UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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MEETING WITH DEPARTMENT OF ENERGY

OFFICE OF NUCLEAR ENERGY

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MONDAY,

JUNE 20, 2016

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ROCKVILLE, MARYLAND

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The Commission met in the Commissioners' Hearing Room at the Nuclear Regulatory Commission, One White Flint North, 11555 Rockville Pike, at 9:00 a.m., Stephen G. Burns, Chairman, presiding.

COMMISSION MEMBERS:

STEPHEN G. BURNS, Chairman

KRISTINE L. SVINICKI, Commissioner

WILLIAM C. OSTENDORFF, Commissioner

JEFF BARAN, Commissioner

ALSO PRESENT:
ANNETTE VIETTI-COOK, Secretary of the Commission
MARGARET DOANE, General Counsel
NRC STAFF:
VICTOR M. MCCREE, Executive Director for Operations
BILL DEAN, Director, Office of Nuclear Reactor Regulation
RICHARD LEE, Office of Research
JANE MARSHALL, NRR
MICHAEL MAYFIELD, NRO
JENNIFER UHLE, Director, Office of New Reactors
MICHAEL WEBER, Director, Office of Nuclear Regulatory Research

DEPARTMENT OF ENERGY STAFF:
JON CARMACK, National Technical Director for DOE Fuel Cycle Research & Development Advanced Fuels Campaign, Idaho National Laboratory
RAY FURSTENAU, Associate Principal Deputy Secretary for Nuclear Energy
JOHN KELLY, Deputy Assistant Secretary for Nuclear Reactor Technologies
JOHN KOTEK, Acting Assistant Secretary for Nuclear Energy, Department of Energy

P R O C E E D I N G S

9:02 a.m.

CHAIRMAN BURNS: All right, good morning everyone. I want to welcome our panelists from the Department of Energy and, later, we'll also be hearing from the NRC staff and I also welcome other members of the staff and members of the public who are here with us in the audience today or who may be listening in.

The purpose of today's meeting is to provide information regarding items of mutual interest to the NRC and the Department of Energy's Office of Nuclear Energy and will include discussions on advanced and small modular reactors, continued operation of existing nuclear power plants beyond 60 years, advancements in fuel design, and programs that support students and universities and nuclear research and development.

And, we'll begin presentations with our panel from the Department of Energy including John Kotek, Acting Assistant Secretary for Nuclear Energy.

Sir John Kelly, Deputy Assistant Secretary for Nuclear Reactor Technologies.

Ray Furstenau, Associate Principle Deputy Assistant Secretary for Nuclear Energy.

And, John Carmack, National Technical Director for the DOE Fuel Cycle Research and Development Advanced Fuels

Campaign at the Idaho National Laboratory.

And, following the panel, we'll have a panel from the NRC staff. I think we just have -- I'll take a brief break between the two panels.

And, we look forward to the presentations and ensuing discussion with Members of the Commission.

Before we begin, any opening comments from our colleagues? No? Well, thank you.

And, I think with that, we'll begin with John Kotek to begin the DOE presentations.

MR. KOTEK: Great, thank you very much and thank you for the opportunity to be here this morning.

I'll just give a brief overview and then hand over to my colleagues to get into more detail in each of the areas we're going to present on today.

Of course, there are a wide range of areas of mutual interest to the NRC and DOE's Office of Nuclear Energy. Today, we'll focus on some of the things we're doing in advanced reactor technology and looking at today's plants.

There's a growing interest, I'd say, nationally and internationally in nuclear energy as we and other countries look to meet our climate commitments as we try to move forward with what Secretary Moniz sees as a need to essentially de-carbonize the electricity sector over the intermediate term.

We, in the Department, have been highlighting nuclear over the last year or more in a variety of forum, not least of which was an event on Capitol Hill last month that the Chairman attended where we looked at some of the economic challenges facing today's nuclear plants and looked a policy options that might be available to help address the loss of those plants.

We've also been doing things in DOE trying to chart a course for the future of nuclear energy. And, as we look at nuclear in DOE, we tend to think in three general time frames.

The first is today's plants and what do we do to help ensure the safe, reliable, long-term operation of those plants?

Second, is kind of in the intermediate stage. What near-term options can we provide to ensure that there are multiple potential pathways for new nuclear deployment in the U.S. and internationally? And, that's been concentrated on our support for small modular reactor development.

Then, of course, over the long-term looking at advanced reactors non light water reactor technologies that might be available coming -- starting in the 2030 time frame.

We'll spend some time today talking to you about programs that we have and initiatives that we have to try to make progress in each of those areas.

And, I'll start by turning it over to Ray Furstenau who's going to give you an update. So, Ray?

MR. FURSTENAU: Thank you, Commissioners, for letting us speak to you about our ongoing programs and future programs.

I'll start with the outline page to kind of frame up what John Kotek referred to with our ongoing programs, what we're focusing on and then I'll get into a little more detail on the GAIN initiative, the Gateway for Accelerated Innovation in Nuclear, our Nuclear Energy University programs, and our Nuclear Science User Facilities.

Go to slide three?

As John talked about, we're, you know, we have a focus on sustaining the current fleet, of course, and commissioning the next generation of that advanced light water reactors. And, John Kelly will go into a little more detail when I turn it over to him about those programs.

Also, we have programs looking at the utilization of nuclear and hybrid systems. We need to develop really a fundamental change in how nuclear technologies are perceived by the public, develop license and deploy with industry and regulated by a government in order to really move nuclear forward.

And, of course developing solutions for the waste that's generated.

If we go to slide four, really, this is a nominal time line here. I think also John Kelly will give a time line that shows a different projection on nuclear.

But, the point, whether it's 200 gigawatt capacity by 2050 or some other number more or less, the point of this is to show that the current fleet, which ever scenario is going to be decreasing in its nuclear capacity. If we're going to maintain some nuclear capacity, we need to deploy current Gen III+, SMRs and Gen IV.

And, that's really our strategy as we talk here later today. We have life extension programs for 60 years and beyond 60. John Carmack will talk about accident tolerant fuels, in particular, as part of the current research being done.

John Kelly will also talk about the Gen III+ Advanced Light Water Reactors that are being built right now as well as Small Modular Reactors and a little bit about the Gen IV Advanced Reactors that are being developed.

And, I'll go in now in a little bit more detail on to slide five about what we're doing to support the U.S. industry in the Gateway for Accelerated Innovation in Nuclear.

It's really an organizing principle that we have that how can we provide the nuclear community with access to the expertise that the laboratories and DOE has in technical, regulatory as well as financial support as we move advanced nuclear technologies forward?

And, it's an integrating function, as I mentioned, and a facilitating function for advanced reactor and advanced technology concepts.

A few things that, in recent -- recently that we have

taken on under GAIN, the voucher initiative, it was announced earlier this year for a $2 million program, small business vouchers. It kind of took off of an EERE program on small business vouchers.

We just announced those last week, eight small business vouchers. Some companies, you may recognize, some may not. But, that was the intent was to have -- give a little boost to some of the newcomers to help them develop their concepts. So, those were announced last week.

Also, this year, DOE has this Energy Technology Commercialization Fund. And, that's where it's a 0.9 percent of our R&D budget in the Office of Nuclear Energy, that amounted to about $4.3 million and it's allocated to pursue some high-impact commercial activities where there is lab involvement as well.

Expect those matching fund announcements to be made later this month, maybe early next month.

And, a longer ongoing program, SBIR, STTR and that -- what those acronyms are, the Small Business Innovative Research and the Small Business Technology Transfers. And, they'll add about 3.4 percent. The SBIR is around 3 percent and there's usually Phase I and Phase II activities involved in that.

Phase I are usually around $100,000.00 to $150,000.00 range and then some of those Phase I activities with small business then to into a Phase II activity which are in the million, million and a half range.

We go to slide six, a little bit more on GAIN. The challenges column there is -- a lot of that is well known to most folks, I think. And we sponsored a series of workshops. Actually, geographically, they were far disbursed, but we brought them all together in March of 2015 that really looked at how can we help bring technologies to market? What are the challenges?

And, the results of those workshops from the spring of 2015 really then helped us frame the development of GAIN, the Gateway for Accelerated Innovation of Nuclear. And, the DOE response to that is in that center column.

And, we're really looking to how can we, as the Government, and DOE really provide access? That was a big issue that innovators have, that National Labs, the DOE sites, have a -- really have a -- it's a vast resource of people, expertise, facilities, real estate that may be of use to nuclear innovators as well as expanding our cooperation with the NRC here to assist developers through the regulatory process.

And then, so GAIN was kicked off during the nuclear summit sponsored by the White House in November of 2015 and really been taking off and developing ever since.

The three main labs associated with that right now are Idaho National Lab, Argonne National Lab, and Oak Ridge National Lab.

But, the capabilities of all the national labs can really

be accessed through that framework.

On page seven, really, the GAIN innovation test bed really has built on our successful nuclear science user facility model which really is a subset of GAIN.

Our user facility concept in the Office of Nuclear Energy really developed in the 2007 time frame with the Advanced Test Reactor which is a reactor in Idaho that's sponsored by the Office of Nuclear Energy. And, it was made a user facility in 2007.

And, it was really done to expand beyond the traditional naval reactor's role with the Advanced Test Reactor and really allow access to many more users, university and industry, isotope production.

And, I know I've been involved in ATR for 25 years and it has really made a difference. I've seen with -- it's far exceeded what I thought it would with regard to having access the radiation space and the ATR, it is really been more utilized than I've seen it in my years involved with the ATR.

And then, it really took off from there because we also expanded the user facility concept in NE to the Post-Radiation Examination facilities.

At Idaho, we also brought in partner facilities, we call them, like MIT Reactor is a partner facility, Oak Ridge facilities, other university facilities. And, I'll get into that a little bit more later in the discussion.

But, again, part of that is to use our existing capabilities

from multiple institution. And, again, GAIN is that organizing function to do that.

It also includes high-performance computing capabilities that we have within the labs as well as a knowledge and validation center to basically take advantage of work, experimental work, research that's been done in the past and allow access to that historical data as well as the historical knowledge of the people that work at the labs.

One other question or topic area that was on our agenda was the initial steps towards internationalizing GAIN. And, I'll go to slide eight with that.

We've had -- CRADA work for others arrangement with SCK-CEN in Belgium, the BR-2 Reactor, in particular to irradiate material. We also have done work -- and NSA has done work with the BR-2 Reactor for the reduced enriched research and test reactor program to develop LEU fuel.

And, we're in the process right now of developing an MOU with SCK-CEN and the BR-2 Reactor to allow R&D access to those facilities. And, we're doing some work right now, like I mentioned, on a CRADA basis with ATR.

But we see, as we look at the research capabilities across a complex and the universities, there are international components of this that we can -- we think can be beneficial to DOE as well as the cooperating nations and BR-2 could be one of those having

high-flux neutrons available for capacity that we may not have in the DOE complex in the U.S.

Also, John Kotek just this week asked the NEAC, our Nuclear Energy Advisory Committee, to initiate a review of the availability of R&D capabilities internationally.

The charter letter is not quite out yet, I think, John, but we're in the middle of developing that.

Okay, on to NE's University programs on slide nine.

Off to the right there it kind of shows you a map of where the NE University programs have touched across the nation. And, as you can see, almost every state is seeing some benefit to that.

This orange block, since FY '09, it's really, we just announced a week ago the FY '16 awards. And so, the number there, we've really awarded over $460 million to 113 schools across the nation. So, it's been quite successful.

We designate up to 20 percent of our R&D funding to that program and then we do a competitive bid along with the integrated use of university program and the research reactor infrastructure program.

That's one giant announcement, if you will, every year where there's a request for proposals to -- for those grants. And, it's really been quite successful.

The Integrated University Program, the fellowships are $50,000.00 a year. Then in addition to that, there's like $5,000.00 for

summer work at a laboratory or elsewhere in addition to the $50,000.00.

And then, for the undergraduates scholarships, it's $7,500.00 a year.

And then, the research reactor infrastructure is to provide funding to universities with research reactors to modernize their infrastructure, instrumentation, for example, a number of things and as well as a traineeship program.

Going to slide ten, I spoke about this a little bit early on, Nuclear Science User Facilities, again, a very, very successful program. And, we're really looking at expanding that.

This lists the reactor facilities that are in the NSUF family. Right now, I also have beam lines and post-radiation examination facilities at the laboratories. And Westinghouse is also a member, a commercial entity.

So, in summary, I think a recognition of the importance we see of nuclear in today and in the future to reach carbon reduction and our climate goals.

Of course, in the near-term, there is concern on the financial viability. Some currently operating plants, but there's a huge carbon reduction benefits in keeping them, so we have that dilemma that the nation is dealing with.

We've seen increased interest in nuclear on some domestic and international markets, Gen III+ Reactors, John will talk about that, some of our technologies here in a little bit in more detail.

And, we'll also looking at Gen IV technologies. Earlier this year, we had a funding opportunity announcement on two activities, one headed by Southern and one headed by X-Energy to pursue Advanced Reactor concepts as well.

And, with that, I'd like to turn it over to John Kelly. He'll go into a little bit more detail on a few of the programs I mentioned.

John?

DR. KELLY: Thank you, Ray.

So, the slides loaded? Great.

So, to give an update on the nuclear energy -- our nuclear reactor R&D program.

So, if -- next slide, please?

So, I think over the last year, we've seen tremendous enthusiasm about new reactors. This is being driven by a couple of factors.

One is certainly the interest in reducing carbon emissions and the agreements that were reached in Paris back in December.

But, if you extrapolate what that actually means and the Secretary has come out and talked about this, is that we actually need to decarbonize electricity production by about 2050.

Now, next slide, please?

So, what does this mean? Well, in terms of decarbonizing the electricity production, we have to think about the

current fleet and then what the next generation is.

So, you know, we currently are operating under the fact that most of the plants are going to go from 40 years to 60 years, some will close early. But then, we're looking now at 60 to 80 years.

But in 2050, we're looking at about a doubling of the nuclear capacity. And, this is in, if you look at the numbers, we need a tenfold increase in renewables, you know, carbon with sequestration needs to basically come to the point that we currently have all of our natural gas.

And so, the doubling of nuclear is certainly within, I think, a reasonable grasp.

The key, though, is what is the outlook for nuclear?

Well, we think that our large Light Water Reactors will certainly have a key role in the 2050 time frame and beyond.

SMRs, which we're currently developing will come to the market in the 2025 range.

And, the key question is really for in terms of our R&D program is what will the role of Generation IV reactors be in that 2050 time frame?

Next slide?

So, the strategy we have is really this three-prong effort.

The first is looking at continuing the safe and reliable operation of the current fleet with the focus on aging management,

advanced instrumentation and controls, looking at the margins, safety margins as the plants age, looking at emerging issues as they arrive and then reactor safety technologies which is really an effort that we launched after the Fukushima accident.

We're coordinated very well with the NRC and EPRI. And I think this continued coordination will be important for the success of the program.

And, you know, we've recently heard of two plants that are going to see subsequent license renewal going from 60 to 80 years.

Next slide?

I think, though, if you look at the previous chart, you'll see that, eventually, the current fleet will eventually retire. And so, we need to be looking at new reactor technologies.

DOE invested in the Gen III+, the Westinghouse AP-1000 and then the ESBWR. But, we need to be looking forward.

And so, one thing that we've been very interested in is the small modular reactors.

