes back to something I said in my opening remarks. I think it is a tragedy in a carbon constrained environment to have nuclear plants closing that are producing carbon free power for no other reason than no one has figured out how to pay them for what we all almost agree is the value of the carbon freeness of their power.

We have an Administration that has an Office of Management and Budget that has a \$42.50 per ton social cost of carbon. If someone has a suggestion as to how we can figure out a way to pay the existing nuclear fleet \$42.50 per equivalent of voided ton of carbon, I am down for that. We need to find the revenues.

I do not think it is a good thing to run up the deficit but I do think there ought to be a way to provide that revenue stream to these facilities so that artificially driven economic decisions that are in fact wrong from both an environmental and economic perspective are not being driven across this industry by this market failure.

I know that is a bit beyond the scope of this particular

bill but if any of you have ideas on that, I would encourage you to please go ahead and offer them. I would offer that solicitation to my colleagues as well.

Again, Mr. Chairman, thank you very much.

Mr. Merrifield. Senator, if I may, on the first point you made.

Senator Whitehouse. The one about Chairman Inhofe?

Mr. Merrifield. Not that one.

Senator Whitehouse. You saw the twinkle in his eye too?

Mr. Merrifield. I did see the twinkle in his eye.

Senator Whitehouse. There you go.

Mr. Lyman. I would like an opportunity to respond.

Senator Whitehouse. You will have an opportunity to respond. I would just like it in writing because I think it is going to be a long response. This is a continuing conversation that I think we need to have to make sure we stay on the right track.

Mr. Merrifield. On your first point, I think you were entirely correct. I think the process does need to be tailored for these advanced reactor technologies.

As a Country, we have had a leadership role historically in the nuclear energy field. It is a different world today. There are lots of opportunities for advanced reactor developers to work with regulators around the world.

If we do not maintain our lead in having them come before the NRC for review, they may well decide there are other countries better suited to have those licensed. That is not in the best interest of our Country.

Senator Whitehouse. I have been to China and heard the reports on the facilities that were designed in the United States but are being constructed over there.

My time has expired.

Senator Crapo. Senator Fischer needs to go next. I do not know if anyone else wants a second round but I have one more question. Then I will give you a chance, Dr. Lyman, to respond at that point.

Senator Whitehouse. I do look forward to working with you. I am not trying to be hostile; I am trying to open a conversation that separates what I think is a good way point that you have indicated for us.

Mr. Merrifield. I appreciate that.

Senator Crapo. Senator Fischer.

Senator Fischer. Thank you, Mr. Chairman.

Nebraska hosts two nuclear reactors that provide clean, affordable, reliable energy to our ratepayers and also our families. This important legislation we are discussing today will provide our nuclear innovators the transparent framework that is necessary to launch this nuclear fleet into the future.

It will also enable our utilities to continue to provide affordable and reliable energy. I am appreciative of the discussion we are having today and also that we are recognizing the outstanding job that our nuclear reactor utilities perform every single day.

Mr. McCree, the legislation we are considering today creates an Advanced Nuclear Energy Cost Share Grant Program that enables the Department of Energy to establish a grant program.

I understand there have been criticisms regarding the DOE grant programs that share the costs of NRC licensing as picking winners and losers. In your experience, do you believe it would be appropriate for the NRC to manage such a grant program to reduce review fees for applicants or would the NRC consider that promotional and in conflict with its role as a regulator?

Mr. McCree. Again, we reiterate that the Commission has not expressed its view on the bill but I would note as written, NRC would not manage the grant program but the DOE would. In that sense, it is not too dissimilar from a grant that the DOE made available for the combined operating licenseholders for the AP1000s in Georgia and South Carolina.

To that extent, it has worked well and has not impacted our fundamental safety and security mission or our independence principle to which the Chairman referred earlier.

Senator Fischer. You would not be supportive of the NRC

becoming involved in the grant program in any promotional way?  
You do recognize there is a conflict there?

