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NUCLEAR REGULATORY COMMISSION

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PUBLIC MEETING ON DEVELOPMENT OF GUIDANCE DOCUMENTS TO SUPPORT LICENSE RENEWAL FOR 100 YEARS OF PLANT OPERATION

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THURSDAY

JANUARY 21, 2021

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The Commission met via Video Teleconference, at 9:00 a.m. EST, Daniel Mussatti, Facilitator, presiding.

NRC STAFF PRESENT

DANIEL MUSSATTI

ANNA BRADFORD, NRR

SCOTT BURNELL, OPA

ALLEN HISER, Ph.D., NRR

CAROL MOYER, NRR

DARRELL MURDOCK

ANDREW PRINARIS

HECTOR RODRIGUEZ-LUCCIONI, Ph.D.

MADHUMITA SIRCAR

ANGELA WU, NRR

ALSO PRESENT

JAN BOUDART, Nuclear Energy Information Service (NEIS)

MICHAEL BURKE, Electric Power Research Institute (EPRI)

STEVEN DOLLEY, S&P Global Platts

CHRIS EARLS, Nuclear Energy Institute (NEI)

CARLOS FERNANDEZ

CINDY FOLKERS, Beyond Nuclear

LEO FIFIELD, Ph.D., Pacific Northwest National Laboratory (PNNL)

FRANK GARNER, Texas A&M University

ERICA GRAY, Sierra Club

PAMELA GREENLAW

PAUL GUNTER, Beyond Nuclear

NATALIE HILDT TREAT, C-10 Research and Education Foundation

ACE HOFFMAN

SANDRA KURTZ, Blue Ridge Environmental Defense League, Bellefonte Efficiency & Sustainability Team

SAM JOHNSON, Electric Power Research Institute (EPRI)

MICHEL LEE, ESQ., Council on Intelligent Energy & Conservation Policy

YANN LE PAPE, Ph.D., Oak Ridge National Laboratory (ORNL)

ANDREW PARISH

ANDREW MANTEY, Electric Power Research Institute (EPRI)

THOMAS M. ROSSEEL, Ph.D., Oak Ridge National Laboratory (ORNL)

ROBERT REESE, Lower Richland Community Action Committee

VICTOR SAOUMA, Ph.D., University of Colorado, Boulder

DON SAFER, Tennessee Environmental Council

MIKHAIL SOKOLOV, Ph.D., Oak Ridge National Laboratory (ORNL)

KALENE WALKER

BARBARA WARREN, Citizens' Environmental Coalition

EMMA WONG, Electric Power Research Institute (EPRI)

AGENDA

P-R-O-C-E-E-D-I-N-G-S

9:00 a.m.

MR. MUSSATTI: I am Dan Mussatti, your facilitator for the day. I would like to introduce you to Anna H. Bradford, the director of NRR's Office of New and Renewed Licenses.

Ms. Bradford joined the U.S. Nuclear Regulatory Commission in 2000 in the Office of Nuclear Material Safety and Safeguards. Since that time, she's held positions in multiple offices in the Agency, leading efforts in a wide range of areas, such as low level waste management and disposal, environmental reviews, fuel cycle facility licensing, small modular reactor licensing, and non-light water reactor policy issues.

Prior to joining the NRC, Ms. Bradford worked as an engineer consulting firm supporting nuclear-related projects for the Department of Energy.

Ms. Bradford has a bachelor's degree in mechanical engineering from Virginia Tech, a master's degree in environmental engineering from Johns Hopkins University, and is a graduate of the NRC's Senior Executive Service Candidate Development Program. Anna.

MS. BRADFORD: Thank you, Dan. Can you

please confirm you can hear me?

MR. MUSSATTI: Yes, I can hear you perfectly well.

MS. BRADFORD: All right. Great. Good morning, everybody. As Dan mentioned, my name is Anna Bradford. And my division's purview includes the renewal of operating licenses for nuclear power plants.

I'm very happy to be here today for this discussion. And it's my pleasure to welcome you to this meeting.

We're here today to get your thoughts, perspectives, and comments on whether the NRC should begin to consider the potential technical issues and guidance document development related to license renewal that would authorize nuclear power plant operation for up to 100 years and when that work should begin.

We're looking forward to hearing from stakeholders and the public so that we can inform our decision whether to pursue work on this topic.

I wanted to emphasize again that we do not have any plans to revise license renewal durations at this time to allow operation for 100 years nor do we have any requests from any licensees to approve them

to operate for 100 years.

This meeting is help us decide if and when we should begin activities to identify the technical issues associated with plant operation to 100 years.

As Allen Hiser will describe in a few minutes, 86 out of the 94 operating units have received renewed licenses to operate for 60 years and 4 units have licenses to operate to 80 years. The oldest operating unit began operation in 1969 and has been operating for 51 years.

So, if the oldest units are only a little over 50 years old, why did we schedule this meeting to consider technical issues for 100 years? Well, we're exploring the idea of whether to revise license renewal durations from 20 years to 40 years and are having a separate public meeting on that topic on February 18th.

And if we were to increase license renewal durations from 20 years to 40 years, then it's conceivable that a licensee could ask for a license renewal time period that would cover 60 to 100 years. And we're starting to think about what additional information we would need for that.

Therefore, we believe it's prudent to seek your thoughts and perspectives on if and when we

should begin to gain insights on the technical issues for plant operation to 100 years.

As you'll hear later, both the NRC and the industry have ongoing confirmatory research in each of the technical areas that are identified in the meeting agenda.

Should we determine that consideration of technical issues for 100 years is appropriate, then we could be well positioned to extend some of those ongoing research programs to ensure that they cover the conditions that would be evident with 100 years of operation.

From budget and time perspectives, it would be easier and more efficient to extend those existing programs rather than to later begin new programs. More importantly, it would provide data in a timely manner to inform regulator and plant operator decision-making.

So, with that, I look forward to the discussion today. And I'll now turn the meeting back over to Dan Mussatti, our facilitator. Thanks, Dan.

MR. MUSSATTI: Thank you, Anna. Well, let's get started. As your facilitator, I want to welcome you to this Office of Nuclear Reactor Regulations Category 3 public meeting to discuss what

technical issues and guidance documents would be needed to be developed to authorize nuclear power plant operation from 80 to 100 years.

Category 3 meetings are designed to accommodate technical exchanges and comments from the public that are related to the topic at hand.

We will start with some opening remarks and a brief history of license renewal, then transition to a series of focused presentations on four topics that are outlined in the agenda.

After the presentations on each topic, we have an opportunity for comments from the public, and with any remaining time, a short roundtable discussion among the presenters at the end of the meeting.

The purpose of this meeting is to hear your thoughts, perspectives, and recommendations regarding when the NRC should consider the technical issues related to extending plant operating licenses to 100 years.

In order to accurately capture your comments, we have a court reporter transcribing this meeting.

My role is to help ensure that this meeting is informative, productive, on topic, and on time. Of these four tasks, the most important is to

keep the meeting on topic. We have a lot to do and only a short time to do it.

If you planned on speaking to some other topic and not the potential technical issues related to reactor operations from 80 to 100 more years, please take time to send those comments to Scott Burnell at the NRC. His email is scott.burnell@nrc.gov.

Most of us have participated in many public meetings, but with the current COVID constraints, our processes have changed a bit. For that reason and to remind everyone about our process, I'd like to go over some housekeeping items before we get started.

First of all, so we can have a complete record of all you participating today, please take a moment to send an email confirming your attendance to either Allen or Hector. Their email addresses are on the official announcement for this meeting. Please include your name and your affiliation in that email.

This meeting is being provided to external participants via Microsoft Teams. Because everyone is using media platforms like Teams and Zoom these days, we would prefer it if you would use our bridge line to listen to the meeting and provide your oral comment.

That reduces our need for bandwidth and helps prevent delays.

Teams has a great chat function. So, if you want to, you can just type in your question. And Hector can pass it on to the speakers.

If you are listening through Teams audio feed right now, please take a moment and call 1-800-857-9650 and enter the passcode 4903279 when prompted.

Just in case you were scrambling for a pencil and paper when I called out that phone number and passcode, I'll do it again for you here in a second, as soon as my computer wakes up. There we go. I would like you to call 1-800-857-9650 and enter the passcode 4903279 when you are prompted.

You'll be participating through our phone operator, Jennifer, who will manage the order of people making comments. Jennifer, would you please take a moment and explain to everyone on the line how they get in line to speak for the record?

OPERATOR: Yes. If you'd like to make a comment from the phone, please press star followed by the number 1. Please make sure to record, unmute your phone and record your name at the prompt. Again, that is star 1 for any comment from the phone.