This was a program that we started in 2012. So, it's kind of amazing it was just four years ago that we actually started this. And, we're now at the point where the -- we have actual submittals to the NRC in terms of early site permit, design certification later this year. So, we're very excited about the opportunity here.

But, what we're trying to do is accelerate the deployment. We thought that the, left on its own, the industry would

eventually come to this, but by having the government invest in this, we could significantly accelerate the deployment of this technology.

So, NuScale is our primary partner right now in terms of reactor design. They're working on the design certification.

TVA has been -- just submitted their early site permit last month.

And then, the organization called UAMPS which is a group of utilities out in the west is also looking at the NuScale reactor as a potential source for power in that part of the country.

We've also been working with industry and trying to solve some of the generic issues associated with user requirements, licensing, economic and market studies and siting.

Next slide, please?

So, as I mentioned, that NuScale was making great progress. They just froze their design at the end of May with the intention of submitting their design certification by the end of this year.

TVA submitted their early site permit earlier this last month. And, they will be looking at technology specific selection in the fall of this year followed by a COLA development.

So, the early site permit that they submitted will be bounding in the sense that they will basically be able to cover any of the SMR vendors in the U.S.

In terms of the NuScale and UAMPS, I think what was really interesting for our perspective was putting together a Site User

Agreement earlier this year where we've given them the opportunity to use a parcel of land on the Idaho National Lab Reservation.

There were four candidate sites that were screened in that process and they are going to get to the point of selecting one of those in the next month or so.

And then, the decision to proceed will be coming next after they pick their site.

Next slide, please?

But, we feel like we're not done yet. We've been working the licensing regulatory issues associated with SMR designs and the sites, but we think more will be needed.

And so, this week, later this week, we are conducting workshops out here in the Rockville area to look -- to get input from our stakeholders as to what are the next steps needed for commercialization of SMRs?

Some of the things that have come to our minds is that with the -- there is more work needed on design finalization. We actually need more sites, so additional COLAs are probably in order.

We need to be looking at advanced manufacturing technologies. How do we actually make these SMRs?

And, looking at alternative uses for SMRs, in particular, looking at the integration of nuclear with renewables in the long term.

We've been working closely with the Nuclear Energy Institute and our industry partners to understand the dynamics. And,

as I said, the workshop will be held just across the street next week.

Next slide, please?

So, that sort of is the Light Water Technology, but what's the vision for the future? And, I think, really, it has to come down to what's the role of Generation IV reactors in this 2050 time frame and beyond?

We've just recently posted our vision and strategy for the development and deployment of these reactors, Advanced Reactors. This has been put out on our website.

And, I think the key thing, though, is that by 2050, we have to have Advanced Reactors become part of the actual mix. And, in order to have them be part of the mix, we have to actually have to do the development and deployment of the concepts, but in the 2030s.

That means the next 15 years are going to be a very important time for us to get Gen IV ready for market.

Now, why is Gen IV going to be important, well, I think because of the higher temperature that the reactors can operate, they'll be more efficient. This could be led to better economics. It also leads to improved safety. So, there's many good reasons to consider Generation IV.

Next slide, please?

You asked us to talk about our Advanced Test and Demonstration Reactor Study, so we have a report that we've published -- released, actually, very recently on this. And, it look at two

categories of reactors.

The first as a Test Reactor which was in principle to provide irradiation services. It would be primarily used for R&D. It would provide the appropriate environment, that is the coolant for the Advanced Reactors and it must support the development of Advanced Reactors.

So, there's a variety of concepts that are available to do this. So, basically, we come down to the idea of having a fast neutron spectrum with cooling channels that will allow us to test either in gas or sodium or lead or molten salt.

We're also looking at the ability to have demonstration reactors. And this would be to do technology and validation.

So, while we've built in the past sodium fast reactors, gas cooled reactors, there are certain reactors that have only been demonstrated at the experimental level.

And so, we're -- and with a number of vendors that we see today, we're looking at how do we combine our resources to make the most effective use. And, this gets back to the GAIN initiative to how do we use our capabilities to demonstrate new reactor technologies?

In this effort, we would be looking at doing technology integration, demonstrating transient performance, be able to flexibly swap out components and provide feedback and designs.

Next slide, please?

So, fundamentally, though, our objectives are to create the environment that will allow our industry to come in and demonstrate their capabilities.

So, we're basically seeing three main missions right now. One is on high temperature process heat applications which can not only generate electricity but generate a high temperature process heat for a variety of industrial purposes.

Actinide management which we expect to be important in the latter half of this century which will allow us to increase the use of uranium to -- and reduce our nuclear waste in the future.

And then, we also are looking at the ability to, you know, demonstrate at smaller scale reactors of less mature technologies. So, for instance, molten salt type of reactors.

And, as I mentioned, the reactor -- the irradiation test reactor would be to develop irradiation capability to test fuels and structural materials for the reactors.

Next slide, please?

So, the study is out. It basically looked at these four different options where the conclusion was that if we wanted process heat, then the high temperature gas reactor would probably be the preferred option.

If we demonstrate waste management, then it would be a Sodium Fast Reactor. If we wanted to demonstrate a less mature technology, it'd be the fluoride-salt high temperature reactor or a lead

fast reactor and for testing purposes, we're kind of heading toward a Sodium Cooled Fast Reactor.

So, in summary, I think in order to meet our clean energy goals of the future, we need to have nuclear remain as a key and significant part of our electricity production.

It starts with making sure that we have safe and reliable operation of the current fleet and extend that as long as possible.

Begin to deploy the SMRs in the mid-2020s and then develop the Advanced Generation IV Reactors for deployment beginning in the 2030s.

So, thank you.

MR. CARMACK: So, I'll start on slide two.

I'm not sure where, if you have had a previous presentation on accident-tolerant fuels for Light Water Reactors, but I will give you some of the history of where this program started and how we are to where we are today and then move forward pretty quickly into where we are right now and how we see going forward over the next few years.

We had actually started working on sort of revolutionary innovative fuel, research and development activities and concepts in the spring of 2010. And, the program, based on some input and feedback that we have gotten from our industry advisory committees and such.

We'd then primarily focused those on looking at higher

burn up fuels or fuels that could possibly go to higher powers and things like this.

But, shortly after Fukushima, we were reviewing those concepts with some of our industry advisory committees and it was suggested that we add something on off-normal performance of fuels.

And then, shortly after that, in the fall of 2011, in our Consolidated Appropriations Act of 2012, we received specific guidance to do a program like this specifically on -- and it was termed Meltdown Resistant Fuel.

We did not like the term Meltdown Resistant Fuel, so we worked pretty hard on page three across the domestic as well as international community to define a consistent set of metrics about how we define and characterize what we mean by enhanced accident tolerant fuels.

And so, that's the term that we've come up with to really sort of communicate what we mean in enhancing the accident tolerance and providing grace time and coping time to utility and operator to respond to off-normal conditions in the plants.

We think we've come up with a fairly concise set of attributes and metrics that sort of clearly define what we mean by enhanced by enhanced accident tolerant fuel performance. But, you'll notice that it doesn't specifically include the economics of the situation.

So, we did not want to prejudge possible research and development concepts based on the potential economics of the future,

which are very hard to predict at this early phase of research and development.

But, we do have that as well as back end performance, fuel cycle considerations as attributes and metrics that have to be looked at in terms of looking at how to put these types of fuels into the fleet in the future some time.

So, we also were required to and directed to provide a report to Congress which we delivered in 2015. It's available publically, I can give you the reference to that, it's not listed on the slide, but it is available of the Department website.

And, it outlined a ten-year goal. Because, as you noticed in the 2012 language, it directed us to demonstrate these fuels in an operating commercial plant by 2020, which we felt was a really aggressive goal.

So we worked pretty hard also to extend that time line to at least ten years to give us time to identify candidate research and development technical options and then put them through the development phase to the point that we felt that we could demonstrate them at a commercial scale.

So, we have been focused over the last four to five years since 2012 in doing the preliminary feasibility studies on some of these concepts.

We have a range of concepts that have been proposed by a number of entities.

And, at the end of Phase II, or at the end of Phase I, we have defined a specific fuel selection and I'll talk about that a little bit later.

But, one of the things we realized on slide five is that, to really do this as quickly as we've challenged to do it by Congress that we needed to quickly engage the entire nuclear community in the United States as well as internationally.

And so, the Department established three competitive projects, one led by AREVA, one led by GE and one led by Westinghouse to define specific technologies that, they as institutions felt that they could provide on this ten-year time frame and successfully demonstrate in a ten-year time frame.

And so, these teams have been working together individually over the past four years to develop specific and research -- perform research and development on specific technologies that are now under the procurement phase for Phase II.

So, these teams will complete Phase I in September of this year and then in October, they will change into what we refer to as Phase II, which I would characterize as really taking the technology, bringing the fabrication processes to a scale that demonstrate commercial viability as well as increasing the prototypicality of the irradiation testing and assessment of the concepts.

We are moving from a sort of drop-in capsule irradiation test series that we've been performing over the last four or

five years to some initial assessment of these concepts to specific PWR prototypic loop irradiation in both the Advanced Test Reactor at the Idaho National Laboratory as well as the Halden Test Reactor in Norway.

In addition to that, the Department is invested heavily in the transient testing capabilities in the United States by deciding to refurbish and restart the TREAT Reactor at the Idaho National Laboratory and we anticipate that it will be available for testing purposes beginning in the 2018 time frame.

We have some recent interest and engagement with the utility representatives. They've been asking for the possibilities of enhanced accident tolerant performance that can provide an impactful coping time for the current fleet.

They believe that this can help them economically in the current situation in the United States. And, one of the statements that's made is to make the Gen II Reactors that we have today on par with the Gen III+ designs of 72 hours of coping time.

So, we'll see as the technologies go forward as to their capabilities in that regime.

But, I will note that, in closing, that to take full advantage of some of these accident tolerant fuel technologies, we need to consider all of the core and reactor components that will be affected.

MR. KOTEK: I thought I might just wrap up and then

I'll to go to questions.

CHAIRMAN BURNS: Okay, that's fine.

MR. KOTEK: A few things I want to highlight out of that.

So, what we've tried to lay out for you today is things that we're doing, looking at today's reactors, things that we're looking at to create a frame -- or a set of nuclear choices for the relatively near-term and then choices for nuclear over the long-term.

There are a few other things going on that will help inform our strategy going forward.

As John Kelly mentioned, we've put out this draft vision strategy document, that's out. We're receiving input from a variety of sources on them including our Nuclear Energy Advisory Committee.

There's also a Secretary of Energy Advisory Board Task Force that's looking at this question and looking at the future of nuclear power and what it takes to get to having Advanced Reactors available in the 2030 to 2050 time frame. They're expected to report out this fall in response to a charge from the Secretary, Dr. John Deutch from MIT is leading that effort.

Looking more near-term, the challenges facing today's reactors, we talked about a little bit earlier and, again, thanks to the Chairman for joining us at the event last month.

There are other things going on in the Department and other things that we're trying to do to provide greater clarity on the

importance of today's nuclear and of the challenges facing today's nuclear plants.

For example, the Quadrennial Energy Review 1.2 is underway right now. They are evaluations looking at the question evaluation going on.

We, in DOE, are also planning on preparing a report from the summit that we had last month that, again, will we hope serve as a resource for policy makers.

On the question of the test and demo reactor that John Kelly described, the study done by NEAC helped us understand what our options are for going forward. It didn't say you should go do one or the other, it said, if you want to do X then here's the things that's kind of best positioned to serve that need in the near-term.

What we've done is we've asked our Nuclear Energy Advisory Committee -- or we've told them we're going to ask them, we haven't chartered them yet -- to help us look at taking the next step on the test reactor side.

You know, as you could hear from the discussion today, one of the things we're trying to do is figure out how to make our capabilities and make our programs more impactful in helping the industry get technologies into the marketplace.

A test reactor has been identified by several entrants in the -- participants in the nuclear innovation community as something that would be very helpful to them.

We haven't made a decision to go down that road yet, but we want to look at what is the potential need? What's the user community that's out there, both domestically and internationally, and help us define what that might look like and see whether it might be worth going down that road. And also to help informed design choices.

So, we're going to ask our Nuclear Energy Advisory Committee to help us take a hard look at that.

And then, of course, there are, you know, things we didn't talk about today, and particularly the waste program that we're restarting in DOE right now. We're in the midst of a series of eight public meetings to get input on the design of a consent-based siting process.

In fact, I'll be headed out to Arizona this week for the next of those meetings. So, that's underway and we can talk about that detail another time, if you'd like.

And then, I just wanted to close by thanking you all for the opportunity to be here. I want to thank the staff as well. Of course, John Kelly and his team have been working extensively with your folks over a number of years looking at some of the licensing issues facing tomorrow's reactors.

And, I think we have certainly found that partnership to be very constructive and hope to continue that over the long-term.

And, again, thank you for their efforts, thank you for your efforts and for the opportunity to be here.

CHAIRMAN BURNS: Well, thanks, John, and thanks to all of you today for the presentations. I think very informative, particularly as at one point, we were all part of the same agency, a long time ago, in 1974.

But, it does, I think, from my standpoint, the presentations from you and I'm sure what we're going to hear from the staff in this intersection between development of technology, continued research and then, you know, our role as regulators is very important.

And, it is important for my perspective that we are, you know, talking with one another to understand where we're coming from, where is, you know, John put up the chart about the potential in terms of employment of new technologies and all, that we have an understanding on this side of the table and our staff of where things are going.

I'll start off, and you need to, I think, start my -- yes -- the button here, the magic timer here.

I'll start off.

One of the questions, and this may be just a sort of a clarifying question because, I get this sometimes, sometimes in international fora or other places about the distinction.

We're often, even, I think, sometimes in our discussions with the Congress, and I'll try to be very careful about when we talk about SMRs and then Gen IV Advanced Technology.

Is there -- when we speak of SMR or when you talk

about SMRs or Gen IV, is there -- can you elaborate on any of the distinctions you might be making there in that kind of discussion?

Anyone? John?

MR. KOTEK: Well, I'll start and ask John Kelly or others if they want to add on to it.

I mean, when I think about Gen IV, of course, I was involved heavily in the Generation IV road mapping effort, right, so when I think of Generation IV technologies, we were looking at sodium and gas and lead and super critical water and molten salt back then.

So, that's kind of the frame work I think about. I've always thought of SMRs as it's something beyond what we have in commercial use today. So, certainly, there may be different, you know, different licensing considerations.

I know there are things that you all have been taking on and in that space, as have we. And so, there are all things that kind of aren't here today, so they all might require, you know, efforts in different directions to help them get to commercialization.

But, at least I've thought of them as kind of when I say Generation IV, I'm generally not talking about SMRs.

John, what's --

DR. KELLY: So, I think a couple of things about SMRs, the first is that the designs that are out there right now have basically, through the design, eliminated large pipe break scenarios.

And so, eliminating that whole class of accident

scenarios is really important and innovative type -- innovative idea.

But also, because of the design of the systems, they can actually cool the reactor core after shutdown and with loss of power for weeks, perhaps a month or more.

And so, the coping time, which has become evidently important since Fukushima, is really long for them. So, their improved safety, eliminate a whole class of accidents.