Mr. McCree. Yes, ma'am, I do. Again, although the Commission has not weighed in on this, it would appear, I believe, to represent a conflict. Again, I would feel confident that the Commission would weigh in on that with a similar view.

Senator Fischer. Thank you.

Ms. Korsnick, in your testimony you stated that the cost and duration of reviews for license renewals and new plants have dramatically increased rather than decreased as the NRC and the industry gains experience with processes.

S. 2795 directs the NRC to ensure funds are available to complete reviews that the industry needs. The bill also has provisions, as you know, requiring performance metrics and reporting.

Do you believe this two-pronged approach will improve the efficiency and the timeliness of these reviews?

Ms. Korsnick. Yes, Senator, we do. The fact that the NRC will budget specifically for licensing requests of the industry, we think will help provide the necessary focus and attention on those. We do think this bill will be helpful in that area.

Senator Fischer. Do you believe it will also help lay the groundwork so we can have more predictable reviews in the future?

Ms. Korsnick. I think so. The challenge is when we say performance metrics and reporting. Of course the devil is in the detail on that in terms of what performance metrics are developed, but in concept, I think having metrics and reporting is absolutely helpful in demonstrating the success. Quite frankly, if the NRC is so successful, it is an opportunity to share that.

Senator Fischer. As we look at developing those metrics, how important is it that we have all the stakeholders at the table? You said it is very important and the devil is in the details. Can you give me an example where you would be representing a view that might not be available that other stakeholders would present?

Ms. Korsnick. I think stakeholder engagement would be very helpful in that way. As with any performance metric, you get what you measure. You can perform in a way that you say we are making the metric look good but it is actually not satisfying the greater good.

I think the way to avoid that is to get stakeholder engagement and review what the metrics would be to make sure all of the stakeholders' concerns would be reflected appropriately in the metric.

Senator Fischer. Thank you.

Mr. Merrifield, during your service as a Commissioner, you

helped prepare the NRC to review new plant applications. This bill directs the NRC to undertake several activities to develop a regulatory framework and get prepared to review the applications.

Do you think the scope of this work is too ambitious or do you think it is feasible?

Mr. Merrifield. I think it is absolutely feasible. Credit to the NRC staff, I think they will throw themselves at making this work. They are talented people led by Vic McCree who is a talented gentleman.

I think it is very achievable for the agency to do this. I think they can come up with a process that is risk informed, predictable, transparent and done in such a way as to allow these technologies to move forward. I think the bill encourages that.

I have one point on the earlier issue I would like to mention given my having been on the Commission. I do think the oversight this committee provides on the timing of various activities of the agency, license renewals and new license applications, are important metrics to look at.

The timing of those has increased since I left the Commission. That is an area of productivity I think certainly needs some attention.

Senator Fischer. Thank you.

Thank you, Mr. Chairman.

Senator Crapo. Thank you, Senator Fischer.

Senator Markey. Thank you so much, Mr. Chairman.

Mr. McCree, sequestration and the early closure of a number of nuclear plants have already put the NRC in a declining budget environment. At the same time, the revelation that ISIS recorded video at the home of a Belgian nuclear official underscores the need for additional resources for security and safety at U.S. nuclear power plants. It is at the top of the terrorist target list for ISIS.

Instead, the bill under consideration in this committee would constrain the NRC's resources by imposing a blanket cap on fees for operating reactor licensees.

Do you agree there is a possibility that such a cap could adversely impact safety and security by reducing resources and support for NRC staff working to protect reactors against insider threats or physical attacks?

Mr. Merrifield. I would reiterate that the Commission has not weighed in on the proposed bill including the caps described in the bill. If they would become law, of course then the NRC would abide.

Senator Markey. Fewer resources are not good for the agency in protecting against a potential terrorist attack, is that true?

Mr. Merrifield. Quite frankly, Senator, we are in a declining budgetary environment and we are doing our due diligence to assure that our resources are appropriately allocated to ensure our safety and security.

