BEFORE THE

ILLINOIS COMMERCE COMMISSION

ILLINOIS' POWER METER POLICY SESSION

NUCLEAR ENERGY: SAFETY, RESEARCH & DEVELOPMENT,

AND FUTURE SUSTAINABILITY

Tuesday, October 1, 2019

Chicago, Illinois

Met pursuant to notice at 10:00 a.m. at 160 North LaSalle Street, Chicago, Illinois.

PRESENT:

CARRIE ZALEWSKI, Chairman

SADZI M. OLIVA, Commissioner

BRIEN SHEAHAN, Commissioner

D. ETHAN KIMBREL, Commissioner

MARIA S. BOCANEGRA, Commissioner

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1 COMMISSIONER OLIVA: All right. Good
2 morning, everyone.
3 I want to thank everyone for being
4 here this morning and, also, to those who are
5 listening in on our audio webcast.
6 I'm so excited to present our
7 panelists this morning and to welcome you to today's
8 policy session on *Nuclear Energy: Safety, Research &*
9 *Development and Future Sustainability*. This is my
10 office's fourth installment of Illinois' Power Meter,
11 so this is really exciting, and I have been looking
12 forward to this for a long time.
13 This forum is convened pursuant to
14 the Illinois Open Meetings Act, and our guests and
15 panelists should be aware that a court reporter is
16 present. A transcript of this session will be posted
17 to the Commission's website.
18 I want to thank my colleagues who are
19 here this morning for supporting me on this policy
20 session, and with me today are Chairman Zalewski,
21 Commissioners Sheahan, Kimbrel, and Bocanegra. We
22 have a quorum, so let's begin.

1 The purpose of today's policy session
2 is to explore the current and future role of nuclear
3 power. This discussion is relevant, especially here
4 in Illinois, because nuclear energy has been a
5 reliable source of energy in the United States and
6 makes up 55 percent of America's carbon-free energy.
7 Additionally, Illinois has the most nuclear power
8 plants in the country, and they generate 52.2 percent
9 of the state's electricity and supply 88 percent of
10 its carbon-free energy.
11 We have a panel of experts who will
12 provide a reading on the state of nuclear power, the
13 research and development underway, the safe storage
14 and disposal of nuclear fuel, the role of today's
15 current fleet, and the global scaling and demand for
16 nuclear energy.
17 As far as the format this morning of
18 this policy session, each panelist will give a
19 presentation, and a moderated discussion and a Q&A
20 will follow.
21 Our subject matter experts today are
22 Maria Korsnick, President and CEO of the Nuclear

1 Energy Institute; Suzanne Jaworowski, Senior Advisor
2 for the U.S. Department of Energy Office of Nuclear
3 Energy; Dr. Mitchell Farmer, Program Manager of Light
4 Water Reactor Programs within the Nuclear Science and
5 Engineering Division at Argonne National Laboratory;
6 Marilyn Kray, Vice President of Strategy and
7 Development at Exelon Generation; Steven Swilley,
8 Senior Director and Deputy Chief Nuclear Officer at
9 the Electric Power Research Institute; and Dr. Robert
10 Rosner, who is a theoretical physicist at the
11 University of Chicago.
12 So please join me in welcoming the
13 panel.
14 (Applause.)
15 COMMISSIONER OLIVA: Maria, if you could
16 begin with your presentation?
17 MS. KORSNICK: Great. Thank you so much
18 for that kind introduction, Commissioner Oliva, and
19 for the invitation to be part of today's discussion.
20 I'm looking forward to our conversation with this
21 great group of panelists.
22 I'm excited to be here to talk about

1 something that I'm very passionate about, the role of
2 nuclear energy as a critical element of our ability
3 to roll back the effects of a changing climate. To
4 truly understand the important role of nuclear in the
5 State of Illinois, the United States, and, quite
6 frankly, the world, we need to understand what
7 nuclear brings to the table, some of the challenges
8 that we face, and where we're headed in the days to
9 come.
10 I have spent 33 years in the nuclear
11 industry as an engineer, as a licensed operator. As
12 a Site Vice President, I ran one plant, and as a
13 Chief Nuclear Officer, I was responsible for five
14 reactors at three sites.
15 We need to appreciate all the
16 benefits that this industry brings. Let's start
17 talking about today. Illinois has the most nuclear
18 plants in the country with more than half of your
19 state's electricity generated by nuclear power and 88
20 percent of your carbon-free electricity. You've
21 committed to reducing greenhouse gas emissions
22 consistent with targets that were set in the 2015

1 Paris Climate Agreement. Maintaining your fleet of
2 nuclear power plants is the only way you're going to
3 be able to reach those commitments.
4 Today, our nuclear fleet is more than
5 92 percent efficient. A generation ago, we were only
6 at 63 percent. And what's even more remarkable is
7 that now it only takes 96 nuclear reactors to produce
8 what a few decades ago would have taken 130.
9 Nuclear is responsible for one fifth
10 of the nation's total electricity. It represents
11 more than 55 percent of our emission-free energy,
12 which is more impressive when you consider that there
13 are about 8,000 power plants that are connected to
14 our electric grid, and only about 1 percent of them
15 are nuclear plants. So I'd say they're punching way
16 above their weight.
17 Along with wind and solar, we're
18 making our air cleaner. We're making our planet
19 safer for ourselves and for our kids. But the sun
20 doesn't always shine, and the wind doesn't always
21 blow.
22 Nuclear feeds the grid around the

1 clock. It's firm, it's dispatchable, it's constant,
2 and it's carbon free.
3 I know what it takes to operate an
4 electric grid. You need to balance the supply and
5 the demand at all times. You need all of these
6 sources working together.
7 But our progress is not inevitable or
8 automatic. It won't happen without all of us pushing
9 together.
10 The challenge before us as a nation
11 is stark. In the next five years, we're at
12 significant risk of increasing, not lowering, our
13 carbon emissions in this country. This year alone,
14 we saw two perfectly good reactors shut down
15 permanently. Three Mile Island closed just two weeks
16 ago in Pennsylvania joining Pilgrim in Massachusetts
17 just a few months before.
18 Between now and 2025, more than
19 nine -- nine nuclear reactors which run 24/seven and
20 at more than 92 percent capacity have announced that
21 they will close prematurely. This is in
22 Pennsylvania, Iowa, New York, Michigan, and

1 California.

2 Even more reactors have made it clear

3 that they are in financial distress, including three

4 stations here in Illinois.

5 Those nine reactors help avoid more

6 than 39 million metric tons of carbon dioxide each

7 year. That's equivalent to the emissions from more

8 than 8.2 million cars driven in a year, or said

9 another way, it's the equivalent of nearly all the

10 cars in Pennsylvania and Ohio, and at current build

11 rates, it would take 15 years to build enough wind

12 and solar just to replace the 67 million megawatt

13 hours of clean electricity generated from these

14 plants.

15 In reality, the intermittent

16 renewables cannot replace the around-the-clock power

17 of nuclear energy. At best, we'll be running in

18 place where new wind and solar will be trying to make

19 up for the lost nuclear, rather than replacing coal

20 and natural gas. And at worst, we cannot build

21 enough wind and solar to replace the lost carbon-free

22 generation from those shuttered nuclear plants. That

1 will mean coal and natural gas will take their place,
2 which increases carbon emissions.
3 To make sure nuclear is available, a
4 few things need to happen. The first step is
5 preserving the plants that we have today. Saving
6 today's plants and approving second license renewals,
7 which add an additional 20 years to the life of an
8 existing plant, are the cheapest and most efficient
9 ways to limit carbon emissions.
10 The fleet has been reducing its
11 costs, slashing them by 25 percent since 2012. It's
12 the most efficient it's ever been, but even with
13 those reductions, it's not enough to preserve all the
14 plants in the nuclear fleet. And remember, there are
15 incentives in the market for wind and solar so they
16 can compete and grow.
17 Illinois has enacted a bill that will
18 value two of Illinois' six nuclear plants for their
19 carbon-free attributes with the passage of zero
20 emission credits just two years ago. But even in
21 Illinois with its rich history of nuclear
22 generation, there are plants that remain at risk.

1 And when we look nationally, nuclear still lacks the
2 incentives and recognition in the marketplace with
3 the exception of a few states like Illinois that have
4 acted.
5 In the absence of federal policy
6 recognizing the carbon-free benefits of nuclear,
7 states are acting to preserve their nuclear fleets,
8 and states need to have the ability to make decisions
9 about their energy resources in order to meet their
10 climate goals.
11 The most important consideration in
12 drawing these standards should be our shared goal --
13 lower emissions. Any technology that gets the job
14 done should get the chance.
15 But despite the challenges, one thing
16 I don't want to lose sight of is the incredible
17 innovation that's happening in our industry. A few
18 weeks ago, I was part of a conversation with Bill
19 Gates. As many of you know, he's someone with a very
20 keen interest in nuclear power.
21 He told us that when he looks at his
22 investment opportunities, he doesn't have a bias for

1 the United States or any particular place around the
2 world, but as he looks back, he said 75 percent of
3 his innovation investments are based in the
4 United States, and he attributes that to the kinds
5 of innovations that we're seeing in the energy
6 sector, and I'd like to thank those who make it
7 possible each and every day. Our national labs are
8 powerful incubators for innovation, and we have
9 companies that are also putting incredible
10 advancements to work.
11 Some of the biggest news in nuclear
12 is coming from new reactor designs. Small modular
13 reactors like those coming out of partnerships
14 between NuScale in Oregon and UAMPS in Utah. They're
15 making nuclear possible in all kinds of places
16 where larger plants simply can't meet the community
17 needs.
18 This is something I often hear about
19 from leaders like Senator Lisa Murkowski of Alaska.
20 She knows better than most how challenging it can be
21 to meet the electricity needs of people in very
22 remote locations. In the future, micro reactors can

1 even replace diesel and improve our health in the
2 process. And not just in Alaska, but anywhere people
3 need it.
4 Micro reactors also make our nation
5 safer. The Department of Defense is looking for
6 reliable alternatives to diesel generators or coal
7 boilers, these energy sources that need frequent
8 refueling.
9 Nuclear micro reactors are a
10 solution. They can operate independent of the power
11 grid. They run clean. They're reliable, secure.
12 And they need to be refueled only about once every
13 decade. They could help our nation's military bases
14 better protect themselves from a potential attack on
15 the grid.
16 With our rigorous standards and
17 culture of innovation, the United States leads the
18 world in advancing nuclear technology. Last fall,
19 Senators Whitehouse and Crapo led the charge to
20 improve nuclear research through new public-private
21 partnerships. Thanks to their vision, Congress
22 passed and the President signed a law to move us

1 toward a new generation of clean, advanced nuclear
2 power.
3 While we have some of the brightest
4 ideas, other countries are more focused on building
5 nuclear. Russia and China. Two thirds of the
6 reactors that are being built around the world today
7 are their designs. It's critical that the
8 United States remain influential in the global
9 market.
10 With continued conviction and with a
11 collective effort to make tough choices and changes,
12 we can remain the global leaders.
13 There are many innovations and
14 innovators advancing nuclear as we know it today.
15 NuScale's innovations are just one example. There's
16 others like Westinghouse, TerraPower, Oklo, and
17 Kairos. They're are all making significant progress
18 towards the next generation of nuclear technology.
19 So are X-energy, Terrestrial Energy, General Atomics,
20 and the list goes on.
21 Our industry's innovations have come
22 a long way in really a short period of time. It's