But, the designs are also such that they could be manufactured in the U.S. in factories and shipped to the site. So, we no longer would have to rely on factories in Korea or Japan or China to make the reactor pressure vessels because of the size of these -- the pressure vessels are something within the range of the capabilities within the U.S.

And, because of the reduced or improved safety and the reduction in potential accidents and the reduction in the source term, these plants can be sited closer to population zones than the large plants.

And this opens up a whole new market for nuclear, in particular, we expect many of our coal plants to be retired in the 2030 and beyond time frame and so having a clean energy technology such as nuclear SMRs, the SMRs can fit nicely into the footprint that the existing cola plants.

So, this is why, from an SMR perspective, we're so interested.

Now, Generation IV is sort of a continuity of this. And, it's really can we, you know, what's the economics going to look like in the 2050 time frame?

We expect natural gas in this country to be still an important player, but it will probably have to have sequestration. And so, the question is, is there a nuclear technology that can be competitive with fossil fuel and sequestration?

We think because of the higher temperature, the better our safety, et cetera. This is why we're interested in investing in Gen IV.

How it plays out? There's 30+ companies out there right now. We don't know who's -- what the down select is going to look like. But, we think that there's enough good ideas out there that we're interested in investing in the technology today for the future.

CHAIRMAN BURNS: Okay, thanks, that was a good -- great explanation there.

I think I might ask, yes, to Ray, in terms of talking about the voucher initiative under GAIN, it's a $2 million voucher or coupon. What does that do for the person who receives it? What do they do with that? How does that help them?

MR. KOTEK: Well, how that helps them, it provides them that access to the lab. They have some contributory to that.

CHAIRMAN BURNS: Okay.

MR. KOTEK: But, it basically gives -- it pays for the

laboratory people's time to help them with their concepts. So, it's the access and the laboratory expenses during -- for that access is what it does.

CHAIRMAN BURNS: So, to help them carry out demonstration or certain research aspects of what they're --

MR. KOTEK: Correct.

CHAIRMAN BURNS: -- finding?

MR. KOTEK: I mean, it's small to begin with.

CHAIRMAN BURNS: Yes.

MR. KOTEK: But, it gives them the ability where they maybe have not had the experience of dealing with this daunting task of how do you do work a national lab or how do you do work with DOE to help?

And, that's where GAIN helps with that, as well, is to get that initiating input into the DOE system and help them with that, to take advantage of that expertise.

CHAIRMAN BURNS: Okay. I mean, I wanted to -- and I think, one of the Johns mentioned this, in terms of -- I think what we're seeing with this notion that we have 25 or 30 organizations or groups or small startups, ever who or have some sort of interest in this advanced technology would -- it strikes me.

But I probably went back and looked in the history of the 1950s, that's not so much what I had. I probably had, you know, the Westinghouse, General Electric, and actually, I know from looking

back at some of liability -- my old -- looking at some of the liability issues and the, you know, the development of liability conventions in terms of why they developed in terms of the vendors and interests like that.

What -- coming back to the model we have today, how do you all -- how do you sort of cope with that from the standpoint of looking at what's real, what, you know, making decisions without stifling innovation, obviously, but how do you make decisions about what merits going forward or merits, in effect, the voucher or what's real, what's just a PowerPoint dream, if you will?

MR. KOTEK: Well, I'll start and ask the rest of the folks to comment on this.

But, you know, we do have to sometimes make decisions when it comes to, you know, putting out some sort of funding opportunity announcement and we've got to establish criteria that they've got to try to meet and in their application.

And, you know, just because somebody, you know, doesn't win one of our funding opportunities doesn't mean that they don't have a good concept, it might mean they just didn't have the right, you know, the best proposal at that time or maybe, you know, maybe there were half a dozen great ideas in there, but we only have enough funding for two of them. And so, you know, we have make those decisions sometimes.

But, of course, you know, part of what we're seeing as well with this is, you know, the marketplace is now getting involved.

And then latest number I heard at our NEAC meeting last week was we're now approaching $2 billion in private capital that's gone into financing these several dozen, what I call, you know, nuclear innovators or aspiring nuclear vendors.

And, I think, you know, part of the reason they're, of course, interested in working with us and with you all on maybe building more feedback loops into the regulatory process, for example, is they want to be able to show potential investors that they're making progress, right, and there's some there there, it's not just a PowerPoint, but there's some hope that they'll get through, you know, through the development stages and into the regulatory process and into the marketplace.

And so, you know, we, of course, as, you know, as we have funds available to provide, we put together expert teams that, as you'd expect, you know, that review proposals and decide who's got the most meritorious applications and we award funds that way.

But, you know, to the extent that they've got resources that they want to bring to the laboratories, for example, to get access to capabilities, that's, you know, to the extent that they can pass through the laboratory reviews for work for others or for a cooperative research and development agreement, they can access capabilities that way whether there are DOE funds involved or not.

So, there's a lot of ways for them to get in to the system. There are times where we have to make a call as to who's got the most

meritorious proposal just because that's -- because of the limitations we've got, but we're trying to make our capabilities broadly available, whether somebody's using federal funds or not.

And, in fact, we do have at least one large company I can think of off the top of my head that, you know, hasn't really been applying for DOE funds, but they bring in funds to the laboratory and paying for quite a bit of work there. So, it can work a variety of ways.

And, I'll ask John to kind of build on that.

DR. KELLY: Yes, so a couple observations.

First is that if you look at the history of innovation in the last couple decades, it's been driven by small business that can do things quickly, you know, they can have success or failure and then they just keep moving and moving.

So, one of the emphasis through GAIN is to support small business innovation. And, it's -- the voucher program is one way to do that.

I think the other thing that we're -- as part of GAIN coming to grips with is that, you know, the Generation IV roadmap, the things that we did 15 years ago, is still valid, but we need to sort of corral the different design together.

And so, what we're beginning next month is to conduct technology centric working groups -- workshops and then hopefully that will evolve into working groups.

Well, everyone interested in the technology such as

Sodium Fast Reactors, would get together and help identify the key R&D needs that they need from both a technology risk and a regulatory risk perspective and then we can work to get collectively to reduce those risks.

And so, we will be convening these meetings beginning next month and really try to shepherd the technologies so that we get a consistent story and then we can make investments, I think, much more effectively and with the private sector and the government funding, you know, this should lead to a very successful path forward.

CHAIRMAN BURNS: All right, thanks again for your presentations.

Commissioner Svinicki?

COMMISSIONER SVINICKI: Well, good morning and thank you all for being here.

The Chairman noted that our agencies have their origins together and, although he might not mention it, Commissioner Ostendorff wore his atom tie today in your honor because you are our guests and he wanted to honor nuclear sciences by wearing that tie.

I have some specific questions, but I want to begin with some observations and I was having a hard time realizing kind of what were the constructive things to say? I sometimes think in terms of Hollywood movies and I think, if it was a movie, you were panning this side of the table or your side of the table and like what ware people thinking, you know, while they're listening to the presentations?

Some of what I was thinking is how long have I known some of these folks that we've been talking about some of these same issues? But, the truth of the matter is that, for nuclear science and technology, those of us working in the public policy space are a pretty small community of people.

So, as administrations come and go, the chances that you're going to walk into a room and know a lot of the people is pretty high. There just aren't that many of us toiling away on these types of energy policy issues.

So, I sit here in this moment and I've got this huge diametrically opposed set of observations about nuclear. I'm serving my ninth year on this Commission and when I joined this Commission, there was a lot of talk of the nuclear renaissance based on incentives provided in the Energy Policy Act of '05.

At our peak, I think we had applications for 28 new nuclear units and there was a lot of excitement about SMRs.

I will say that every year that I've served on this Commission, we have projected that we are going to receive a design certification application for an SMR next year.

So, if we get one this year, we'll finally break that nine year streak of it's going to be next year.

And, I think, again, based on the maturity of some of the work that's done in the vendor community, I'm feeling a lot more confident about that actually happening according to schedule later this

year.

But, we do have a lot of forces at work that aren't controlled by people at this table. I know that DOE had a workshop that Mr. Kotek referred to on the economic challenges to the current fleet.

So, it's interesting to sit in year nine thinking that we have had a number of currently operating reactors either shutdown or announce their premature cessation of operations.

The industry itself at the DOE workshop, and I think that they're not probably in the business of creating or predicting the most bleak picture. They talked about the possibility for 15 to 20 more shutdowns.

So, the Federal Energy Regulatory Commission is an also independent regulator as we are. We meet jointly with them. I know that they are looking at some of the market structure. Some of this, I think, falls squarely for state legislatures and state regulators.

So, you know, taken that it isn't solvable by the people at this table, I wondered if DOE was doing any work related to an entirely new thought process about the plants that face a noneconomic circumstance in the moment of potentially being put into lay up for extended periods as is done with fossil units?

It would require a fundamental paradigm shift by operators and for NRC to have a new regulatory paradigm. But, you haven't mentioned it, but is that anything even in a conceptual stage of

looking at what that might look like?

Again, the option would be that the asset itself, as an asset for the nation's clean energy, is not permanently moving towards a shutdown which, again, is the way things are structured right now.

So, I know -- I would note there's some conferring at the table.

MR. KOTEK: I mean, certainly that's an approach we've taken in DOE before. So, for example, the TREAT Reactor is going to restart now after being in lay up for more than 20 years. And, well, even with FFTF, I think that was in a kind of a standby state for a number of years before the decision was taken to finally shut it down.

I've heard the idea raised just in the last couple of weeks, we haven't started anything.

COMMISSIONER SVINICKI: Do you think it's more a regulatory issue than a technical issue?

MR. KOTEK: I honestly haven't looked at it hard enough yet to know. I don't know whether John has looked at it any closer than I have.

COMMISSIONER SVINICKI: I just, you know, from my own standpoint, it would seem to me that even the preliminary or fundamental viability of it would reside so heavily in terms of what regulatory measures would need to be maintained, that it seems like there would at least be some fundamental questions that you would then need to engage in regulatory space before you could really look at

it as kind of technical systems and what needs to be done to have something in extended lay-up.

MR. KOTEK: I'll certainly raise that idea. You know, as we talked to the folks involved in the industry who are confronting these challenges, I'll certainly ask the question and see if there's any, you know, anything going on in their space and where they think you might start.

But, we just haven't looked at it close enough to have a good answer for you.

COMMISSIONER SVINICKI: I have heard some mumblings out of EPRI, that might be a place to start. I don't know if they have an internal group looking at it and I certainly can't speak for them.

But, it was not the first place I heard of this. I heard of it in hallway talk at a conference. But, I just wondered if DOE had taken anything on. It sounds like not formally. Okay.

And, I said I had a diametrically opposed set of observations. The other perhaps more forward looking set of observations is that I think in my 25-year career in nuclear, I think that advanced nuclear has the broadest public policy support, I think, right now of any time in the last 25 years. So, that's an interesting set of circumstances to try to square.

I also think that there are opportunities for innovation. I think the availability of venture capital, just a resurgence of

nonconventional operators in the nuclear space who are interested with the development of nuclear technology. That's out there.

But, again, we see strange outcomes such as very successful innovators in the U.S. tech industry who have decided that going outside of our country to demonstrate these reactors is more promising than doing it here.

And I think I visited a university in China that is a potential location where I think U.S. tech innovators interesting in making some prototypes and demonstration reactors. And, it gives me a lot of pause to think that a U.S. -- a successful U.S. business innovator has decided that engaging with the Communist Government of China is less bureaucratic than working with DOE and NRC.

I think that for everyone around this table, this should give us some pause to step back and wonder why that is.

And, in that light, I really appreciate that DOE is looking at, you know, national user facilities and the access to the national labs, which were such cradles of innovation at their origin. That was the whole purpose that they were made.

So, I know that you're looking at what barriers exist there.

A lot of think tanks and groups that are looking at barriers to advanced technology, though, seem to circle back to the regulatory framework as a strong impediment or obstacle.

It's hard, I think we've done some honest soul-

searching here at NRC. We feel that through the use of our current frame work, coupled with selected and justified exemptions, that we could regulate technologies that look a lot different than we have today.

I struggle a little bit, and maybe I'm too linear in my thinking about this, but at the end of the day, the certification of a technology or the issuance of a license is a legal action. And, I say this as the only person on my Commission without a law degree.

But it, you know, it arises, the authority comes from the Atomic Energy Act and it's a group of five people or maybe four or three or however many are serving at the time. It's their determination that, based on tens of thousands of staff hours of review that we probe and scrutinize that issuance of that license or certification of that nuclear reactor design technology is not going to have an adverse effect on the common defense and security and it's going to protect public health and safety.

And so, all of these calls for phased and staged licensing are different. It's hard for me to wrap my mind around, I think, you know, what people are asking the regulator to do is engage intermittently and say, looks good so far, looks good so far.

And, at the end of the day, they want all of that to roll up into this decision about the common defense and security and public health as safety.

So, somehow we have to find a way to bring that together. I realize that without greater confidence in the licensing

process as it moves forward in some sort of phased or staged way over time, that innovators simply are not going to want to take that risk here in the U.S.

But, it is, I think, there are some paradigm shifts and new ways of thinking that we will have to have. I'll explore this with the NRC staff and I know that they are already thinking about it.

Accident tolerant fuels, I think, is very tantalizingly within our grasp. That's the kind of innovation that I think, in terms of mission space, both NRC and DOE could share -- have a mutual goal there since it's accident tolerant or resistant fuels.

And, I hope that NRC is engaging with DOE with the requisite, I think, urgency over that. Or, I know the Congressional direction came to DOE, but I think also it's an expression of Congress's desire that these types of innovations maybe not take until 2022, which I think is your aggressive time frame for having deployment of that.

So, I, again, I assess that it's good to have this engagement with DOE today. We obviously have a lot of things that we're working on mutually. And, I think, from all I hear, both from meeting with the NRC staff and hearing from you today, it's a very cooperative movement forward on all of these topics.

I would say on subsequent license renewal, just to close, that the one thing that appears clear, given that we are all made humble about projecting the energy future, given how much it changed in my nine years serving on this Commission, it appears that for some

fraction or percentage of the fleet of currently operating reactors subsequent license renewal and the successful execution of that by NRC and the industry is really important to the energy planning of this country because these are these are huge projects that, if we were not to be successful on that and suddenly have a need to replace substantial capacity, that is not something that the integrated resource planning of states, regions and the industry can support in short time frame.

So, that will have to be something that we have a good sense of our confidence on being able to carry forward with subsequent license renewal reviews without technical challenges or surprise.

We almost need to know that yesterday because the kind of planning that needs to be done for energy infrastructures is decadal and not something that and not something that we can do on a short period of time.

So, I think I just appreciate the opportunity to hear the presentations and I'll close with that.

Thank you.

CHAIRMAN BURNS: Okay, thank you, Commissioner.

Commissioner Ostendorff?

COMMISSIONER OSTENDORFF: Thank you, Chairman. Thank you all for being here today.

The partnership between the part of Energy and

Nuclear Regulatory Commission is very important. I've noted that, in my time on the Commission with various leaders in NRO and our side of the house with Mike Johnson, Glenn Tracy and now Jennifer Uhle, that they've all reported on their close working relationship with you and your predecessors and in many respects, and it's been a very good news story as far as governancing and government.