Senator Markey. Now you are pulling it away from other nuclear and safety issues in order to deal with a terrorist attack when both are very real in our Country. I just think we have to be realistic, that the Belgian warning that they were looking at a nuclear power plant and that they were trying to attack it is clearly something we have to take into account here in the United States.

When we talk about the Nuclear Regulatory Commission's budget, yes, we might want to do a favor for utilities and reduce their fees, but where is the money to come from in order to produce the level of safety we are going to need in our Country?

The findings in this bill state that nuclear energy provides for just short of 20 percent of electrical generation in the United States. There are currently 99 reactors producing electricity in our Country. At least three are closing very soon, Fitzpatrick, Oyster Creek and Pilgrim.

According to the Department of Energy data for nuclear energy to stay at 20 percent of total energy generation by 2025, we need to bring 13 large reactors online in the next nine

years. We are currently building four and one more. Watts Bar 2 is scheduled to produce electricity this year. That leaves us at least eight reactors short of the goal.

Do any of you disagree that there is little or no possibility that eight additional new reactors that we have not begun to build will come online by 2025? Do any of you disagree that there are not going to be eight new plants operating between now and 2025? Do any of you disagree with that?

Mr. McCree. No, sir.

Senator Markey. Let the record reflect that no one disagreed with that. Remember, eight new nuclear reactors are what we need to maintain nuclear share of electricity generation in our Country.

There would be a need to replace even more of that to replace fossil fuel generation as coal plants go offline. We need even more electrical generation capacity. The two reactors under construction at Vogel have experienced years of long delay, billions of dollars in cost overruns and it took 43 years to complete construction of Watts Bar 2.

Do any of you disagree that problems that caused the cost and schedule overruns at Vogel would need to be solved before any significant number of new reactors could be built in the next 10, 15 or 20 years? Do any of you disagree with that?

Let the record reflect that no one disagrees.

In recent years, the price of renewable energy sources has declined considerably. Here is the big number. Since 2010, the price of solar panels has declined by 80 percent. We are talking five years, an 80 percent decline.

By contrast, the cost of constructing nuclear plants has remained stubbornly high. In light of these facts, it simply is not realistic to expect that nuclear power will continue to provide the majority of emission-free electricity in the United States let alone be part of a solution for climate change.

In 2005 in the United States, there was 79 total new megawatts of solar installed. This year, it is 16,000 new megawatts of solar, in one year. You can see where the trend lines are. Increase solar deployment and wind deployment as the price of both declined radically in total cost where stubborn regulatory issues in terms of safety and design still plague the nuclear industry.

Dr. Lyman, this bill would scrap the requirement that the Nuclear Regulatory Commission hold a mandatory hearing on each application for a construction permit or operating license. Instead, such hearings would only occur if they are requested by a person whose interest might be affected.

Is there any evidence that mandatory hearings have uncovered weaknesses in NRC staff evaluations of construction permits or operating license applications that otherwise would

never have come to public view?

Mr. Lyman. In our view, the mandatory hearing does establish a unique and important role in filling a gap in the event that a contested hearing does not occur. Even if a contested hearing does occur, the mandatory hearing scope examines other issues including the adequacy of the NRC staff review.

A colleague of mine, a lawyer, Diane Kern, has compiled a number of instances where the mandatory hearings have uncovered significant inadequacies in the NRC staff review. I would offer that list for your inspection.

We believe the mandatory hearing process is important. It is also important for transparency. We heard a lot about the need to maintain transparency in the NRC review process.

The fact is the public does not always have the resources to be able to contest a hearing even if there are very important safety issues that need adjudication. For those reasons, we think the mandatory hearing should be preserved.

Senator Markey. I agree with you. There are mandatory hearings if you want to build a new house next door to someone else. We had public hearings at town hall. They were building a nuclear power plant and mandatory hearings for a construction permit, for an operating permit would no longer be mandatory. That makes no sense whatsoever. That is an inherently dangerous

technology that needs all kinds of tough questions to be asked about it.