1 one of the reasons that I'm so very proud to work in
2 nuclear and so passionate about our future. I'm
3 grateful that Secretary Perry and the entire
4 administration are committed to ensuring that America
5 is energy dominant.
6 And recently, the Senate
7 Appropriations Committee advanced a bipartisan bill
8 that supports the development and deployment of
9 advanced reactor projects and advanced fuels. That's
10 a bright spot for the kinds of investments that we'll
11 need moving forward.
12 As nuclear technology improves,
13 becomes more agile, comes in smaller sizes, we'll
14 open new markets for its success around the globe.
15 We're creating a whole new suite of options that will
16 help us partner with renewables like wind and solar,
17 and this really isn't in the distant future. It's
18 really right around the corner.
19 And not just because nuclear is the
20 nation's largest source of carbon-free energy.
21 Because of nuclear, scientists are developing and
22 powering new cancer treatments. Because of nuclear,

1 communities can keep the lights on through natural
2 disasters. Because of nuclear, our space crafts and
3 satellites are exploring distant planets.
4 When you're standing up for the
5 nuclear industry, for the communities, the
6 competitiveness and the carbon-free future that it
7 secures, we simply don't have the luxury of standing
8 still. We need nuclear, and we need it now.
9 But getting there isn't automatic.
10 This challenge won't correct itself. Now is the time
11 for federal and state policy that values nuclear,
12 that recognizes it for the reliable, resilient, and
13 emissions-free source of energy that it is.
14 Now is the time to finance advanced
15 technologies and international exports, to keep
16 innovating and to keep investing to preserve the
17 existing fleet. Now is the time to save and create
18 jobs. Now is the time to lead.
19 I'm so passionate about nuclear,
20 because it has so many advantages. One of them is
21 that, unlike nearly every other clean or carbon-free
22 energy source, nuclear is online 24/seven/365. In

1 other words, nuclear doesn't stop, and to build the
2 future we want, neither can we.
3 Thank you very much.
4 COMMISSIONER OLIVA: Thank you, Maria.
5 And now we'll hear from Suzanne
6 Jaworowski from the U.S. Department of Energy.
7 MS. JAWOROWSKI: Thank you so much,
8 Commissioner.
9 It's my pleasure to be here today. I
10 appreciate the invite, and I'm really happy to be
11 here in Illinois, our state with the largest nuclear
12 fleet in the United States.
13 My role and my message here on behalf
14 of the U.S. Department of Energy's Office of Nuclear
15 Energy is to communicate the U.S. Government's
16 commitment to reviving, revitalizing, and advancing
17 the next generation of civil nuclear power.
18 As Maria talked about, nuclear energy
19 is an essential element to a clean energy future,
20 and I want to be able to communicate to you what
21 the U.S. Department of Energy is doing to invest both
22 in the existing fleet and the next generation of

1 nuclear energy to create a collaborative clean
2 energy solution with nuclear as its base-load power
3 source.
4 Also, I'd like to include a bit about
5 our education and outreach, because it's really
6 important that nuclear tells its story. Nuclear is a
7 technology that's often not understood or not
8 completely examined, and so our office is really
9 making efforts to try to communicate the benefits,
10 the values of nuclear as an energy source, and be
11 realistic about the opportunities and the obstacles
12 as well.
13 So the administration is soundly
14 committed to supporting nuclear energy. In June of
15 2017, President Trump and Vice President Pence came
16 to the U.S. Department of Energy. Among the
17 President's top ten mission initiatives for the
18 Department of Energy, one was to revive, revitalize,
19 and expand the civil nuclear industry.
20 The Secretary of Energy is often
21 quoted as saying, "If you care about the environment
22 in which we live, you must care about what nuclear

1 energy can bring to clean energy solutions."

2 With that, I just wanted to highlight

3 a few of the benefits that nuclear does bring to

4 clean energy solutions. Nuclear is clean. Nuclear

5 is a zero emissions way to create base-load

6 electricity. It's a top source of carbon-free

7 electricity in our country. It protects our air

8 quality by generating electricity without harmful

9 pollutants.

10 Additionally, nuclear is powerful.

11 It's a very powerful base-load source. One small

12 pellet of uranium is equal to the same energy output

13 as a whole ton of coal. Also, the same as 149

14 gallons of oil or 17,000 cubic feet of natural gas.

15 One single nuclear reactor is large

16 enough to power 755,000 homes or a city about the

17 size of Philadelphia without emitting any greenhouse

18 gases.

19 Nuclear is also reliable. It's a

20 24/seven/365 source of electricity. Nuclear power

21 plants are the most efficient source of electricity

22 as they operate 24/seven at more than 90 percent of

1 the average capacity factor. Capacity factor is the
2 ratio of actual amounts of electricity generated by a
3 plant compared to the maximum amount that could be
4 potentially generated by that same plant. That's
5 more than two times the capacity factor of any other
6 clean energy source.
7 During the 2019 polar vortex, U.S.
8 power plants operated at more than 98 percent
9 capacity factor. Nuclear plants can achieve these
10 numbers because of the world class operations and
11 because plants only refuel once every 18-to-24
12 months.
13 Nuclear creates valued jobs in the
14 community and also enjoys public support. With
15 nuclear energy in the mix, a study found that the
16 current diverse electricity portfolio lowers the
17 average retail price of electricity by 27 percent and
18 reduces the variability of monthly consumer
19 electricity bills by about 22 percent. That equals
20 major savings for consumers.
21 The study also found that losing this
22 diversity would cause a decline in U.S. gross

1 domestic product by $158 billion a year, a reduction
2 of 1 million jobs and $845 less in disposable income
3 annually.
4 According to a Gallup poll in March
5 2010, 62 percent of Americans favor nuclear, an
6 all-time high at that time.
7 We consistently see in attitude and
8 awareness studies that nuclear enjoys usually around
9 50 percent approval rating by any individual. What
10 we're starting to see is that people are seeing that
11 within their communities that nuclear is greatly
12 valued, and the perception of nuclear is increasing
13 as people become more and more educated about the
14 source of technology and energy.
15 At the U.S. Department of Energy, the
16 Office of Nuclear Energy is all in in terms of
17 supporting the U.S. position for civil nuclear
18 energy. Our newly sworn in Assistant Secretary of
19 Energy in the Office of Nuclear Energy, Dr. Rita
20 Baranwal, comes from us from the GAIN program, the
21 Gateway for Accelerated Innovation In Nuclear. She
22 is an established leader and has hit the ground

1 running for our office.

2 On her behalf, we are continuing many

3 important programs to help move the United States'

4 civil nuclear industry into a leadership position.

5 I'll mention just a few of them:

6 Our continued support of the first

7 advanced reactor being built in the United States in

8 Georgia at Plant Vogtle, which is on its way to

9 seeing its completion. The newly-developed Nuclear

10 Reactor Innovation Center at the Idaho National Lab,

11 which will help demonstrate and deploy advanced

12 nuclear technology, both in terms of new builds and

13 technology that can make the existing fleet more

14 efficient, safer, and more reliable.

15 The Virtual Test Reactor is a new

16 endeavor that's being built and being started right

17 now in the planning phases. This reactor will be a

18 test reactor so that our new designs in advanced

19 reactor networks can be tested and deployed here in

20 the United States and not have to go to foreign

21 countries for their testing and demonstration

22 capabilities.

1 The Carbon-Free Power Project is a
2 very important demonstration project that is on track
3 to be deployed by 2026. It includes the small
4 modular reactor that Maria, of course, made mention
5 made by NuScale and will be -- the energy will be
6 sold through UAMPS through four states in the western
7 part of the country. It will be the United States'
8 first small modular reactor.
9 In a modular reactor like this, they
10 can put in up to 12 reactor units. The first unit
11 will be called the jump unit, a joint-use, multiple
12 purpose research reactor for testing small modular
13 reactor environments. Then Reactors 2 through 12
14 will produce electricity for the Idaho National Lab,
15 surrounding areas, and surrounding states.
16 This is really exciting not just for
17 our office, because it's a first-of-a-kind
18 technology, but for our country being able to compete
19 with the rest of the world through innovation and new
20 technology and deploying safer, more modular, small,
21 reliant technology in small modular reactors.
22 Maria talked about the DOD, the

1 Department of Defense, looking at micro reactors, but
2 also, our government is very interested in utilizing
3 mobile reactors. So not just small scale in terms of
4 what their output is in electricity, but also modular
5 and mobile so that they can be moved to be deployed
6 in different areas. This is significant and exciting
7 for the future.
8 Right now, we're enjoying bicameral,
9 bipartisan support out of Congress in support of
10 nuclear technology and helping to move the
11 United States forward on legislation so that our
12 industry can be unbridled and move forward, but
13 continue to have the safety oversight of the our gold
14 standard in the Nuclear Regulatory Commission.
15 Some of this authorization that's
16 come through Congress includes the Nuclear Energy
17 Leadership Act, the Nuclear Energy Innovation
18 Capabilities Act, the Nuclear Energy Innovation and
19 Modernization Act, and an area that's really
20 important for international competitiveness for our
21 industry is the area of financing tools, and right
22 now, our leadership in Congress and across the U.S.

1 Government is reevaluating a lot of the financing
2 tools that can help U.S. industry build abroad where
3 they're creating loans that can be repaid by other
4 governments so that our U.S. industry can be revived
5 by having these international projects.
6 When a country starts to develop its
7 own nuclear infrastructure, they're going to have a
8 partnership with the supplier country that will last
9 80, maybe 100 years. If the United States is not
10 part of these international nuclear builds, we'll be
11 locked out of the whole fuel cycle and managing what
12 happens, not just with the reactor safety and
13 implementation, but also how the fuel is handled.
14 So it's critically important and it's
15 a matter of national security both on our side and
16 our allies' sides for the United States to be primed
17 to be able to participate in this kind of
18 international build.
19 Our office has been financing
20 advanced reactor technology that's applied both to
21 new builds for the future, but also to existing fleet
22 infrastructure. In the last two years, we've had

1 funding opportunity announcements for more than
2 $170 million that have gone towards new advanced
3 reactor designs.
4 And I want to share with you some
5 renderings a third party has developed, an
6 organization called Third Way. It's a policy
7 organization. And they have developed some designs
8 of how nuclear can be integrated as part of a clean
9 energy system in three different scenarios that I'll
10 share, but if you do go to the website and look at
11 their nuclear reimagined renderings, you can see how
12 these small modular reactors and even large advanced
13 reactors of the future can be integrated into
14 different scenarios.
15 Because a small modular reactor
16 could possibly have a zero emergency planning zone in
17 the future, that means it can be put into an
18 environment like in this Arctic remote location
19 where it's helping to power an Arctic village along
20 with windmills. It's kind of hard to see, but up on
21 the top left on the mountain, there are windmills
22 there, and that can be integrated as part of a

clean energy solution in a very remote, harsh environment.

The next is a transit hub, so this clean energy transit hub could be powered by a large, thousand watt, advanced reactor with zero carbon emissions, zero pollutants, and in this scenario, this large, advanced reactor could be right there in an urban environment powering unmanned vehicles that could be part of a transit system, electric vehicles, electric trains, and even at the nighttime, the power from the small modular reactor could produce hydrogen for a bus or truck depot.

The third scenario would be in another remote area in a desert scenario. This would use solar integrated on the grid with a small modular reactor for clean energy to be dispatched at a nearby city in a desert environment.

So you can see the future of reactors can be placed in areas that our existing fleet hasn't been able to be placed to date and can be integrated as part of a clean energy solution along with renewables.