MR. MUSSATTI: Thank you, Jennifer. I

appreciate all of your help.

We want a clear transcript of this meeting. So, to do that, we have a court reporter with us today.

When it is your turn to speak, be sure to speak slowly, clearly, and directly into your telephone or microphone, starting with your name and affiliation. Even if you have spoken before and if your name is one that might be hard to spell, please spell out your name for our court reporter.

As much as possible, please minimize any background noises, such as pets and children, while you're speaking on the record.

We want to ensure each person who wants to speak gets the chance. So please make your comments as brief as possible, no more than maybe two or three minutes.

I will take comments from the phone and the Teams chat room. So, if you want to speak, just get in line on the phone or on the chat.

Toward the end of each session when it becomes obvious we're not going to get any new commenters, people who have already made a comment will be able to have a follow-up comment. This includes any comments from an earlier session where we

may have run out of time and we still had people that wanted to get on the record.

As a heads-up, some of us may drop off the call after the opening remarks and rejoin for a specific topic later on. When we come to the end of a session and there are no more commenters, we may move directly to that next session.

So, if you're interested in a specific topic and expect it to start at the scheduled time, it may not. Check the Teams chat line to get a sense of where we are in the agenda so you don't miss your opportunity to speak.

If you have a question on how to do this, chat with Hector. He's managing our Teams chat line.

Do you have any questions? Jennifer, do we have any questions from the phone?

OPERATOR: No questions at this time.

MR. MUSSATTI: Anybody raise their hands, Hector?

DR. RODRIGUEZ: No. But someone asked the question to please repeat the password for the phone number.

MR. MUSSATTI: Oh, you bet. Let me run back up there. The passcode is 4903279. Okay. Well, let's get started.

PARTICIPANT: I'm sorry. Can you repeat the number that we're supposed to call when we want to comment?

MR. MUSSATTI: You're already on the phone with that, aren't you?

PARTICIPANT: Okay. So this is the same one, then?

MR. MUSSATTI: Yeah. What you do is you press star and 1, and that alerts the operator that you would like to get online.

PARTICIPANT: Okay. Thank you.

MR. MUSSATTI: Yep, you bet. I know it's a little complicated if you haven't done it before, but this is actually pretty easy-peasy.

Okay. We're going to start --

DR. RODRIGUEZ: Allen, I have to clarify something. The person who called in, that person used a phone number that was in the old agenda, which is the phone number for Microsoft Teams.

We need people who call into the Microsoft Teams number to call into the 1-800 number so they can be connected to the operator. I can see still a lot of numbers on the Microsoft Teams. All those people should be calling into the bridge line instead --

MR. MUSSATTI: Okay.

DR. RODRIGUEZ: -- so they can be managed by the operator.

MR. MUSSATTI: Thank you, Hector. Once again, for everybody, if you had the wrong phone number before and didn't realize it, and I wasn't clear enough in explaining that, the number is 1-800-857-9650. And the passcode is 4903279.

I'm going to move on to our first speaker because we're really tight on time today with a lot of people that want to talk.

We're going to start with the history of license renewal from Allen Hiser of the NRC staff.

DR. HISER: Okay. Thank you, Dan. Let's see. Okay. Let's go ahead and get started. First of all, good morning. And I want to welcome you to the meeting we have today.

What I want to do is start off with a little bit of background on license renewals so that we're all on the same page.

So I'll talk about the legislation and the regulations that we have that govern license renewal and talk about the background on how we have gotten to the point that we are with subsequent license renewal. Next slide, please.

So, in terms of an outline, I'll talk

about the basis for license renewal and the process, talk about the development of the SLR guidance documents for subsequent license renewal, talk about the status of license renewal, which is indicated here as LR, and SLR represents subsequent license renewal from 60 to 80 years. And then I'll talk about the purpose of today's meeting. Next slide, please.

Now, the legislation that enables the NRC to license nuclear power plants is in the Atomic Energy Act of 1954 as amended. What I've done here is just extract some of the text from the AEA, Atomic Energy Act.

And basically, the AEA enables the NRC to license plants to operate for 40 years and allows for renewal of the license upon the expiration of each period.

Note that there is nothing in the AEA that prohibits or has any restrictions on the number of renewals. And that is the basis for subsequent license renewal that we have implemented. Next slide, please.

Now, the NRC has implemented those provisions for license renewal in Title 10 of the Code of Federal Regulations Part 54, which was implemented in, or promulgated in 1995.

Some of the rule provisions that are important here is that this rule permits license renewal for up to 20 years, for example, to go from 40 to 60 years or now with subsequent license renewal from 60 to 80 years.

Applicants can apply 20 years before their license expires. So that means that a plant that has a 40-year license can apply for license renewal once they have hit 20 years of operation.

Plants must apply at least five years before expiration in accordance with 2.109(b). This is referred to commonly as the timely renewal provision.

And in accordance with 54.31(d), a renewed license may be subsequently renewed. As with the Atomic Energy Act, there is no restrictions on the number of subsequent renewals.

Now, within the license renewal rule, the process focuses on demonstrating adequate management of the effects of aging for long-lived, passive structures and components that are important to safety.

The other aspects of the original license are not reconsidered other than those that are directly affected by aging management. One provision

within the process is that an aging management program that's based solely on detecting structure and component failures is not considered an effective aging management program. Next slide, please.

Now, the license renewal is underpinned by two safety principles that the Commission has issued.

The first is that the current regulatory process used at the NRC is adequate to assure plant safety. The license renewal review is necessary just to ensure that the effects of aging would be adequately managed in the period of extended operation.

In addition, the plant's current licensing basis, or CLB, is to be maintained during the renewal period. And the specific words that are used are in the same manner and same extent.

What this means is that the same plant operating rules apply for the renewal term, and the aging management is accomplished through a program of age-related degradation management of, as I said before, passive, long-lived plant systems, structures, and components that are identified as in scope for license renewal. Next slide, please.

Now, the previous slide talked about, the first principle was that the regulatory process is

adequate. Now, there are certain regulatory process aspects that I'll call here are essential elements. And these are critical for license renewal to be effective for U.S. plants.

Some of these elements are listed here, effective compliance with the regulations, and the next slide I'll talk about what some of those regulations are.

We have onsite resident inspectors. And we do many specialized inspections at plants. We have performance assessments of inspection findings. We review and analyze operating experience and how that has been utilized by the plants.

For safety issues, we have resolutions of those. And they may be generic or plant specific safety issue resolutions.

Specific to materials aging and degradation issues that are important to safety, these can be addressed by changes to the rules, for example, to Part 50 of Title 10 of the Code of Federal Regulations.

We can issue generic communications. We can issue orders. And also plants can take voluntary actions to address the aging and degradation issues. Next slide.

This slide lists some of the Part 50 regulations that are a part of the ongoing regulatory process. I won't go through these.

Some of the ones -- and these that are listed are very specific to aging management. For example, we have fracture toughness requirements in 10 CFR 50.61 and 61a, QA, quality assurance criteria in Appendix B, and fracture toughness requirements in Appendix G. Next slide, please.

Now, I show how the regulatory process works for the original license period for plants and also for license renewal.

This slide depicts on the left-hand in purple the existing regulatory process is specific for the first 40 years of plant operation. And this includes use of the maintenance rule, the quality assurance program that I mentioned previously.

And also we have 10 CFR 50.55a requirements. And for the initial 40 years, these, this regulatory process is adequate for both active components and also for passive components.

Now, when we bring in license renewal, the Commission concluded that the items that are on the left are still sufficient for active components, but in terms of the safety of passive components, that

additional actions were necessary to implement aging management, and is again cited in Part 54 to ensure that the effects of aging will be effectively managed throughout the period of extended operation.

So, for license renewal, things that are on the left side and things that are on the right side work together to ensure safe plant operation throughout the license renewal operating period. Next slide, please.

In terms of the scope of the license renewal review, the scope is safety-related systems, structures, and components that are necessary to maintain the integrity of the reactor coolant pressure boundary, to ensure capability to shut down and maintain safe shutdown, and also to prevent or mitigate offsite exposures comparable to the regulations that are cited there.

In addition, non-safety related SSCs whose failure could affect safety related SSC functions are included in the scope.

A third class is SSCs that are relied upon for compliance with the following regulations. And some of these look familiar, fire protection, environmental qualification, pressurized thermal shock, anticipated transients without scram, and

station blackout. Next slide, please.

Now, from the previous discussion with the focus of license renewal on aging management, all other issues are not in the scope of license renewal.

