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HEARING ON ADVANCED NUCLEAR TECHNOLOGY: PROTECTING U.S.  
LEADERSHIP AND EXPANDING OPPORTUNITIES FOR LICENSING NEW NUCLEAR  
ENERGY TECHNOLOGIES

Tuesday, June 4, 2019

United States Senate

Committee on Environment and Public Works

Subcommittee on Clean Air and Nuclear Safety

Washington, D.C.

The committee met, pursuant to notice, at 11:33 a.m. in room 406, Dirksen Senate Office Building, the Honorable Mike Braun [chairman of the subcommittee] presiding.

Present: Senators Braun, Whitehouse, Capito, Ernst, Carper.

STATEMENT OF THE HONORABLE MIKE BRAUN, A UNITED STATES SENATOR  
FROM THE STATE OF INDIANA

Senator Braun. Good morning. We are going to call this hearing to order. Thanks to everyone for being here today.

This hearing of the Clean Air and Nuclear Safety Subcommittee is called to order officially. The purpose of our meeting today is to examine the international and domestic outlook for advanced nuclear technologies. We look forward to using this information to help us inform the Nuclear Regulatory Commission's licensing and regulatory process for these new technologies. You will also help us consider the importance of maintaining American leadership in nuclear energy development and regulation.

I will begin by recognizing myself for a brief opening statement before turning the floor over to Ranking Member Whitehouse for five minutes. The last 70 years, the U.S. has been the global leader in civilian uses of nuclear technology. This leadership has offered great opportunities to our Country. A clean, reliable source of baseload electrical power, a strong domestic supply chain, able to develop and supply the world's largest and most powerful nuclear navy, ownership of the world's best nuclear technology, allowing the United States to lead the world in setting international non-proliferation standards, and the knowledge and experience needed to create a nuclear

regulatory regime and a Nuclear Regulatory Commission.

The NRC's leadership not only assures nuclear energy is safe and secure, but is recognized around the world as the gold standard of nuclear regulation. But today, America's nuclear leadership is at risk. China and Russia are using nuclear energy to advance their geostrategic interests. In turn, our domestic civilian industry is losing its competitive edge.

While the U.S. struggles to complete the first two new nuclear reactors in a generation, China has set a national target to build 58 gigawatts of nuclear power capacity by 2020, bringing four new reactors online just last year.

While nuclear charges ahead in countries like Russia, and China, in the U.S., our industry risks being caught in a downward spiral. America's supply chain, nuclear scientists, engineers, and regulatory standards, may be overtaken by our international competition. It is alarming. A recently released Atlantic Council report identifies the threats and consequences if the U.S. is no longer the nuclear energy leader. Senator Crap and our ranking member, Senator Whitehouse, were the honorary co-chairmen of the report.

The report states the growing dominance of Russia and China in current nuclear construction and export, with Russia's far greater international presence and China's growing ambition, is an immediate concern from a geopolitical standpoint as well as a

safety and security perspective. Congress has already taken action to ensure that the Nuclear Regulatory Commission has the tools it needs to facilitate the development of this new reactor technology .

But what else can we do? Today, this subcommittee will examine the international and domestic outlook of advanced nuclear technologies to help inform the NRC's licensing and regulatory processes. The witnesses before us today will provide an important opportunity to consider the future of U.S. leadership in nuclear energy development and regulation.

I in particular am interested in hearing which technologies other countries are trying and how their regulatory environments may facilitate the development of advanced nuclear technology abroad. We may learn from their experiences and benefit by facilitating such development on U.S. soil. Additionally, I look forward to hearing how we can enable American nuclear innovators to export our own home-grown technology abroad.

Today's hearing is of the utmost importance. Without new reactors coming online, aided by the development of advanced reactors, the entire U.S. nuclear fleet could be idled within 20 years. Instead, with the right investments in these new technologies, and the regulatory apparatus to keep Americans safe, advanced nuclear could help power the American economy for the next 70 years.

Now, I would like to recognize Ranking Member Senator Whitehouse for his opening statement.

[The prepared statement of Senator Braun follows:]

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

Senator Whitehouse. Thank you, Chairman. I appreciate that we are having this hearing, and I am grateful to the terrific witnesses that we have here.

We are clearly witnessing a transition in the United States toward clean energy, despite some what I consider to be reprehensible behavior by the fossil fuel industry to interfere with that. Renewables and advanced nuclear technologies are leading this transition.

Renewables now provide nearly 19 percent of our energy, and the trajectory of their growth is steeply upward. Renewable energy capacity in the U.S. has more than tripled since 2008. In 2019, renewables will lead new additions to our energy grid.

Energy storage is a big part of the renewable story. The Federal Energy Regulatory Commission recently finalized its rule for battery storage on the electric grid. FERC's storage rule is projected to spur 50,000 megawatts of additional energy storage across the U.S. To its credit, FERC, led by Chairman Chatterjee, has rebuffed efforts to weaken the rule, setting a good precedent for the pending distributed generation rule.

Advanced nuclear technologies are the topic of today's hearing. The next-gen nuclear reactors can do two key things. One, help us reduce emissions as we move toward a clean energy

economy; and two, potentially transform our existing nuclear waste stockpiles from liabilities into assets. I would like to offer, Mr. Chairman, for the record, an op-ed with our colleague, Senator Crapo, that he and I wrote entitled The U.S. Must Reassert Global Leadership in Nuclear Energy or lose out to Russia and China.

Senator Braun. Without objection, so ordered.

[The referenced information follows:]

Senator Whitehouse. Thank you, sir.

Nuclear plants close because they get no compensation for being emissions-free. That is a big step backward for emission reductions, for climate change, and for the nuclear power industry. That is one reason why it is so important to factor the cost of carbon emissions into the energy market. That way, the compensation is built right in.

Our op-ed also discussed the partnership we have with Chairman Barrasso and Ranking Member Carper to pass two recent bills: the Nuclear Energy Innovation Capabilities Act, which will foster and accelerate development of advanced reactors through collaboration among our national labs, private industry, and academic institutions; and the Nuclear Energy Innovation and Modernization Act, which requires the Nuclear Regulatory Commission to develop a regulatory framework for licensing these new advanced reactor concepts.

These bills give a glimmer of hope that Republicans and Democrats can work together effectively on clean energy issues in bipartisan, legislative fashion. Sadly, however, I don't see a whole lot of regulatory bipartisanship in the NRC's new rule for U.S. nuclear power plants to prepare for or deal with the effects of climate change and sea level rise. With neither warning nor evidentiary support, Republican NRC members made this rule voluntary. Senator Carper and I are trying to

understand why Republican commissioners would weaken the rule, when no public comments requested it, and NRC career staff advised against it.