I have to, I can't let this moment go by without commenting on Commissioner Svinicki's remark about her time and seeing some of the same faces here, I note in the audience John Kotek, you're a strong very personal friend of mine. Craig Welling, who, in January of 1977 when I was as an ensign reporting at the prototype, Craig was my lead engineer on the watch of SG3 up in Ballston Spa, New York. And, I give Craig full credit for getting my Navy nuclear career off to a good start. So, Craig, thank you for your leadership and mentor of this young ensign many, many years ago.

MR. WELLING: Thank you for your kind remarks.

COMMISSIONER OSTENDORFF: I've got a few questions and maybe I'll start out, because I'm not sure where to start, but I'm going to start with John Kelly, so we'll go there.

When we were looking at your slide three, and the graph that says Nuclear Power Capacity Needed to Meet Clean Power Goals, I think that was your slide.

DR. KELLY: Yes.

COMMISSIONER OSTENDORFF: So, I realize there

are things that are under our control as a safety regulator and a lot of things are not under our control. I realize with your responsibilities in the Office of Nuclear Energy, you have things under your control and things not under control.

And, there's broader U.S. Government, White House, Environmental Protection Agency, Congressional actions and policies FERC, I guess Commissioner Svinicki mentioned, regional power of authorities and so forth.

I guess I'm struck by the little small piece there that says double U.S. nuclear capacity required to meet clean power goals. And, you have the line there for Generation IV reactors.

Is that an assessment by your office that the only way to make clean power goals under certain economic assumptions is to build more nuclear?

DR. KELLY: Well, let's see --

COMMISSIONER OSTENDORFF: I want to better understand the foundation for that.

DR. KELLY: Yes, so, there are several ways to look at this.

In order to basically decarbonize electricity production, we have to take all the fossil fuel driven electricity out of the market. That's about 50 percent of our current generation.

So, we looked at what would that mean in terms of, you know, you get to the specifics, but it means about a tenfold increase in

renewables. So, what it is today, ten times.

Completely taking all the carbon -- all the natural gas generation and putting that on sequestration.

And then, the gap is this is nuclear, which basically leads you to a doubling, doubling of nuclear.

Now, if you look at that curve, you'll see it's about 4 gigawatts per year that we would add, which has historically been something that we've accomplished in the past. So, this is not out of our realm of engineering.

We have a group at DOE called EPSA that is doing systems analysis. They also are projecting -- they're predicting a range, but it's somewhere between 180 and 250 gigawatts of nuclear being needed to meet the clean power goals in the 2050 time frame and beyond.

So, there is -- it's -- you can sort of do a thumb or you can do more detailed analysis.

The OECD has done a study that showed that worldwide, the amount of nuclear needs to double in this time frame.

So, there's lots of evidence that shows that this is about the right order of magnitude.

I think from our perspective that the question is, what is that mix? And, what's the baseload mix going to be in the 2050 time frame?

Certainly Light Water Reactors, which we've invested

in heavily in the NP-2010 program, will be a significant contributor, as will the SMRs that we're developing now.

The question is, is there a Generation IV technology that's even better? And, that's what our quest is now is investing in the potential for even better technology that will be available in 2030 and beyond.

MR. KOTEK: Yes, and, you know, from an administration standpoint, of course, you know, we're not in the business setting targets for particular types of generation. But, you know, building on what the Secretary has said about the need to essentially decarbonize the electric sector, you know, as he looks at this and as he said publically many times.

It's hard to see how you get there without a significant contribution from nuclear. Right? And so, that's what we're -- what our program is all about is and is, you know, is developing multiple potential pathways so that you could achieve the types of growth that we've, you know, that we've laid out here and in what's admittedly not a, you know, it's not a goal or anything, it's just a picture of what might the future look like if you're going to get to a decarbonized electric sector?

And, to John's point, you know, some of the technologies we're looking at, get nuclear beyond just electricity. And, I know it's been used for district heat or desalination in some applications.

But, broadly speaking, you know, if you could get nuclear to be a supplier of industrial process heat or desalination services or hydrogen production or, you know, I mean any number of other things, now, you know, now you now you can obviously start penetrating other energy products and services which seem to be where at least some of today's utility companies are going.

I mean, when we engage with some of the large utility companies, they are thinking 20 years down the road, do we still want to be an electric utility or do we want to be a provider of energy projects and services?

More broadly speaking, we're trying to provide nuclear options that get them there.

COMMISSIONER OSTENDORFF: Okay. I'm going to stay with John, if I can, for the next question.

And, I know that a lot of us have seen each other at the Department of Energy, NRC, Advanced Non-Light Water Reactor Workshops, various industry laboratory type conferences and you're aware of what we've done with respect to the FY '17 budget request to the Congress on requesting $5 million off of our fee base to help us prepare on the regulatory development side of the house for non-LWR technologies.

Recognizing the constraints that we have within some resource issues, are the things that you think we ought to be doing that we're not currently doing or planning to do?

MR. KOTEK: Well, I'll start and I'm going to ask John to get into this in more detail because he's been closer to it.

First of all, I can tell you that just the mere fact that you asked for the $5 million that was a really important signal to folks on the outside and the innovator community that you all are taking this seriously. Right?

And, you guys started -- when I got here, it was Glenn and Glenn was working with us very closely on things like the workshop and then, of course, Jennifer's picked up and now you've got the vision strategy document. I forget exactly what you've called it, but looking at Advanced Reactor licensing.

From what I've seen, at least, you all are sending very important signals to the innovator community that you do take this seriously, you want to find ways to help them, you know, to help develop a process that better suits kind of what they see as their development trajectory.

When I talk to them, I liken it to the experience I had -- I actually worked with some mining companies back in a past life when I got out of nuclear and I came back and I see the same people.

But, you know, they will go through a process of, you know, identifying a potential resource, proving up that resource, going through getting -- a lot of these are on federal land, so they've go to get approval to do an exploratory drilling program, maybe do a larger drilling program.

Then they put out a mine plan and then they get, you know, the federal -- the agencies review that through, usually an EIS or EIEE process.

So, there's a whole bunch of stages along the way to getting to an actual functioning mine.

And, every time they get through one of those gates, they go back to the investor community and they say, see, we're further along and they get the next tranche of funding.

And, I think -- so I think they're looking for something like that and I think they see that you all are trying to work with them to find ways of kind of fitting with, again, what they see as their development time line.

On the specifics, John, anything you want to add in terms of kind of what we're doing, need to be doing question?

DR. KELLY: Well, just reflecting on the last couple of years, I think we've made -- together have made tremendous progress. Things are slow, I mean, they tend to be slow. But, we're heading in the right direction.

So, we've got our strategy and visions aligned. We're working the key issues, you know, the fact that we need to involve the public in this leads to some time delays, but I think in general, we're all rolling on the same -- in the same direction right now.

COMMISSIONER OSTENDORFF: Okay.

DR. KELLY: And, I just would encourage the

Commissioners to continue to push on that because this is one of the key areas that will -- needs to be -- come to a conclusion in order for the investment of the private sector to come to fruition.

COMMISSIONER OSTENDORFF: Okay. Thank you.

I've got just to make two very quick remarks, my time is almost up.

Ray, I want to just echo your comments. I think the Advanced Test Reactors is a national asset. And, I had a chance to visit when I was an official at NSA eight years ago. I'm a big believer and it's a great program.

So, I just want to thank you for your stewardship out there and for the Idaho National Laboratory stewardship of that resource.

And, John, on the fuel piece, I will just throw my voice in with others. I think it's really important what you're doing there.

Even if it results in not necessarily deploying widespread new fuels, the learnings that will occur through the process, that, by itself, will be extremely valuable. So, thank you for your work in that area.

MR. KOTEK: Thank you.

COMMISSIONER OSTENDORFF: Thank you all for being here.

Thank you, Chairman.

CHAIRMAN BURNS: Thank you, Commissioner.

Commissioner Baran?

COMMISSIONER BARAN: Thanks.

Well, I want to add my thanks to all of you for being here. It's very helpful to hear directly from you about what DOE is working on and where you think the technologies are heading.

I want to follow up on some of the Advanced Reactor questions for a minute. We'll hear on the next panel that NRC is looking at updating our regulatory frame work to be able to more efficiently license Advanced Reactors.

And, part of that is thinking through the time frames involved and when we need to have an updated regulatory frame work ready to go.

So, I'll just ask you to predict the future a little bit. I mean, what is your sense, what's your assessment of what are the technologies, the one or two technologies we're likely to see come in for a design certification first and when do you think that'll be?

MR. KOTEK: Well, I'd certainly hesitate to try to put too fine a point on that. There are, of course, a couple of technologies that are pretty far down, call the TRL line.

And as John Kelly mentioned, we talked about the test and demo reactor study. You know, that concluded that gas cooled reactors and sodium cooled reactors were the ones that had the, you know, the --or the furthest state of development.

You know, there are folks, of course, you know, TerraPower is one we talk about that are looking at a sodium cooled reactor technology that, you know, they have invested, what, from what we've seen in public reports, a few hundred million dollars in that. So, that would seem to be pretty well down the pathway of, you know, having a design in place.

And then, there was a lot of work that was done by the NGNP on gas reactor technology that, you know, that a couple of these companies are looking at.

John, I don't know if you have -- if you've heard anything publically from any of these companies about when the Commission might see something in the way of an application. I've not seen anything specifically from anyone on that.

DR. KELLY: Yes, but I agree with John, that the sodium cooled reactor technology and the high temperature gas are at the highest level of technical maturity. We've built them before, we've got the experience base.

What is interesting, though, is that utilities are now getting involved. So, two years ago, no utility was saying anything about advanced reactors. Now, we have NEI had a working group on advanced reactors.

The CEO from Southern Company is the Chair -- Chairs that group. They're trying to bring in that.

So, this is moving from a completely technology push

to technology pull. And, I think that's going to be critical for the, you know, the next steps in this.

And so, we see NEI having this activity. The EPRI has a working group now on, you know, getting utility investment into advanced reactors.

So, things are coming together. When is still a good question, but I think if we open up our doors like we've been trying to do, I think this will really accelerate the innovation and push forward.

COMMISSIONER BARAN: Just for our planning purposes and maybe it's just too hard to say at this point, I mean, do you think, for example, we're likely to see a design cert application in the next five years or is it going to be longer than that?

MR. KOTEK: I don't have a great answer for you because I haven't asked that specific question of the developers and to get a sense of their time lines. Why don't you let us do a little canvassing and get back to you with a -- if we learn something, we'll get a letter over or something like that.

COMMISSIONER BARAN: That'd be helpful, thank you.

MR. KOTEK: Yes, okay.

COMMISSIONER BARAN: Let me ask about the work you're doing on the subsequent license renewal issues, the aging issues and the outstanding technical issues there.

Can you walk us through, briefly, just the time line for

when you think that work will be completed and those outstanding technical questions resolved and what are you finding so far? Are there issues that you're concerned about or that you see as potential show stoppers for operating plants beyond 60 years?

DR. KELLY: So, I think, you know, our coordination with the NRC to try and identify the aging management issues has been very important.

This allows us then to maximize the data collection and have that data available.

You know, we're looking at applications in the 2018 time frame. And, we suspect that, based on the previous license extension process, this may be a, you know, a five to ten year kind of process.

So, we see that the data will be collected, will then be processed through the SLR. And, I guess we're not seeing any major hiccups. I think we're -- we think we have the -- not only the data, but the material science, background, that we're not expecting any surprises, but it's really a question of follow through and delivery.

COMMISSIONER BARAN: Okay. And, John Kotek, you briefly mentioned -- you kind of referred to high-level waste and it's not something we really talked about today, so I just wanted to ask you about that a little bit.

Can you give us an update on the status of DOE's plan to move forward with a defense only high-level waste repository or

disposal facility?

MR. KOTEK: Yes, so we're in very early stages right now of developing the design of the consent based siting process. So, we're out getting the input from states, Tribes, local governments, other interested parties on what they think a process ought to look like. What factors should be considered in the design of a process.

We've made it clear that what we're ultimately looking for is to develop an integrated waste management system that includes both storage and disposal facilities. And, disposal facilities that could include a separate repository for defense waste.

The President, of course, issued a finding last year that allows us to move forward with that consideration of a separate repository. It doesn't require it, but allows us to look at it.

We have not yet gotten to the stage where we're out looking for sites or even, you know, engaging in conversations with states and communities or potentially Tribes that might be interested.

We see that as something that comes after we have both issued a design of a process and then after we've also start -- begin providing resources, particularly in the form of grants to, again, states, Tribes, local governments, potentially others so that they can study whether they might be interested in serving as ultimately a willing and informed host of such a facility.

So, we're still several years aware form actually getting to the point of, you know, looking at specific sites. But, you know, we

will go through a process of explaining, you know, laying out the process, establishing guidelines, considerations for siting. Then, engaging in conversations and then starting to identify specific sites. So, it'll take us a few years to get there.

COMMISSIONER BARAN: Okay. So, it's -- this is something that, it's a little ways down the road --

MR. KOTEK: Yes.

COMMISSIONER BARAN: -- before we would be expecting --

MR. KOTEK: Certainly on defense repository side. Yes, obviously, we've seen interest from commercial entities and from states --

COMMISSIONER BARAN: Right.

MR. KOTEK: -- and communities interested in the consolidated storage piece. So that could certainly move faster, we think.

COMMISSIONER BARAN: Okay. And, then, one other question I had was on the test and demo -- going back to test reactors for a second, on the potential test and demonstration reactor for a less mature advanced reactor technology, is this something that you would anticipate NRC licensing or no? Do you have a sense at this point?

MR. KOTEK: Yes, and of course, the test versus demo question, you know, if you're talking about the demonstration of

what will ultimately be a commercial design, then, of course, well, one, you have a commercial partner, they're going to have a say in that.

But, you know, you would think that -- I mean, certainly, there's going to need to be some sort of a regulatory review at the point that -- so they can get it into the marketplace.

For, you know, DOE test reactors, of course, we haven't built on in a long time. I think the FFTF was probably the last test reactor that we built. Is that -- I'm looking at Ray. Yes, okay.

At the time, I think we had the -- it wasn't an NRC licensed facility, but there was NRC review done of the design and those, you know, the results of that review were factored into the, you know, the ultimate plans for the facility.

So, you know, we're far away from having made a decision as to what the relationship would be there, but there's certainly a history in DOE of involving the NRC even though we've, you know, we do regulate our own test reactor operations.

COMMISSIONER BARAN: Okay.

Thank you very much.

CHAIRMAN BURNS: Commissioner Svinicki?

COMMISSIONER SVINICKI: I would be remiss, having remarked upon Commissioner Ostendorff's tie if I didn't mention the fact that Dr. Kelly is representing in fine form that, on his wristwatch, that proud mammal, the Michigan Wolverine.

Thank you.

DR. KELLY: Thank you.

CHAIRMAN BURNS: Thank you.

I think it's time for a break.

No, thank you all for the presentations. We'll take about a five or six minute break and then hear from the NRC staff.

(Whereupon, the above-entitled matter went off the record at 10:30 a.m. and resumed at 10:40 a.m.)

CHAIRMAN BURNS: Well, I'll start the second half of our meeting with the NRC staff. And Vic, I'll let you lead off and we will go to our other speakers and presenters.

MR. MCCREE: Thank you, Mr. Chairman. Good morning. It is good to see you.

As the earlier panel also emphasized, I would to highlight the value of the continued strong relationship that NRC enjoys with our DOE colleagues. The DOE and NRC collaboration has deep historical roots, as you heard this morning and it remains strong today, through such activities as joint workshops like the workshop we conducted two weeks ago, working group participation and some annual senior management meetings to name a few. The DOE's contribution will have a critical role in future NRC activities as well.