Examples are given here that have ongoing regulatory oversight. These would include emergency planning, security, and current safety performance. There is a long list of things that are not within the scope. License renewal scope is restricted to aging management of in-scope systems, structures, and components. Next slide.

Now, the main topics of the safety review that we do, and this also represents clearly information that's provided in applications by plants, first of all, we review the scoping and screening of SSCs. In particular, we want to make sure that the SSCs that have been identified as in-scope are, is a complete list.

In addition, we review the way that the plant has identified structures and components that are subject to aging management review. So this identifies, this review enables a list of the systems and structures and components that plants need to demonstrate adequate aging management for.

So, in terms of aging management, the

aging management review identifies relevant aging effects and aging management approaches that might be used. And then aging management programs are specified in the application that are, will be used to manage the effects of aging to provide reasonable assurance that aging effects will be adequately managed.

In addition, there are time-limited aging analyses. And the application has to demonstrate that the CLB analyses, these TLAAs, are acceptable or will be managed during the period of extended operation.

Now, to implement the safety review, the staff relies on license renewal guidance documents, which I'll talk about in a couple of slides, and also the plants use those documents.

Now, for the NRC to approve an application for license renewal, 10 CFR Part 54.29 provides the standards that must be applied.

First of all, the staff has to find that the application has identified actions that have been or will be taken such that there's reasonable assurance that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB.

And the specific actions relate to

managing the effects of aging on the functionality of structures and components and that TLAAs have been adequately resolved with, consistent with the regulation.

In addition, the environmental review requirements that are a part of the license renewal application and a part of Part 54 have to be satisfied and any consideration of Commission rules and regulations and adjudicatory proceedings have been resolved. This would be hearings that you may be familiar with. The next slide, please.

License renewal guidance documents, we generally have to have two types of documents. The first are referred to as generic aging lessons learned or GALL report. For license renewal, this is NUREG-1801, Revision 2. For subsequent license renewal up to 80 years, it's NUREG-2191.

Let's see. And the GALL report provides assessments for aging management review, including identification of materials, environments, and aging effects that require management.

A GALL report maybe more importantly also identifies acceptable aging management programs that the NRC staff has found to be acceptable for license renewal implementation.

In addition, we have a standard review plan. And the standard review plan for license renewal, NUREG-1800, Rev. 2 is for license renewal from 40 to 60 years. We also have a standard review plan for subsequent license renewal, NUREG-2192.

These plans provide guidance for staff review of the scoping and screening, aging management review, and TLAAs that I mentioned on a previous slide.

Now, the books that we print as NUREG-1801, Rev. 2 or NUREG-2191 for the GALL reports or the SRPs, the printed books we update through a process called the interim staff guidance process.

And this could be an LR, license renewal ISG, or a subsequent license renewal ISG. And these are based on operating experience or lessons learned from license renewal applications and subsequent license renewal application reviews.

So you always have to keep in mind that the GALL report is more than the original published reports that are listed above. These ISGs are very important as to amend the provisions that are in the reports.

In addition, we have a regulatory guide, 1.188, Rev. 2, which provides application format

guidance. And this endorses NEI guidance in NEI 95-10 or 95-10 for license renewal and NEI 17-01 for subsequent license renewal. Next slide, please.

Subsequent license renewal enables plants to receive licenses for plant operation from 60 to 80 years. The Commission determined that no rule changes were necessary as we transition from license renewal to subsequent license renewal. And this is conveyed in Commission staff requirements memorandum SRM-SECY-14-0016.

Several generic technical issues were identified in this SRM. And we'll talk about those on the next slide.

And one of the things that was, is emphasized in license renewal is that it is industry's responsibility to resolve technical issues generically or individual plants have to provide plant-specific solutions in the SLR applications. Next slide, please.

Now, the technical issues that were highlighted in the Commission SRM are listed here. They relate to reactor pressure vessel neutron embrittlement with reactor vessel internals, looking at high fluence effects.

And there are, you know, several specific

phenomena there. Irradiation-assisted stress corrosion cracking, loss of fracture toughness and void swelling, concrete and containment performance, long-term radiation, and high temperature exposure are the important factors that we're looking at, and also alkali-silica reaction, or ASR, electrical cables, environmental qualification, in-service testing of cables, condition monitoring, and also long-term submersion of low and medium voltage cables.

Jumping back up to reactor pressure vessel neutron embrittlement, the two specific topics relate to trends for high fluence levels of embrittlement and also the adequacy of surveillance programs for the 60 to 80-year operating period. Next slide, please.

Now, as we started to consider the aging effects that would be important for the SLR operating period, we looked at several things. First of all, we wanted to identify potential new aging phenomena that we had not seen before and maybe had not considered for the 40 to 60-year period.

Clearly as plants age, you may have known mechanisms that go, that maybe we're used to seeing in one place but they expand to other locations. The severity of the degradation can become worse. So those are some of the things that we considered. In

addition, we wanted to identify any new phenomena that could occur specific to the 60 to 80-year operating period.

Now, the approach that we used for identifying potential new aging phenomena was a four-step process.

First was an expanded materials degradation assessment. Then we used results from the first renewal aging management programs to inform our guidance. Also, we have looked at domestic and international operating experience. And we also incorporated research findings. Next slide, please.

Now, the four specific actions that we took was that we initiated an expert panel process to identify potential materials degradation issues for 80 years of operation. This included academic, international, U.S. industry, Department of Energy, laboratory, NRC, and a wealth of experts from a cross section of the technical community.

We also conducted audits of plants that had had begun operation in the license renewal period. So they had begun to implement aging management programs. And we wanted to assess the results from implementation of those AMPs. And we looked at three plants in specific.

We were most interested in whether plants were able to access the areas that required aging management, whether they were finding new phenomena that had not been anticipated, things like that, overall just looking at the effectiveness of the implementation of the AMPs.

In addition, we conducted a multitude of public meetings on technical issues. And these included looking at operating experience and industry research activities. We received a lot of excellent input from the general public. And we incorporated that into our decision-making as we felt appropriate.

Finally, the NRC staff conducted a review of the information from the first three bullets. And we proposed aging management approaches that we believe are adequate for 80 years of operation. Next slide, please.

Now, I mentioned the expert panel process on the previous page. The result from that was five volumes called the Expanded Materials Degradation Assessment.

As you can see, Volume 2 addresses aging of core internals and piping systems, Volume 3, aging of reactor pressure vessels, Volume 4, aging of concrete and civil structures, and Volume 5, aging of

cables and cable systems.

This generally covered all of the important systems, structures, and components that are in-scope for license renewal. Next page or next slide, please.

Now, since we had the GALL report to begin with, it was, that is adequate for 40 to 60 years, when we developed guidance documents for 60 to 80 years, we started with the GALL report as the beginning point.

The changes that we made to GALL as we developed GALL SLR were intended to reflect expected aging differences for the increased operating time from 60 to 80 years.

We looked at new plant operating experience that has been identified since the issuance of GALL Revision 2. We looked at gaps that have been identified in the current guidance in the GALL report.

In addition, we looked for improvements in efficiency and effectiveness, both of the applications and NRC's reviews, trying to cut out redundant steps and things like that.

We made corrections to GALL Rev. 2 and SRP-LR Rev. 2. And also we incorporated the interim staff guidance that was issued for the GALL report.

We incorporated that into GALL Revision 2 as the starting point. Next slide.

The guidance documents that we developed for subsequent license renewal are shown here, the GALL report SLR, NUREG-2191, Volume 1 and Volume 2 and also the standard review plan for subsequent license renewal, and that's NUREG-2192. Next slide, please.

The prior discussion talked about how we developed the license renewal guidance documents for subsequent license renewal. Now I want to transition to a description of the license renewal status.

At present, we have 94 operating reactor units in the U.S. We have issued licenses for 94 units, which sounds like maybe every unit has been renewed. Unfortunately or just given the status, eight plants that had renewed licenses have ceased operations. So, at present, we have 86 operating reactors with licenses that go beyond 40 years.

So we have eight units that have 40-year licenses. Four of those have committed to submit applications for license renewal. The Diablo Canyon Unit 1 and Unit 2 have indicated that they will shut down in the 2024/2025 timeframe. So that would leave two units right now that have not committed to apply for license renewal.

In addition to those 8, we have 82 units that have 60-year operating licenses and 4 units that have 80-year licenses. And those would be for Turkey Point and Peach Bottom units, two at each site.

The little pie chart there shows that the vast majority of the plants have 82, or 80 of 82 plants have 60-year licenses. We have 8 that have still their original 40-year license and then 4 that have licenses to 80 years.