The Fourth National Climate Assessment found that extreme rain events and more intense hurricanes are likely to occur over the next century, making the recent flooding events in Nebraska, Maryland, and Texas more normal. Now is the time to harden our nuclear facilities to deal with rising seas and more intense storms due to climate change, not to weaken them.

I still intend to understand why this happened, to make sure that nothing ex parte took place, and to keep pressure on the NRC to ensure that safety remains at the forefront of its decision-making. I hope that all my colleagues will join me and the Ranking Member in this oversight.

The Nuclear Regulatory Commission is known internationally as the gold standard of safety, and it should stay that way. Where our often-divided committee can find a way to set an example of bipartisanship, the NRC has no business injecting its own regulatory partisanship into the same question.

I look forward to hearing from our witnesses, and Mr. Chairman, I thank you.

[The prepared statement of Senator Whitehouse follows:]

Senator Braun. Thank you, Senator.

I am pleased that we have a great panel here today. We met you before the hearing started. Our witnesses bring decades of experience in the development, execution, and regulation of not only light water reactors, but also the next generation of advanced reactors. Our first witness, William Magwood, is the Director General of the Nuclear Energy Agency at the Organisation for Economic Co-operation and Development. He has served in this position since 2014, and brings to this committee extensive experience in both the regulatory and developmental aspects of nuclear energy.

Prior to his service to the OECD, Mr. Magwood served as one of the five commissioners on the U.S. Nuclear Regulatory Commission. Mr. Magwood has also served at the U.S. Department of Energy, where he was Director of Nuclear Energy. During his tenure, he launched several important initiatives, including the U.S. Nuclear Power 2010 Program, and the Generation IV International Forum. Mr. Magwood holds bachelor's degrees in Physics and English from Carnegie Mellon University, and a Master of fine arts from the University of Pittsburgh.

Our next witness is Chris Levesque. Mr. Levesque is the President and CEO of TerraPower, an innovative American company working to bring advanced nuclear technologies to market. He brings over 25 years of experience in the nuclear industry,

including senior leadership roles for two large new-build reactor projects in Finland and South Carolina. I learned about that latter last week. Prior to joining TerraPower, Mr. Levesque served as a vice president at Westinghouse Electric Company, where he directed a project for one of America's first new reactor construction efforts in several decades.

Mr. Levesque began his career as a nuclear submarine officer. He qualified as a chief engineering on the U.S.S. Boise. He holds a Bachelor of Science in mechanical engineering from Rensselaer Polytechnic Institute, and a Master of Science in mechanical engineering and Naval Engineer degree from MIT.

Our last witness today is Bob Perciasepe, the President of the Center for Climate and Energy Solutions. Prior to his current role, Mr. Perciasepe was Deputy Administrator at the Environmental Protection Agency, where he served as a respected expert on environmental stewardship, natural resource management and public policy.

In 2002, he joined the National Audubon Society, one of the Nation's oldest conservation organizations, as its Senior VP for Public Policy. He served as the group's chief operating officer from 2004 to 2009, where he worked to protect wetlands and expand environmental education, especially in urban areas.

He has also held top positions in State and municipal government, as Secretary of the Environment for the State of

Maryland from 1990 to 1993, and as a senior planning official for the City of Baltimore, where he managed the city's capital budget. Mr. Perciasepe holds a master's degree in Planning and Public Administration from Syracuse University, and a Bachelor of Science degree in Natural Resources from Cornell University.

I want to remind the witnesses that your full written testimony will be made part of the official hearing record. Please keep your statements to five minutes, so that we may have time for questions.

I look forward to hearing your testimony, beginning with Mr. Magwood. Mr. Magwood, please proceed.

STATEMENT OF THE HONORABLE WILLIAM D. MAGWOOD, DIRECTOR-GENERAL,  
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT NUCLEAR  
ENERGY AGENCY

Mr. Magwood. Thank you, Chairman, and good morning. Good morning to you and to Ranking Member Whitehouse and members of the subcommittee.

I am Bill Magwood, I am Director-General of the Nuclear Energy Agency, and I thank you for the opportunity to provide my perspectives on the future outlook for nuclear energy. As you noted, I have a written statement that I ask be included in the hearing record.

The Nuclear Energy Agency is an intergovernmental agency operating within the framework of the OECD, the Organisation for Economic Co-operation and Development. As you may know, the United States help found the OECD as part of the Marshall Plan to help prevent wars and give countries a common purpose to improve their citizens' living standards.

The NEA has 33 member countries. Those countries are those with the deepest experience in nuclear technology, policy, and regulation. Our purpose for more than 60 years has been to facilitate cooperation among our members to address challenging issues associated with the use of civilian nuclear technology.

The United States is our largest member country, and each year dozens of Americans lead and participate in the many

cooperative activities, including research projects and working parties underway within the context of the NEA. As the first American to lead the NEA since 1980, it is my particular pleasure to share observations based on the work of our agency, its expert staff, and the contributions of our members.

I will note that as I engage member countries around the world, I find that essentially every country with which we work, there is a very large level of uncertainty regarding the future of energy. This is particularly true in the case of nuclear. Existing plants around the world are faced with premature closure and few new plants are being built.

We have analyzed the reasons for these trends, and they are very, very complex. In OECD countries, first and foremost, I think the electricity markets have become dysfunctional in many areas. It is not unusual to see market prices for electricity zero or even negative during parts of the day.

We believe electricity markets require significant reform. Whatever goals countries have for the future, today's markets are not serving those objectives. For those who are concerned about emissions of carbon, the trends are particularly alarming. In the face of heavy investments in renewable energy sources, emissions are rising steeply, and last year, reached an all-time high.

You would think that this would provide an opportunity for

nuclear. But the nuclear industry in many OECD countries has damaged reputations as a reliable supplier of plant and equipment. Cost overruns, schedule completion misses by decades, failed projects and very, very high cost estimates for new builds do not build confidence.

The fact is that the capacity to build nuclear power plants in countries that led to development in past decades has deteriorated. Skilled project leadership, supply chains for critical nuclear quality components and trained workforce needed for effective construction simply have not been available to support projects in many OECD countries.

After not building nuclear plants for decades, they are like the overweight man who never exercises but decides to clear his driveway of snow in a Washington winter. Not a pretty sight.

Many government and industry leaders hope to leapfrog these difficulties by shifting from light water-based Generation III designs to small, modular reactors and Gen IV technologies that seek to shift old paradigms. About 30 companies around the world are vying to develop game-changing technologies, most of them working on Gen IV concepts. While there is great hope and enthusiasm in each of these companies, it is important to note that the developing of new light water technology, and shepherding it through regulatory approval, cost at least a

billion and a half. Generation IV technologies will cost substantially more. And this is before billions are spent on demonstration facilities.