1 Another area where the U.S.
2 Department of Energy is working globally is with the
3 Clean Energy Ministerial. The Clean Energy
4 Ministerial has been open to an initiative where we
5 partnered with Canada and Japan on the Nuclear
6 Innovation For Clean Energy Future. This is where --
7 an effort that now nine countries have come together
8 to support that investigates how nuclear can be that
9 base-load source integrated onto the grid with
10 renewables as part of a clean energy solution.
11 There's also -- part of the Clean
12 Energy Ministerial is a gender diversity effort that
13 encourages women in clean energy fields. Women
14 currently are underrepresented around the world in
15 clean energy fields, and this is something that has
16 been acknowledged by many countries. The U.S. has
17 supported this C-3E effort. It's Clean Energy,
18 Education, and Empowerment to encourage women
19 for a more diverse workforce and more creative
20 solutions.
21 So finally, the last area I want to
22 just quickly go through, there's a lot of outreach in

education that's happening. We're working with doing Atomic Wings Lunch and Learn, we call them, every month on Capitol Hill to educate Congress and staffers about what is happening at the Office of Nuclear Energy, what's being invested in for new technology and applied to the existing fleet.

We have a youth outreach with Millennial Nuclear Caucuses and clean energy talks on college campuses and other places around the country. There's a K-12 program that we partnered with the America Nuclear Society, the curriculum to teach the facts about nuclear technology and how they apply to our world as well as just ongoing outreach in social media and other channels to try to educate people around the country.

So this is a little bit of our classroom materials. These are some that we're supporting the ad council's program on She Can STEM about how nuclear science is important for the future, our youth outreach and some of the events that we've been able to create dialogues with young people who have questions about nuclear.

1 Here's a look at the Atomic Wings
2 Lunch and Learns that happen every month on the Hill,
3 and then just some of our outreach through social
4 media.
5 So I would encourage you to become
6 part of the conversation. Follow us at our website
7 at Energy.gov, on our Facebook page, through Linked
8 In and Twitter.
9 Thank you very much.
10 COMMISSIONER OLIVA: Thanks, Suzie.
11 Now we'll hear from Dr. Mitchell
12 Farmer from Argonne National Lab.
13 DR. FARMER: Good morning, everybody. I'd
14 like to thank the Commission for inviting me to be
15 here. This is both a real pleasure and an honor, and
16 I'm very passionate about nuclear power. I have
17 worked on it my entire career just down the road here
18 at Argonne National Lab, and it's a real pleasure to
19 be here.
20 From a topical viewpoint, I would
21 like to talk a little bit more about the area of
22 advanced reactors, which we feel is the future of

1 nuclear energy, and where we're at today.

2 But before I start, I'd just like to

3 give a little shout out to the State of Illinois in

4 the area of nuclear power. You may not know it, but

5 the first nuclear reactor was a few miles south of

6 here at the University of Chicago on a squash court

7 in 1942.

8 After that, they moved it down the

9 road to the present site where Argonne is, and that's

10 where I have worked my entire career. It's been a

11 real pleasure.

12 We talked about the number of plants

13 in Illinois and the importance of it. I do want to

14 say, also, from an employment viewpoint, the nuclear

15 plants running in the state now currently employ

16 about 6,000 people. These are high-tech, high-paying

17 jobs, and they're often in rural areas where these

18 kind of jobs are hard to come by. That just has to

19 do with plant operations.

20 I will say that there are hundreds of

21 other jobs in the state that are supported not only

22 at Argonne, but other institutes in the state related

1 to doing research on some of the reactor topics that
2 we'll hear in a second.
3 But it's a very important industry
4 for me, and it's been a pleasure for me to work in
5 this area because I think, as we've talked, it's
6 really the future of carbon-free emission energy in
7 the world, and it's at a turning point with respect
8 to where it's at, and there's a lot of really good
9 work going on in terms of being able to develop new
10 concepts that we can utilize moving forward.
11 So you might ask, what is an advanced
12 reactor? I mean, that's a good question. The
13 current fleet we have has been running for 20, 30
14 years very reliably. It's increased its
15 productivity.
16 These are all water cooled reactor
17 concepts that have run reliably. But the questions
18 we're asking moving forward, are there other types of
19 advanced reactor concepts that can be developed. To
20 meet a few goals and for the advanced reactor fleet
21 we're talking about, there are some very specific
22 targets for the things we're trying to prove, and I

1 have listed them here, and I'd like to go down these
2 quickly.
3 The first is sustainability. The
4 reactors we have right now have an energy cycle that
5 they utilize, but they really use a small amount of
6 the energy that's available in the fuel. So we want
7 to come up with better concepts that take better
8 advantage of the fuel. This is an important thing
9 not only from increasing the utilization, but from
10 minimizing waste. So that's one of our key research
11 goals.
12 The second is economics. Nuclear is
13 basically a private commodity, so it's got to compete
14 with everything else. So there's a real thrust in
15 the industry to come up with technologies that can be
16 more economic not only from the viewpoint of building
17 the plants. They're not -- there's technology
18 involved here, and it's not cheap to build right now.
19 We're working on that. But, also, the cost of
20 running the plants and increasing the productivity of
21 those units at least on a per kilowatt basis and
22 improving the economics.

1 The third is safety and reliability,
2 and I'm careful when I use the safety word, because I
3 have to say the industry right now is incredibly
4 safe. They have been safe for years, decades, and
5 they continue to get better, but there are some
6 things you can do with advanced plants that can
7 increase their passive safety.
8 What you mean there is that basically
9 if something goes wrong, you lose power, you don't
10 have to do anything. It's more of a walk-away type
11 technology.
12 So there's a big thrust in the area
13 to capitalize on these capabilities to make advanced
14 reactors even safer and more reliable, because
15 there's less equipment involved in running the plant.
16 So from a safety and reliability viewpoint, there are
17 things that can be done in advanced systems to
18 improve in that area.
19 And finally, with respect to
20 versatility, we've talked a lot today. Solar and
21 wind are here to stay. These are great energy
22 sources for the world and for the country. I love

these sources.

And the thing with them, they're not steady state energy producers, as we've heard. So we need to build the next generation of reactors so they can interface with those types of power sources to produce a nice, steady power production capability for the country. That's what we need and expect as an economy, and that has to be the way it's done.

So the new reactors moving forward are targeted on how they can be more versatile, on how they can interface with renewables. So those are big topics that we're working on in the advanced reactor area.

I thought it would be good to go over that, and say, what are we trying to do with advanced reactors? That's a good question, and I've tried to summarize that here in the B graph.

The next thing, I'd like to say just a little bit about the details of what some of these systems look like. We've talked about, you know, they can use different coolants or different fuel

1 types to try to meet these types of objectives that I
2 had on the previous page.
3 The other thing we've talked about
4 doing is making these reactors small and modular so
5 that they can be brought in, factory produced. You
6 can really reduce the cost of building something if
7 you can build it in a factory.
8 The fleet that's out there today were
9 basically construction projects that were built on
10 the site, but trying to make these a little bit
11 smaller so they can be moved around, as we talked
12 about, that makes them a little more economic to
13 build.
14 We've talked a few times about
15 NuScale. They're well-along in the licensing
16 process, which is very important, to get one of these
17 plants built, and hopefully, I think they're
18 targeting to have this first small modular reactor
19 built around the 2026 time frame.
20 So these are not long-term,
21 multi-decade investigations. There's been a lot
22 going on, and they're going to be coming online soon.

1 So a lot of work in this area.

2 These are great things to work on

3 from a viewpoint of doing research, and the

4 Department of Energy has been very proactive about

5 supporting this work across the country at the

6 universities and at the laboratories and in

7 industry.

8 So advanced reactor startups we've

9 heard a few times. I have to say this is a national

10 undertaking. Here's a -- it's a little hard to see,

11 but if you look on that map there, this shows across

12 the country where there are startup companies,

13 working on advanced reactor concepts. There's

14 several dozens of these. They span industry,

15 universities, the national labs.

16 The beauty about this process, it's

17 very interactive. There's a lot of interaction

18 between different companies and the national labs to

19 try to get this technology developed and to the

20 public where it needs to be. So there's a lot of

21 work going on in this area. As you can see, it's all

22 across the country. This is not something that

1 people are just idly chatting about at universities
2 or labs. It's actually happening.
3 So with that said, I think I'll just
4 leave with a few takeaways. I'm not very good at
5 takeaways, but I'm going to attempt it here.
6 With the advanced reactor fleet,
7 we've talked a few times about this, but we want to
8 really design the new version -- or reactors of the
9 future to increase their sustainability on the fuel
10 cycle. They will be more economical and they are
11 more versatile so they can interface with the other
12 power sources in the country which are here to stay,
13 and we need to make all that work together to produce
14 a steady power production capability for the country
15 which we need to be economically viable.
16 These new concepts will provide safe
17 and sustainable energy production that meets clean
18 air objectives and promotes long-term availability
19 and effective fuel utilization while minimizing
20 nuclear waste. These are the ideas and concepts
21 we're working on for the advanced reactor fleets.
22 It's fun to work on.

1 I'm going to end on that note.

2 COMMISSIONER OLIVA: Thanks, Dr. Farmer.

3 And next we'll hear from Marilyn Kray

4 from Exelon Generation.

5 MS. KRAY: Good morning. I know you're

6 familiar with my colleagues in Exelon from Government

7 Affairs, but I come from the Operations and

8 Generation side. So we follow, as you can imagine,

9 very closely your decisionmaking and are grateful for

10 your support. So thank you for the invitation and

11 also for making me feel welcome here.

12 I wanted to share with you -- just

13 Exelon's view, and it's very consistent with what I

14 think you heard from Maria certainly, and that is our

15 goal, obviously, is to preserve our existing fleet.

16 We're down to 96 reactors right now, almost 20

17 percent of the U.S. electricity coming from those

18 reactors.

19 But at the same time -- and this is

20 not just the industry, but Exelon's position, and

21 that is to look to the future. And so we strongly

22 support the development of the light water SMRs as

1 well as the advanced reactors and helping to get them
2 ready for commercial deployment.
3 And the link -- there is a very
4 strong link there that you need the momentum of the
5 current reactors in order to enable the new reactors
6 to come online. They need to sustain both the talent
7 pipeline, and that is the students and universities,
8 as well as going into any of the craft fields to have
9 a healthy nuclear, commercial nuclear industry, and
10 then also the manufacturing pipeline. For companies
11 to continue -- companies in the U.S. to continue to
12 invest in nuclear services and components, you need
13 the current fleet to really usher in the next
14 generation of those.
15 So this next slide, I guess it
16 wouldn't be an Exelon presentation if it didn't
17 include this information, but Commissioner Oliva and
18 Maria already mentioned that, so you're all
19 well-aware of nuclear power in Illinois, else why
20 would you have even called this session?
21 So really, again, picking up on what
22 Maria had said, you know, she gave the numbers, and

1 here's the names behind the numbers of the plants.
2 And it is so frustrating to have to update this
3 slide, which unfortunately I had to do in the last
4 two weeks because we shut down our Three Mile Island
5 site.
6 What a somber time in the control
7 room for the workers who put their hearts into
8 operating that plant safely, and through no fault of
9 their own, are now no longer able to work there. So
10 it is -- TMI has been a phenomenally run plant, and
11 sadly, we added the name to the list above the line
12 of the plants shut down.
13 And the plants global line are those
14 that have a formal announcement that they, too, are
15 planning to shut down. Again, coming from the
16 operations side, how difficult it is to work in that
17 environment knowing that your job is going away. How
18 difficult it is for the human resources people to try
19 to figure out what you're going to do, but really,
20 just the emotion.
21 What I can say, not just for the TMI,
22 and Oyster Creek is our other plant on that list, all

1 of them have gone out in style. That is that they
2 have taken that opportunity for that last run to
3 really carry that plant across the finish line
4 upholding the safety standards that they met
5 throughout the life of the plant.
6 So what are we doing about it?
7 You're probably well-aware of what we're doing with
8 you, but we're also looking internally. So in
9 addition to seeking the policy changes and advocating
10 for that, you know, what are we doing to help
11 ourselves?
12 The biggest thing we do is uphold
13 safe operation, because we know that if we don't
14 operate these plants safely, nobody really cares
15 about the future of our industry. So that is,
16 whatever it is that we do, always our fundamental
17 objective.
18 At Exelon, you're probably aware that
19 we have upgraded a number of our units, and that is
20 the cheapest way to get additional nuclear plants.
21 Instead of building a new one, what can we get -- can
22 we get more out of the ones that we have. So we

1 think we have done a good job with that.