I understand the wish list of the industry would say no more hearings, no more public input, no more questions asked by the Union of Concerned Scientists in public hearings questioning the underlying premise of building a nuclear power plant in somebody's neighborhood.

I do not think the public will be happy when they are told no hearings on this dangerous technology. Again, it still needs insurance protection from the Federal Government. That is how inherently dangerous it is. The private sector still is not willing to provide the insurance. You need the government to intervene, to provide that insurance coverage.

I thank you for your indulgence, Mr. Chairman.

Senator Crapo. Thank you, Senator Carper.

Senator Carper. If I were the Chairman, you never would have gotten those extra 3 minutes and 6 seconds.

Mr. Chairman, I would say it is probably safe to assume that Senator Markey is probably not going to co-sponsor this legislation any time soon.

Senator Crapo. I got that figured out.

Senator Carper. One of our colleagues is not here today, Mike Enzi. He and Ted Kennedy used to lead the Committee on Health, Education, Labor and Pensions for a number of years.

Enzi was a very conservative Republican and Kennedy was a very liberal Democrat. Somehow or other, they managed to get a huge amount done.

I used to say to Mike Enzi, how are you and Ted Kennedy able to bridge the divide and get so much done? He always talked about the 80/20 rule. I said what is that? He said, Ted and I agree on 80 percent of the stuff; we disagree on 20 percent. What we decide to do is focus on the 80 percent on which we agree.

Chairman Inhofe and I have co-sponsored legislation and I used to do this is George Voinovich on diesel emission reduction and we are making great progress on that front. We decided to focus on what we agree on.

In the spirit of the 80/20 rule, I want to ask this panel, we will start with you Dr. Back, what is the 80 percent where you folks agree or maybe 70 or 60 percent? Where is the agreement of this panel on some of the important issues? Just take a minute, nor more than a minute.

Ms. Back. I am not quite sure I understand the question.

Senator Carper. I am asking you what are the points of consensus for this panel. Where do you think you guys agree?

Ms. Buck. I believe we agree that early interaction with the NRC is helpful for new technologies for advanced reactors. I believe a staged approach is also very helpful. I believe

some kind of cost share to help with the fees or change the burden of having an all fees due for the design certification or licensing application is maybe not appropriate.

Senator Carper. Thank you.

Dr. Finan.

Ms. Finan. I think there is a very important area where we all agree. Even Senator Markey laid out some of the challenges faced by nuclear.

This is an industry that desperately needs innovation to address those challenges. Solar and wind have done really well and benefitted from a great deal of innovation in that space. Nuclear energy is ready. There are innovators and investors who are ready to really take on that innovation challenge.

I think we need to have a more efficient and transparent regulatory framework to enable the work we need to do to address those challenges that Senator Markey outlined.

Senator Carper. Thank you.

Ms. Korsnick. I think we all agree that nuclear power is very important and very necessary for a baseload, carbon free future for how we generate electricity. I think we also agree that we need a strong, effective regulator.

Earlier, we used the term gold standard. I think we do not want the NRC to be a weakened regulator. I do not think that is helpful for the industry. We do feel that we can have an

efficient and strong regulator, a regulator that is more transparent from a cost perspective.

Senator Carper. Thank you.

Dr. Lyman, where is the consensus?

Mr. Lyman. I would hope the consensus is that there needs to be a structured process to ensure that NRC safety reviews of new reactors are not spent, that those resources are actually used to end up with a product that generates electricity and are not just academic exercises. That is one concern we have with the bill and we hoped the panel would agree.

Also, I would point out that we do not agree that the stage process outlined in the bill necessarily would be helpful.

Senator Carper. Dr. Lyman, I was looking for points of agreement. We will come back to the 20 percent in some other hearing.

Commander McCree, a Navy captain, right?

Mr. McCree. Yes, sir.

Senator Carper. Naval Academy?

Mr. McCree. Yes, sir.