A typical company working to develop an innovative nuclear technology today has perhaps a dozen engineers and scientists devoted to the technology efforts and access to tens of millions of dollars. In comparison, I recently visited the Shanghai Institute of Applied Physics, which is developing a molten salt reactor technology. Molten salt reactors are a Gen IV technology that is high interest to several private sector companies. Because it represents a path of extraordinarily safe and efficient nuclear reactors, they have the potential to consume waste rather than generate it. The project in China has currently over 400 scientists and engineers hard at work developing this technology, with plans to build a demonstration reactor in the next decade.

Finally, with regard to nuclear regulation, we are not particularly concerned about the availability of regulators, given sufficient time to react to new technologies. I believe that the bigger challenge will be to find ways to avoid forcing companies to resolve technical and regulatory questions about nuclear technologies multiple times as they seek to introduce their technologies in multiple countries. For light water technologies, it takes about four years and nearly half a

billion dollars to navigate approval processes. It is extraordinarily costly and inefficient if this is done in each country for each technology.

Moreover, if regulators can reach common positions on key aspects of technology, such as requirements for autonomous operation and the nature of emerging preparedness requirements, companies can deploy their technologies around the world, applying the same rules. For small reactors in particular, which these would benefit from access to large markets, this is a vital issue. We at the NEA are working with many member countries to explore how this issue might be resolved.

With that, Mr. Chairman, I will conclude my comments and be happy to answer any questions.

[The prepared statement of Mr. Magwood follows:]

Senator Braun. Thank you, Mr. Magwood.

Mr. Levesque.

STATEMENT OF CHRIS LEVESQUE, PRESIDENT AND CHIEF EXECUTIVE  
OFFICER, TERRAPOWDER

Mr. Levesque. Thank you, Chairman Braun, Ranking Member Whitehouse, and members of the subcommittee, for this opportunity to testify. My name is Chris Levesque, and I am the Chief Executive officer of TerraPower, an advanced nuclear technology company based in Bellevue, Washington.

In 2006, our company's founders, Bill Gates and Nathan Myhrvold, began looking for a technological solution to the dual challenges of the growing global demand for energy and the threat of climate change. They discovered the answer is advanced nuclear technology.

My remarks reflect my role as TerraPower's CEO, but also as an engineer, a nuclear navy submarine veteran, and an American who has spent my career working in nuclear energy. From my perspective, it is clear that our Country will lose our leadership in nuclear energy if we fail to innovate and demonstrate the next generation of advanced reactors in the United States.

TerraPower's mission is to approve nuclear energy technology, because it provides reliable, zero-carbon, cost-effective electric and thermal energy. In addition, nuclear power is resilient and can be deployed in the United States and abroad without requiring a natural gas pipeline or a coal train

to operate.

Advanced reactors offer next generation safety benefits. In the event of a failure, no human or mechanical intervention is necessary to shut the reactor down. If you were to put these reactors through the Fukushima test, there would be no accident. A fast reactor would shut itself down independently, requiring no human operator action to keep the plant in a safe condition indefinitely.

Advanced nuclear will meet a number of global market needs. Our potential export markets rely on other countries for energy commodities like coal and gas, and all have signed on to the Paris Climate Agreement. The U.N. projects that the demand for nuclear power across the globe could increase as much as five times current levels.

As such, it is not surprising that countries like China and Russia are actively supporting the development of advanced reactors with direct investment by their governments. Some state supported companies sell their reactors and provide fuel, operations and maintenance services and waste services, bringing a multi-decade strategic partnership between the country selling the nuclear reactors and the country purchasing them.

Demonstrating new nuclear technologies is the most important step to jump start an advanced U.S. nuclear industry and compete globally. No company can commercialize advanced

nuclear technology until it is demonstrated. Federal support of demonstration efforts has driven down costs for technologies like solar, wind, and hydraulic fracturing. We need a similarly ambitious effort to demonstrate a portfolio of advanced nuclear reactors. This will take increased public-private cooperation, and we need to start this now.

TerraPower appreciates the work of this committee and the Nuclear Regulatory Commission to prepare to license advanced nuclear technology. The enactment of the Nuclear Energy Innovation and Modernization Act, NEIMA, will provide significant help, and we are grateful for your leadership on this legislation.

The recently introduced Nuclear Energy Leadership Act, NELEA, provides a robust and important framework. In particular, NELEA focuses on the need for public-private partnerships to demonstrate advanced nuclear technologies. We strongly support NELEA and hope Congress will move to pass it expeditiously. We want to thank the members of this committee who have co-sponsored it.

However, even without NELEA, Congress, through appropriations, can direct the government to develop and fund more coordinated and expedient demonstration activities. We hope to work with you on both to advance demonstration as quickly as possible.

The country that owns advanced nuclear will be a leader in the global nuclear market. Our Country led the world in developing civilian nuclear power, and has decades of R&D experience on a wide range of reactor concepts. Having personally worked on nuclear projects in Europe and Asia, I can attest to how the world looks to the U.S. nuclear industry for our leadership. American deserves to reap the economic and national security benefits created by our innovation and our expertise. With the right public-private partnership and investment, I know we can succeed.

Once again, thank you for the opportunity to testify. I am happy to answer any questions.

[The prepared statement of Mr. Levesque follows:]

Senator Braun. Thank you, Mr. Levesque.

Mr. Perciasepe.

STATEMENT OF THE HONORABLE BOB PERCIASEPE, PRESIDENT, CENTER FOR  
CLIMATE AND ENERGY SOLUTIONS

Mr. Perciasepe. Thank you, Mr. Chairman and Ranking Member, and Mr. Ranking Member of the full committee.

I am honored to be here with all of you. It has been a while since I have been in this room. I have great memories of confirmation hearings.

This is a pretty important subject, and I think the opening comments by the members were right on target, really important issues. You had mentioned my experiences in the past. I am currently the President of the Center for Climate and Energy Solutions, which is an organization that looks at global climate, and we are recognized and trusted as a pragmatic and wise counsel on technologies and on technology-inclusive approaches.

The climate change challenge is another one of the important contexts for this conversation. Decarbonizing U.S. energy is a pretty significant task. We need to get to at least 80 percent by the middle of the century, and we are currently about 11 percent less than we were in 2005. Current nuclear power is at 50 percent of that zero-emitting electricity.