Right now we've had 55 units that have entered their 41st year of operation. And the first of those was in April 2009. As I mentioned before, seven of the eight units that have ceased operations entered into the 41st year of operation before they shut down. In total, right now we have about 350 reactor years of operation beyond the initial 40-year licenses.

In terms of the SLR application status, we have three applications that are under review for Surry Power Station Units 1 and 2, North Anna Power Station Units 1 and 2, and Point Beach Units 1 and 2.

We have one expected application. And that's for the Oconee Nuclear Station Units 1, 2, and 3. And that application is expected by the end of 2021. Next slide, please.

Now, Anna mentioned previously the, just to talk about today's meeting. The purpose of this meeting is to have a public dialogue related to the need and timing for the NRC to consider potential technical issues and guidance documents, guidance document development related to license renewal but also information for up to 100 years.

The subquestions that we have asked our presenters to comment on, first one is, should the NRC begin to consider the potential technical issues and development of guidance documents? And if so, when should the NRC start to do that work?

Second item, what are the technical issues that could be potential challenges for license renewal to 100 years? And in addition, what approaches should be used to optimize the development of data to address potential technical challenge areas, if any, for operations up to 100 years? Next slide.

The presenters that have been invited to make presentations today are listed here. We have some public interest groups, Beyond Nuclear, and Victor Saouma of University of Colorado at Boulder, the Electric Power Research Institute, Nuclear Energy Institute, and three of the Department of Energy laboratories or contractors. That would be Oak Ridge

National Laboratory, Pacific Northwest National Laboratory, and Texas A&M.

I tried to list all of the presenters for each of the organizations. Of course, the NRC also has three presenters that will comment on the topics. Let's see. Next slide, please.

Now, in terms of the format of the meeting, we do have four topics. For the three technical topics, so this would be topics two, three, and four, we have an NRC presentation that talks about ongoing research and potential future research. We have presentations from invited speakers, who were listed on the previous page.

We will have time for a public comment period after the presentations. And if we have any remaining time within the agenda, we'll have a roundtable discussion.

Following the discussion of the four topics, we'll have a final discussion and summary and then closing remarks from Anna Bradford. Next slide.

And the next slide is just my contact information. As Dan mentioned earlier, in particular, well, I guess, everyone, if you would just send me an email or an email to Hector just to be sure that we have your participation in this meeting adequately

documented for the meeting summary, we'd appreciate that. Next slide.

What we have here are the related links to important documents that are shown here. I won't go into detail on those. But you can go to those to get additional information.

And I guess the only other thing that I would say is the public meeting notice page on the NRC website has links to the presentations that will be made.

The last time I looked three of the presentations from the NRC have not been made public on our public document system, ADAMS system. And as soon as they are made public, then we will add those links to the web page.

But you can go to that page. And there are links to all of the other presentations at this point.

And, Dan, that's all that I have. I'll turn it back to you.

MR. MUSSATTI: Well, thank you very much. And I appreciate you gave me back four precious minutes for public comment periods.

As I just indicated here, we have about an hour for each session's presenters. And that means

about 15 minutes for each speaker.

Please stay sensitive to the time that you are using, and if possible, try to end early so that we have even more time for public input. And that's pretty much what we're here for is to hear, to get input from everybody who we possibly can.

Our first topic is on the timing of guidance document development. And we have Chris Earls from the Nuclear Energy Institute to give us a presentation. Chris.

MR. EARLS: Thank you, Dan. I appreciate it. And I want to thank the NRC staff for putting together this meeting. I think it's an important topic to discuss. I'm going to keep my introductory remarks brief to try to provide that extra time that Dan is looking for.

What I'd like to focus on is what I believe this meeting is intended to cover and what it is not from an NEI perspective.

Let me start by what I don't think this meeting is intended to accomplish. And that is to determine whether we should allow plants to go to 100 years through the licensing process.

Frankly, we are a long ways away from any utility having internal discussions about that. I'm

not aware of any utility that is actively discussing that or intends to in the near future.

So I think we need to be careful not to spend too much time talking about that. It frankly is too early.

I think that, you know, Allen did a really great job of summarizing the types of documents that typically update in preparation for the next period of extended operation. I don't see us going into that process for at least another ten years.

I think, you know, we're still very early in the subsequent license renewal process. And, you know, our focus has been on trying to learn lessons of the initial applicants. We just went through the first phase of that.

Over the past year, we've discussed some of those lessons learned. And the NRC has begun publishing some of the related interim staff guidance documents that have captured those lessons learned.

I see us going through at least another iteration of that once we go through the next set of applicants and continue to refine the process as we learn the lessons. And so I see that as the real near-term focus of our efforts from a regulatory guidance perspective.

What I think today's meeting is focused on, and I think appropriately, is research. As most people know, research never really ends. It's an ongoing process.

The focus of the research may change based on current priorities and that sort of thing. The level of effort applied to that research may ebb and flow depending on those priorities as well.

One thing that I do know about research is that it takes a long time. It's not something that you can decide today that we're going to do research, some research on a particular issue and have an answer in a year. It typically takes many, many years to get to the point where we have a level of confidence in our knowledge.

And for that reason, you know, it's important for us to look ahead. Even though we may not have any utilities that ever want to pursue a license to 100 years, it is prudent for us continue the research, extend it beyond our current level of knowledge. And, you know, at some point we may discover there is an end point for some, you know, components.

That will be important information to understand for the utilities when they do get to that

point of wanting to make a decision on going further with their licenses.

So today you're going to see a lot of presentations by our industry research partners. They're going to talk to you about some of the current research that is ongoing, perhaps some of the planned research in the future.

And potentially, we may identify some gaps in that research. And that may be something that we can discuss in terms of potential for future meetings to dive into those specific issues.

So, again, I want to thank the NRC for providing us this opportunity. You know, I look forward to the discussion. And we look forward to supporting the staff and the industry in any way we can.

Dan, I'm going to hand it back to you. And I think I got you back a lot of minutes.

MR. MUSSATTI: Well, thank you for that. Chris is the senior director of regulatory affairs over at NEI. And we really appreciate his input. And we appreciate his brevity.

Following Chris, we have Emma Wong from the Electric Power Research Institute. Emma, are you there?

MS. WONG: I am here. Can you hear me all right, Dan?

MR. MUSSATTI: Yes, ma'am.

MS. WONG: All right. Thank you. And thank you for projecting this presentation.

First, I mean, I echo a lot of NEI's and Chris' sentiments. Thank you for letting us, you know, giving EPRI the opportunity to also present at this meeting.

You know, we do work very closely with NEI and the NRC, providing them a lot of our research insight and things like that going forward.

And so I'm going to give the EPRI perspective on the technical considerations for 100 years of operation. So if you'd please move to the next slide. Thank you.

So I am cognizant that not everyone may know the Electric Power Research Institute. So we are a non-profit institute. We are independent. And, you know, we do research to basically discover, you know, the unfettered truth, right. So we try not to be unbiased. And we try to, you know, let the research speak for itself.

Our mission is to advance the safe, reliable, affordable, and environmentally responsible

use of electricity for the society and global collaboration. So we do work all across the world looking at different types of reactors, looking at materials, and long-term operations for all of them.

We are, you know, doing a lot of thought leadership in these areas. And we do a lot of science and technology innovation as well.

So we try to apply all of this to thinking not just in long-term operations but, you know, plant modernization, you know, nuclear beyond electricity. We do have a lot of interests, you know, besides just reactors.

I would also like to say, you know, EPRI, we do have a nuclear sector. But we also do do research across the electric industry as well, in the grids, looking at all sorts of power generation as well.

So we're also trying to use a lot of those lessons learned from those different sectors of electricity and trying to apply it to this technology. So next slide, please.

So, just looking at long-term operation and just thinking about the value, right now we have lots of research that provides a technical basis to help operating plants make decisions about whether or

not they would like to extend their lifetime.

So, as Chris had mentioned, you know, research doesn't happen overnight. And if plants were to want to make decisions, if they want to extend their operation, they need, you know, some sort of basis to say whether or not, you know, these components would make it through this lifetime, whether or not repairs or mitigations would be needed, or maybe even replacements.

So we try to provide that research for this strong technical basis to help plants make this decision.

We also provide guidance and technology to help plants manage their assets through and through their extended lifetime, so looking at what they're doing now for operation and, you know, if they want to extend their lifetime, you know, what type of aging management guidance we have out there for asset management and also risk management. So we do cover all of the different areas.

And we look at not only safety but also performance and cost as well. So we have a very broad scope in front of us in looking at long-term operations. So next slide, please. Thank you.