Let me first agree with my fellow panel, Ms. Korsnick, on NRC remaining a strong and credible regulator is essential. We are committed to our efficiency principle of good regulation and are making strides to become more efficient in this important area. The most important thing we do is assure the safety and

security of the 100 operating nuclear power plants and the materials licenseholders.

Within that, earlier, I alluded to the three-pronged strategy, the multipart strategy. I believe that is in perfect alignment. NRC needs to improve its regulatory infrastructure to make the prospective reviews of advanced non-light water reactors more efficient, more effective, more clear and predictable.

We are committed to build that framework, to have it in place, by 2019 so that if, and, or when an application is submitted for advanced non-light water reactors, we can conduct those reviews in a timely, efficient and effective manner.

We are on path to do that including considering stage reviews, conducting additional outreach with folks at the table, as well as other stakeholders, both domestically and internationally to make sure we are ready.

Senator Carper. Thanks very much.

Mr. Merrifield.

Mr. Merrifield. Think there is a consensus that we can build safer nuclear reactors.

Going forward, I do also want to mention there are small modular reactors in the pipeline contemplated to be built by 2023. As a Country, we have the capability of building more nuclear reactors by 2025.

We can have savings in the building of new reactors if we replicate and learn from the experiences at Summer and Vogel.

Obviously we need to make sure that the NRC has the resources necessary to protect public health, safety and security. Ultimately, it is the nuclear power plants that physically have to defend against potential ISIS threats.

From my view as a former Commissioner, those are the safest industrial facilities in the United States from a security standpoint and would well be able to defend against the kind of threats we have from that particular adversary.

Senator Carper. Mr. Chairman, let me go back to you. Maybe you can give me some more time later. Senator Markey, I did not take my earlier time so I am catching up.

Senator Crapo. Do you have more questions, Senator Markey?

Senator Markey. It would just be a comment, Mr. Chairman.

Dr. Lyman, do you agree that granting safety exemptions to advanced reactor licensees could lead to a net reduction in overall safety?

Mr. Lyman. Yes. To elaborate on that concern, the industry is pressing for generic decisions to be made on certain policy issues including the size of emergency planning zones for advanced reactors or small modular reactors, the level of security that is needed, whether or not the containment needs to be robust against large pressure increases and whether the

number of operators needed to staff a nuclear reactor complex should be reduced. They want these decisions to be made based on the expectation or the assertion that advanced reactors are so much safer than current reactors that we do not need these extra levels of protection.

Our concern is that assertion is not always based on a full enough body of evidence and experimental data to justify making those decisions so there could be a net reduction in safety if exemptions and other relaxations in safety procedures are granted based on a presumption that a nuclear reactor is safer without a full examination of that claim.

Senator Markey. Mr. Chairman, laced throughout the bill, as it is drafted, is an assumption that there are inherent safety features built into advanced design reactors that make it safer automatically.

That is a nice assumption to make. It is a nice assertion to make but that is going to be tested. We have to make sure that any one additional, potentially successful safety feature interacts with the totality of the rest of the nuclear power plant in terms of assuming the power plant is safer.

We do not know that. That is an assumption built into the language of the bill. This just goes to the question, and it is an 80/20 question, what are the big issues that we have to deal with. Eighty percent is still going to remain is there enough

money for the NRC to do their job, having enough personnel asking all the right questions, having the right supervision and the fees are going to be reduced.

Are these new technologies actually inherently safer? We have to have the capacity to be able to determine that. Will the public be able to ask questions? The industry has always tried to get the public out but after Three Mile Island, Chernobyl and any number of other incidents, the people do not trust the experts anymore. They want to be able to ask questions too because these power plants are going into their neighborhoods. You cannot wall out whole areas of the Country.

These have historically always been big questions. From my perspective, public input is vital and should actually be strengthened. The new reactors should not be exempted from important safety requirements that historically have been required and that the NRC budget should not be capped.

These are the central areas, the big questions that we are going to have to answer in this legislation. It is going to keep coming back to the same questions we have asked for the last seven years on technology. The questions do not change. We will be the ones that have to decide.