Decarbonizing electricity is on the critical path for decarbonizing our economy and for meeting our mid-century goals for climate change. Virtually all the analysis that has been

done in the Intergovernmental Panel on Climate Change, the U.S. Climate Assessment, all of them show that the long-term need for zero-emitting energy is looking at all the different technologies together, as the least technically challenging, but also the least-cost path to decarbonization. The value of the existing nuclear fleet is pretty important. It is 20 percent of our total electricity, but it is also 50 percent of our clean electricity. Emissions will increase if the existing nuclear fleet retires prematurely.

The other important part of the existing nuclear fleet, they are the foundation and the technical capacity for many of the issues that the previous witnesses discussed. And keeping the existing facilities going will also buy time needed for the additional innovation for advanced nuclear, deployment of advanced renewable technologies and innovation with carbon capture.

There is a simple math here that we have pointed out in a number of our publications, that, if you need to get to 80 percent and your current situation is, you have about 10 percent from renewable -- I am rounding the numbers here, so these are not precise -- and 20 percent from nuclear, that is 30 percent of our electricity coming from clean and non-emitting sources. But if you triple those renewable sources over the next 15 to 20 years, and you lose the nuclear, you are back at 30 percent, 20

years down the road, on that.

I want to commend the committee for the work they have done on NEIMA and the work they are doing on NELA. These are really important pieces of legislation. They are sending really important signals to people like Chris. Our view is there are over 50 companies out there that are working on advanced nuclear strategies, and also probably close to a billion dollars in private capital somehow involved with that.

Some of the actions that have been taken to preserve the existing nuclear, and I want to be clear, preserving the existing nuclear preserves our intellectual capacity, which sends the right signal to the advanced nuclear industry, which sometimes are interspersed. So Senator Whitehouse mentioned the market failures of these facilities not being compensated for their zero emissions. Several States, and I will mention New York, New Jersey, Hawaii, Connecticut, are States who have moved ahead to put together zero emissions credits to provide compensation for the zero-emission work. And it sends signals to the innovators. That has changed the trajectory of eight different plants, and has saved us 33 million metric tons of carbon.

There are federal approaches also, including the work that you all have done on NEIMA, and the work that you continue to do. Market signals for zero emissions is always good, carbon

fees, capital investments by the Federal Government, clarity on new paths for permitting, for new technologies, clarity on extending licensing on existing facilities.

And an even bigger picture I want to mention, which has already been mentioned, I also served on the task force for nuclear energy leadership at the Atlantic Council. Really, maintaining the existing fleet, catalyzing innovation and being a nuclear power exporter is really in the strategic interests of the United States. Being on that task force enabled me to look at both of these climate issues, but also the global strategic issues that are involved.

So I will stop there. Sorry, I went over a few minutes.

[The prepared statement of Mr. Perciasepe follows:]

Senator Braun. Thank you. Thank you for your testimony.

The committee is scheduled to meet through 1:00 o'clock, and I intend to keep it open that long, unless we just run out of questions. I don't think that is going to happen. So I would ask fellow members to keep the questions to five minutes, so we can keep churning through everyone getting a chance to do a second or third round. And we will have others join as well.

I still start it off by making this general statement. I had the pleasure of seeing a nuclear facility, the Cook Facility, in Michigan. I was overwhelmed by how well it was run, the redundancy with the emphasis on safety. It was harder to get in and out of that facility than I think of any building I have tried to get in and out of here, even once they know you are a Senator. So that was very impressive.

I think what we are talking about here, for any of us that are worried about the climate, and to eliminate carbon emissions, this is the only bird in the hand that I can see that is scalable. There is another thing in economics called sunk costs. We have sunk a ton of costs into nuclear energy. And the fact that we are talking about shutting down plants, some plants having trouble, whether they want to do the extensions that are out there that they can pursue, I think it would be a travesty if we don't find a way to navigate into the future. You can see our geopolitical competitors look at it otherwise.

So for the sake of myself, other members here, and folks out there listening, I want to start off with Mr. Levesque. Advanced nuclear technology, give us a little description of how that is different. Use megawatts in terms of, we heard it is safe, and that it could never create a catastrophe. I think that would be the heartburn that anybody has with nuclear energy. Tell me about that.

Then also tell me about the industry's appetite to scale to into where it would even be more important as a percentage of our electric generation, as opposed to something that we pursue timidly. Contrast that to the plants that are online, and I would also like you to comment, Russia and China, are they building advanced nuclear facilities only? Or are they doing more of what we have come to know as the status quo?

Mr. Levesque. Thank you for your question, Senator Braun. Speaking for the advanced nuclear energy, there are many new advanced nuclear technologies that have appeared over the last 10 years. That is why you have seen many new companies, companies like Mr. Magwood brought up. I would say a major enabler to these advanced nuclear technologies coming into focus is, advanced computer modeling.

We have 98 Generation II reactor plants in the U.S. that have been operating safely for decades. Those are pressurized water reactors, light water reactors as we call them. It is a

very safe technology. It is the result of U.S. government development efforts that go back to the 1950s, when we built plants like Shippingport, and when the nuclear navy made technology decisions.

So these hundred or so plants that are operating today are the result of significant U.S. government sponsorship that goes back decades, and we are still reaping the benefits of those decisions and that support going all the way back to the 1950s.

So again, those plants have been operating very safely today. If we go back and look at the 1960s and 1970s, there were also U.S. government efforts to look at non-light water reactor technologies. Examples of those technologies were the molten salt reactor experiment at Oak Ridge National Labs, and the experimental breeder reactor at Idaho National Labs. The EBR, experimental breeder reactor, was a sodium cooled, and given by its name, the molten salt reactor experiment at Oak Ridge was salt cooled.

So even though the U.S. did not decide to pursue those technologies and commercialize them at that time, the U.S. government did prove that those technologies were viable, and that the basic engines of those plants could be built and operated safely. So the idea of sodium cooled or liquid cooled, liquid salt cooled reactor is nothing new.

But what we have had happen in the last 10 to 15 years is

really due to the advent of very high-fidelity computer modeling, where we are obviously, 20 years ago, the computing power simply did not exist to make these designs. That is why we have all this attention now on advanced nuclear. That has a lot to do with the founding of TerraPower. Twelve years ago, Bill Gates and Nathan Myhrvold, and our other founders were together, and they were looking at, hey, how can we create a new source of scalable, clean energy. At this time, they had physicists with them from Lawrence Livermore National Labs, and they said, hey, we think we can go back to these old designs -- go ahead, Senator Braun.

Senator Braun. To honor the five-minute rule, we will come back and get the rest of that long set of questions I had.

Mr. Levesque. Okay, sure.

Senator Braun. I am going to turn it over to Senator Whitehouse now.

Mr. Levesque. Okay, thank you.