2 We have renewed the license -- if you

3 recall, plants are initially licensed for 40 years,

4 we've renewed the license of all but our Clinton

5 plant, and we've gone from 40 to 60 years, and for

6 our Peach Bottom plant, which is located in

7 Pennsylvania, we're actually pursuing the license

8 renewal to 80 years for that.

9 Also, the long-term asset management,

10 and that is how you take care of the plant. Because

11 they are. They're just like whatever it is that you

12 treasure, your house, your car. You put money into

13 it to make it last as long as you can.

14 We spent an average of $600 million

15 across our fleet in capital investments just to

16 refurbish, replace components of our plants.

17 And then also looking to reduce

18 costs. So that is, one, the industry banding

19 together really under Maria's and NEI's leadership to

20 share best practices through the delivery nuclear

21 promise. How can we get costs down? How can we do

22 that?

1 So we did that as a collective effort
2 through that and have had some phenomenal results. I
3 believe at the U.S. fleet, if you compare 2017 to
4 2012, it's almost a 19 percent reduction in the total
5 costs of the fuel, O&M, and capital. So that's
6 really the utilities and the plants working together
7 to see how can we do that.
8 Exelon Specific, we're looking at
9 project legacy, which is associated with
10 restructuring our organization to again continue to
11 make -- to streamline it, to cut down our O&M costs.
12 And then fostering innovations.
13 Working to -- with digitalization, with virtual
14 reality, with electronic work packages. Again, just
15 things to make the plants work more efficiency while
16 always upholding safety.
17 I was going to skip over into advance
18 reactors, because as I said, that's really our dual
19 focus. Keeping our eye on the ball with the plants
20 that we have and then also looking towards the
21 future.
22 So Dr. Farmer talked about some of

1 the reasons why the industry is so excited about
2 advanced reactors, and I thought I would also share
3 with you, because these names get confused quite a
4 bit. You can categorize plants a couple of different
5 ways by size.
6 You might hear of a micro reactor.
7 Well, a micro reactor, the unofficial, I think,
8 definition is it's less than ten megawatts electric.
9 If it's a small modular reactor, it's between 10 and
10 300. And then if it's a large light water reactor,
11 which is what everybody in Illinois is accustomed to,
12 which are all around 1,000, then it's a large light
13 water reactor.
14 You can also characterize it or
15 categorize them by the type. So again, we're all
16 used to using light water reactors. Light water,
17 most people just call it water. But when you get
18 into these other worlds, you differentiate between
19 light water and heavy water.
20 So here in Illinois, we're light
21 water, large reactors, but once you get into some of
22 the other designs, a molten salt design, if you have

1 heard of that, that's where the fuel is actually
2 dissolved into the pool as opposed to being in a
3 solid form.
4 And then, also, you can have a high
5 temperature reactor and also a fast reactor. So I
6 could talk all day if you wanted, but I'd bet you
7 don't want me to.
8 The reason I say that is because
9 these things are confused a lot. And someone says,
10 well, is this an advanced reactor or is it a micro
11 reactor, and that's kind of like saying, do you drive
12 a red car or do you drive a SUV. Those are two
13 different categories. They are not mutually
14 exclusive. You can categorize them one way or the
15 other.
16 The other piece, and I think it was
17 mentioned here, the commercialization. We expect
18 some of the light water, small modular reactors to
19 come online in the mid '20s, and most of the others,
20 the advanced reactors are targeting 2030s, not
21 because that's with the license extension of the
22 current fleet, that's when we see them retiring.

1 So again, there is quite a bit of
2 buzz everywhere, whether it's in the media, the
3 financial area, and also at the congressional level
4 about why. And just to give you an idea, to kind of
5 put it in context, what kind of items are driving all
6 of that, there is that strong need, a concern about
7 the lack of U.S. leadership in the nuclear industry
8 globally.
9 And Suzanne mentioned both China and
10 Russia. They are out there, and their designs are
11 the ones being built right now. So this is a very
12 strong urge to continue in the U.S., primarily for
13 proliferation, not to mention the business
14 opportunities that U.S. companies have.
15 Linked to that proliferation are also
16 the protection for national security and interest in
17 it for grid resiliency, which I think is another
18 theme that you might have heard here as well, and
19 then also the need for fuel diversity. This is not
20 nuclear at the expense of renewables, but maintaining
21 the nuclear contribution to that diverse portfolio.
22 And then lastly, the environmental

1 trends, you know, the two Cs, the two degrees carbon
2 increase and climate change. The best way to
3 mitigate that or one piece that needs to be part of
4 that solution is certainly nuclear.
5 So all of those collectively are
6 really creating this platform for action, which is
7 why you're seeing the government response on
8 legislation that was mentioned. Obviously, the DOE
9 leadership, which I again applaud, Suzanne and the
10 Department of Energy, for really leading us as a
11 nation through that, and the NRC, our regulator, the
12 work that they're doing to adjust the regulatory
13 process.
14 And then on the industry side, you
15 have heard mentioned, there are so many technology
16 developers that are out there. I'll speak to that in
17 a minute. There's availability of venture capital
18 and then, also, the coordination among the industry.
19 So again, you're very wise in this panel, because NEI
20 is a central piece of that coordination. EPRI is
21 where we pool our research piece of it, so this panel
22 certainly well-represents what's going on here.

1 Again, kind of the players that are
2 shaping this. I have the Department of Energy, which
3 is really, again, taking the leadership on all of
4 this, because they have that ability to do that,
5 their connections through Congress, the mandates they
6 get, the influence they have. The Department of
7 Energy through the secretary and also through the
8 national labs. And Argonne, again, not just a
9 national lab, a national asset, but the work that the
10 national labs are doing to promote and advance some
11 of this technology is quite amazing.
12 That box there on the left, I
13 couldn't fit in all of the developers. That's one of
14 the new things. It used to be this is a
15 Westinghouse, GE, or Ariba, you know, one of the very
16 large companies that were developing reactors. But
17 now you've got -- the map that you saw, there's
18 30-to-40 different developers that are out there.
19 TerraPower is the one that Maria mentioned. That's
20 the one being funded by Bill Gates.
21 In the center of that, the U.S.
22 Nuclear Regulatory Commission, their job is not to

1 promote nuclear power, but to ensure the safety of
2 whatever is designed and operated. But again, they
3 are critical in this, because they are part of that
4 deployment.
5 The financial investments, that's
6 another market there. Obviously, you heard from
7 Suzanne about a number of the different
8 congressional -- the legislation that's out there.
9 There's a lot of policy influencers, think tanks,
10 people who have a focus. Primarily what they have in
11 common is a climate change or an environmental piece.
12 Each of those that I've listed is also looking at
13 nuclear as being part of that solution.
14 Lastly, as I mentioned, the industry.
15 So that's that box. Again, not only of NEI, that is
16 our coordinator for all of that, EPRI for our
17 research, NIC is the collection of suppliers, and
18 then, of course, the utilities.
19 So the utilities, you know, we range,
20 and Exelon -- we range in our activity level with
21 respect to advanced reactors. There are some who
22 have chosen to not have any activity at all, and

1 that is, they would just -- they don't have any
2 immediate need for anything, and, therefore, just not
3 involved.
4 Back in late 2016, Exelon adopted a
5 formal strategy to define how involved we wanted to
6 be with respect to advanced reactors. Because we,
7 too, could have taken that position and said we're
8 not in the market for a new plant right now. But
9 rather, we said, we do, and I'll talk about our
10 motivation in a minute.
11 But we really see the objective to
12 create and sustain some long-term optionality for
13 Exelon that I'll speak to, and that really goes to
14 engaging with those developers, also with the
15 internal and external stakeholders, and then lastly,
16 just to participate in these industry forums that are
17 really looking to change the regulatory process,
18 which is primarily through NEI.
19 So the motivation. Again, how can
20 we -- you might ask, how can we have shut TMI down
21 two weeks ago and now be sitting before you talking
22 about advanced reactors. How do you reconcile

1 that?

2 The answer is the climate change.

3 That eventually policy is going to acknowledge,

4 because it has to, is going to acknowledge that

5 nuclear power does need to stay there, be part of our

6 energy mix and our energy solution going forward.

7 So as the largest utility, it's

8 actually a responsibility for us to be involved in

9 it, and we want to influence those future designs,

10 because some of those names -- Maria mentioned a

11 number of them as well. It's to add in operational

12 insight. So we work with them on their emerging

13 design and say, this is a beautiful design on paper,

14 but it's going to be really difficult to maintain it

15 or to refuel it or to operate it.

16 So we provide that input to those

17 developers so that when something comes, it is

18 something that we feel comfortable with that that

19 alternative is there. Because we do want to have

20 competition. We want for there to be multiple

21 designs out there as a utility that we can select the

22 best design that would fit our needs.

1 It also -- as I mentioned, Exelon has
2 adopted a decarbonization effort, and this, again, is
3 a piece of that puzzle.
4 And it's also to create business
5 opportunities for us. Many of these new designs are
6 not going to be sold to the traditional electric
7 utilities, such as Exelon or Southern Company or
8 Dominion, each of whom can very easily operate any of
9 those plants on their own, but rather, they will most
10 likely sell globally and domestically to entities
11 that have never owned or operated a nuclear power
12 plant before.
13 So it's not only a business
14 opportunity for us to share that operational
15 expertise, but, also, it will ensure the safety and
16 the quality of the operation of those going forward.
17 It's also making a commitment to our
18 employees long term. So as I mentioned, the
19 difficult struggle it is when you're announcing the
20 shutdown of a plant, it is also very uplifting to be
21 able to say that we are looking to the future. We
22 are not just looking to run our plants into the

1 ground and then walk away from this technology, but,
2 rather, we are investing and committed to its
3 future.
4 Lastly, as I mentioned, as a leader
5 and the largest operator in the U.S., it's actually
6 part of our responsibility to uphold that position.
7 So the takeaway box there, it is. You know, we
8 recognize the challenge that the current plants have,
9 but we also recognize the future that the technology
10 has, the need for the current plants to help that
11 future.
12 This slide, I won't go through it in
13 detail, but it's kind of a continuum. I think it's
14 some of the pictures that Dr. Farmer had as well.
15 But if you start at the top, it's the light water
16 reactors, the larger reactors that we have now.
17 He mentioned the plants that are
18 under construction in Georgia. Those are the passive
19 light water reactors that will come online soon, and
20 then what we expect to see would be the light water,
21 small modular reactors, and in the U.S., there are
22 three developers. NuScale that was mentioned. Also,