I thank you, Mr. Chairman, for having this very important hearing. We know one thing, that these power plants are now 20, 30 and 40 years old. You have to go to the doctor more the

older you get. There are more things that can go wrong the older you get.

To reduce the budgets of these aging power plants in densely populated areas all across the Country and say at the same time we are going to have lower numbers of personnel, lower amount of fees and revenues going in is totally contrary to how we think about it.

There are issues like embrittlement in nuclear power plants that are the same as cholesterol going through the veins of older Americans. They cause issues that require a lot of additional attention.

To say that is not as accurate for technology as it is for humans just belies the reality of what we have already learned about nuclear power plants in our Country.

I thank you for the courtesy, Mr. Chairman, and the additional time to question.

Senator Crapo. Thank you, Senator Markey.

I will take my last round right now and then you will be able to finish, Senator Carper.

I just want to make the comment that this legislation does not make assumptions. It sets forward a new process, a more transparent and I think effective process for the decisions you are talking about to be made.

It definitely does not give any exemptions to any

technology. It puts the NRC directly in charge of improving and strengthening our safety. I would actually like to use my time to ask Mr. Merrifield and Ms. Korsnick to respond to that very issue.

Mr. Merrifield. I think the NRC is going to be able to continue to meet its mission of appropriately looking at these technologies and ensuring they are assured that they are safe. I think it will be able to do so in a way which is risk informed such that it will be able to judge is there a need for a large, emergency planning zone, where the amount of radiation in that reactor zone may be much less.

Senator Crapo. This legislation does not choose technologies. It does not define standard.

Mr. Merrifield. No, it does not. Those tools remain with the NRC.

The other point I would make is it is not as if these technologies are entirely new. Indeed, most of the advanced reactor technologies being brought forward today were originally developed by the Atomic Energy Commission and DOE during the 1950s and 1960s.

There is a significant amount of research information available to demonstrate the safety of these reactors today and justify the NRC making changes which would more appropriately tailor their regulations for advanced reactor technologies fully

consistent with public health and safety.

Senator Crapo. Thank you.

Ms. Korsnick.

Ms. Korsnick. I have a couple of comments. Clearly the industry and the folks representing advanced reactors, none of us are interested in reducing safety margins. The conversation and structure in this bill that provides a licensing process really informs that licensing process that these safety margins might, in fact, be met in a new and different way with this innovative technology. That needs to be acknowledged through the licensing process.

We are not in any way lowering the bar or lowering the standard. Quite frankly, we are meeting or maybe even exceeding the standard but just in a new way.

The other item I wanted to mention and I appreciate Senator Markey is not here but the mandatory hearings that were mentioned earlier, these are uncontested hearings. That means the public does not participate.

The hearings that are referenced in this bill, in fact, are held between the Commission and the staff on construction permits and combined license applications. It is not cutting the public out, if you will, of any conversation. We are very interested in the public being involved in dialog.

Senator Crapo. If there is any public interest, the bill

allows for a hearing to be held.

Ms. Korsnick. Absolutely. There are many ways the public can request a hearing on an application and be involved. This does not take away any of the public engagement and involvement.

I just wanted to make that clear because I felt a different impression was left with the committee.

Senator Crapo. Thank you very much.

Senator Carper.

Senator Carper. Thank you, Mr. Chairman. You are doing a great job, by the way. I look forward to the day when you chair this more often.

Senator Crapo. Thank you for that too.

Senator Carper. Unless, of course, I could be the chairman. In the meantime, I will be your wing man.

I have an old car. In 2001, I stepped down as governor and became a Senator. I went out with my oldest son, Chris, who was then 12, to buy a new car. We drove Porches, Mustangs and Corvettes. We bought a Chrysler Town and Country minivan. He said it was bait and switch.

Yesterday, I was driving back to Delaware. We usually take the train but we drove back last night to Delaware in my 2001 Chrysler Town and Country minivan. Along the way, the odometer crossed 419,000 miles.