Senator Whitehouse. Thanks very much. I want to start by reading something from the exhibit to Mr. Magwood's testimony. It asks the question, on page 11, it is the appendix. What should policy makers do? And then it answers the question as follows: implement carbon pricing as the most efficient approach for decarbonizing the electricity supply. This approach would increase the cost of high carbon generation technologies, reduce

greenhouse gases and enhance the competitiveness of low carbon technologies, such as nuclear and VRE. Carbon pricing will produce an overall gain for society.

However, it will also produce losses for some stakeholders, in particular, fossil fuel producers and their customers. Appropriate policies to facilitate a "fair transition" for the affected businesses and households, particularly those in vulnerable regions and communities, will be needed. No one can be left behind.

I just want to go on the record as somebody who has a carbon price bill, who is an ardent advocate for a price on carbon, in offering my personal commitment to my colleagues that we will work with them to make sure that that standard of no one left behind gets met. We can't be in a situation where the whole U.S. Senate is held hostage in order to take care of people in a way that ignores the coming disaster when, by addressing the coming disaster and remediating and preventing the coming disaster, we can actually take better care of those same people.

I am willing to do all the pensions of everybody who ever swung a pick in a coal mine or drove a piece of equipment in a coal mine, fill them up, a lot of them are broke. Make all those pensions solid, let people retire now, if they want to. Fill up the health and welfare plans, make sure they have health

care for themselves and their families for the rest of their lives. I would support a GI bill for the men and women who have worked in our energy sector who are having a transition concern, for them and for their children.

There are ways that we can make this a fair transition. The bill that I have proposed raises \$2.3 trillion over 10 years. We can make every miner a king.

Senator Carper. Or a queen.

Senator Whitehouse. Or a queen, out of those revenues, and still leave plenty to make sure that this is done in a way that helps jet the economy forward the way almost every economist who has looked at this suggests. And I would suggest that the economists who come to a different conclusion, you can trace that back to fossil fuel industry influence.

So I just want to go on record saying that I am eager to make sure that the, what I will call the Magwood standard of no one left behind, but a carbon price being essential, is met.

Mr. Perciasepe says the fooling in his testimony: "Nuclear power has been providing a significant environmental benefit for decades. Society and markets in most instances are not valuing that." Bob, that is what you just said. You go on to say, "Modeling to date clearly shows that we need nuclear power, renewables, carbon capture and improved energy efficiency to achieve large-scale economy-wide emission reductions."

Describe for me what the difference is between no carbon price and an economically effective, robust carbon price with respect to the opportunities for nuclear power, renewables, carbon capture and improved energy efficiency.

Mr. Perciasepe. Thank you, Senator. The driving force behind the concept of a carbon tax or a carbon fee or tax incentives that provide those differentials is to use the power of the economy, the market, to drive the change, to drive the movement of private capital into the needed investments. So it is not only on the backs of the Federal Government to do it, but it moves the capital into the technologies that are going to be the technologies of the future.

Senator Whitehouse. So all four of those technologies?

Mr. Perciasepe. All four of those technologies, including not only energy efficiency, existing nuclear, more incentives for investment by the private sector and advanced nuclear, because there will be a turnover during this century. The advanced renewable technologies and batteries and electric vehicle technologies and infrastructure, as well as renewable energy, straight-up.

Senator Whitehouse. In the second round, I will pursue that further, specific to carbon capture. But time in this round has expired, so let me yield to Senator Carper.

Senator Braun. Mr. Carper.

Senator Carper. Thanks, Mr. Chairman, and to our ranking member, thank you so much for calling this hearing. I could be in a number of other places right now, but I wanted to be here. It is good to see you again, Mr. Magwood, thank you for your service in the NRC and the Navy salutes Navy. I spent a lot of years of my life tracking Soviet nuclear submarines from Navy P-3 airplanes. I am very grateful for your service in that regard, and for being here today.

For our neighbor, Bob, it is great to see you again, and thanks for your years of service in so many different roles.

I especially want to thank Sheldon Whitehouse for his terrific leadership on this, and for trying to find common ground on these issues. He and I are joined at the hip in the idea that we can clean up our air, clean up our water, try to address climate change, create jobs. I think that is something that ties us all together. For me, that is the holy grail for where I want to go and where we need to go.

Nuclear power serves our Nation's largest source of reliable carbon-free energy, and several of you have alluded to that already, which can help combat the negative impacts of climate change and at the same time, foster economic opportunities for a lot of Americans. If we are smart, we are going to replace our aging nuclear reactors with new technology, hopefully, in this Country, that is safer and produces less

spent fuel and is cheaper to build and to operate.

I would ask each of you just to take a moment and share with us one thing, each of you share with us just one thing, that the Federal Government is doing right in this regard, and one area where we could do a better job in order to support the development and deployment of advanced nuclear power. And I would ask Mr. Perciasepe to just lead us off. Again, the question is, share with us one thing with the committee, one thing the Federal Government is doing right and one thing the Federal Government could do a lot better to support the development and deployment of advanced nuclear power. Bob?

Mr. Perciasepe. I think getting the proper incentives in place, particularly whether it is carbon pricing or other tax incentives, other forms of tax incentives, those signals are going to drive capital to help invest. So you put that on top of putting the full force of the federal, intelligent lab facilities behind this, I think would be the best thing the Federal Government could do.

Senator Carper. Okay. Chris?

Mr. Levesque. One thing the government, and specifically this committee, has done very right, I think, is the passage of NEIMA. That really empowers our safety regulator to entertain these advanced reactor designs. So thank you for that support.

One area where improvement is needed, I think, and the

committee is already focusing on this, is with NELA, the Nuclear Energy Leadership Act, we really need a demonstration project, we need multiple demonstration projects in the U.S. where we actually design, build and demonstrate advanced technologies. Otherwise, this will all be talk and we won't realize this new technology in the United States.

Senator Carper. All right, thank you. Mr. Magwood, please, two questions, just briefly.

Mr. Magwood. Thank you, Senator. I think I would agree with what both my colleagues on the panel have said. But I would emphasize that more than anything else, what the government is doing right is just bringing attention to this issue of innovation in advanced nuclear technologies.

This is probably, in the time that I have been in, well, I am not really in Washington at the moment, but since I have been around in Washington, I don't think the interest in advanced nuclear technology has been higher than it is today. I think there is a lot of excitement and enthusiasm, both in the government sector and in the private sector, toward this subject.

But I do think that moving from that excitement to implementation is something we really have to give a lot of focus on. It is going to be difficult, expensive work that I think the government will have to play a large role in. That

is, I think, the next step in this conversation.

So I agree with what Chris was just saying, that building demonstration facilities, don't underestimate how difficult this is and how much it will cost. We are really talking about large amounts of money. But that is what is happening in other countries. And if it doesn't happen here, then the opportunities will go overseas.