1 GE Hitachi as well as Holtec. So each of them is
2 developing or designing it's own small modular
3 reactors.
4 And then -- again, perhaps, in no
5 particular order here, it's hard to say who is going
6 to come first in these advanced reactor designs.
7 There's high temperature gas-cooled reactors. As I
8 mentioned, molten salt and fast reactors.
9 And we also have fusion on there
10 because there have been advancements in fusion. You
11 know, the joke is that it's always been 20 years in
12 the future, and that's been the same for the last 20
13 years, but there really have been some changes in
14 that.
15 So I'm just going to conclude with
16 this slide, again, just some of the examples of our
17 involvement. Again, NuScale was mentioned. I'm a
18 member of their advisory board, and that is a formal
19 board that they have where they, to their credit, do
20 solicit input from Exelon and some of the other
21 operators with respect to the emerging design.
22 Holtec, you may not be as familiar

1 with them, but they are certainly prominent in our
2 industry as a developer and manufacturer of spent
3 fuel storage casts. But now they are entering the
4 market of designing that. So we have an MOU in place
5 with them, and we're also part of their advisory
6 council.
7 And then as I mentioned, GE Hitachi,
8 Exelon has a longstanding relationship with them as
9 they are the designer of many of our plants, most of
10 the ones here in Illinois. So we're working with
11 them as they develop their design as well.
12 So in addition to some of the things
13 at the bottom, again, NEI which is essential for the
14 coordination of our industry activities. We're
15 active in their SMR program, the micro reactor, and
16 their advanced reactor program.
17 Obviously, with Steve and his
18 colleagues at EPRI, again, who are coordinating the
19 research that is being done to facilitate these new
20 designs, then also working, as I said, with a number
21 of the think tanks and other policymakers.
22 So there's some slides in the back

1 with some of the specific details if you're
2 interested in at least some of those three designs
3 which we think will probably be the next deployed in
4 all the U.S. space technology.
5 Thank you.
6 COMMISSIONER OLIVA: Thanks, Marilyn.
7 Now we'll hear from Steven Swilley
8 from the Electric Power Research Institute.
9 MR. SWILLEY: Thank you. Thank you to the
10 Commission for the invitation and the opportunity to
11 speak on this panel on this very important topic.
12 There's always a danger in going
13 toward the end of the panel that many of your points
14 have been made, but I'll try to only amplify the ones
15 that haven't.
16 A little about myself, 33, 34 years
17 in the nuclear community. About half of that time
18 was in Texas building a couple of large light water
19 reactors, starting them up and then operating them,
20 and then the second half of my career has been at
21 EPRI trying to do R & D to help maintain these
22 reactors.

1 Let's see. I've got lots of slides.
2 A little bit about EPRI, you may not
3 be familiar -- you may or may not be, but I wanted to
4 take a quick opportunity.
5 We're probably a little bit different
6 organization than the rest of the ones on the panel
7 today. We do -- we're a nonprofit, and we do
8 independent scientific research. But it's really a
9 collaborative model where we're trying to bring
10 together all of the right stakeholders to solve the
11 problems for the electric energy sector. Not only in
12 nuclear power, but all forms of generation,
13 transmission, and distribution as well as
14 environmental aspects.
15 I did want to touch -- there's been a
16 few comments today. I know this is a very
17 U.S.-focused, a very Illinois-focused discussion, but
18 EPRI as an organization is working around the globe,
19 and I will go back to that a few times today to talk
20 about the importance of understanding what's going on
21 in other countries.
22 The map there just indicates all the

1 different countries that have participated in our
2 collaborative research model.
3 Now, there's really three core
4 drivers around nuclear R & D, and we are an R & D
5 company, so that's what my focus will really be. We
6 need to do the R & D to understand the existing
7 fleet, how can we sustain it, how can we operate it
8 to the maximum efficiency and optimization.
9 We also have a core bed of research
10 on the advanced reactors trying to lower the risk.
11 How can we get to the point of actually deploying new
12 construction, new technologies.
13 And then another aspect that I will
14 touch on is long-term operations, understanding how
15 do you go to 60, to 80, and beyond 80.
16 So this is a good graph. There's
17 been several comments from my colleagues already
18 about, you know, the original license period was 40
19 years. Most of the U.S. fleet have gotten approval
20 to go to 60 years. There's a new wave now looking at
21 going from 60 to 80, but I think the graph on the
22 screen there bears out some important things that I

1 will go back to.

2 One thing that you will notice there

3 is most of these plants were designed in the '60s,

4 constructed in the '70s, and some into the '80s. The

5 plant that I worked on in Texas, construction started

6 in 1974, and the first unit went operational in 1990.

7 There were a lot of things that happened in the

8 interim.

9 But because of that, most of the

10 domestic fleet today, with the exception of the two

11 passive reactors in Georgia that Marilyn just

12 mentioned, are really 1960s technology. Very robust,

13 work very well, but they are not what I would call a

14 modern plant. So I will come back to that concept in

15 a little bit.

16 So when it comes to the existing

17 fleet, what kind of research has EPRI been doing,

18 what kind of research is still needed, it's really --

19 it's like Marilyn talked about automobiles. That's

20 probably a good analogy. If you're going to maintain

21 an automobile for two years versus 20 years, you're

22 going to approach it differently.

1 So what is that research you need to
2 do to understand aging mechanisms, you know, how are
3 the metals going to age, how is the concrete going to
4 age, how are the electrical cables going to age, how
5 are the polymers going to age, how are the
6 electronics going to age.
7 If you're doing the right research
8 and understand you may not have all of the answers,
9 but as you deploy what we call an AG management
10 strategy, as you continue to do research, as you
11 continue to gain operating experience, you can inform
12 things like guidelines. How am I going to inspect,
13 how am I going to mitigate, how am I going to repair.
14 And if you're actively doing that work, you can
15 easily maintain an asset, very similar to an
16 automobile.
17 It becomes very important, that
18 global footprint. Now, while the U.S. has the oldest
19 fleet, there are many other countries that are not
20 too far behind us, and there's some countries that
21 are just now building and deploying, but it's a very
22 small community, and it's very important that we all

1 share operating experience and lessons learned across
2 the entire globe, so that we all learn from each
3 other. And there's also a responsibility --
4 everybody bears a responsibility to make sure that
5 the lessons learned domestically in the U.S. are
6 shared globally and internationally so that any
7 learnings or opportunities that we found in the U.S.,
8 we want to make sure that other countries benefit
9 from that.
10 So what kind of research do we need
11 to do to go from 40 to 60? About ten years ago, EPRI
12 set up a research program around long-term
13 operations, and it was really asking the questions,
14 you know, what are the research gaps, what are the
15 knowledge gaps. Now, we work very closely with NEI
16 and the Department of Energy, their light water
17 sustainability program, to deploy, identify, do the
18 right research, understand what would it take to go
19 to 80 years.
20 I guess I'm happy to say that the
21 research, while not completely done, has given
22 confidence to three utilities who have now filed

1 petitions with the NRC to extend the license for
2 three sites from 60 to 80.
3 So now that we have line of sight to
4 80 years, there's a lot of discussion today about
5 economics, the cost of generation of electricity,
6 acknowledgment through the -- delivering the nuclear
7 promise at NEI, there has been some reduction in
8 costs to generate electricity, but we still need to
9 do more.
10 If you look at the costs to run a
11 nuclear power plant, you know, fuel, physical
12 security, and maintenance are three large drivers.
13 So EPRI has been working a lot on the maintenance end
14 of it.
15 Now, the plants from the '70s to now
16 2019, they have gone from not so stellar plant
17 availability numbers to now very, very reliable.
18 Plants are operating breaker to breaker. Equipment
19 is operating very well. But with that, the culture
20 has been, you know, whatever it takes to make sure
21 that the equipment is maintained where it will
22 operate without any issues.

1 But now it's kind of taking -- okay,
2 we have great experience with that. What is the
3 right reliability and the right cost. That
4 culture -- there might be equipment that we're
5 overmaintaining. There may be equipment that it's
6 okay to run to failure if it doesn't impact nuclear
7 safety. What are those aspects of those things. We
8 have been collecting information on that.
9 We have about ten years' worth of
10 work order data. We're using data analytics trying
11 to understand plants that are operating very well
12 versus plants that might not be operating so well.
13 What is the difference.
14 Even within a large fleet like
15 Exelon, as they have gone through this data, they
16 have discovered that they might maintain equipment
17 differently from site to site. In data analytics,
18 you can begin to explore and understand what is the
19 difference and maybe raise your level from one to the
20 other with that understanding.
21 There's kind of a new term in the
22 community these days called plant modernization. I

1 talked earlier about plants being designed in the
2 '60s, constructed in the '70s and '80s. They're not
3 exactly what you might call modern in today's terms.
4 A lot of analogue electronics, very little
5 automation, a lot of human labor needed to maintain
6 daily activities. You know, chemistry grab samples
7 as opposed to online automated chemistry.
8 But there are a lot of things that
9 EPRI and others are looking at that are done in other
10 industries, can we bring them into the nuclear
11 community. So EPRI's role in this is, you know, to
12 collect this information. We're going to build a
13 handbook, categorize the technologies, document the
14 pilots that are done.
15 Exelon is probably in the forefront
16 of the utilities in investing capital to bring
17 modernization to their units. What was the return on
18 investment. You know, if you deploy a technology, a
19 salesperson may tell you what great benefit you're
20 going to get, but what did you actually get. How can
21 others benefit from those demonstrations and apply
22 lessons learned and make improvements.

Now, the nuclear industry, it's kind of a little bit slow to adopt technology. A lot of that is deliberate. The nuclear industry is very cautious of risk and nuclear safety.

But if you take an example of NASA, you know, the space program, NASA had some issues and they became risk averse. NASA kind of got to the point where they really don't innovate anymore.

Now you have new entrants come in like SpaceX. If you followed the press over the last couple of days, apparently, they're going to build a spaceship that can go interstellar, and they're going to build it in six months. But some of that is a philosophy. You know, it's fail fast, but fail in an area that's not impactful. And I think there are some lessons learned there for the nuclear industry as well.

The last topic I want to touch is really one -- this benefits the existing fleet, but also benefits new construction. It's around advanced manufacturing.

There have been a lot of advancements

in manufacturing practices since these plants were constructed originally. There's things like powder metallurgy, electron beam welding, laser cladding, technical terms, but really what it means is I can now build components, big components faster, cheaper, and build a better component.

I also have a way to address operational experience from years past. The picture in the center at the top there is a two-thirds scale SMR reactor head for the NuScale design. That's built entirely out of powder metallurgy. You build a can, put the powder in it, put it under intense pressure and heat. I can now build a head that has no welds, no increased residual stress from the manufacturing process, so it's going to be easier to maintain for many more years.

I can also make it much faster. I can improve the time, the schedule, the lead time. I can now have a supply chain that can be deployed around the world. So there's a lot of opportunities here.

EPRI didn't invent this technology.

1 EPRI's role is really can we validate the technology,
2 can we improve it, and then can we get it into the
3 construction codes so that suppliers and vendors and
4 utilities can deploy it, and that's really what our
5 role is there.
6 I'll leave you with one last slide,
7 back to the global footprint. EPRI engages around
8 the world not only with our utility participants, but
9 many other research organizations to make sure that
10 we're all communicating, sharing lessons learned,
11 operating experience, and making nuclear safe around
12 the globe.
13 Thank you.
14 COMMISSIONER OLIVA: Thanks, Steven.
15 And we'll end with Dr. Robert Rosner
16 from the University of Chicago. And even though
17 you're last, it's great that you're a professor, and
18 we get to hear from you.
19 DR. ROSNER: Thank you. It's a pleasure to
20 be here, and I really would like to thank the
21 Commission for inviting me.
22 COMMISSIONER SHEAHAN: Doctor, I don't

1 think your mic is on.