When I first got my minivan, there were some warranty

clauses, things that needed to be fixed from the factory, so we had a warranty to pay for that stuff. For a long period of time, we almost spent no money on it. I could get it washed every two weeks and maybe change the oil. In recent years, to be honest with you, I spent more and more money on my minivan.

We have all these old nuclear power plants out there. My guess is when they first came online there were some problems with them sort of like the warranty stuff. We dealt with that and continued to monitor them as time goes by.

Like Ed Markey said, your body gets old and you have to spend more money. I always spend more money on my minivan. I will say this. About a month ago, I went out to start it one night down in southern Delaware after a meeting and it would not start.

The guy came from AAA and he said, you need a new battery. I said okay. He said, we have a two year and a six year, which would you prefer. I said the six year. Some people say that is confidence. That is optimism. I am Mr. Glass Half Full.

Here is where I am going with this. If I am a utility and I am paying 90 percent of the cost for running NRC. I see the NRC having fewer reactors because we are shutting down reactors and have fewer reactors to monitor.

We are adding four new ones but it is not a huge increase. Why does the NRC continue to need all this money? I think you

knocked your budget down by \$5 million. That is not very much in the scheme of things. I am trying to figure it out. Maybe you can help me with this, Commander.

In terms of cost, four new power plants, monitoring and shepherding them through is not cheap. You have, as I understand, closures.

I had a Ford Explorer about a year or two ago and was going to retire it or decommission it, if you will. We just took it to a place and in one minute, they squashed my Explorer. That was it and they gave me a check.

It does not work that way with these nuclear power plants. It is an expensive process to decommission them. I guess that is a cost for you.

Fukushima, we have all these recommendations from Fukushima that we are implementing. We are making some progress but we had a hearing a week or two ago and said we are not there yet.

Plus, you have all these advanced technologies, all these people with brilliant ideas, I hope, who are saying look at my idea, so it takes money to pay for all this.

After thinking about it a bit, my sense is that what you are asking for in the budget is not unreasonable but this guy here is interested in how we get better results for less money and finding out how to save some more money.

If I was the utilities, I would say you guys have to

sharpen your pencils a little bit more and figure out how to save some money if you expect us to continue to pay through the nose. React to that for me, if you will.

Mr. McCree. I appreciate the analogy to your minivan.

Senator Carper. Never tell my wife I bought a six year battery, she would die.

Mr. McCree. A nuclear power plant is much more complex.

To your point, the NRC is reducing its costs. We are committed to doing so. If you look at the trend from 2014, we are reducing our costs. Our fiscal year 2017 budget request is another \$20 million below our fiscal year 2016 request.

The Commission has accepted a number of the recommendations from our Project AIM re-baselining which will enable us to reduce our fiscal year 2017 appropriation request by at least another \$31 million. Those are significant reductions. We are still not done.

Lowering our costs will translate to reduced fees, both the user fees and the annual fees to this industry that we regulate. While there may be a delay or reaction, there is a commitment to reducing our fees. It is tangible. I believe the industry will recognize those reduced costs.

Senator Carper. Thank you.

I have one last quick question. As the budget is reduced in the future, would the workforce reflect the reduced workload?

Take a minute to talk about the ramifications of cutting nuclear engineers today which might arguably be needed for tomorrow's advanced nuclear applications.

Mr. McCree. One of the more significant challenges I think any organization experiences, one that is human capital dependent and dependency on people to get work done, that is certainly NRC, is to manage cost reductions, reductions in staffing in a way that you retain your core capability to fulfill your mission.

Of course our mission is safety and security, so we are working very closely, as a leadership team, using a strategic workforce plan, to make sure the work we have now and the work we predict in the future will have the right people in the right place at the right time with the right skills.

Again, that is our commitment. We are working very closely to get that done, including nuclear engineers who are one capability, one competence that we need within the NRC.