So our approach to long-term operations,

and I want to say long-term operations, you know, this is part of our core business now.

You know, we consider long-term operations in any of our research that we're doing. They are living research programs. So it's not like we do research in one area and then we're done, and we don't pick it up or we're not tracking it.

We are consistently and constantly looking at the operating experience, especially through the NEI Initiative 03-08, which is on, you know, collecting this operating experience from across the industry. So we're very aware of any experience that would happen in real time.

We are collaborating with the U.S. DOE at the Light Water Reactor Sustainability program and the NRC research arm. And we also do collaborate and have very, you know, consistent conversations with our international partners. You know, we talk to the IAEA, the NEA, and many other research arms as well from, you know, Japan to the Czech Republic.

So we're trying to make sure that all of this research from across the world and operating experience is fed into our guidance documents and any considerations for aging management that we would put out there.

And then when we were thinking about long-term operations out to 80 years, you know, we had decades of aging management research behind that. We added on many more years of research based upon a lot of the knowledge gaps that were identified. A lot of this will be talked about my colleagues in later presentations when we dive deeper into those areas.

We looked at all the operating experience. And we still are collecting operating experience.

And we also looked at all of the data from inspection results, all of the images, visuals, everything that we could possible to try to put together a very solid technical basis going out to 80 years of operations to help support the SLR effort, or subsequent license renewal effort, that the NRC talked about just previously.

And, of course, you know, aging management I already mentioned is a core part of our business now. You know, we always consider aging management. We're always looking to the future.

So we will always be continuing aging management technical support for long-term operations. So this is just something that we're always paying attention to at our institute. And we'll always continue to do so. So next slide, please.

So, just a few highlights of things that we've done in the last decade, so the gaps that I had mentioned that were identified were identified around the 2010 timeframe.

And within that ten years, we were able to close a lot of those gaps or at least give a lot more knowledge and so we can make better decisions about some of these areas.

So, for reactor vessel and core internals, we have updated technical basis to, on the reactor pressure vessel, or RPV, and internal materials.

And we've also made advances in welding of highly irradiated materials just in case for the reactor pressure vessel or internals that maybe there might want to be repairs in the future. We're looking into advances in this technology.

For concrete and civil structures, the two big areas with big knowledge gaps were on the alkali-silica reaction and irradiation effects of the concrete biological shield.

We have, we and the rest of the industry and other research institutions have put out a lot of effort into trying to close these knowledge gaps to give us more information to make better decisions.

In the area of electrical cables, we have

a lot of research to support cable reliability and advances in condition monitoring. We'll hear lots more about this in subsequent presentations.

And we're just not focused in those areas. We are also looking at different projects, for instance, looking at risk insights and whether they could be used in aging management program implementation.

And we are also developing a spent fuel pool coupon international database to support those aging management programs.

And EPRI is always supportive of knowledge transfer. Because of aging management, you know, we have identified that, you know, a lot of us are probably not going to make it out to, you know, 80 to 100 years of operations. So we need to be able to do this knowledge transfer efficiently and be able to keep capturing this.

So we upgraded (audio interference) computer-based aging modules. And we'll continue to update these as more information is learned.

And we are also in the process of digitizing (audio interference) make inspections more efficient. So next slide, please.

So, when we're considering longer term

operations, and my colleagues in further presentations will kind of dive deeper into each of those different technical areas about, you know, their thoughts on this, but we do at EPRI have a systematic approach to thinking about this type of technical basis.

Our aging management programs and practices, you know, they can be very effective we believe going out to any timeframe, because it is kind of based upon a lot of monitoring and, you know, corrective action practices. We think they're very robust as they are. And they could use improvements whenever we do learn more information.

There are repair technologies that could be researched. There are some now. But if we are thinking about a longer term operation, there could be more technologies that could be researched in this area.

And, of course, when considering this, there may just need to be replacements. Not everything in a plant, even going out to 40 years or going out to 60 or 80, you know, not everything is that age. There are periodic replacements. And so more timely or optimal replacement strategies could be thought about.

And also, and when you're thinking about

longer term operations, you know, this does have an impact on, you know, plant modernization, which is another area where we're considering. And the length of operation would kind of impact those considerations.

We're also thinking about nuclear beyond electricity, right. You know, these power plants could be operating out longer and not just producing electricity. They could be producing hydrogen. They could be producing, you know, heat or steam for other applications.

So we're thinking a little bit beyond that. And that might also drive for a longer term consideration.

And we're also thinking about the low carbon resource initiatives and considerations. And that also may play into whether or not a longer term consideration and basis would be needed.

So I would like to conclude that, you know, at EPRI and with a lot of our partners and, you know, coordination partners, we do have a strong R&D framework in place to support longer term operations if that is the, kind of the decision that we as an industry would like to move towards.

So, with that, I hand it back over to you,

Dan.

MR. MUSSATTI: Thank you very much for your presentation. You have successfully given us back a bunch of time. It only took 12 minutes for your presentation, so thank you again.

At this time, we are going to have Paul Gunter from Beyond Nuclear. Paul, are you on the line?

MR. GUNTER: Yes, can you hear me?

MR. MUSSATTI: Yes, I can.

MR. GUNTER: Okay, thank you very much.

Well, I think that, you know, the presenters at this point have given a lot of illumination to some of the issues that we're most concerned about. The Nuclear Energy Institute, you know, raises the whole idea of, that the current conversation has to do with research. But what is neglected is to look at the issue of, that issue of cost of the research. And the questions that it raises as to how and who will cover these costs.

But you know, we do have a question in the opening here that needs to be addressed as to, you know, if in fact this is still very much in a crystal ball kind of framework, why are we looking at this now? We'd like a little more explanation as to the

evolution of this discussion that brings us today.

But, you know, you're going to see a theme through our presentations today that are to specifically focus on, you know, areas of research that relate to initial license reviews and renewals and subsequent renews and reviews, but are not currently funded.

So again, you know, we're taking these looks into the distant future, when in fact the current license renewal process in our view and as we have been participating in it, we find it lacking.

And particularly lacking in the fact that safety-critical research is not being funded and the discussions on how to proceed with addressing these identified safety-critical knowledge gaps is not being addressed nor funded. Next slide.

So the NRC asked the question should the Agency proceed with developing guidance to extend reactor operating license for the 94 units out to 100 years. And our position and that of our constituents is a resounding no.

And I just want to mention that it's, this no is based on, you know, many more reasons than just the narrow scope of today's discussion on technical issues that are looming now in the subsequent license

renewal period, and even farther off into the 100-year prospect that's being discussed.

But I've got a short list here of some of those areas beyond technical issues that you have to meet in order to arrive at the required reasonable assurance standard for operational reliability and safety. But that's only one area in that these other areas have arguably gone unaddressed, and for the initial and the subsequent license renewal.

But we believe that these are critical in order to address public confidence and public acceptance, which is, you know, basically the platform that we operate from. Next slide, please.

So to answer the NRC's technical questions, though, is whether or not it should proceed to build the regulatory bridge for reactor operations out to 100 years. The NRC and the industry must first scientifically take a hard look at identifying safety-critical knowledge gaps in current reactor age management and the Agency's license extension safety review process for the initial license renewal period and the subsequent license renewal period.

In this regard, we came across a critical document that provided some very interesting input that stands out. And it's from the Pacific Northwest

National Laboratory.

And this document, as you can see published in December 2017, it was publically posted to the, not only the PNNL website, but it was also posted to the Department of Energy's Office of Scientific and Technical Information and the international atomic energy agencies' International Nuclear Information Service.

So the national lab's 2017 technical letter report expounded on critical needs to -- that needed to be addressed through harvesting of aged materials from nuclear power stations both closed and operational.

And you know, we've looked at this much like you would an autopsy or a material biopsy, only to closely examine the harsh operational environment of nuclear power and a host of degradation mechanisms. And more particularly, to look at that in the context of their synergistic effects on attacking reactor safety margins. Next slide, please.

So here's some examples. The technical states in its abstract, A key challenge will be to better understand likely materials' degradation mechanisms in these components and their impacts on component functionality and safety margins.

Research addressing many of the remaining technical gaps in these areas for subsequent license renewal may greatly benefit from material sampled from plants decommissioning and operating.

This document describes a potential approach for sampling harvesting materials that focus on prioritizing materials using a number of criteria. So this document, on contract with the US Nuclear Regulatory Commission, specifically with the Office of Research, was a public document for eight months.

And frankly I don't know how I came across this because it could have very well been downloaded from the Department of Energy's OSTI website or the Atomic Energy -- the international atomic energy agencies' technical information site.