2 DR. ROSNER: Is that better? All right. I

3 can hear myself as well.

4 So first of all, you might wonder

5 what an academic is doing here. So one of my past

6 jobs was Laboratory Director of Argonne, and it just

7 so happens that my office is directly across the

8 street from where CP-1, the very first nuclear

9 reactor ever is located. So by both distance and

10 avocation, I'm here.

11 What I thought I would do -- I'm

12 sort of a cleanup guy here, and so what I thought I

13 would do is hit on five points that are sort of key

14 to the question of why are we talking about nuclear

15 at all.

16 So the first one has to do with the

17 idea that nuclear power really should be thought of

18 as a hedge against the possible failure of effective

19 good storage. I think everyone agrees that we need

20 to decarbonize the energy economy as well as the

21 transport sector, and that really means we're going

22 to electrify the transport sector, and we basically

need to ensure that we have reliable power.

Now, decarbonizing means relying on renewables. Wind and solar are the obvious ones, but we know that wind and solar, the renewables, are inherently intermittent. This means that as long as they form a small fraction of the power supply on the grid, the grid management can basically take care of those fluctuations. Dispatching still works.

But as the renewables become a larger and larger fraction of grid power, dispatching becomes much more challenging, and so folks have talked about deploying grid storage. Unfortunately, grid storage today -- grid storage designed to really handle outages that are typical when you have fluctuating energy supplies is basically nonexistent. It does not exist. It's a research question.

By saying it's a research question, it means I also can't tell you when it's going to be here.

So if you think about the utilities' perspective, by custom, by law, by popular understanding, they're supposed to be highly risk

1 averse. When you flip the electric switch, you
2 expect the power to go on.
3 So they are going to need to depend
4 on base power capability that's known to work
5 today -- they can't bet on guessing -- and it has to
6 be something that's not carbon intensive, because
7 they do pay attention to climate, as you've heard.
8 And the only such technology today is nuclear power.
9 So if you look into a future where
10 you want to be sure that power is always there and
11 you're not going to guess about what research will
12 bring us, you're going to have to absolutely require
13 nuclear to be there.
14 Now, having said that, you have heard
15 the previous speakers allude to this point, but let
16 me just be very direct. Economics matters. Money
17 matters.
18 The challenge for nuclear power
19 really comes down to whether it's existing or new and
20 dealing with a low spot price of power that's
21 produced by natural gas combined cycled plants as
22 well as subsidized wind and solar.

1 This is going to be true for the
2 foreseeable future as long as the externalities of
3 fossil fuel power is not priced. In other words, we
4 don't have a carbon tax or any other mechanism for
5 cost of these externalities that come with burning
6 fossil fuels.
7 I must say that the energy producers,
8 the Exelons, cannot be faulted for taking this
9 economic reality into account. We live in a time
10 when quarterly results really do matter to
11 corporations, and if you ask, what's the evidence for
12 this, well, this is probably why we're seeing so many
13 premature retirements.
14 So this economic disadvantage of
15 nuclear power is unrelated to the kind of cost
16 overruns for nuclear power construction we've seen in
17 the U.S. in Georgia and South Carolina, in Finland
18 and France. It's not that nuclear power can't be
19 produced, new builds can't be produced on time and on
20 budget -- look at, for example, Abu Dhabi where both
21 of those things happened, the plants came in on time
22 and on budget -- but we have to face the reality that

there is this competition, and from my perspective certainly and I'll bet also from the perspective of my fellow panelists, it's unfair competition.

Now, the cost overruns that we're talking about for new builds make the problem worse, but even if those projects were on time and in budget, the economic disadvantage would still remain as long as fossil fuel power receives an effective subsidy by not pricing the externalities.

Now, new designs such as small modular reactors, SMRs, might help. The key is these new designs basically offer the opportunity for dramatic changes in the capital construction costs of nuclear power based on the upfront cost.

The idea is basically to replicate the construction methods developed by, for example, the airframe industry, the Boeings and the Airbuses, which rely on factory-built assembly line methodology to move from expensive first-of-the-kind plants to -- basically, the early prototypes -- to market competitive, Nth-of-a-kind construction costs.

Now, this approach, however, relies

1 on the existence of an order book; i.e., a list of
2 customers that have committed to buy. That's how the
3 aircraft industry amortizes the learning curve
4 necessary to achieve Nth-of-a-kind costs; namely,
5 over the ensemble of airplanes that have been
6 pre-sold.
7 And I think this will also be an
8 important issue for the nuclear industry, and I'm
9 heartened to hear that the NOE is planning to build
10 up to 12 modular reactors in Idaho. That's a great
11 idea. That's exactly the order book that we're
12 looking for.
13 Right now, the Department of Energy
14 is, in fact, as you heard, supporting one SMR vendor,
15 NuScale, to actually build a prototype at Idaho
16 National Laboratory, and quite frankly, without an
17 order book, I think the economics would really look
18 bleak for SMRs in the United States today.
19 Now, if you're wondering whether we
20 have some data to support some of the things that I'm
21 talking about, well, Germany's experience should be a
22 warning.

1 Germans are, first of all, committed
2 to decarbonizing their economy, both from the energy
3 production point of view as well as the transport
4 sector. They want to go to 80 percent renewable by
5 2050, and they have decided -- here's the key
6 point -- to exit nuclear power by 2022.
7 Keep in mind that in the absence of
8 new nuclear builds in the United States, we're going
9 to be in the same position. Our existing nuclear
10 fleet will go out of service if we only go to 60
11 year -- 20-year life extensions, a 60-year age, by
12 the 2040s and 2050s, 2050s, 2060s if we go to 80-year
13 lifetimes. The only surviving plants by the end of
14 that period are going to be those two plants that are
15 currently under construction.
16 The German experience is that
17 maintaining secure electric service while eliminating
18 nuclear power requires an increased reliance on
19 coal-powered power. In other words, it goes directly
20 in the opposite direction to how they want to respond
21 to climate change.
22 In fact, they are using coal that is

1 the dirtiest of all coal. They're using lignite.
2 And that's true even though Germany has power
3 purchase agreements with, for example, the French.
4 By the way, that would be nuclear power.
5 Now, what does it mean for the German
6 consumer? The considerable subsidies paid to German
7 producers of wind and solar power has also meant that
8 the German electricity prices are very high. About
9 30 Euro cents per kilowatt hour compared to the
10 Illinois cost of -- for example, if you have a
11 30-month contract, you can get electricity for less
12 than 8 cents a kilowatt hour. It's a stunning price
13 difference.
14 This price shock may well be in our
15 own future unless natural gas prices stay at current
16 levels until well past mid-century, and would you
17 want to bet on that? I don't think so.
18 So there is the matter of the spread
19 of nuclear power worldwide, and that's been alluded
20 to already. It's well-recognized that the key
21 concern certainly in the United States about the
22 ongoing spread of nuclear power in the developing

1 world relates to proliferation of nuclear expertise
2 and the increased threat of nuclear weapon
3 proliferation. Those two things are just tied
4 intimately together. There's no way of untying that.
5 The United States played a decisive
6 role in non-proliferation issues world-wide until the
7 1990s. With the demise of nuclear plant suppliers --
8 Westinghouse and GE have not built nuclear power
9 plants in decades. Westinghouse is back in the
10 business, but it's suffering, as you know -- we have
11 demonstrably lost influence.
12 And just to give you an example, I
13 was at Argonne during the Bush administration, and at
14 that time, the United States attempted to have a
15 number of nations sign the so-called gold standard
16 123 Bilateral Agreements, part of the G-net Program
17 (phonetic.) The idea was basically to extend the
18 standard 123 Agreements to include commitments not to
19 enrich and not to reprocess.
20 And what happened? Even allies such
21 as Australia refused to sign.
22 So the demise of the nuclear industry

1 in the United States that might well happen assuming
2 that no further new builds are going to happen,
3 assuming that these plants just end up disappearing,
4 our international influence and perceived expertise
5 is likely to continue to decline. And is this really
6 what we want?
7 So just to summarize, nuclear power
8 really is an effective hedge against future
9 technological limits on grid-scale storage of
10 electricity.
11 Economics does matter, and nuclear
12 power is at a significant disadvantage as long as it
13 competes on spot price with natural-gas-powered power
14 plants and subsidized renewables.
15 SMRs may help and other new kinds of
16 designs may help on the economic front, but in the
17 absence of an order book for such a plant -- I hope
18 such order books will, in fact, materialize like the
19 one that's materializing in Idaho -- they're not
20 likely to be economically viable.
21 And finally, if we value the U.S.
22 role in maintaining nuclear non-proliferation, the

1 decline of our nuclear industry should cause
2 considerable alarm.
3 So thank you.
4 COMMISSIONER OLIVA: Thank you, Dr. Rosner.
5 So that concludes our panel
6 presentations, but I do have questions. But I want
7 to open it up to my colleagues first, so we don't run
8 out of time, and you get your questions asked and
9 answered.
10 COMMISSIONER SHEAHAN: I have a question
11 for anyone on the panel who would like to take this
12 on. I thought this was really terrific, and thank
13 you, Commissioner Oliva, and all of you for being
14 here.
15 Illinois really is at the center of
16 the nuclear industry in many ways, and the ICC played
17 an important role in ensuring that policy support was
18 there for the industry.
19 However, PJM has really dragged its
20 feet and really been an obstacle towards allowing
21 that state policy to have the effect that was
22 intended.

1 So my question is if any you have any
2 specific suggestions as to how PJM might value the
3 attributes of nuclear. I mean, there's a carbon tax
4 obviously. They haven't shown much interest in that.
5 But aside from that, are there any
6 specific market valuations that they could attribute
7 to nuclear power?
8 MS. KORSNICK: I guess I'll start to frame
9 it out. You sort of hinted about it even in your
10 question. I mean, fundamentally, what nuclear brings
11 is the carbon-free attribute.
12 So whether you want to call it
13 emissions, because it also doesn't emit nitrous
14 oxides or sulphur oxides, but fundamentally, carbon,
15 there are ways that PJM can consider that.
16 The real challenge that you have
17 right now is that the states are really interested in
18 that. Fundamentally, if you look at why did a market
19 like PJM form, I mean, it formed to really reduce
20 electricity prices. And one would say, well, they
21 have been pretty successful with that. Electricity
22 prices are relatively low.

1 But the conversation that we're
2 having now is around the environment, it's around
3 people's health, and it's around keeping the planet
4 healthy, quite frankly.
5 It shouldn't surprise us that a
6 market like PJM isn't facilitating that. It really
7 wasn't designed for it.
8 So fundamentally, we have to figure
9 out, is the market going to bear that and find some
10 way to price in that externality, or are we going to
11 leave it up to the states. And if you leave it up to
12 the states, you're going to get a bit of a patchwork
13 quilt of solutions. Every state does it sort of a
14 little bit different. And, of course, that's going
15 to be a real challenge to the otherwise, sort of, you
16 know, market that PJM has created.
17 But I do think fundamentally it needs
18 to be looked at and really approached from a very
19 basic place. PJM wasn't formed for this reason.
20 That market wasn't formed for this reason. And yet,
21 if you look now at customers and you look at states,
22 they're demanding it.