As we look at the agenda for this morning on slide 2, the presentation that you are about to hear from us will provide some specific examples of NRC activities, which have benefited from the ongoing collaboration with the DOE, including the deployment of

advanced reactor technologies, accident tolerant fuel, and the grants program, to name a few.

Dr. Jennifer Uhle, of the Director of the Office of New Reactors will discuss developments associated with non-light water reactor designs. This is a key focus area for us and I am pleased to report that we have made significant progress.

Most recently, the NRC published a draft of our advanced reactor design criteria and our vision and strategy documents for advanced reactors. These documents were discussed at the June DOE/NRC workshop two weeks ago in advanced reactors and our major milestones in our ongoing efforts to be ready to license these designs.

Jennifer will also present to you the NRC accomplishments in preparing for the review of small modular reactor applications.

Bill Dean, to my far left, the Director Office of Nuclear Reactor Regulation, will provide an overview of our preparation for subsequent license renewal, that is licensing plants beyond sixty years.

Also in this area, we recently published draft guidance for comment and look forward to continued engagement with the DOE and other stakeholders as we move forward.

Of particular note, the Peach Bottom plant recently sent us its formal letter of intent to provide its application for subsequent license renewal in 2018, the first application of this sort that NRC

expects to receive.

Bill will also speak to ongoing activities in the area of accident tolerant fuel.

Additionally, Mike Weber, Director Office of Nuclear Regulatory Research will speak to our collaboration with the DOE to resolve various challenging technical issues, such as our efforts to enhance our severe accident codes, using lessons learned from the Fukushima-Daiichi accident.

Finally, we will conclude our presentation with an update on NRC's Integrated University Program, a vital important initiative to support the development of students entering the nuclear workforce and foster the talent of future generations to design, construct, operate, and regulate nuclear facilities.

So, now I will turn the presentation over to Jennifer Uhle to discuss non-light water reactors and small modular reactors. Jennifer.

MS. UHLE: Thanks, Vic. Good morning Chairman, Commissioners. I will be describing for you the activities we have underway, as well as our future plans to prepare us to review non-LWR designs and I will also be covering our readiness to review small modular reactors.

Slide 4, please. So, let me start by describing our activities covering the review of non-LWR applications. First, our regulatory framework could support the review of non-LWRs today;

however, we are making a lot of progress on enhancing our framework to support the efficient and effective review of these designs. There is tremendous interest in advanced reactor technology, as demonstrated by the 30 or so different designs that are being discussed within the industry.

We are developing a comprehensive plan to ensure we will be ready to conduct efficient and effective reviews of these designs when they are submitted. We recently made a draft version of our vision and strategy document available to the public. It summarizes our plan for achieving what we call mission readiness.

This chart illustrates the construct of our approach. In the first phase of our work, we started with the NRC's mission and vision and then developed strategic goals for non-LWRs. Specifically, the goals are to assure NRC readiness for an efficient and effective review of non-LWRs. We have verified that our vision and strategy is aligned with that of DOE.

We then developed strategic objectives and strategies to achieve the goal. In the second phase of our work, we will work with our partner offices within NRC to develop specific implementation action plans that will support task execution, the action plans, our description of the actual work that must be completed in order to achieve our goal.

I should note that we have very active engagement with DOE on the non-LWR activities and I will touch on this more during

my presentation. We feel the work with the DOE, the open sharing of information, and our cooperative activities have contributed appreciably to our progress in this area.

So, next slide, please. As I noted, NRC and DOE do have complementary goals. DOE is supporting the deployment of two different non-LWR designs by 2030. So, this means that the NRC must be ready to review these designs efficiently by about 2025.

So, what do we mean by being ready? Ready means that the elements needed to conduct our reviews are in place and ready to go. So, we must ensure that the designs are safe but we also must ensure that we are not imposing any unnecessary regulatory burden.

So, slide 6, please. So, we will achieve our readiness goal by using a three-pronged approach. First, as you can see in the slide, enhancing technical readiness, optimizing regulatory readiness, and optimizing communication.

Technical readiness means that the NRC has the specific technical knowledge, skills, and tools in place to efficiently and effectively review a non-LWR application.

Regulatory readiness means that the NRC has appropriate guidance available to both the applicant, as well as to our reviewers internal to NRC. It also can mean that in the longer term we have completed rulemaking that we may find useful to support a number of reviews of these non-LWR designs.

So, optimizing communication means that when we are

communicating to the public and our external stakeholders we are disseminating clear expectations and requirements for the review of non-LWRs, using multiple channels of communication that are appropriate for the different stakeholders. We have binned the work into three different timeframes. Some activities under each of the prongs need to be completed in the near-term, which is zero to five years; mid-term, which five to ten years; and then some activities may take longer such that they are beyond the ten-year horizon.

It is important that we continue to engage with our external stakeholders so that we know the work we are doing is the right work at the right time. Continued interaction with DOE, the industry, and the public will help ensure this alignment.

Next slide, please. As I stated earlier, the second phase of our work is developing specific implementation action plans for each of the strategies. The action plans will address the detailed tasks, the estimated costs of performing these tasks, and the duration of the task. It also identify what groups inside NRC will be performing the work. We have a number of partner offices, including our partners in the Office of Nuclear Regulatory Research, Nuclear Reactor Regulation, Nuclear Material Safety, and Safeguards as well as Nuclear Security and Incident Response. They will all be key players in developing and executing the action plans.

The plans for the near-term will be completed in September and the mid-term and longer term plans will be completed

more like February of 2017.

So, I would like to provide an example of an activity that we are planning to support the objective of regulatory readiness. Operating nuclear plants now, are operated temperatures are well below 700 degrees Fahrenheit. In contrast, most advanced reactor designs operate at temperatures well above this point.

This introduces significant additional material property considerations that must be addressed in order for the plants to operate safely. So, the NRC and DOE have been working the American Society of Mechanical Engineers, Boiler and Pressure Vessel Code Committees to support the development of code rules, as well as qualification of appropriate materials for high temperature applications. DOE supports the development of the technical information that underpins the ASME Code rules; whereas, the NRC is preparing to review the ASME Code requirements with the objective of endorsing them as acceptable rules for advanced reactor design and construction, if appropriate.

Slide 8, please. So, I would like to emphasize the very successful collaboration we continue to have with DOE Office of Nuclear Energy. You heard about some of our activities on the previous panel.

During the development of our vision and strategy document, we took the opportunity to compare our goals to those put forward by DOE and we found that they are complementary. Beyond

just comparing the goals, we shared with DOE and DOE shared with us the actual vision and strategy documents and we commented on each other's documents.

While our roles of regulator and promoter are clearly distinct, we should not work in isolation, certainly, and we should, in fact, collaborate in technical activities to defray costs and also so as not to duplicate effort. We will ensure NRC's independence is maintained.

We have collaborated on a number of activities, including the development of non-LWR design criteria and we have exchanged ideas and pertinent information that has helped NRC resolve key policy issues.

One recent example of successful collaboration between NRC and DOE has been the co-sponsored advanced reactor workshops. These workshops are intended to allow key stakeholders to share perspectives, reach a common understanding on issues, identify potential challenges, and explore opportunities to resolve them.

We held the first workshop in the fall of 2015 and the second workshop just a few weeks ago and both workshops received a great deal of feedback on the desire to have an agile regulatory process for non-LWR reviews. We provided an overview of our proposals to support step-wise licensing review and also for reviewing a preliminary design in terms of a conceptual design assessment process. They were both very well received.

We are in the early planning stages for the next

workshop and expect to provide more details on these regulatory proposals at that point.

The workshops have been attended by well over 300 attendees. In each case, they represent a broad spectrum of stakeholders. These workshops, I think, are a great example of an effective public outreach sponsored by both NRC and DOE.

Slide 9. So, we believe that planning for readiness is critical to our long-term success in reviewing advanced reactor applications. However, we have asked ourselves whether or not we would be able to review a design for a non-light water reactor if it were submitted today. The answer is that yes, we could perform that review, however, it would not be anywhere near as efficient as it would be ten years from now.

If we go back many years, NRC's predecessor agency, the Atomic Energy Commission licensed three commercial non-LWRs that were constructed and operated. First was Fermi 1, a sodium-cooled fast reactor which operated until 1972. The second was Peach Bottom, a high temperature gas-cooled reactor which operated until 1974. And the third was Fort Saint Vrain, which was another high temperature gas-cooled reactor of much larger size than Peach Bottom Unit 1 and that was operated until 1989.

In the mid-1980s and into 1990, the NRC staff also completed pre-application safety evaluation reports for a sodium-cooled fast reactor, as well as a modular high temperature gas reactor.

So, from these experiences, it is clear that the current regulatory framework can support licensing of these designs today. However, we have work to do to achieve our goal of assuring NRC readiness to efficiently and effectively review these designs. We have set the pace of our activities to be commensurate with the industry maturity, as well as their deployment goals. And at this point, DOE's deployment goal of 2030 and NRC's review readiness goal of 2025 are aligned.

Slide 10, please. So, I would like to switch topics now to talk about our preparations related to small modular reactors. This chart shows the current list of utilities and vendors that have approached NRC with specific plans to move small modular reactor projects forward to a review stage.

So, I will start with the vendor NuScale. NuScale began pre-application discussion with the staff around 2008 and they expect to submit an application for design certification for a small modular reactor, which is an integral light water reactor, by the end of this calendar year. So, I would just say, Commissioner Svinicki, it is the end of this calendar year, 2016.

So, on May 12, 2016, the NRC received an application for an early site permit for a small modular reactor site at the Clinch River site in Tennessee. TVA expects to follow-up with a combined licensed referencing a small modular reactor on the site in the mid-2018 time frame.

Utah Associated Municipal Power Supply, or as we like to call it, UAMPS because it is a lot faster that way, UAMPS expects to submit a combined license referencing the NuScale design at a site within DOE's Idaho National Laboratory in early 2018.

So, clearly, the SMR industry has moved from a concept to a licensing reality. The NRC is in a strong position to conduct those reviews efficiently, while meeting our mission of safety security and environmental responsibility.

In the next few slides, I will be discussing work that has been done to facilitate these reviews, beginning with some policy issues.

So, if we go to Slide 11, please. In 2010, the staff submitted SECY-10-0034 to the Commission, which identified key technical and policy issues, whose resolution was seen as critical for the review of SMR technology. Resolution of these issues is also critical to NRC's ability to conduct efficient and effective reviews.

We have discussed these issues a number of times in a number of public presentations, as well as previous commission papers and meetings. This slide lists those issues for which the staff has received direction from the commission or that are covered by our existing regulations or guidance. An example is control room staffing for small or multi-modular facilities. The current requirements for operator staffing prescribed a number of operators required per unit and per control room.

The regulation doesn't address the situation where three or more units are controlled from a single control room. So, in SECY-11-0098, the staff indicated that it would address this issue through the use of exemptions. In fact, the existing version of the standard review plan contains adequate guidance for performing the exemption request evaluations. The staff is using this guidance in its pre-application discussions with NuScale.

As experience is gained in performing the operator staffing exemption requests, we will evaluate whether additional guidance is needed.

So, slide 12, please. So, this chart shows the status of the remaining issues from the 2010 SECY paper. Two issues of particular interest to the SMR applicants include emergency preparedness and fees.

In SECY-15-0077, the staff proposed an approach to changing the emergency preparedness requirements such that license applicants for SMRs and other technologies could demonstrate the acceptability of a smaller emergency planning zone. The Commission directed the staff to engage in a rulemaking and a rulemaking plan was recently provided to the Commission for your consideration.

Finally, the NRC staff reviewed and endorsed an NEI proposal on how the Part 170 fees could be revised for small modular reactors. After detailed evaluation by the staff, a revision to Part 170 was proposed to the Commission, which led to rulemaking to codify that

change. And in fact, the final rule was published on May 24, 2016 closing this issue.

So, we are continuing our efforts to resolve the remaining issues over the next few years. Slide 13, please.

As I have noted previously, we have initiatives underway to improve the efficiency of our reviews for non-LWRs and small modular reactors. For the anticipated NuScale review, we are implementing what we call a safety-focused review. It began with the development of design-specific review standards for NuScale, where the staff went through the standard review plan and identified those sections that apply to NuScale. We are now using risk insights of the design that we have garnered through pre-application activities to determine what review areas could be stressed and those that could be reduced.

We are doing this so that our review will focus our attention on the most significant technical areas of the design. I will describe this further on the next slide.

We are also emphasizing the quality of staff information requests and each request for additional information is receiving senior management review.

Our goal here is to assure that the request for additional information issued from the office are of appropriate quality and focus on the most important safety issues affecting the design.

We are also investigating whether we can develop

what we call requests for additional information templates that can more quickly be filled out by the staff, improving the efficiency, as well as the clarity of the information request.

And then, finally, we are stressing staff and management familiarity with the NuScale design. In order for us to perform a very safety-focused review of this unique design, everyone involved in the review really must understand the overall safety principles of the design so that each system, structure, and component can be put in its appropriate safety perspective. So, NuScale has conducted detailed familiarization briefings and these sessions were attended by all the reviewers and their management and were very well received.

Slide 14. So, this slide depicts the key elements of the safety focused review process. We have a list of all the system structures and components in the design. There are far fewer than a large light water reactor, thankfully, and we are listing its risk significance, whether or not it is safety related in its role in defense-in-depth. And then we are determining the level of review it should receive.

For instance, if a component or system is of a novel design, it is not safety-related but it is risk significant and plays a key role in defense-in-depth, then, we will focus more attention on it, than on another component that is not.

So, slide 15. So, to summarize, I piloted our focus on

readiness to conduct reviews for both small modular reactors as well as non-light water reactors.

With regard to non-light water reactors, we have prepared a vision and strategy document and will implement the forthcoming action plans so that we are technically and regulatorily ready to conduct efficient and effective reviews.

In the case of small modular reactors, we are committed to performing a safety focused review of the NuScale design and are in the midst of determining what areas of the design warrant the most attention.

So, in closing, the NRC and DOE have effectively collaborated in a number of areas and we continue to do so. Both organizations have been careful to respect our individual roles and responsibilities. This collaboration and open communication has greatly contributed to our progress in these areas.

So, this concludes my remarks and I would like to turn the presentation over to Bill Dean.

MR. DEAN: Okay, thank you, Jennifer. Next slide, please.

Good morning, Chairman, Commissioners. I am pleased to be with you here this morning to provide you with an overview of NRC's activities related to subsequent license renewal or SLR. As Vic noted, I will also spend a minute or two talking to you about our preparations for being able to license accident tolerant fuel.

Next slide, please.

This slide illustrates how our aging management programs or AMPs supplement the regulatory process for assuring safety during the license renewal period. Through the regulations in 10 CFR Part 54, the NRC established two fundamental safety principles.

First, with the exception of the potential detrimental effects of aging, the existing regulatory process is adequate for assuring safe plant operations. Secondly, the licensing basis at the time of license renewal is not the same as the licensing basis at the time of initial licensing. It has evolved over time through license amendments to address operating experience and changes in regulatory requirements. Each plant's current licensing basis must be maintained through the license renewal period.