Senator Carper. All right, thanks. I don't have time to ask and receive your answers from all of you on this next question. I am just going to just state the question, if I can, and I will ask you to respond to it for the record.

I think there at least six different advanced reactor technologies that could be pursuing a license from the NRC in the near future. The question I will ask you for the record, you don't have to write it down, you will get it from us subsequently, do you believe there are critical skill gaps at the NRC that affect how the agency is able to review and consider applications for the use of technologies? That is one.

The second half of the question that I will submit for the record is, if so, has Congress done enough, has the Administration done enough to address those skill gaps? I would just ask when you get those questions, please respond to us in a timely manner. Thank you so much, and again, my thanks to our chair and ranking member for scheduling this and for all of you

joining us. This is a hugely important issue, and we are grateful.

Senator Braun. Thank you, Senator Carper. We are going to start another round of five-minute questions. Chris, I will start, and we will maybe have some other members maybe come in here, we will get with them.

We were at the point of, I want to know about our competition. So what are China and Russia building, what kind of plant technology? Talk about how many megawatts of generation, because that is what I understand here, that is kind of the basic measurement on electric generation.

And then contrast the present capabilities to what you think will be the advanced technology that is going to be scalable, and talk about its features, elaborate a little bit in terms of fuel storage, safety. You hit on a little bit of that, it sounded like, it took a lot of those issues out of place.

So first start with China and Russia, what are they doing? Because they seem to be really energetic with nuclear energy. What kind of plants are they building?

Mr. Levesque. China and Russia are each moving forward with dozens of new bills, both in their own countries and in export markets as well. Most of these gigawatt level plants are Generation II technology, like the 98 plants we have in the U.S. Some are moving to Generation III, which was also largely based

on U.S. technology.

They really have their eye, though, on these advanced nuclear technologies. There are several demonstration plants around the world now. People are really looking to these U.S. precedents. The things we did in the 1960s and 1970s combined with what all the advanced reactor companies in the U.S. are now doing with computer modeling and the materials advancements.

Senator Braun. You mentioned computer modeling as a difference. Give me some other differences, so I can easily understand what Generation I and II is, and then what this miracle might be, if we ever see it.

Mr. Levesque. So this is leading to some of the benefits of advanced reactors, and this applies to many of the technologies. These are now low-pressure systems. They are systems that have inherent safety, meaning we don't need a lot of extra mechanical and electrical systems.

Senator Braun. Can you store fuel on site when it is spent?

Mr. Levesque. They do require onsite fuel storage, and some of them require a future geological repository, which the U.S. Government is working on. But many of these technologies, like TerraPower's, also because of the computer modeling, they add very advanced physics to the core that generate much lower waste at the end of the fuel cycle, up to an 80 percent

reduction in that waste.

That is why China and Russia, even though they are building plants that are much like what we developed in the U.S. They have their eyes on these advanced reactor designs, and really, the U.S., because of our national lab complex, and our legacy from those plants I mentioned --

Senator Braun. But not developed yet, still in developmental stage?

Mr. Levesque. Right. But we are really the best poised, the U.S. has a leadership opportunity here that, if we don't take it, China and Russia will. But we are best situated today to take leadership on advanced reactors. If we don't, China and Russia will in a very short period of time. The time to act is now, as in this year. We need to begin work on demonstration of advanced reactors.

The Generation II facilities, what are the megawatts of generation capability? Roughly, on the larger ones.

Mr. Levesque. Generation II facilities, we usually refer to as gigawatt level, 1,000 megawatts electric on each plant. Sometimes slightly larger or smaller. Each enough to power 1 million homes.

Senator Braun. What would the forecast be on the advanced technology approach? It is less, isn't it?

Mr. Levesque. Some. Because TerraPower wants to attack

the huge increase in global electricity demand and fight climate change, our company is going after these same gigawatt level plants. In certain niche areas, we can build smaller plants. But I would say advanced nuclear offers the flexibility for anything from a microreactor to gigawatt scale. Advanced reactors doesn't necessarily mean you go big or small.

Senator Braun. It will be a complete difference in technology that has flexibility and much better safety features.

Mr. Levesque. Absolutely. It will have inherent safety, it will be a lower pressure system, it should have a much smaller emergency planning zone. And then another major, major benefit is, these advanced reactors will run at higher temperatures, which will make them more efficient and also more able to supply industrial processes.

Senator Braun. Thank you. Senator Whitehouse.

Senator Whitehouse. Thanks, Chairman.

Just to confirm something that I think is probably the case, from the testimony and from the body language from my last question, do each of you support a price on carbon? Director Magwood.

Mr. Magwood. As I mentioned in my oral remarks, and in the written statement, our view is that the markets need to be reformed and restructured entirely. Depending on what the objectives of the particular country that is reforming its

markets have in mind, you can shape those markets to accomplish those markets what you want. You mentioned economists. This particular view of our economists, there is no better way, if your objective is to reduce CO2 emissions, there is no better way than introducing a cost on carbon.

Senator Whitehouse. And there are ways to do it fairly, that you would want to do?

Mr. Magwood. Yes.

Mr. Levesque. We think a broad range of incentives are needed, beginning with serious government R&D investment, but also including carbon incentives.

Senator Whitehouse. Including a price on carbon, of some kind.

Mr. Levesque. Correct.

Mr. Perciasepe. Yes, is the simple answer. It will stimulate all the different technologies we need, from carbon capture on fossil sources to --

Senator Whitehouse. We ended with carbon capture. Let me focus specifically on that. With respect to carbon capture, in a world with a carbon price and a world without a carbon price, what is the difference for a carbon capture innovator with regard to what they are looking at as a revenue proposition?

Mr. Perciasepe. Say that again.

Senator Whitehouse. You have two identical worlds. You

have the same innovator; you have the same carbon capture technology. In one world, there is a carbon price and, in another world, there is not. What does that mean for that innovator to have or not have a carbon price with respect to their prospects for having a revenue proposition? If it is free to emit carbon --

Mr. Perciasepe. Right. That is generally currently free, to emit carbon, with some nuances, like what they use in California. But what to do with the carbon when you capture it, there is a cost of capturing it. Although those technologies are evolving quickly, I want to --

Senator Whitehouse. The point I am trying to ask you about is, whether it helps this, in carbon capture innovation, if you have a carbon price. Because the existence of the carbon price gives an incentive for people to pay for that innovation, which gives the innovator a revenue proposition for their business plan. Otherwise, you are standing next to the smokestack with the carbon going up into the air for free, and you are saying, who is going to pay me to take that out of the air, when it is free to pollute? Why would that make any sense?