1 In fact, we just -- recently there
2 was an article in *Bloomberg*, and it did a graph of
3 most of the utilities in the United States, and it
4 showed going forward carbon commitments. And
5 literally, across the United States, all of the
6 utilities are trending down -- if you will, down and
7 to the right in terms of as the years go out, they
8 want less and less of a carbon footprint.
9 And it's not just for the good hearts
10 of utilities. It's the customers that are demanding
11 that. The customers are speaking.
12 COMMISSIONER SHEAHAN: Does Congress have
13 to impose that, or -- we currently have a governor
14 who is committed to 100 percent noncarbon, zero
15 carbon by 2050. You can't do that and close nuclear
16 power plants, as I think was pointed out.
17 Does Illinois have to join RGGI? I
18 mean, how does that happen?
19 MS. KORSNICK: I mean, FERC could play a
20 role in this. FERC could weigh in and say, again,
21 that these markets need to, you know, value, if you
22 will, the carbon complement and just sort of let the

1 market figure it out.

2 The challenge that you have right now

3 is FERC has sort of played a role that says, well,

4 it's not our jurisdiction to worry about the

5 environment. So you have a bit of a standoff between

6 the federal government arm that could say, hey, let's

7 work through this market solution and PJM.

8 So I do think at some level we need

9 to have a press by the government to say, you know,

10 this is important. But again, PJM could take that on

11 just from the response, if you will, from the states

12 that it has jurisdiction over.

13 DR. ROSNER: I think there's something that

14 can be done, also, in state. I mentioned the

15 competition of nuclear against gas plants, but they

16 also compete against the renewables, and the

17 renewables have a state subsidy, the REC. They don't

18 apply to nuclear.

19 Nuclear, from the point of view of

20 saving of climate, plays the same role as wind and

21 solar. You might think that the REC should really be

22 relabeled as non-carbon energy credits, and that will

1 help the industry for sure.

2 MS. KORSNICK: I'd like to echo that

3 sentiment. We're very much trying to change the

4 conversation and get away from things like renewable

5 portfolio standards or renewable energy credits and

6 change the conversation to clean energy standards and

7 clean energy credits.

8 And as I mentioned in the talk and as

9 he's mentioned, it shouldn't matter what your

10 technology is. It should matter if you're deploying

11 that deliverable, which is clean power.

12 MS. KRAY: I would echo that. As far as

13 what appears to have worked in Illinois and New York

14 is that appreciation of nuclear and the zero emission

15 credit as opposed to simply just the renewables.

16 COMMISSIONER SHEAHAN: It works only as

17 long as PJM doesn't mitigate -- it doesn't sort of

18 back that out of their market price and their

19 mechanisms, which they seem to be pretty determined

20 to do. So that's the challenge.

21 COMMISSIONER OLIVA: Do any of the other

22 Commissioners have questions?

1 COMMISSIONER BOCANEGRA: I do. Thank you,
2 Commissioner.
3 Thank you to all of you.
4 I think this question is probably for
5 Dr. Rosner. You mentioned earlier that, perhaps,
6 this serves as a hedge against storage. In your
7 opinion, do you think that there's any dispatch
8 capability concerns with storage currently?
9 DR. ROSNER: Well, I think the problem, of
10 course, is that grid scale storage really doesn't
11 exist. There are a few places where grid scale
12 storage does exist in the form of basically pump
13 storage facilities, but there is no such facility as
14 far as I know in the State of Illinois.
15 Europeans are looking at storage
16 facilities, mostly in the Alps. It's probably in the
17 future for Switzerland. For example, as the glaciers
18 melt, it's going to end up being kind of a hydro
19 battery for the continent.
20 Except for that, you're counting on
21 battery technology that really does not exist yet at
22 the grid scale. So we just don't have it.

1 MS. KORSNICK: I would add to that, because
2 I know many of us hear about batteries, and batteries
3 will continue to get better. Batteries have a role.
4 But in terms of the scale of that role, it's really
5 minor and will continue to be.
6 So people will invest in it. It's
7 sort of a good thing, if you will, to go forward. It
8 will be expensive, but it will play a bit of a role.
9 This is really one I would encourage us to have kind
10 of an all-of-the-above sort of mentality as we go
11 forward for the amount of carbon that needs to be
12 reduced, but we shouldn't imagine that batteries can
13 get large enough, and that that storage -- in fact,
14 I'll be honest. I'll reflect again on the
15 conversation that I was recently at with Bill Gates,
16 because he personally has invested heavily in battery
17 technology. And in the conversation that we had,
18 there were sort of several other people from the
19 renewable community.
20 And he was very direct in his
21 statement to say, I get it, we should continue to
22 invest and see where batteries are going to go, but

1 they're never going to get to the point where you're
2 not going to need base-load power.
3 And when you think about it, just
4 think about a huge weather front that comes through,
5 and if that weather front comes through from sort of
6 Texas to Ohio, and it's cloudy everywhere and maybe
7 the wind isn't blowing, there's not batteries big
8 enough to enable you to turn on that light switch.
9 And because that will happen -- as we
10 mentioned earlier, utilities are intended to be very
11 risk averse. They're going to have to create enough
12 energy to be ready for those opportunities. You're
13 going to always need base load. We just have to
14 determine, do you want that base load to be carbon or
15 not carbon.
16 So really what we need to put our
17 minds around is how do we get all of this stuff to
18 work together and optimize it, and ultimately for the
19 consumer, for the consumer to pay the least costs.
20 COMMISSIONER OLIVA: All right. So this
21 question is for Maria. Used fuel is a significant
22 challenge to perception of nuclear power today and in

1 the future. What progress can we expect on this
2 issue and that challenged perception?
3 MS. KORSNICK: Thanks. My favorite
4 question, quite frankly, that I get.
5 So I'll start out by being just a
6 little bit bold, and I'll say some people call it
7 used fuel. I call it future nuclear fuel.
8 So the used fuel that we have today
9 has 95 percent good energy in it. It's just been
10 transformed. It started from one sort of version of
11 uranium, and it turned into another version of
12 uranium and a little bit of plutonium. And the
13 reactors that most of us talked about here today, the
14 light water reactors, they don't burn that sort of
15 transformed energy, but it's in there, and your kids
16 and your kids' kids, they're going to want it.
17 So the first thing we need to do with
18 what we were calling used fuel is put it someplace
19 where we can get it again, because there's a lot of
20 good energy still left in that.
21 And let's talk a little bit about
22 what we think for used fuel. I would point to the

1 nuclear industry and say it's been thoughtful and
2 responsible about used fuel. It knows exactly where
3 it is. These are solid rods. They're stored in
4 concrete and metal containers. You know exactly
5 where it is. They're monitored very closely and
6 safely stored today at all the different plants that
7 they're at.
8 But it's not the most efficient way
9 to do it. When these plants were all built, the deal
10 was made with the federal government that said they
11 were going to take care of long-term fuel storage.
12 That was the commitment when these plants were build
13 many years ago.
14 As ratepayers across the country,
15 they have given $40 billion to the United States
16 government to make good on this request. So the
17 ratepayers have done their thing. I would tell
18 you the nuclear industry has done its thing in terms
19 of operating things safely and has safely stored this
20 used fuel, but the federal government, not so much.
21 So with that $40 billion that's been
22 provided, there has not been an answer. And it's not

1 a technical problem. It's a political problem.
2 And so we continue to work to see if
3 we can't break this stalemate and move things
4 forward. We're advocating for consolidated interim
5 storage, which means you take the storage from the
6 variety of plants that are located today and put it
7 in one consolidated place. That's an interim type
8 solution.
9 And then ultimately, a long-term
10 storage, and we advocate for continuing to go through
11 the licensing process for Yucca Mountain. That's a
12 process that has been started and yet unfinished, and
13 going through that licensing process will make sure
14 that that site is fully understood to understand if
15 it is, in fact, a long term -- a location for a
16 long-term repository or not.
17 But ultimately, we need to find a
18 long-term repository solution here in the
19 United States.
20 COMMISSIONER OLIVA: Dr. Rosner?
21 DR. ROSNER: I just wanted to add to that
22 that if you're worried about the spent fuel, the

1 safety, one thing you might want to look at is what's
2 happened in Sweden.
3 So Sweden, I think most of us think
4 is a pretty rational place, and I had the good
5 fortune in the last year of visiting the repository
6 that they're building. It's an underground
7 repository. It's about half a kilometer underground.
8 And the Swedes are about 50 percent hydro, 50 percent
9 nuclear, and they intend to keep it that way. They
10 burn absolutely no fossil fuel to provide their
11 electricity.
12 And the politics there was not the
13 way it was here in the United States. They were able
14 to deal with it. So it can be done.
15 COMMISSIONER OLIVA: Dr. Farmer, you noted
16 that advanced reactor designs would be able to
17 increase the level of safety relative to current
18 reactors. How is that done?
19 DR. FARMER: Thank you. That's one of my
20 favorite questions, also.
21 As I said, the advanced reactor
22 designs are capitalizing on basic things that you use

1 in your house, like natural convection. You start
2 your fireplace. The heat goes up. It's gone away.
3 It's dissipated. Some of it comes into your house,
4 but a lot of it goes up your stack.
5 And basically, they're just using
6 simple physics to capitalize on those things,
7 reducing the scale to limit the amount of heat.
8 They're smaller, so there's less energy, and they're
9 just using those kinds of concepts to get there.
10 So it's not rocket science. It's
11 just good basic engineering that they're using.
12 Is that okay?
13 COMMISSIONER OLIVA: Yes.
14 So a lot of you talked about the U.S.
15 collaboration with other countries. So here's my
16 question to all of you. Isn't it too late? The
17 current nuclear suppliers, such as Russia, aren't
18 likely to pay much attention to what we have to say
19 if we do or don't have a nuclear power industry. So
20 what are your thoughts on that?
21 MS. JAWOROWSKI: I would reiterate and
22 state firmly that it is not too late. This

technology was born in the United States. The rest of the world still respects that legacy. Our national labs, our universities, and our industry are extremely well-respected around the world as well as our diplomacy.

I serve on an organization called IFNEC. It's the International Framework for Nuclear Energy Cooperation. There's 65 countries that are members. It's an informal organization, so you can have very informal conversations country to country, government to government.

Today, China and Russia are bringing complete solutions with a financing package along with basically what is American technology rebranded under other countries. The financing package is one of the elements that's really important to other countries, because it can be expensive to build and develop the infrastructure, have the certification process, develop your workforce. It's quite extensive in terms of the investment infrastructure.