The NRC's major focus in approving a license renewal application is reviewing the aging management programs proposed by applicants. AMPs are intended to identify and assess age-related degradation. License renewal reviews concentrate on structures, systems, and components that are not already covered by other programs, such as the maintenance rule. Next slide, please.

As we know, there are currently a hundred operating reactors. As of June of this year, the NRC has issued renewed licenses for 83 units. This includes two units that ceased operations in 2013 and 2014, that being Kewaunee and Vermont Yankee.

Initial license renewal applications for 12 units are currently under staff reviewed and licensees have submitted letters of intent to the NRC indicating they will submit applications for renewed license for four additional units.

The remaining three sites at the Tennessee Valley Authority has not yet expressed interest to submit license renewal applications for the two Watts Bar units. And the remaining operating that has not applied for a renewed license is Clinton, which Exelon just announced that they will shut down in 2017.

Next slide, please. This slide shows the number of reactors in relation to their years of operation by the end of 2016. By the end of this year, 45 units will be in the period of extended operation, which means they will have been operating for more than 40 years. Plants in this group will begin to reach the end of the first period of extended operations or 60 years of operations starting in 2029. It is anticipated that this group of plants will be the primary source of SLR applications in the near-term.

10 CFR Part 54 allows licensees to submit an SLR application as soon as they enter the period of extended operation. As we know, Exelon has recently indicated its intent to apply for subsequent license renewal for the units at Peach Bottom in the latter part of 2018 and Dominion has indicated its intent to submit an application for a subsequent license renewal in 2019 for the two units at Surry.

Next slide, please. In response to SECY-14-0016, which provided the Commission options for how to regulate subsequent license renewal, the Commission stated that the license renewal rule has provided an effective basis for ensuring safe operation during the license renewal period and will continue to be an effective basis for subsequent license renewal.

Consistent with the license renewal rule, the focus of SLR is on the adequacy of additional aging management activities to ensure safe plant operations during the subsequent period of extended operation.

As part of our preparatory efforts, the staff has developed some strategies to optimize the subsequent license renewal application and review process. The staff is also revising applicable inspection procedures. Next slide, please.

The top four technical issues to provide assurance for safe operation of nuclear power plants for operation from 60 to 80 years are related to neutron embrittlement of the reactor pressure vessel, stress corrosion cracking and other types of degradation of reactor pressure vessel internals, concrete and containment degradation, and electrical cable qualification, condition monitoring, and submergence of low- and medium-voltage cables.

Industry is responsible for developing the technical basis for long-term operation. While much work has been done and continues to progress, these issues are not likely to be resolved on a

generic basis, when the first applications for subsequent license renewal are submitted. Therefore, the first applicants will need to address these issues on a plant-specific basis.

In a few minutes, Mike Weber will discuss how the NRC is collaborating on SLR-related research activities with domestic organizations such as DOE, through their light water reactor sustainability program and the Electrical Power Research Institute, as well as international partners.

Next slide, please. The NRC has two major guidance documents that support license renewal activities to generic aging lessons learned or GALL Report, which provides acceptable methods for managing aging, once a plant enters the period of extended operations and the standard review plan, or SRP, which provides guidance to NRC staff on how to review license renewal applications.

The current GALL and SRP are focused on the effects of aging beyond 40 years. Both of these documents need to be updated to support periods of operation beyond 60 years. The NRC published a draft GALL Report and a draft standard review plan for public comment to support subsequent license renewal in December of 2015.

It is important to note that while the GALL provides methods acceptable to the NRC on managing aging effects, a licensee may propose plant-specific alternatives. Currently, the NRC is evaluating the public comments we received on the draft guidance

documents and we expect the final guidance to be issued in July of 2017.

Next slide, please. While the GALL Report and the standard review plan I just discussed provide an acceptable method for developing and reviewing aging management programs, the license renewal program embodies a continuous improvement philosophy. Therefore, as lessons are learned from operating experience and during license renewal applications reviews, these guidance documents will be periodically revised to capture new insights or address emerging issues. As such information emerges, the NRC staff develops license renewal interim staff guidance or ISGs until such times as the GALL Report and the SRP can be updated, which is a much more time-consuming process.

But just like the process used to develop the GALL and the SRP, the ISG process is a transparent process that involves stakeholders. By issuing ISGs, the NRC is able to improve the efficiency and effectiveness of the license renewal process by providing guidance to license renewal applicants relatively quickly until that guidance can be incorporated into a license renewal guidance document.

Some examples of current ISGs, including aging management are buried in underground piping and tanks, internal coatings, and linings, reactor vessel internals, steam generators, and stainless steel structures and treated borated water. Please note that

the current ISGs were incorporated in the SRL draft guidance documents that are currently under NRC review.

Next slide, please. Mr. Carmack, this morning, discussed DOE's engagement with industry who have recently expressed significant interest in accelerating the development of accident tolerant fuel. The Agency has been preparing to address several matters related to the licensing of accident tolerant fuel over the past several years. While substantial research remains to characterize fuel properties and demonstrate performance of accident tolerant fuel under both normal and accident conditions, as we noted earlier, both DOE and industry are working on the selection of candidate designs that can serve as lead test assemblies.

The scope of our licensing review will depend on the level of departure from existing designs that use low enriched uranium oxide ceramic pellets within zirconium alloy tubing designs. The technology neutral performance-based aspects of 10 CFR 54.46(c), which is currently with the Commission for approval, provides a regulatory framework that supports the introduction and use of accident tolerant fuels.

In a few minutes, Mike will also provide a summary of the technical aspects associated with the accident tolerant fuel.

This concludes my presentation and, since I have teed up a few topics for Mike, it is only fitting I hand the mike to Mike.

MR. WEBER: Thanks, Bill. Could I get the next

slide, please?

As Vic already alluded to, and as you have heard in the prior panel, the NRC has a long-standing cooperative partnership with the Department of Energy. And so, it is my pleasure this morning to appear before you, Chairman and Commissioners, to talk about how are we enhancing nuclear safety through that partnership both through research and through educational grants?

Now, you will notice a great deal of similarity not just with what the Department of Energy presented but also what my colleagues have presented in this panel and that similarity reflects the synergy and the focus on those topics that are most relevantly significant in terms of our nuclear safety focus.

If I could go to the next slide, please.

I will touch on only a few examples of our collaboration between the Department of Energy and NRC. These include ensuring safety for subsequent license renewal, learning from the accident at Fukushima-Daiichi, reviewing accident tolerant fuels and issuing educational grants.

Next slide, please. In terms of ensuring long-term safety for subsequent license renewal, as Bill has already alluded to, we are focused on aging management programs to specifically address the materials degradation phenomena and these include topics that I will get to in a moment on neutron embrittlement of reactor pressure vessels, reactor internals, concrete aging, and also cable aging.

Our cooperation with the Department occurs through the light water reactor sustainability program or LWRS. This program specifically focuses on that period of extended operation for 60 to 80 years. And you have heard already a brief description of that both by the Department of Energy and by Bill.

Our expanded materials degradation assessment provides the technical basis for the GALL-3 update, which Bill talked about. That is specifically the technological information that we rely on for both the identification and the resolution of the technical regulatory issues. And that is documented in NUREG/CR-7153 in a five-volume set.

The objective of the staff's work in this area is to resolve technical and regulatory issues before the first application for subsequent license renewal. While we may not get there, that is clearly our objective and that is consistent with the Commission's direction to the staff. And we are working in this area in collaboration with the Department of Energy, as well as the Electric Power Research Institute, the National Laboratories, and our international partners.

Next slide, please. Specifically on the degradation issues that we are resolving, the upper left-hand corner, you can see work on reactor pressure vessel embrittlement, where we are developing criteria to evaluate embrittlement of the pressure vessels.

On the right-hand side of that upper corner, you see some embrittlement trend curves, which reflects the integration of

assessment of world-wide surveillance data on the reactor pressure vessels.

In the lower left-hand corner, you can see a photo of concrete that has been adversely affected by alkali-silica reaction. This is another project where we are working not only with the Department but also with the Electric Power Research Institute and we are trying to understand the phenomena, as well as how do you evaluate the impacts of alkali-silica reaction in the field and evaluate the impact on structural integrity, as well as block expansion.

And that coin is in that photo for scale, so you can get a sense of the large cracks.

In terms of the upper right-hand corner, the focus is on vessel internals and cracking specifically here of the pressurized water reactor baffle bolts. This is caused by irradiation-assisted stress corrosion cracking. In this program, we are focused on austenitic stainless steel plates and welds, as well as cast austenitic stainless steel.

The photo that you see on the top there is cracking of a baffle bolt from Salem Unit 1. That is very similar to the baffle bolts you have heard a lot about in the media recently at Indian Point Unit 2.

And then finally, in the lower right-hand corner, you have just a shot of some cables at a nuclear power plant. While a lot of work has been done in the high rad field and high temperature field, not as much work has been done historically on the aging of the cables

in a low radiation and a low temperature environment.

And as Bill talked about, we are looking at both dry and submerged cables in our evaluation of this area.

Next slide, please. Shifting to the lessons learned from Fukushima-Daiichi, and I will point out that this was talked about at the most recent briefing for the Commission on the progress on the post-Fukushima improvements, this represents an area of cooperation collaboration not only with the Department of Energy but also with the Government of Japan, other international counterparts, and, again, with the Electric Power Research Institute.

I highlight three specific studies here. The first is what we call the Benchmark Study or otherwise known as BSAF and the purpose of this work is to collect and assess data to validate severe accident codes and modeling and it also supports our Japanese colleagues in their recovery and decommissioning of the Fukushima plants.

The first report for Phase 1 of this work was completed earlier this year. That report focused on the first six days of the accident, where models were used as well as the information available from the sites to forecast the phenomena that occurred during that time period and compare with what we have actually observed. That work was completed, as I mentioned, in March 2016 and the best estimates presented in that analysis are useful in predicting the possible location of the reactor core debris for the three units that suffered the accident

at Fukushima.

The next phase, Phase 2 of this Benchmark Study started last year and should be completed by 2018 and that extends that focus from the first six days to the first three weeks approximately.

The second project is the Senior Expert Group on Safety Research Opportunities Post-Fukushima, otherwise known as SAREF. This project operates under the Nuclear Energy Agency and it is specifically looking at research needs in approximately the three- to five-year window. I am happy to report that at the recent meeting of the Committee on Safety and Nuclear Installations at the NEA, the committee approved this report. So, we would expect to see this report be published and released for use later this fall.

Like the Benchmark Study, this specifically focuses in on those research needs that would support the forensics, both in-vessel and ex-vessel phenomena that occurred at Fukushima.

And then finally, the U.S.-Japan Civil Nuclear Energy Research Development Working Group. And the focus here is on the forensic analysis for the Fukushima plants, as well as any technological gap analysis. And this work is being done with the Department of Energy, as well as the Japanese Nuclear Regulatory Authority and the owner and operator of those plants, the Tokyo Electric Power Company.

If I could go to the next slide, please. Shifting to the review of accident tolerant fuel, we have already heard a lot about the

background and the origins of the program so, I will focus in on what are we doing working with the Department of Energy in this area.

First, we have been participating in the routine biannual meetings of the Advanced Fuel Campaign. We send staff from my office, the Office of Nuclear Regulatory Research to observe and then report back and then share with colleagues, not only in research but also in NRR and NRO.

Secondly, the Halden Reactor Project Program Review Group meetings. This is another cooperative research project through the nuclear energy agency specifically allowing for international collaboration to assess and to confirm fuel performance as new designs are evolved to actually test them and evaluate to confirm that they do in fact perform as expected.

And finally, under the Accident Tolerant Fuel Working Group, the offices at the Nuclear Regulatory Commission are working together to establish this working group between my office, Nuclear Reactor Regulation, and New Reactors to anticipate the licensing and technical issues that would be associated with the qualification of fuels for use in the commercial fleet. And we are ensuring that in research that there is an adequate technical basis to support the use of these accident tolerant fuels.

The photo you see there is of TRISO particle fuel and this work has been underway since the 1980s. And we heard in the recent Advanced Reactor Workshop that this fuel might be qualified or

the testing and demonstration to support qualification might be completed by 2021, 2022 time frame.

So, it is a long-term program that is required to demonstrate the safety and that is our focus throughout our cooperation with DOE on the accident tolerant fuel.

And finally on developing the workforce, in my office we are looking forward to the transfer of the educational grants program from the Office of the Chief Human Capital Officer to the Office of Nuclear Regulatory Research because we see an opportunity here for synergy between the research that we conduct and the development of the workforce through the educational grants. As the Commission is aware, the Omnibus Appropriations Act of 2009 established this program as a coordinated program not only with NRC and the Department of Energy but also with the National Nuclear Security Administration, where each of those entities is funded in the range of $15 million per year to support educational grants programs.

NRC, we have issued numerous grants to universities, colleges, trade schools in 35 states and Puerto Rico that have supported the development of over 100 faculty, more than 2,700 students and that has been through about 370 grants that have been issued to date.

And of course, the focus is on the development of the workforce in the areas of nuclear engineering, in health physics, and in related nuclear science and engineering fields that would support

certainly what we do and the Department of Energy does in nuclear safety.

And the Commission is well aware of this from the Chairman's recent letter to Chairman Rogers of the Appropriations Committee and other members of Congress back in May that reported to the Congress on the status of our grants program.

So with that, I would like to thank you for your attention and I will return the briefing to our EDO, Victor McCree.

MR. MCCREE: Thanks, Mike.

Mr. Chairman, Commissioners, as you have heard, we have made notable progress. We are making notable progress on a number of fronts, due in no small part to the positive very healthy open collaboration we have with our DOE colleagues and in a way that is consistent with our principles of good regulation and we look forward to continuing that.

With that, that concludes our presentation and we would be happy to respond to your questions.

CHAIRMAN BURNS: Well thank you all for the presentations. It was a good overview from both looking at issues related to the existing fleet of reactors and the possibility of further extension with this subsequent license renewal two, technologies we are looking at now and are reviewing now to being prepared for those that come. I think that is important for us in terms of trying to anticipate or position ourselves well for existing, as well as potentially for future

reviews and future challenges that may become before. Although, as Commissioner Svinicki said and remarked earlier, that is often very hard to understand where that may be.

Actually just a clarifying question, Mike. The BSAF is also an NEA -- isn't it also an NEA-sponsored project? One of the things related to -- and I found it interesting we are focusing in terms of the lessons learned from Fukushima. And there is always a lot of international cooperation, both multi-nationally and also on more one to one with the Japanese.

One of the things, turning to the -- and a lot of that has impact for us in terms of looking at the question of accident tolerant fuels, whether they might be something that is implemented in the next decade or so.

One of the things, sort of shifting from that into looking at the license renewal, is there international work on sort of long-term operation that has been done that informs us or have we somewhat -- my impression sometimes in talking with counterpart regulators is we are looking sort of beyond where they are now. So, I don't know.

And really any one of you might be able to comment on that.

MR. DEAN: I think I probably would agree with your assessment, Chairman that I think we are a little bit cutting edge in terms of where we are looking at the 60 to 80. You know a number of

us, certainly a lot of our European counterparts are just struggling now with looking at life beyond 40, as you get to the fourth ten-year review period.

So, I just was over in France and talking with some of my counterparts at ASN and getting some information on some of the things they are focusing on jut for that fourth term review. So, I think we are a little bit ahead of them in that regard.