But the point of the matter is there are -- this is a very interesting document because it focuses centrally on how a host of critical, technical gaps in the license review process that would benefit by gathering the scientifically observable and measurable material evidence from the real world of reactors that have operated. And that there's materials are similar to those in the plants that are seeking license extension. Next slide, please.

Now, here's another example of an excerpt

from the technical letter report's summary, and it says, Many of the remaining questions regarding degradation of materials will likely require a combination of laboratory studies as well as other research conducted on materials sampled from plants, decommissioning and operation.

Excerpt taken from Section 2 of this technical letter, nuclear plants, materials harvesting, you know, further qualifies harvesting in the context that where available, benchmarking can be performed using surveillance specimens.

And this would be like coupons taken from within the reactor pressure vessel. But it adds most importantly in most cases, However, benchmarking of laboratory tests will require harvesting material from reactors.

So this technical letter was not only identifying a whole host of technical gaps critical to safety and operability into, in this case, projected out to the 60 to 80 year time frame, but it made some de facto recommendations to require autopsies of these -- in support of license extension. Next slide, please.

However, the discovery of this report basically revealed that the NRC itself was not

prepared for the findings that were now internationally available.

And in fact, what we ran up against was that when we raised questions about this, that in the September 2018 timeframe, that the NRC subsequently scrubbed the national report to remove scores of references to technical knowledge gaps in industries, particularly age management programs and the current license renewal technical review process, as well as remove the laboratory's recommendations to require strategic harvesting at decommissioning reactors and laboratory testing and technical analysis of aged materials to support the license renewal reviews.

So the sanitized report was republished in March 2019 after it was taken down from the government websites, but has not been re-posted to those other government laboratory and technical information websites.

However, Beyond Nuclear has been working on a Freedom of Information Act now for more than two years to request, you know, basically what has revealed in large part email comments roughly around the March 2018 timeframe of an anonymous staffer with the technical review team of the NRC's Office of Nuclear Reactor Regulation.

And in the License Renewal Division, recommending, quote, Big picture, I think the entire report, this being PNNL-27120, needs to be scrubbed for text that points to gaps. And if issued, we need a stronger basis for why we will grant renewed licenses before the harvesting and testing is completed.

But again, however, following a September 26, 2018 public meeting on subsequent license renewal that I attended and raised these questions with regard to the technical letter, the NRC -- within days they basically said that the report had been publically released for eight months and charged that the report was -- had not been fully reviewed and received the staff's outstanding comments. And so they had -- they were able to remove this document within a matter of a couple days.

So I'll end my comments there and resume them at the other junctures. Thank you.

MR. MUSSATTI: Thank you, Gunter, I appreciate your being sensitive to our time needs, that's highly appreciated. Back to my list to see who is our next speaker. You caught me checking my mail, actually. Okay, our next speaker is Thomas Rosseel of Oak Ridge National Laboratory. Thomas.

DR. ROSSEEL: Thank you, Dan. My name is Tom Rosseel, I'll spell it for the person doing the transcription. It's R-O-S-S-E-E-L, three syllables. My colleague is Frank (Xiang) Chen. We're both at Oak Ridge National Laboratory, but we do research both for the Department of Energy as well as the Nuclear Regulatory Commission.

So the title of my talk is, Is There Life Beyond 80 and Why Should We Prepare for License Renewal to 100 Years. Next slide, please.

So to discuss the future, we believe it's critically important to understand where we have been, where we are now, and where we think we need to be. And I think for Paul's presentation, I think this might be very useful. So hopefully this will give you some additional information to help you understand the research that has been going on at the Department of Energy and at other organizations.

So let's talk first about the current US DOE light water reactor materials research goals and objectives. Our goals are to develop the scientific basis for understanding and predicting longterm environmental degradation behavior of materials at nuclear power plants.

So obviously, by looking at this, the

figure on the left, you can see that what we're concerned about is time at temperature, the water environment, radiation, and stress on materials that are used in a nuclear power plant because they could impact the plant operation in terms of load and the ability to respond to safety impacts our capacity.

So the objective then is to provide data and methods to assess the performance of systems, structures, and components essential for the safe and economically sustainable operation of the US nuclear power plant fleet. Next slide, please.

So again, I think this is important for, in respond to some of what Paul was talking about. Let's talk a little bit about the current US DOE light water reactor materials research, and I think this will give you a good idea about the scope of the research. And in many ways I believe that you will see that there will be overlaps when we go onto the technical presentations between the NRC, DOE, and EPRI research or industry research.

So we've had a longterm focus on reactor pressure vessels. We had programs with regard to the US NRC, as well as with the Department of Energy, specifically the light water reactor program has been in existence since 2008/2009 timeframe, and it's still

ongoing. A great deal of emphasis on research for reactor pressure vessels.

We also study the effects of irradiation and other degradation mechanisms on core internals and piping. We're interested in concrete degradation, cable degradation, which I think is certainly -- as a matter of fact, some of the coauthors of the report that Paul mentioned actually are working for the LWRS program, the DOE program on cable aging, and are trying to address some of the issues that were in that report, as well as mitigation technology.

We work with four national laboratories, Oak Ridge National Laboratory, Argonne National Laboratory, Pacific Northwest National Laboratory, Idaho National Laboratory. We work with universities through a variety of methods, both through subcontracts, University of Michigan; UCLA; University of Tennessee, Knoxville; University of California, Santa Barbara, as well as many other universities through the US DOE Nuclear Energy University Partnership Program.

We also collaborate with EPRI, the US NRC, with the PWR and the BWR owners' groups, as well as international research organizations to leverage that research so we can advance our knowledge at a

much better pace. Next slide, please.

So what's the approach we use to address aging management knowledge gaps? And we do this through what we consider to be a sound nuclear materials research approach. The first thing is you obtain high quality measurements, and the reason you do that is because from those high quality measurements you can develop a mechanistic understanding of the degradation process.

From the mechanistic understanding, you can proceed to develop a predictive model, and doing through simulations and modelings, you should be able to then go on and understand better how to monitor the degradation, as well as how to mitigate the degradation. And that's important, because we provide this information publically to the regulators as well as industry with the hope that we can reduce margins and improve sustainability. Next slide, please.

The approach we've used is through a research assessment, and Allen had mentioned this a little bit earlier. I'm going to do a little bit deeper dive into this. And back in, I think it was 2004, the US NRC put together a proactive materials degradation assessment. And the focus was primarily on internals to identify possible degradation for the

effects of operation 40 to 60 years.

They put together an expert panel, as Allen mentioned, from the nuclear community, and it included industry, universities, as well as international experts. The approach they used is something called the PIRT process, which is phenomena -- I'm having with saying this, my little dry mouth right now.

But I'll just say that it's a process involved with trying to determine the susceptibility or likelihood of damage and what our knowledge is of that particular mechanism at this particular time.

The input from the PMDA was used as input to develop the Generic Aging Lessons Learned document. I should point out that this only addressed gaps, it didn't rank in terms of priority. Next slide, please.

So when there was -- the discussion began with regards to life beyond 60 or second license renewal, the US Department of Energy joined with the NRC to have the expanded materials degradation assessment panel put together.

And it expanded upon the scope to include RPVs, not internals, what would happen from 60 to 80, as well as concrete and cables. So very similar, but an expanded scope. And again, Allen mentioned this in

his first presentation.

We had the expert panel expanded to industry, EPRI, national labs, universities, and international, as well as of the course the NRC participation in this. It addressed gaps, as pointed out previously, but it did not rank them in terms of priority. This began at about 2011, it ran through 2013.

It was a very extensive, careful look at what the gaps were. It was published, and it is publically available either through OSTI or through ADAMS, and the document is there for those who are interested.

I should mentioned, by the way, that the light water program for US DOE began in 2008 and is obviously still ongoing. Next slide, please.

So over the last 20, 30 years, the US DOE, the Nuclear Regulatory Commission, and industry materials research programs have significantly advanced the understanding, characterization, and modeling of materials degradation in nuclear power plants. And I just realized that I meant to respond to one other thing that Paul had mentioned and that is validation.

A critical component of what we're doing,

and if you could go back a slide, please, Dan. One more, please -- one more. In looking at that figure on the right, the important part that I accidentally skipped over in my enthusiasm, was that validation is critical to what we do. We do harvest materials to validate the research that we're doing.

We began our first interaction with obtaining materials from nuclear power plants in 2011 for the Zion Plant. We held a meeting in May of 2011 and began to plan for when we could work with the decommissioning company and with the plant owner to be able to obtain materials.