If the United States can recalibrate some of our financing options to be risk averse, but

1 also be able to support U.S. industry working around
2 the world, other countries are absolutely prepared
3 and would like to work with the United States. I
4 have seen this firsthand from conversations with
5 other countries that are buying from China, not
6 because they want to, but because they're bringing
7 the financing, and they don't have another
8 alternative.
9 There are other countries, like
10 Poland, that are looking at the United States as a
11 key partner for national security. They do not want
12 to rely on gas from other countries. They want to be
13 able to have their own power that they can control
14 that nobody else can turn the switch off, and they
15 trust working with the United States. So I don't
16 think it's too late at all.
17 MR. SWILLEY: If I could add a little bit.
18 Like I said, EPRI is working throughout the globe,
19 and we have members in China participating in our
20 research. We have several Russian VVR designs.
21 Russia is not participating.
22 Other countries, like Czech Republic

1 and Hungary, are participating, and they're really
2 hungry for knowledge, because the U.S. is the oldest
3 fleet. So as their fleet begins to get older, they
4 really want to understand the lessons learned from
5 what happens in the U.S. So there's a hunger for
6 that knowledge throughout the world.
7 While they may be leading in some
8 areas in advanced technology, there's still a great
9 interest in the existing technology.
10 MS. KRAY: I would add to that that, again,
11 it's the respect of the U.S. that designs -- you
12 know, a lot of the Chinese designs are actually
13 derivative of what they bought from the Americans.
14 COMMISSIONER SHEAHAN: Shocking.
15 MS. KRAY: So you can basically kind of
16 relabel it and then resell it. But as Suzanne said,
17 it is the economic aspect of it in that one kind of
18 package that says, I will not only design your plant,
19 I'll construct it, I'll operate it, and I will
20 finance it for you, and so then that buyer is
21 completely beholden to that entity.
22 And the U.S. companies trying to sell

1 is -- it's a struggle, because many of the ones from
2 Russia and China, those are state-owned entities, so
3 they have the backing of their government being part
4 of the fact that they're integrated into their
5 government for that financing piece of it, and that's
6 where, if you had somebody in here from NuScale or GE
7 or Westinghouse, would say when they're sitting
8 across the table from their competitors or with their
9 competitors, they don't have that complete package
10 there.
11 But the westernization with respect
12 to the approach to the robustness of the design and
13 the way in which it's operated is still
14 well-respected.
15 DR. ROSNER: Just two points. One is that
16 just to point out that the two major firms, U.S.
17 firms that were in the business of building nuclear
18 reactors, Westinghouse and GE, of course, are
19 partnering with Japanese companies. Westinghouse is
20 a Japanese-owned company, and GE is partnering with
21 Hitachi. That's the first point.
22 The second is that the financing, I

1 think, is key, but there is another issue for
2 U.S.-based manufacturing and selling plants, and
3 that's brought out by the deal that the Russians are
4 offering, for example, to Turkey and Vietnam. That
5 is what they call the build-own-operate, the BOO
6 model. They will build the plant for you. You don't
7 have to pay a cent for it. They will operate the
8 plant for you. They will own the plant, and they
9 will take back the fuel. So they provide the fuel,
10 and they also take it back.
11 So for a country, like, for example,
12 Turkey, what it means is they don't have to worry
13 about the issues that we alluded to before, which is
14 what do you do with the used fuel.
15 The United States is not in a
16 position to do that. We cannot take back fuel, and
17 that's by law. So to compete against the Russians,
18 we will actually be challenged, and unless the
19 federal law is changed, it's going to remain
20 challenging.
21 And the Chinese are also going to go
22 that route. They are not really yet in the export

1 market. They have been talking about it. They have
2 not yet built a reactor outside China. But they're
3 likely to go the same way, because they also have the
4 resources to deal with take-back. We do, too, but we
5 have a legal problem.
6 MS. KORSNICK: I'm going to just jump in,
7 and then I think Suzie has a comment to make as
8 well.
9 You might ask yourself why, in fact,
10 do China and Russia have this sort of zest, if you
11 will, to build, and it's pretty simple. When you
12 take on what we just mentioned here in building these
13 reactors, it's essentially a 100-year relationship
14 that you're forming with these countries.
15 And China and Russia really play the
16 long game, and they really want to control the --
17 quite frankly, the electricity supply and the
18 infrastructure of these countries as part of their
19 foreign policy.
20 My hat's off to Secretary Perry. He
21 has really demonstrated a strong knowledge and
22 understanding of the importance of this. He has

1 traveled extensively to other countries to make sure
2 it's clear that the United States would like to do
3 business.
4 But this is where -- and maybe you
5 have heard about it in the press and other things.
6 You might have heard of something called the EXIM
7 Bank, which stands for the Export-Import Bank.
8 People have a variety of opinions about it, but the
9 importance of the Export-Import Bank to the
10 United States is it helps to level that playing field
11 that we're talking about.
12 When Westinghouse sits across not
13 from another company, but from a country, China or
14 Russia, having a working Export-Import Bank here in
15 the United States helps to level that playing field.
16 Our Export-Import Bank has not had a quorum for a
17 bit. That has recently been established by this
18 administration and is now up for reauthorization as
19 well.
20 So these are very important things to
21 appreciate and understand. When you hear some of
22 those things that sound like they're not necessarily

1 connected or related, they're very important for the
2 export market and for the United States, which I'll
3 tell you across-the-board, we operate nuclear plants
4 the best in the world. There's no question.
5 And we have the highest safety
6 standards. And that's why we -- through our
7 operational excellence, that's why we want to be in
8 the nuclear conversation around the world.
9 MS. JAWOROWSKI: I just want to make an
10 addition. Dr. Rosner brought up a great point about
11 Russia and their kind of one-stop shop,
12 build-own-operate.
13 China has a similar approach. They
14 call it the Road and Belt Program. It's all about
15 providing investment in infrastructure, and the
16 United States is really working to facilitate all the
17 different areas that you need to work with to try to
18 create a process that's sort of a one-stop shop
19 through a program called Team USA. It's a
20 multi-agency government organization.
21 And the appropriate role for the U.S.
22 government is to show, here's how you work with U.S.

1 industry, through commerce. Here's how you work with
2 financing, through EXIM Bank. Here's how you work
3 with certification and safety criteria, through the
4 Nuclear Regulatory Commission.
5 But on the issue of spent fuel, it is
6 not a technological challenge that we have in front
7 of us. It is a much more of a political challenge on
8 the spent fuel front. The U.S. could compete, and
9 there are many countries talking about taking back
10 spent fuel and developing what they call
11 multinational repositories. Whether it's an interim
12 or a long-term repository, as Maria talked about, it
13 can be a money maker.
14 If you have the right geological
15 makeup to be able to store either in an interim way
16 or a long-term way the spent fuel, it's a very safe
17 way to do it. Given the right environment, it can be
18 a great way for a country to make money to say to the
19 rest of the world, we'll take your spent fuel and
20 store it for you.
21 But it is a major political
22 challenge, because often politicians will say, you

1 want a dumpsite in your backyard? The answer is, no,
2 no one wants that.
3 But there are safe, economical ways
4 that that spent fuel can be stored if we can get over
5 the perceptional issues about it, and there are a lot
6 of friendly allies that are coming together to think
7 about that in the long run.
8 So the U.S. is really trying to be
9 competitive in this area, and I'm just really pleased
10 with the cooperation we have from universities, the
11 national labs, industry, and our nongovernment
12 organizations. I think we're all on the same team to
13 try to get back in the game and compete.
14 COMMISSIONER OLIVA: Anybody else want to
15 share their thoughts?
16 DR. FARMER: I just want to reiterate that
17 spent fuel is not a technology issue. I'm an
18 engineer. I wonder about volume. But if you took
19 all the waste that the U.S. has generated, it's very
20 small in terms of volume. It would cover a football
21 field about 20 feet deep.
22 So it's not like this is a huge

1 geometric problem. And the technology exists. As
2 Dr. Rosner said, they're taking care of it every day
3 in Sweden. So there are ways to manage it, and as a
4 research, it should be kept.
5 COMMISSIONER OLIVA: We have time for one
6 more question, and this is for Marilyn Kray.
7 So where and when do you see these
8 new reactor designs being deployed, and can you talk
9 a little bit about the approval process for these new
10 designs in the regulation space?
11 MS. KRAY: Sure.
12 So probably most folks are interested
13 in the domestic, what's going to happen. There was a
14 couple of references to it.
15 It appears that the first one will be
16 the NuScale design, which is a light water, small
17 modular reactor, and it is being sold to an entity
18 called UAMPS, which is the Utah Association of
19 Municipal Power Suppliers, which is actually a
20 conglomerate, I think, 40-to-45 different small
21 municipalities whose common purpose is to fund new
22 generation.

1 And they have a zero carbon project
2 that is what launched them into selecting the NuScale
3 design, and then they further selected Idaho. Idaho
4 is actually one of the states which they service.
5 They selected a parcel of land at Idaho National
6 Labs.
7 And as Suzie had mentioned, what they
8 plan to build, NuScale has 12 units, and they're 60
9 megawatts electric each. Two of those units the
10 Department of Energy is going to fund as part of that
11 joint use program, which is really interesting
12 because you can do a lot more with nuclear energy
13 than just make electricity, and that is what they are
14 going to help demonstrate.
15 So right now, the plan is for them to
16 have that constructed and built in 2026.
17 And with respect to the regulation
18 aspect of it, NuScale is going through the design
19 certification process, and that is, they present to
20 the U.S. Nuclear Regulatory Commission their design,
21 and they get essentially generic approval for that
22 design.

1 And that is expected to be approved,
2 I believe, in 2020, and they have been meeting all of
3 their milestones with respect to this phased approach
4 to that.
5 That being said, some of the newer
6 plants coming online -- because the NuScale design is
7 really just a small version of what we have in
8 Illinois and everywhere else. So it's essentially
9 the same fuel, just a shorter size of it, but the
10 same composition, same materials. Similarly, the
11 plant operates at the same operating temperatures and
12 pressures so there's no introduction of really
13 anything new.
14 You can very easily take an Exelon
15 operator, with a small amount of training, he or she
16 would be able to operate that NuScale plant without
17 any issues.
18 So the NRC is similarly saying, yep,
19 this is what we're used to.
20 The new designs are quite different,
21 and so the NRC is having to go back and say, hey,
22 these regulations that we have, they were designed

1 for light water reactors, and they are very specific
2 to that effect, and now they have to kind of regroup
3 and say, well, it's not so much that this has to be
4 at this certain temperature or it can't be above this
5 pressure, because that really only applies to that
6 design, but what did we really want.
7 And what we wanted, well, we didn't
8 want the release of fission materials outside of
9 here. We didn't want any releases. So they're
10 having to kind of go back really to the essence of
11 the regulations and to make them somewhat
12 transferrable to other designs.
13 But the NuScale one is actually a
14 good test case for that, because it is introducing
15 some changes, but really serving as that bridge for
16 the regulatory piece as well.
17 MS. JAWOROWSKI: I'd like to just add on to
18 what Marilyn was talking in that, yes, the technology
19 is very similar to what is in place with the
20 large-scale reactors today, but something that is
21 very distinguished and unique is the passive safety.
22 So as several on the panel talked

1 about passive safety, it comes down to some very
2 significant differences when applied in these small
3 modular reactors. You do not need a secondary energy
4 source if there is an overheating situation, so you
5 don't have to have it plugged into the wall. So if
6 there's a situation where there's no electricity, the
7 fuel can still cool on its own.
8 You do not have to have a human
9 operator. It cools on its own.
10 And then, also, you do not
11 technically -- now, I'm not the NRC, and they have
12 not come out with their final statement on this, but
13 the ten-mile emergency planning zone will likely be a
14 thing of the past for only those larger reactors and
15 will likely not be applied to these small modular
16 reactors, also.
17 So even though it is proven
18 technology in just a smaller package, some of the
19 safety benefits are very unique and different from
20 today's existing reactors.
21 COMMISSIONER OLIVA: All right. Well, that
22 concludes our policy session, and I just want to

1 thank all the panelists for sharing your valuable
2 knowledge and all of your opinions and thoughts and
3 for bringing your passion to this topic. I really
4 appreciate that, and, of course, bringing a human
5 element to it.
6 So thank you again for your time and
7 for being here.
8 (Applause.)
9 COMMISSIONER OLIVA: I also want to thank
10 my colleagues for their support, and to all of the
11 attendees. I see a lot of familiar faces, so thank
12 you for being here.
13 (WHEREUPON, the meeting was
14 adjourned.)
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