Mr. Perciasepe. Whatever you are going to do with the carbon, if you are, if there is a financial incentive to capture it and do something with it, you are going to do it. And that is going to stimulate those carbon capture technologies to go

even faster and innovate and become cheaper.

Senator Whitehouse. Totally a real success on.

Mr. Perciasepe. Yes, and it has had, as you know, bipartisan support.

Senator Whitehouse. Yes, with our chairman on this committee, on the full committee.

Mr. Levesque, one of my earliest exposure to TerraPower involved a proposition that the technology had the promise of allowing us to go back through the currently just sitting there nuclear waste stockpiles that we have, for which we no plan, and actually be able to utilize that and repurpose it as fuel, and turn, as I said in my opening remarks, a liability into an asset.

Is that still a focus of TerraPower? Will it remain a focus of TerraPower? Is it a focus of the industry? What can we do to help make sure it remains a focus of the next gen, or Gen IV industry?

Mr. Levesque. Senator, you point to a very major capability of advanced reactors. Today's reactors only use about 5 percent of the fissile material before the reactor has to be shut down and the fuel is removed. It is just the way the physics work. The advanced reactors, including TerraPower's design, much more completely use that fuel.

Now, TerraPower's designs today plan on using depleted

uranium, which is the waste product of the enrichment process. We can use either depleted uranium or natural uranium to fuel the traveling wave reactor.

However, this entire new family of advanced reactors does offer the potential to go and look at spent fuel. Of course, we are waiting for the U.S. to develop a geologic repository for spent fuel. But advanced nuclear technologies do allow you the opportunity to go look at what amount of fissile material is remaining in that spent fuel, and is there a way to utilize more of it. So that is yet another benefit of advanced reactors.

Senator Whitehouse. If I may make a comment, Mr. Chairman.

Senator Braun. You may.

Senator Whitehouse. I know that you come from a very strong business background. If we were running United States, Incorporated, the liability of all that nuclear waste we have stockpiled all around the Country in dozens of sites would show up when your auditors came. And when you did your financial reporting to your shareholders, they would say, here on the debit side of the column is this liability that you have for having to deal with this nuclear waste at some point. And if it was a \$500 million liability, you would have an incentive to spend up to \$499 million to clean it up.

But because we are the United States of America, not the United States, Incorporated, there is no place where it shows up

in our balance sheet. So we really don't have that persistent economic incentive that a corporation would have to deal with it as a national issue.

There is a bit of a carbon price flavor to the point I am trying to make, but this is like the reverse of it. There is this liability, and there is no way in which, as I can see it, that a TerraPower or somebody else can say, okay, there is a \$500 million problem, that means I can come up with a \$200 million solution and then we can split the difference, and I will make \$150 million and my business sense gets motivated, my innovation juices start to flow, to solve that problem. Instead, it just sits there, and the stuff has sat there for decades, and we are waiting for the magic solution to go put it into Yucca Mountain or some place. But I don't see that happening without a revolt from Nevada.

So we need, I think there is an economic solution here as well. If this was a pure business proposition, there would be a lot more energy in solving it. Because there would be this account that was dragging on our balance sheet saying, fix me, fix me, fix me.

Senator Braun. Now that there are basically two of us left, we are going to go, I think, back and forth with the dialogue like this. I think that is healthy. So I am going to jump in as a business guy.

You would never -- you have a contingent liability, one that might occur, this is a liability sitting on the pads. It was there at Cook nuclear facility. And how we are going to resolve that, I don't know. That discussion has been going on for a lot longer than the short time I have been here. That still is going to be an issue regardless of what happens with advanced technologies.

So I think that whether you price carbon, what you do with that liability that is a real one, both are issues that cloud what is going to happen with nuclear energy. The thing that I have heard that I like most is that there is new technology that is going to address all the inherent disadvantage of nuclear. You have processes now that you are able to use technology to run them better. You mentioned that. Safety is less of a concern, because it is not inherently risky, like the old process.

It begs the question for me, because I think that is valid. We have to address it.

How much of the current cost per kilowatt is built in with safety and regulations currently that, now that we know so much more now than what we used to know, how much does TerraPower or any other business utility that generates electricity through a nuclear source, how much per kilowatt is that costing? Does that put you inherently less competitive than, say, for

instance, now, natural gas, which is adding to our carbon footprint? Can you tell us roughly what that amounts to?

Mr. Levesque. I would say that I think many of those savings that you are talking about have been realized in the last 20 years with our operating plants that have worked on power operates, they worked on regulatory reform. As a result, what you have seen is the dollars per megawatt hours for the plants in the U.S. have decreased from something like 40 plus dollars per megawatt hour down to the low 30s.

So I think many of these benefits have now been realized. There is probably not much more potential there to go and get savings. I would say the big opportunity, or the mandate now, is to move to new technology. There is new technology available that we have to go get.

Senator Braun. What has been forecast to be? How much additional savings per megawatt hour? Is that part of the equation?

Mr. Levesque. Absolutely. In general, we believe those reactors should be at least 20 percent cheaper than existing reactors on operating costs. That is going to vary.

Senator Braun. Taking it down about four bucks per megawatt. Where is natural gas in the other stuff down there?

Mr. Levesque. Natural gas today is making it very hard for any nuclear power plant to compete at a profit, unless it is --

Senator Braun. Unless you are taking it all around carbon.

Mr. Levesque. Right.

Senator Braun. Because it is emitting it. So defer to that line of question, with all that you need to know in terms of certainty and running any business, do you think, now, you are in a market, and obviously the least expensive, cleanest fuel will run in the long run. Do you think that with what it would take to invest in even advanced technologies that you would do that as a company, with natural gas out there, being at a lot less megawatt hour?

Mr. Levesque. Yes, absolutely we would. We believe the U.S. Government should think strategically about its energy supply and natural gas is cheap today. But we need to think decades ahead. We think that you absolutely need nuclear and advanced nuclear in the mix. We think the economic potential of advanced reactors should make nuclear energy even more affordable. And some of those technology enablers I mentioned to you, having lower pressure systems, having less mechanical and electrical systems because they are inherently safe, there is all of these technology enablers that should make advanced reactors cheaper than today's plants.

We are just really at a time when we have extracted most of the savings that we can get out of the current technology. It is time to move to a new technology that is available. And it

is a new technology that the U.S. is, because of our national labs, because of the work we did in the 1960s and 1970s that we kind of set aside, the U.S. is really the most well-positioned country in the world to be the leader in advanced nuclear.

Mr. Perciasepe. Just to add to this business balance, most of the industry that works in the natural gas arena has it on their mind and in their future planning that there will be more cost to them to capture the carbon that comes out of those generators. Also of tightening up their system, so methane isn't leaking out into the air. So right now, that is not priced into the price that is going to me in my house.