We have since then obtained sections of the reactor pressure vessel. They have been cut into blocks. From those blocks they were cut into specimens, and those specimens are currently being tested, and those results will be made public shortly.

We certainly have published information about how we harvested the materials. We also harvested cables from the Zion Nuclear Power Plant, and I'm sure that the NRC and EPRI will elaborate on this. We did provide cables that were available to the Nuclear Regulatory Commission, as well as for research performed at national labs through the US DOE program, light water reactor program.

So if you can go back to the last slide I was on, which is where our point of view is. Thank you, this is the correct slide. So just to give you again a little bit of a status of where we are now. I've talked about what we started with, what our focus was, and currently we're focused on completing the development of mechanistic understandings and predictive degradation models.

We're trying to refine the predictive models through codes and standards for use by the nuclear industry and obviously for the NRC. And we're interested in continued engagement with stakeholders, EPRI, the NRC, utilities, etc., and the vendors to solve critical sustainability issues.

So the question then becomes for extended operation for perhaps life beyond 80, how should we prepare for the possible needs to -- need to provide electrical capacity from the existing LWR fleet. Next slide, please.

So this is a report that was put out by the US Energy Information Agency. And in this document, they estimated that by 2050, the nuclear capacity in electricity generation, including new builds, could increase by 20% of the -- by 20%, or 80% of 2019 level. And based on the age distribution of

the existing US nuclear fleet, by 2050, 50% of the US fleet will be within ten years of the 80 years of operation.

Without a life-beyond-80 research plan, the US could lose up to 50% of its nuclear capacity due to closures and limited new builds, resulting in as much as a 30-gigawatt capacity shortage by 2060. Next slide, please.

So what are our options? Well, one option could be small modular reactors. Another could be advanced reactors that are currently being developed by a number of organizations, Westinghouse, GE Hitachi, and certainly international as well. And clearly renewables is a key factor.

So there could be a series of questions that one should ask. What is the current outlook in the US for advanced reactors and passive safety systems? Additionally, can costs and time to build be reduced? Do we know how many small modular reactor (audio interference).

Next, what is the path forward to increase the capacity as advanced reactors or small modular reactors by 2050. Another question would be is the electrical capacity of renewables under- or over-predicted. Well, when you're 30 years away, I think

the estimates can be questioned quite easily. Nobody really can predict that far in the future, we can barely predict sometimes it seems like five years in the future.

And finally, can we predict the size of the carbon tax. If it's high, renewables might be the option that most people go to. If not, maybe it's not quite as likely. Next slide, please.

So I'd like to focus a little bit on life-beyond-80 unknowns. And in some ways they are not all that different from some of the issues that we focused for life to 80. But as we understand those, there are still issues that need to be addressed. So for example, degradation modes that are already occurring and may grow more severe during extended operation may take place for life beyond 80.

Degradation modes at life beyond 80 for which there is no -- there is, excuse me, a limited mechanistic understanding, and for which longterm research still is needed. Next, degradation modes for which there is little or not supporting data at this time that may be problematic for lifetime extension beyond 80. And I would certainly think that this would include much more in terms of harvesting and validation. Next slide, please.

Future advances, and I think Emma mentioned this, would certainly be involved with non-destructive evaluation technologies and methods. And clearly, there's a lot of research going to develop improved sensors, as well as real time monitoring or online monitoring.

Additionally, as Emma also mentioned, future advances and mitigation methods and materials could take place, including developing materials that could replace the existing materials because perhaps they're more radiation-resistant or less susceptible to degradation methods, as well as weld repair techniques. And the DOE program has worked closely with the EPRI program to develop weld repair techniques.

So finally, what are our options for a path forward? Next slide, please. And I would suggest that we have a subsequent or second expanded materials degradation assessment, or SEMDA for short, for now anyways. And that should begin perhaps in Fiscal Year '22. And we should -- our goal should be to have a gap analysis report by 2024.

Again, we would put together an expert panel from the nuclear community, industry, EPRI, national labs, universities, international as well as

NRC. It would address gaps but not necessarily rank them in terms of priority.

And I would suggest that we not only have reactor pressure vessels, internals, concrete, and cables, but we focus on mitigation and non-destructive evaluation or online monitoring as well. So from one to 4 to 6 in terms of as we go an additional 20 years. Next slide, please.

So this is sort of my summary slide on establishing a life-beyond-80 path forward. It's to identify the knowledge gaps, a second or subsequent extended materials degradation assessment, to review and identify key priorities and timelines to reach those goals.

And this would be industry-wide or nuclear community-wide, to continue our engagement with stakeholders, which again would include EPRI, the NRC, the owners' groups PWR and BWR, utilities, universities who collaborate with us, as well as the vendors to develop research plans that address key issues and sustainability of the US nuclear power plant fleet.

My concluding statement would be predicting the future is not easy, but planning for the future makes it easier to prepare for the future.

I've got a few additional slides which, Dan, if you want to go through them we can go real fast. Next slide, please. This is just the presentation. These are related to the DOE program, reactor pressure vessel at extended operation. Next slide, please.

Looking at internals, Frank Garner and Lin Shao from Texas A&M, as well as Maxim from Oak Ridge. Next slide, please. Life beyond 80 for concreting again, Yann Le Pape will take the lead on that for our presentation. Next slide. And finally, on cables, reliable use of cables at extended operation, that will be Leo Fifield from Pacific Northwest.

And with that, my presentation is completed.

MR. MUSSATTI: All right, thank you very much. It was worth it to take those extra minutes there to show us those other presentations that are upcoming.

DR. ROSSEEL: You are welcome.

MR. MUSSATTI: Hello? Okay, we have gained a little bit of time here. We have until 11:15 to take all the public comments that are out there and to take a 15-minute break. So we've got a bit of time

on our hands here, almost a -- well, let's see, 10, 11:15, we've got almost 45 minutes.

So we've got plenty of time here to take questions from, and comments from the audience. And then we should probably consider whether we're going to take a break or move on to the topic, the next topic and take our break at the 10:15 time that's on the -- at the 10:45 time that's on the schedule.

So let's get started with comments from the public. We want to hear from as many people as possible, so please hold on -- hold off on a followup question until I ask for them towards the end of the session. We're probably going to have enough time, you'll be able to get that followup question in, but I want to let everybody have at least one chance to speak.

At this time I'd like to go to Jennifer and ask her if there's anybody online that would like to speak. Jennifer? I don't hear Jennifer. How about on the chat line, have we got --

OPERATOR: Hi.

MR. MUSSATTI: Oh, there you are, Jennifer.

OPERATOR: To ask a question, please press star one. Please sure that your phone is unmuted and

record your name clearly when prompted. And to withdraw your request, please press star two.

MR. MUSSATTI: Okay, we have nobody online right now then, do we?

MS. GRAY: This is Erica Gray.

OPERATOR: There is one person, just a moment.

MR. MUSSATTI: Okay.

OPERATOR: Question over the phone comes from Stephen Steven Dolley. Your line is now open.

MR. DOLLEY: Hi, this is Steven Dolley with S&P Global Platts, can you hear me okay?

MR. MUSSATTI: Yes, we can.

MR. DOLLEY: Thank you. Thank you for the interesting introductory presentations. Unfortunately I'm not going to be able to monitor all day, I'll be ducking in and out. I was hoping NRC could provide at least a very brief high level response to Paul Gunter's allegations regarding the treatment of the PNNL report on harvesting.

MR. MUSSATTI: Okay, that's not what I was expecting for a comment from the audience.

MR. BURNELL: Well, hi, Dan, it's Scott Burnell from the Office of Public Affairs. And good morning, Steve. The presentations that are coming up

are going to cover the topic of harvesting, so that will be the Agency's high level --

MR. DOLLEY: Understood, I just (Simultaneous speaking.)

MR. BURNELL: Response.

MR. DOLLEY: I'd like to get a high level response now.

MR. BURNELL: The staff's presentation coming up will cover that topic, so that's going to be the high level response.

MR. DOLLEY: Right, and maybe I wasn't clear. I'm not going to be able to be here all day, so I guess you'll pass something on to me or something. You're declining the answer at this time?

MR. BURNELL: We'll certainly pass along the summary of the staff's presentation later in the day, yes.

MR. DOLLEY: No, no, no, I got a real specific questions here, Scott.

MR. BURNELL: Yes.

MR. DOLLEY: I'm trying to figure out when and where it will be answered. Should I follow up with you? You're all declining to answer now?

MR. BURNELL: You can certainly follow up with me, and the basic answer is that the Agency will

discuss harvesting, as Mr. Gunter mentioned, during later presentations. So at this point, that will be the Agency's answer. And yes, I will follow up with you later with a more detailed summary of what the staff presents.