Mr. Merrifield. Senator, may I make a comment about planning?

Senator Carper. Real short.

Mr. Merrifield. Seventy-three of the nuclear power plants in the United States have sought and received an extension to run for 60 years. That has allowed the utilities to invest large amounts of money to make sure those plants are up to date

and fully meet the safety requirements.

Like your minivan, they have been making a lot of investments along the way to make sure those are useful. Similar to the way the U.S. Air Force 1950s era B-52s are currently being deployed in the Middle East in the right shape to do their mission, nuclear power plants are doing the same here in the U.S.

Senator Carper. Mr. Chairman, I want to make sure I get my six years' worth out of that battery I just bought. We will see how it works.

Mr. McCree. For the record, that would be 83 licenses, 11 under review and 6 expected to come in. The NRC is a bit more successful.

Senator Carper. Thank you for that clarification.

Thank you all for being with us today. Let us continue to look at that 80 percent and see if we can build on that.

Thank you very much.

Senator Crapo. Thank you, Senator Carper.

I do appreciate your constant focus on trying to find solutions and get to that 80 percent. I agree with it.

Dr. Lyman, I indicated I would give you a chance but I think you got your chance to make your comment. Do you feel you have not fully had that opportunity yet?

Senator Carper. I think we have heard enough from him.

Senator Crapo. Go ahead.

Mr. Lyman. I would like just a very short time to explain why we think some of the language in the bill could potentially be interpreted as a reduction in safety standards. That primarily has to do with the language "risk informed" and "performance based."

In my experience with the NRC in its attempts to implement what it calls "risk informed" regulation, it often implies trying to justify what is called a reduction of unnecessary conservatism. Unnecessary conservatism means different things to different people.

Our concern is that this bill would put pressure on the NRC to develop processes that would essentially force them to accept lesser standards for the experimental data for the analytical work that is needed to support an advanced reactor application.

In particular, if you have designs based just on paper studies, the risk analyses do not have operational data to actually validate the studies. There is a concern that over-reliance on or over confidence in paper studies insufficiently validated to meet say less restrictive safety criteria could lead to an overall reduction in safety. That is our concern.

On the question of innovation, Mr. Merrifield pointed out many of the reactor types currently being considered were developed by the Atomic Energy Commission decades ago. We agree

with that. Actually there is less innovation today than meets the eye.

I would submit that argument could also be used to say the NRC has considerable expertise and experience in those reactor types. We think the concern that the NRC is not ready to license non-light-water reactors is somewhat exaggerated for that very reason. For the most part, these are old technologies.

Mr. Merrifield. If I may respond quickly, when I was on the Commission, we did create about \$5 million in funding to better understand pebble bed reactors but molten salt reactors, lead bismuth and some of the others being proposed are significantly different from what the NRC has experience in, so they do need additional funding and resources to bridge that gap.

Senator Crapo. Thank you. I know we have opened some issues here that everyone would like to jump into more and I would too, but I believe we just had a vote called or will shortly have a vote called, so we are going to have to wrap this up.

I do want to remind all of the witnesses that Senator Whitehouse had asked each of you to respond in writing to the question about the safety implications of the legislation on the NRC's capacity to protect safety in its regulatory structure. I

would encourage you to do that and respond to these issues.

Each of the Senators may have further questions. It is customary for them to submit those in writing. Since this is a legislative hearing and we expect committee action on S. 2795 next week, I am asking our Senators and committee staff to provide those questions regarding this bill to the Majority office by 4:00 p.m. tomorrow on Friday.

I am asking the witnesses to be sure to respond in writing by 5:00 p.m. on Monday, April 25. I know that is a short time but we are going to be moving ahead. If you can respond to those questions quickly, we would appreciate it.

All questions for the record regarding the general topic of advanced reactors will be due within the usual two week deadline.

To our witnesses, again, I want to thank you all for coming and sharing your views.

This hearing is adjourned.

[Whereupon, at 11:52 a.m., the subcommittee was adjourned.]