But most of the companies thinking of the future, just like the liability issue we were talking about, can advanced reactors be part of the solution to spent fuel, most of the companies looking ahead at their prices, not so much of getting the gas, like has become so efficient with directional drilling and hydraulic fracturing, but the other issues that they are not currently having to have an expense on.

So I think that there is where you have to look at, where is that business going to be in the future and how they will match up with each other, and what incentives the Federal Government should be putting in place to make sure they all get to the right place, so the consumers are advantaged.

Mr. Levesque. If I might add, Senator, we look at the

nuclear industry, we are thinking globally. Natural gas is not available at the low cost and at the volumes that we enjoy in the U.S. So we are talking about developing advanced reactors in the U.S., we are talking about demonstrations of advanced nuclear technology that we can prove out in the U.S. and then deploy to many other countries that have growing energy demand, and that have higher prices on natural gas.

So we can be very competitive overseas. There will be tremendous demand for electricity and industrial heat overseas, and advanced nuclear will compete very, very favorably with fossil sources.

Senator Braun. I am going to follow up with one more question and then let Senator Whitehouse ask the final round here. Do you think we can survive, due to the fact that natural gas and other competing fuels have higher costs per megawatt hour? Can the U.S. industry, since it is a different technology that can be exported along the lines of what you are talking about? I know that is not ideal, but do you think that is a way we can hang in the game while we are trying to get through all the issues that currently beset the U.S. nuclear industry? Mr. Magwood?

Mr. Magwood. Senator, I think that as we look through our analysis on where nuclear competes and where nuclear doesn't compete, the single effect that seems to overwhelm everything

else is actually the cost of building a nuclear power plant. There is no other factor that seems to be affecting nuclear in most markets. You can talk about safety, you can talk about waste, you can talk about a lot of these other things. But the actual cost of building a plan has become a huge barrier, both for current generation and I think is going to be a barrier for future generations.

So I think one of the things we have highlighted is that there has to be a more cost-effective way to build nuclear power plants. I think that the days of expecting ratepayers and taxpayers to support facilities that cost ten plus billion dollars, those days may very well be over. When I talk to utility CEOs, they tell me they don't see big plants being built any more. They are emphasizing small plants.

I think the reason they emphasize the small plants is, this doesn't quite fit the TerraPower framework, but I think there is a desire to move away from the traditional approach of building plants and move to a manufacturing approach, to where nuclear power plants look more like jet airliners. We know how to do that. The 787s come off the assembly line by the hundreds. It is cost-effective to get an economy scale from that. That is where I think industry, in large part, would like to move toward.

If you can do that, become more cost-effective, I think

there is a chance for nuclear to compete in a broader range of markets. As it is right now, it just simply costs too much. I will relate what I heard from a minister of an eastern European country, who told me that it doesn't really matter how good the technology is, if I can't afford to build it.

Senator Braun. Senator Whitehouse.

Senator Whitehouse. Thanks, Chairman.

Director Magwood, in my opening comments I mentioned the NRC's behavior around what they called the mitigation of beyond-design basis events rule to address earthquake, flood, things like that. As I recall, you were a commissioner when this was first brought up.

It seems peculiar to Ranking Member Carper and myself, as our letter reflects, that without any comments in the regulatory process supporting these rules being merely voluntary, and without a staff recommendation that the rules should be voluntary, without testimony that the rules should be voluntary, it seems like there was full agreement, everybody on course, for the rule to be a mandatory rule, which also makes sense, to me, anyway, when you are considering the risks involved.

So it came as kind of a stunning surprise that there was a partisan opinion that emerged out of the NRC on this issue, and it is particularly disturbing to me when you are seeing this happen on a topic where we have managed to achieve

bipartisanship here in the EPW committee and here in the Senate. I mean, for Pete's sake, if there's any body that is supposed to be partisan, it is us, not a bunch of nuclear regulatory commissioners.

So when we can solve our problems and make progress with these two nuclear innovation bills and get them passed, and then we see the commission divided along partisan lines and doing something that, to me, from a regulatory process point of view, makes no sense, it just seems odd. I wonder if you, I know you weren't there when it ended, but you were there when it began. Does your experience as a commissioner give you any insight into what we should be looking for or what was up with that?

Mr. Magwood. Let me share this thought. And I am aware of the discussion about the mitigating strategies rule, as you mentioned. A lot of this got started when I was on the commission. I think it is important to emphasize that the orders that were issued by the NRC in the years after the accident in Japan put in place a framework of safety to make sure that plants had been brought up the standards the commission saw as necessary to protect safety across the Country. So I don't think that there is a safety issue at play as we stand today.

The process with rules is such that, and I can tell you, there were certainly cases where the staff made recommendations

to the commission and some commissioners just simply didn't agree. That is what commissioners are there for. That is why they go through the process of confirmation, because you are looking for their expertise and their judgment. Sometimes we don't agree with the staff.

I can tell you there are cases where, in the post-Fukushima environment, I will give you a very specific example that left a lot of hard feelings with people, and that was the discussion about whether we should require filtered venting on Mark II reactors. This was a big debate on the commission. The staff recommended it, three commissioners just didn't believe it was necessary, two did. And it was a big debate about that.

When I was on the commission, we just did not look at this in a partisan way. Sometimes it came out that way, and I think regulatory philosophy reflects that. But in large respect, the discussions that I have had on the commission never really broke down along those lines. It is unfortunate that this particular issue seems to have gotten that kind of play in the press.

But my view is that there is an honest debate that takes place on a commission. There is voting that takes place. And if three commissioners agree, that is the direction it goes. Whether it is three commissioners who are Republicans or three commissioners who are Democrats, that is the way the process works. I think that is a healthy process, because that debate,

often you learn things from even the colleagues you disagree with that ends up in the final package.

So I know the commissioners, I think they are all people who are trying to do the right thing. I have met all of them and I have talked with all of them. We don't often agree on things, that is part of the process. But I think they are all people who care about safety and are trying to do what is best for the American people.

Senator Whitehouse. Okay. Thank you for sharing that.

Mr. Chairman, I have nothing further. Thank you for this hearing.

Senator Braun. Thank you for testifying. It was a good, robust conversation, and I think we all want to make sure what we have invested in nuclear energy up to this point is not lost. We don't want our world competitors to outpace us at this moment in time. We do want to decarbonize electric generation.

So hopefully we will have more discussions like it, and thank you again for coming. Any member that would want to add to it can submit follow-up questions for the record. The record will be open for two weeks.

Thanks again for coming. This hearing is adjourned.

[Whereupon at 12:50 p.m., the hearing was adjourned.]