CHAIRMAN BURNS: And I know they have expressed, and again, in interactions I have had, they are interested in I think what we are looking at. So, I know that is something we do and certainly in cooperation through IAEA or through NEA exchange but I would continue to encourage that because I think -- well, as I think we have seen even with the baffle bolt issue, when that issue when identified I think in the 1990s, some of it was operating experience in the French reactors or whatever. So, that continued cooperation I think is important in the aging management issues that arise from our perspective on license renewal.

MR. DEAN: Yes, and just to underscore that, just a couple of weeks ago we had a pretty successful international conference that we supported here where we had Brazil, Mexico, and Argentina representatives here. And I think some other countries are looking for similar sort of collaborative activities to learn about license renewal, not the subsequent license renewal but just license renewal itself.

CHAIRMAN BURNS: Okay, good. Mike, one of the questions I might ask with respect to the Integrated University Program -- oh, do we have -- do you want to add something?

MR. LEE: Yes, Richard Lee from Research. You asked about the accident tolerant fuel. NEA does have a group looking into that, too.

CHAIRMAN BURNS: Okay.

MR. LEE: And also under the DOE's Civil Nuclear Engineering Working Group, under the LWR program, they also have the accident tolerant fuel. So, the Japanese and U.S. is working very closely on that.

CHAIRMAN BURNS: Okay, thank you very much. Thanks for that addition.

I think my question on the Integrated University Program, to what extent does -- you know mentioned in terms of the universities in terms of developing faculty, developing students who may be in nuclear engineering, to what extent is some of these grants going into things like development of craft or particular professions that are basically you need to put the thing together? Because that is a question that has come up from some of our interest in numbers in the Congress. To what extent do the programs develop craft and trade type skills?

MR. WEBER: So, thank you for that question. I mentioned we had issued about 370 grants during the course of our

integrated university program. About 70 of those grants have been issued to trade schools. So, it is roughly about a fifth of the grants.

It is a competitive grant process and so we must respond to the applications that we have received. We have also been doing outreach to encourage a better understanding of potential applicants about the level of quality that we would seek to achieve and how best to be responsive to the notice of opportunity of the availability of those grants.

CHAIRMAN BURNS: Okay, thanks, Mike.

And Jennifer, a couple of questions for you. One thing I notice in terms of the schedule for design certification with respect to NuScale and then the UAMPS -- I agree it is easier to remember than whatever it stands for and then I always get challenged what does the acronym stand for sometimes. But the UAMPS COL, one of the things I see there I see sort of deja vu all over again and that is I recall in terms of looking at the time frame where you are coming to a potential decision on design certification for the NuScale SMR and then looking at the UAMPS COL, the thing that, the word that popped into my mind was Vogtle and the AP1000 rise design certification and the timing of the COL. I mean I don't know, at this point, whether we have anticipated that but it does seem to me something we may need to be sensitive to or understand what may happen. Because as we know, there were issues of finalization of the design cert for AP1000, which then affected the timing of how we proceeded through the COL.

So, I don't know if we have thought about that at this point or what we see the potential challenges are. But any sort of insights, at this point, somewhat a little bit distant but not too far on the curve.

MS. UHLE: So, to answer that question, the NuScale review -- I'm trying not to look at Commissioner Svinicki when I say this, so it will likely come in by the end of the calendar year. We are looking to do roughly a 40-month, 39- to 40-month review that will include rulemaking.

So, most of the review will be done within a few years. So, that is roughly 2019.

Let's see UAMPS is looking to come in mid-2018. Well, the first part of their review for the combined license would be also the environmental impact statement and the site characteristics. So, we are aware of that. If there were to be any design changes, obviously, to NuScale that were anticipated by UAMPS that could cause some conflict. But if the review does go smoothly, as we do expect it to at this point, based on all our pre-application activities, we don't really see that that would be a problem looking at their need to come in in the 2018 because of the focus on the site being the first part of it.

CHAIRMAN BURNS: Okay. It is something I think to pay attention to. And to the extent we have any lessons learned, I recall lessons learned from that, the experience going through Part 52, I would encourage the staff to be sensitive to that.

The last question I am going to ask -- I didn't think I was going to talk about liability very much today but one of the things that struck me, I think, on slide 12, we look at sort of a to be done, and it talks about insurance and liability, which I presume is primarily the Price-Anderson application or the application of Price-Anderson or in a way the appropriate footprint for Price-Anderson for the small modular reactor and it says future rulemaking, if needed.

And I vaguely remember, I have a few brain cells that still remember the SECY from 2010 on the various issues here. How do we deal with that in the meantime? Because if I look at a potential rulemaking here and, given the time even ambitious time, how is that going to intersect with the potential UAMPS type application, again? And as I recall -- what are the primary issues?

My recollection of the primary issue has to do with for a small modular reactor, are you going to do the same kind of insurance level that you require for a quote large, although that is even a varying thing, a large light water reactor?

MS. UHLE: That is exactly correct. And it also is -- are you doing it on a per module basis or are you taking a look at the entire complex, which could be up to 12 different modules in the case of NuScale. So, how would you evaluate that total power? And then looking at potentially scaling what the insurance would cover and what the insurance fees would be.

So, that is part of the issue. We owe you a paper, a

Commission paper, looking to the end of 2016 into 2017 to frame that out in more detail. So, we will be providing that later.

I will ask Mike Mayfield if he would like to provide any more detail.

MR. MAYFIELD: Getting up and down, Chairman, is exciting.

This has been a long-standing issue. If you only look at a single NuScale module, they are not going to trip the thresholds at roughly 50 megawatts. However, if you look at as few as two modules, using two modules at the same time, now you trip the insurance thresholds.

So, it is a question of looking at this is one of several multi-module reactor issues that we have been looking at. The timing with this, we have been struggling with this since 2010. What to do? What do you really consider multi-module failures? And this is one that, as Jennifer pointed out, now that we have a better PRA from the applicant, meaning NuScale, we are going to get some better insights in how to look at the multi-module failure issue.

CHAIRMAN BURNS: Okay. So, yes, I think a takeaway from what you said Mike is that given what we are looking at is probably a one-unit module application or am I wrong about that?

MR. MAYFIELD: No, the design cert is for 12 modules. And then the question is what will --

CHAIRMAN BURNS: But UAMPS.

MR. MAYFIELD: It depends on what UAMPS --

CHAIRMAN BURNS: What UAMPS will do, right. Because the design cert doesn't trip Price-Anderson.

MR. MAYFIELD: Exactly.

CHAIRMAN BURNS: It is only the COL.

MR. MAYFIELD: But it is unlikely UAMPS will come in for a single module.

CHAIRMAN BURNS: Okay.

MR. MAYFIELD: It is a very expensive facility for only 50 megawatts.

CHAIRMAN BURNS: So we might have to face that and we might or might not be ready with the rulemaking.

MS. UHLE: Well, I would say that looking at the UAMPS schedule with NuScale being completed in say the 2020 time frame, including the rulemaking, and then the UAMPS coming in the 2018, they would be, again, looking about the 2020 time frame to have a COL, if all goes smoothly. So, that gives us, from this point, three plus years for rulemaking.

If we determine that we need rulemaking, I would say that it is very unlikely that an applicant for a COL would be using just one module. So, then you trip over that 100 megawatt threshold.

In fact, when you look at the NuScale package, you can buy one module, six, or twelve, based on how the systems are shared. And I believe UAMPS, I am very certain, actually, that UAMPS is looking

to do all 12.

CHAIRMAN BURNS: All right, thanks. I'm over. Commissioner Svinicki.

COMMISSIONER SVINICKI: Thank you all for your presentations and for all the work that you and your teams have been doing on these issues since the Commission last met on similar topics.

Jennifer, I am going to begin with you and the response you gave to the chairman on the hard scrub of a potential schedule for the NuScale design certification.

Now, at the risk of being criticized for picking on schedules kind of incessantly, I do think that I would take just practicality and transparency over optimism on schedules because when we hear that the financial community and others feel that the regulatory process is not stable or predictable, I think that although they would like a quick review, they would take a predictable time frame. If it was really going to be done in six years, I think if they could know that it was going to take six years, they would begin with -- because then they could build their planning around that time frame.

You and your predecessor have taken a lot of looks at Part 52. You have looked at recent experience. You have done a lot of lessons learned reviews and I think that you have some very solid suggestions and changes. You mentioned doing more of the safety-focused review, taking a very hard scrub of the request for additional information, bringing perhaps returning to a discipline and

rigor on those things. Looking at the acceptance review of the applications themselves and applying -- well, it is a possibility to supplement, of course, an application, what level of rigor do we need to bring to that?

But I also look at how have we performed recently. The most recent design certification for the ESBWR took over a decade. And I acknowledge that there were unique circumstances there. There were technical issues to be resolved. But I think that it is reasonable to predict that with the novelty that NuScale might bring to some aspects, there will be issues to resolve with NuScale as well.

So, I really don't want to be the skunk at the garden party but I keep hearing 40, 39 months. The last one we did took over a decade and it was a large light water reactor. I know I have said this and it is very demoralizing to everybody but I think that the community that wants some predictability in the licensing process would rather just have us not be overly optimistic in some of these schedules. And while I don't accuse you all of doing that as I dug into the background information for this meeting, I was reminded of what a thoughtful look NRO and others have taken at how we could perhaps be more safety-focused and more efficient in these reviews. But I think that it will be a validation of a lack of a lack of predictability in the licensing process if we don't temper some of our optimism if, indeed, we are guilty of optimism.

The other thing I noted is something talked about but

not yet adopted by NRC that I, at this moment, do not react terribly favorably to, was giving a schedule of 40 months for an SMR review but having new mechanisms within which we would stop the clock or pause it during periods where we waited in receipt of information, I acknowledge the creativity of that but I am not sure that that is what people are looking for when they want us to just say what do you forecast the schedule of this review taking.

So, I think that we are feeling pressure to show that we can do these efficiently but -- well, I guess I will ask you to react and knowing that you take very very seriously, because we have had a lot of one-on-one discussions about this, you take very seriously any kind of schedule that you are going to put out there. How do you react to this vague unease I have about us being a little too optimistic?

MS. UHLE: Well, I would say that looking at the past, obviously, that would make you -- would put you in a position to potentially be skeptical here.

I would try to focus maybe on the information we have today and that is taking a look at the KHMP review. KHMP review --

COMMISSIONER SVINICKI: And that would be for the APR-1400.

MS. UHLE: That is the APR-1400. That design, we completed Phase 1 on time. We are looking at completing Phase 2 here going into the fall on time.

We have had a couple of issues that we have

highlighted to the vendor that they needed to spend more time on and get additional resources. And they have done that. However, we have continued to engage with them to specifically outline where they are not responding to our request for additional information in a timely way that will impact the schedule.

So, I would say that --

COMMISSIONER SVINICKI: And I would say on that I think that communicating more clearly cause and effect up front, that is a very helpful thing to say that you know if this is doing to take an additional eight months, then I think it is fairly logical and I would hope there would be good acceptance by applicants that that would push out the ultimate -- we can't be reviewing information we don't have.

MS. UHLE: Right, and that was the purpose of our discussion in the case study paper that I think you are referring to. So, I think what we are trying to do now is be much more proactive in our communication at highlighting to senior management in the vendor organization that they need to ramp up their game or focus attention and instead of perhaps in the past not being quite so proactive.

I would say in the case of NuScale why we think we can complete the review as we have budgeted and projected in large part is because we have had very, very good pre-application discussions. In addition, we have identified the policy issues that we feel have been resolved that are pertinent to them and then the review if very simple, with large margins.

COMMISSIONER SVINICKI: And again, I want to acknowledge that your responses to Chairman Burns were about NuScale. There has been a tremendous amount of pre-application engagement there, which I know informs your estimates.

And again, at the end of day, if issues need to be resolved, they need to be resolved. What I am arguing for is just greater communication and transparency. And I think you have indicated that is something you are already adopting for design certification reviews in-house now. And I think that will be helpful. I think the frustration grows around the long-term TBDs on the public schedules and people just don't know what to make of that. And I think a larger community beyond just NRC and the applicant is watching the progress of these activities.

And so I think that is helpful what you have done and I know you will continue to keep your eye on it.

I wanted to ask you, your slide 7 talked about code cases. It is interesting. I know it is a little bit of a detailed topic. I don't think it gets a lot of attention. I know that a number of national laboratories, Oak Ridge, Idaho, Argonne are working on the development of code cases which, as you explained, will ultimately bubble up and form the basis for code rules that we will review.

Beyond maybe medical devices and aircraft, I think that nuclear has got to be right up there with the most involved process for the qualification of like new materials and new alloys prior to their

introduction into regulated facilities. What is your general sense of where we are on that whole code development that would undergird the kind of materials innovation that I think vendors want to adopt?

MS. UHLE: Well, there is actually a particular material name. I am certainly not a materials engineer. So, I am going to give Mike Mayfield some advance warning.

But there has been a look at advanced reactor materials. Hastelloy, in particular, is a high temperature material.

So, Division 5 of ASME Code Section 3, which is design that has already been in place for several years and there is already work that has been done to fine tune that. We have not reviewed that because none of the light water reactors operated at those temperatures.

So, in the case of something like ASME, I think we are in good shape. We do have to review it and determine if there is anything that needs further attention.

In the other areas, for example, of the use of non-restrictive examination techniques for various components, in the case of NuScale, they have taken a look at eddy current probes and whether or not it can be used for their helical steam generator.

So, people are thinking ahead about the importance of having the codes ready to go.

COMMISSIONER SVINICKI: It sounds like it is kind of pacing along with the actual design and technology development.

MS. UHLE: Yes, with the maturity of the design.

COMMISSIONER SVINICKI: So, I won't make Mr. Mayfield get up again, since he has asked for some mercy on that.

MS. UHLE: And we do have, through our standards executive in the Office of Research, we do have a couple of meetings per year with the standards development organizations to project what it is we would like them to focus on because it is efficient. If it is done in the code, then we can endorse if we find it acceptable. And that provides, obviously, efficiency for us.

MR. WEBER: In fact, if I could add, Commissioner, we and the staff in NRO are collaborating on developing a plan for how we would prioritize what codes we would need to review and in what sequence, so we could support the continued development of those codes for advanced reactors.

COMMISSIONER SVINICKI: That's great. I think that will be very informative to have a prioritization there.

And I just wanted to close with a comment from Mr. Dean on subsequent license renewal. As you referenced, in 2014, the Commission did not approve the staff's recommendation to proceed to rulemaking to fundamentally, perhaps, alter the scope, albeit in modest ways of license renewal for subsequent license renewal. The Commission, instead, approved basically validated the current regulations are adequate for beyond 60 years. However, the Commission did direct the staff to look at guidance and other

documents.

I will say, though, that there could perhaps be a temptation or a tendency in the development of guidance to embed within there an expectation that might go beyond what the regulations require. Now, I acknowledge that guidance is not regulations but we all know how this works and that if there is guidance of something that the staff would approve for compliance, there is a strong incentive to move towards that, if you are going to submit for subsequent license renewal. And there is a disincentive, although you acknowledge that applicants could provide other mechanisms of compliance. We all know that the benefit of guidance is that if you do it that way, the NRC is saying that it will be approved.

So, have you received any public comment on the draft guidance updates that would indicate that there is a concern that an expectation of something beyond the current regulations for license renewal is being embedded in that guidance?

MR. DEAN: So, and I will have Jane Marshall come up and give you a little bit more detailed rundown.

We did get some substantial comments on the draft GALL and the standard review plan that I think some entities have taken some exception to. I don't know if it crosses that line about embedding some of that that would have been in regulations but maybe Jane can offer a few more insights in that regard.

MS. MARSHALL: Okay. We have been having a

series of public meetings on the draft GALL and SRP for SLR. And we are working through any difference of opinion between the NRC staff and the interested public, must notably, the industry. And we are down to a handful of issues. Many of the apparent differences were case of not explaining clearly enough what the staff's expectations were.

COMMISSIONER SVINICKI: And is it still the schedule to finalize that mid-2017, that guidance?

MS. MARSHALL: Yes.

COMMISSIONER SVINICKI: Okay, thank you very much. Thank you, Mr. Chairman.

CHAIRMAN BURNS: Jane, will you just identify yourself for the record, so we have it for the transcript and your position?

MS. MARSHALL: Jane Marshall, Acting Director for the Division of License Renewal.

CHAIRMAN BURNS: Okay, thanks.

Commissioner Ostendorff.

COMMISSIONER OSTENDORFF: Thank you, Chairman. Thank you all for your presentations.

Vic, I agree with you that the Agency is making notable progress here. So, that is the big picture, a comment that you made that I agree with.

Jennifer, let me ask you -- I'm going to make one comment and then I am going to ask you a question.

I have had a chance, through various speaking

engagements this calendar year, to talk a lot about small modular reactors and advanced non-light water reactor efforts and so forth. And I acknowledge the exchange with Commissioner Svinicki on scheduling, which some pragmatic, realistic observations based on past experience, which are important.

I have received positive feedback on NRC staff, pre-licensing, pre-application submittals by NuScale senior leadership in three different meetings I have had with them this year. And I know that working very hard, there is only so much you can do, however, until the application is submitted.

Is there anything on the NuScale side of the house that concerns you that you may not be ready for?

MS. UHLE: Well, with any design, the devil is in the details. And so at this point in time we feel, through the pre-application activities that we have the major issues identified. However, in any review, it comes down to the intricate details. In particular, this design, and it is publicly noted that they would like an exemption from a number of regulations, including offsite power. So, GDC-17. There is other areas where they are seeking exemptions. So, although we are aware of them and we have plotted out what we think our answer would be with the information that we know now, until we present that to the Commission to make our final decision, there is obviously a number of discussions that have to occur.

So, I would just say that I think we are aware of the

issues that are different than other plants. But until we have actually completed the review, we don't know what our decision will ultimately be.

COMMISSIONER OSTENDORFF: Okay, that's fair.

On the advanced non-light water reactor stage, I just commend NRO team for their work in getting the vision and strategy out there. I think it is very important and I have been very pleased with what I have observed there for your efforts and that of your team mates there in the organization.

Let me ask -- one final point. Going back to NuScale, but anything else that comes up. I think NRO has done a really good job of coming to the Commission with new issues or policy questions that come up. I encourage you to continue that practice. I think it is important.

Bill, let me ask you, then I am going to ask Mike a question on subsequent license renewal. I will start out with Bill in this area.

I appreciated your slides. You identified various technical issues that you are looking at. Is there one particular technical issue that you think requires more research than others, in order to get to a satisfactory regulatory standpoint foundation?

MR. DEAN: So, I will give you my opinion. Mike might have a different opinion.

So, I think, for example, you look at neutron fluence of

vessels. I think that is a pretty well-known phenomenon. I think that we have a pretty substantial amount of understanding of what is going to transpire there.

I think concrete is a little bit less unknown. For example, we have worked with Department of Energy to extract some samples from the Zorita facility in Spain so that we can do some accelerated testing on that. I know from my experiences in Region I with the alkali-silica reaction issue at Seabrook and the challenges that existed at the University of Texas in trying to test concrete samples, that one gives me a little bit of pause.

You know things that are involved in reactor vessel internals, clearly we understand things like stress corrosion cracking and other phenomena. But again, going through this baffle bolt issue that Mike alluded to at Indian Point and Salem, you know we saw a greater number of indications than we were anticipating. So, I think there is still some emerging unknown things there as these plants age. But we are all learning lessons and that is why it is important to put in place appropriate aging management programs that continue to test and evaluate these areas where perhaps we havesome unknowns about what the future might hold.

I don't know, Mike, if you have any --

MR. WEBER: Yes, thanks. I would agree with Bill. The only two items I would add is we have a research project underway now at NIST, the National Institutes of Science and Technology, where

they are also developing the alkali-silica reaction. So, they are actually casting concrete modules and they are testing them. So, that is going to address, in part, some of that phenomena.

Bill did not specifically address cable aging but that is one where he recently, through a user need request requested that we extend the period. That is a little disconcerting as you go longer term. And it is not just what is happening to the cable but it is the predictability of what will happen to the cables and when.

Will you know that a cable is going to fail at a certain time, so that the utility could take action on it or we, as the regulators, could take action to address? I think that is something we are trying to get our arms around at this point.

COMMISSIONER OSTENDORFF: With respect to the cable issue, is EPRI working in this area?

MR. WEBER: Yes.

COMMISSIONER OSTENDORFF: Do you think their research efforts are allowing you to help answer this question?

MR. WEBER: Yes, we work in strong partnership with EPRI. But we are both searching for those answers.

MR. DEAN: The one thing I was going to add to Mike's comment about cabling is that, as Mike indicated in his presentation, a lot of knowledge about irradiation effects on cabling, a lot of knowledge about temperature effects, he noted the low temperature, low irradiation but we are also interested in the combined

effects, which is another part of that user need. What about them together? Is there some sort of synergies or whatever that might exist in a combined high temperature high radiation environment?

COMMISSIONER OSTENDORFF: So, let me ask one other question to both of you on the same topic again. In your review of aging management programs from licensees' responsibilities, have you identified any really good practices in aging of buried cables?

MR. DEAN: Well, I may have to punt that to Jane. Anything, Jane that you are aware of in terms of good practices we have identified in management of aging of cables?

MS. MARSHALL: This is Jane Marshall, Acting Director for the Division of License Renewal.

Licensees have been doing surveillance. So, they get out and they check the cables. For aging management, cables tend to fail abruptly and so trying to predict that is still something we are interested in looking at.

COMMISSIONER OSTENDORFF: I ask the questions because this is not rocket science. This is not quantum mechanics. It is a pretty basic deterioration mechanism. And so I think that I encourage you all, as I know you are to pulse industry to see what they have learned because I have got to learn that there are some good lessons out there.

Thank you. Thank you all.

CHAIRMAN BURNS: Thank you, Commissioner.

Commissioner

COMMISSIONER BARAN: Thanks. I wanted to follow-up on Commissioner Ostendorff's questions on subsequent license renewal. And thanks for the update. I was going to ask about that, your kind of evaluation, you assessment of where things stood on these outstanding technical issues related to subsequent license renewal.

For some of the items that you have mentioned where the answers are a little bit more uncertain on concrete degradation, on cables, I know Bill mentioned earlier, we are not likely to have the answers to these questions or the research complete in the 2018-2019 time frame when Peach Bottom and Surry applications come in. You referenced a more kind of plant-specific demonstration that could be made versus a generic answer.

If the underlying kind of research isn't done, if the technical issues are outstanding, what is that review going to look like? How would it proceed?

MR. DEAN: So, when I refer to plant-specific aging management programs, so for example, let's take the cable aging issue we were just talking about. The issue is not so much the cable and the aging mechanism but it is the predictability about when might it sort of degrade, in which case you might have a number of cables to grade at the same time. And so, in that case, until we have the research complete, that gives a better sense of when we can predict cables might

fail. Then, we would require licensees to have an aging management program that would do probably more frequent testing and assessment of cables during outages, for example.

Concrete, we may have to require them to take periodic samples of the concrete and test those to evaluate the properties of the concrete.

This baffle bolt issue we just talked about is a good example in looking at the current license renewal program of 40 to 60 years that we worked with industry to develop a testing methodology to do ultrasonic testing of these baffle bolts and refining a greater number of indications than we thought we might. This will help advance the development of that program and we will revise that aging management program through industry working groups and so on.

MR. WEBER: That's a regulatory success. That program developed years ago is now bearing fruit, in terms of confirming that, indeed, there is failure mechanisms occurring affecting these structures.

COMMISSIONER BARAN: Well, let me ask about baffle bolts for a second. So, I know this is a known phenomenon but the number of degraded baffle bolts we're seen at Indian Point and Salem is significantly higher than what would have been expected, I think. What are we doing to understand -- well, first of all, I am curious whether you agree with that. I mean do you see it as substantially higher than what was expected? And if so, what are we doing to

understand why?

MR. DEAN: So, I think the number of indications that we have seen is higher than we expected but there still remains work to be done to evaluate what was the structural capacity of those bolts that had indications and we won't know that until probably the end of the summer, when Westinghouse and other testing labs have a chance to be able to destructive testing.

That being said, I think that our engagement with, in particular EPRI and Materials Reliability Program Working Group will result in a refined approach that licensees will need to take relative to looking at the inspection of and maintenance of the baffle-former bolts.

As you are aware, Commissioner, it is a combination of what type of material are they using. What type of designs, is it an up-flow or a down-flow plant, and all of that? And so I would expect to see some recommendations that would come out that say for example, if you don't convert to an up-flow design, then you are going to have to probably inspect on a more frequent basis, for example. It was probably an outcome of that.

And that conversion is not an inexpensive conversion. So, a licensee would have to determine do I want to, for example, replace all of my bolts now at my next outage or do a large sampling and replace the ones that have indications and what do I want to convert.

So, I think we have to make those sort of business

decisions but that is not going to obviate them from having to have likely a revised inspection and monitoring program as a result of the lessons that we learned from this. But there is still some more information that we have to gather before we can sort of finalize what that program would look like.

COMMISSIONER BARAN: So but for the stakeholders who are out there who are focused on this issue who are concerned about this issue, what I am hearing you say is that we are actively looking at is the current frequency of testing adequate. Is the current type of testing adequate? That is something, as an agency we are evaluating right now.

MR. DEAN: That is correct.

COMMISSIONER BARAN: Okay. And it sounds like you would anticipate that the frequency and potentially even the nature of the testing, that may very well change.

MR. DEAN: So for example, right now, the testing is to look at the baffle-former bolts in a period of time between 25 and 35 effective full power years of operation.

Indian Point 2 was about 31 plus some effective full power years. So, maybe that 25 to 35, maybe that needs to be compressed. Maybe you need to look at it in the 25 to 30 effective full power years, for example. You don't want to look at it too early because you won't see the phenomena. So, you don't want to inspect too early. So, I don't know that I would see it slip forward earlier but it

has got to be in that sweet spot in terms of when this irradiation-assisted stress corrosion cracking phenomena occurs and shows the indications that we are seeing.

COMMISSIONER BARAN: And do we know enough about this phenomenon? Even given the kind of recent data for these two plants, are we confident that we know enough about this to know that this is a fast-acting type of phenomenon?

In other words, you put in new baffle bolts today at Indian Point. This isn't something that is going to appear in two years or three years or five years.

MR. DEAN: No, it has taken 25 or 30 plus years effective full power years, which means over 40 years of operation for this phenomena to be emerging. And of course they would use -- they are using baffle bolts of a different stainless steel that is less susceptible to that. But if they were to put in the 347 stainless steel that currently existed, there would be another 30 effective full power years before you would see that phenomenon again on those new bolts.

COMMISSIONER BARAN: And for the bolts -- sorry, to go into a little more detail but I think people are interested in this. And for the bolts that didn't have an indication, how confident are we that two or three or five years from now they still won't have an indication that they have degraded?

MR. DEAN: So that is one of the reasons why they will be doing an inspection at their next outage to evaluate those bolts

that didn't show indications this time. And that will help, again, advance the knowledge of this phenomenon.

So, these plants that have this susceptible material and this susceptible design, over the course of the next several years, as Cook and Diablo Canyon do their inspections, we will have a much larger set of data that can provide a greater degree of predictability.

COMMISSIONER BARAN: Okay. And based on the fact, as you mentioned, in terms of the material of the baffle bolts, that it be a PWR four-loop configuration in terms of the flow, the universe of plants that we are looking at for this issue, this problem, is Indian Point, Salem, one of the Diablo units and D.C. Cook.

MR. DEAN: That is the near-term group. That is the four-loop PWRs that have a down-flow and the susceptible material. But we have to look at all the other ones that have bolted configurations as well. Obviously, they have not seen the same degree of degradation but they have seen some indications. And so this MRP program applies to the entire universe of pressurized water reactors, not just the four-loop Westinghouse. Those are just the ones that have the greatest susceptibility of this phenomenon at this point in time of their life.

COMMISSIONER BARAN: Thanks. And with just this minute and a half I have left, I wanted to kind of ask a bigger picture question to Vic and Jennifer, however you want to divvy it up, and that is on the advanced reactor piece.

And I know you all are looking at implementation action plans and trying to think through what needs to happen over the next several years to get to 2025 and being ready and the appropriate sequencing.

Can you talk a little bit about that? What are the key actions from kind of a regulatory licensing preparation point of view that have to happen between now and 2025? And what elements can be done generically early and what elements are going to have to wait until we know more about a specific application that comes in the door?

MS. UHLE: Well, there are a number of things that we have been working on that are generic. And an example of that are the policy issues. So, a lot of the policy issues that were identified for the small modular plants, if you are having an advanced reactor that is also smaller, which many of them are, and a lower source term, those generic issues apply to the non-LWRs as well.

So, part of it is also looking to see the maturity of the industry. So, at this point in time, I would agree or if the NRC staff would agree with the previous panel's determination that those designs that are further ahead are more likely to come in sooner would be the high temperature gas or the sodium fast designs.

And so, as we have developed the generic -- as we have resolved some of these generic issues, we then have to then focus on some that are then design-specific. The HTGR example would be confinement versus containment, for example.

So, our advanced reactor generic design criteria that we recently issued for public comment were on high temperature gas, as well as sodium fast. And in those areas that are specific would be treated differently in those designs. We have adjusted our design criteria to reflect that.

And then, going forward, of course as we try to risk-inform our reviews, we are going to need a little bit more design information that will be specific to the particular application that may in fact come in.

COMMISSIONER BARAN: Thanks.

CHAIRMAN BURNS: Well, thank you all for the presentations. This has been an interesting meeting this morning that has focused both with the recent staff presentations in the second panel but also our presentations from our colleagues at the Department of Energy on a variety of topics involving the licensing, oversight and regulation of nuclear facilities, both existing and operating and those potentially planned for the future. And so we appreciate all the input that we have gotten today.

Before we close, although it is not his last commission meeting, I think that is next week, I do want to -- it struck me that we have heard from sort of three prongs of contributions to the development and application of nuclear energy in the U.S. today, in the United States Navy, the Department of Energy, and the NRC. And I want to acknowledge Commissioner Ostendorff's service in all three of

those organizations and for his service here on the Commission. I think we appreciate it.

I think is a meeting you particularly wanted to be able to participate in so we are glad that you have and I think it has been a rich discussion today. And we wish him well and appreciate his service here on the Commission and on these issues.

And with that, we will be adjourned.

(Whereupon, the above-entitled matter went off the record at 12:12 p.m.)