MR. DOLLEY: Okay, and they're going to talk about the specific treatment of the PNNL report as discussed by Paul?

MR. BURNELL: They're going to discuss the topic of harvesting, as covered in the PNNL report.

MR. DOLLEY: But I ask --

MR. BURNELL: I understand, Steve.

MR. DOLLEY: Okay.

OPERATOR: The next question comes from Jan Boudart. Your line is now open.

Ms. BOUDART: Am I on the phone? I'm -- I think I'm going to turn off my phone, I hope it will work.

MR. MUSATTI: Are you still there?

OPERATOR: Next question comes from Erica Gray.

MS. GRAY: Hello, can you hear me?

MR. MUSSATTI: Yes, we can.

MS. GRAY: Hello, good morning. Erica Gray calling from Richmond, VA. I'm also with the

Virginia Sierra Club. Boy, with this topic. I really question even talking about 100 years, because already the current process to take the reactors up to 80 is really inadequate in so many ways.

Talking about the GALL expanded using new plant operators' experience, that's really questionable. I mean, North Anna and Surry here in Virginia just entered into their first license extension, so I'm not sure about what new experience we actually have.

And, well, maybe other than the constant hardship requests and exemptions that are constantly being made and approved by your office, the NRC. There's questions regarding specimens in the pressure reactor vessel. I've been on many meetings, and essentially they are playing musical chairs with the few specimens that they have left.

I've been told that they would be making new specimens. This is a haphazard, guessing process this is not reassuring and nor could it possibly be accurate.

I also wanted to mention that in the last gentleman that was talking at 10:29, a thing came on to the speaker saying that it is no longer recording. So I hope that the NRC's system is actually recording

this whole meeting or transcribing it.

I think basically, you know, to talk about even the license we have now and the new licenses for the subsequent license renewal, there's still no solution to the waste. It's really completely unethical to continue down this path of making the most toxic waste known to mankind, and we'll be dumping it onto the future generations, who will have to live with these hazards for like 3,000 generations actually counting.

You know, essentially it's time to stop this whole new con job. The reality is the research is already showing that renewables, solar, wind, geothermal, etc., and efficiency can power the world. Cheaper, safer, and with less risk of a disaster or terrorism.

And I wanted to mention, too, that, you know, the idea of harvesting materials, yeah, it'll be interesting to see what y'all present later, and I hope to still be on the call since y'all don't want to answer those questions now from the previous caller.

MR. MUSSATTI: Erica --

MS. GRAY: But I can say one thing. Hopefully the samples will be many, because here in Virginia, when they check the canisters that are on

the pad of the high level nuclear waste, they pick one and they lift up one. And they checked under the canister with a GoPro camera, which even the NRC at the time said they needed better technology.

MR. MUSSATTI: Erica, can you wrap up your comments, please.

MS. GRAY: So really, y'all need to a much better job with actually showing the science and stop doing the guessing, because the next accident will be here if we don't stop playing around and realizing we're not doing the science. The science is needed. Thank you very much.

MR. MUSSATTI: Okay, thank you, Erica.

MR. BURNELL: And --

MR. MUSSATTI: Go ahead.

MR. BURNELL: If I could, Dan, just very quickly for everyone who's on the phone and perhaps not following on the Teams chat. There was an inadvertent action by one of our staff people.

They accidentally hit the recording button. The meeting is not being recording through Teams, that what our Court Reporter is for. That transcript from the Court Reporter will be the record of the meeting. Thanks.

MR. MUSSATTI: Okay, thanks for that

clarification. Jennifer, do we have anybody else on the phone?

OPERATOR: The next question comes from Cindy Folkers, your line is now opened.

MS. FOLKERS: Hi, can you hear me?

MR. MUSSATTI: Yes, I can.

MS. FOLKERS: Thank you. Thanks for the opportunity to comment. I just have to say in the introductory presentation that was made for the meeting, it mentions re-licensing considers prevention of mitigation of offsite exposures. Yet Paul Gunter's presentation implies that the health impact studies from operational and accidental radioactive releases may not be a re-licensing consideration.

And so I'd like a little bit of clarification on that. I saw that there was a 50, maybe it's pursuant to Part 50. But before I really -- whether or not the health impacts are considered from offsite, I really think that we -- before we even consider any re-licensing at all, NRC needs to examine the impact of effluent from operating reactors on community health, particularly children and pregnancy.

The NRC had commissioned a study, but then it canceled it claiming that the study would take too long to do. But if the NRC is planning on extending

licenses of reactors, there would be plenty of time to conduct that study. And it would be a very wise idea, since there are similar studies that have been conducted in Europe that show increases in childhood leukemias around similar type facilities as NRC licenses.

It would be important to consider the costs of these health impacts should there be re-licensing, but in general, I wouldn't even ask the question of whether or not we should be re-licensing these facilities without first knowing what the full community health impacts around each of these licensed facilities has been.

MR. MUSSATTI: Okay, thank you, Cindy. Could you hold on, Cindy. I need you to give your name and your affiliation, please. You didn't do that at the beginning.

MS. FOLKERS: My name is Cindy Folkers, F as in Frank, O-L-K-E-R-S like Sam. And I'm with Beyond Nuclear.

MR. MUSSATTI: Okay, thank you very much.

MS. FOLKERS: Sure.

MR. MUSSATTI: Okay, our next speaker.

OPERATOR: Next question comes from Jan Boudart. Your line is now open.

MS. BOUDART: Hi, I need to find out how I can get in through the website, I'm now on my cellphone.

I wanted to comment first of all on Emma Wong's presentation. She said nothing about waste management with the aging of nuclear reactors. Isn't the inevitable increase of waste a worthy subject for aging management? She said they were always paying attention, and she also mentioned knowledge transfer. Nuclear beyond electricity, doesn't that include waste?

Then I would like to say something about Rosseel's presentation. He gave us a huge snow job, if you'll pardon the expression, on who his collaborators are. He went through industry, he went through universities, he went through national labs, etc., etc., so forth.

He made no mention of any Native Americans. All of his references were to Western civilization-type scientists, and there was never a hint of how nuclear, how our nuclear project is affecting Native Americans.

And also, I studied the Genkai Nuclear Reactor restarts in Japan. There were reactor vessels that they did not restart because they were too

brittle. They took coupons from those reactors vessels and they found that their algorithms for embrittlement were inadequate. And the coupons that were taken out were much more brittle than the computer predictions that they were -- than the computer predictions were.

And I'm prepared to send this study to anybody who asks me. My email address is janboudart1@gmail.com, and I will be glad to send the scientific analysis of the Genkai 1 study of embrittlement.

I was holding my breath, not literally, to wait for the 2019 coupon being taken from Palisades. I live in Chicago. And it was never done. Even the one before that was skipped over. Then they skipped over the one for 2019. So that coupon is still in the Palisades reactor vessel, it has not been removed. It has not been tested.

And of course the algorithms say that Palisades is not that embrittled. And I dispute that. I think that we need to have real physical test. There are not enough coupons to extend to 100 years. I think not even 80, and I really think there are not enough coupons to extend to 60 years in these nuclear power plants.

Therefore, we cannot actually test them for this long distance. And if we cannot take samples from the reactor vessels to see how embrittled they are, we should not even consider extending the lives of these nuclear power plants beyond 40 years.

MR. MUSSATTI: Okay, thank you very much.

MS. FOLKERS: And I really appreciate this chance to give -- oh, and I'll tell you I am Jan Boudart, I'm a Board Member at Nuclear Energy Information Service. Thank you.

MR. MUSSATTI: Thank you very much. It is not 10:49 --

MS. FOLKERS: Can somebody tell me how to get in through my computer?

MR. MUSSATTI: Not unless I have your computer in front of me. Thank you.

OPERATOR: Question comes from Steven.

PARTICIPANT: Hello, hello.

OPERATOR: Next question (Simultaneous speaking.) Your line is now open.

MR. DOLLEY: Hi, this is Steven Dolley from Platts. Can you hear me okay?

MR. MUSSATTI: Yes.

MR. DOLLEY: Hello?

MR. MUSSATTI: Yes, can you hear me?

MR. DOLLEY: Yeah, this is a more procedural question. Who is paying for today's meeting and followup track of meetings considering whether guidance should be revised to accommodate reviews for 100 years, up to 100 years of extended operation?

I'm not asking about the funding for the research, which of course is myriad and very diverse. I'm asking specifically about paying for the FTEs for today's meeting and for any followup meetings that might be held in this. I mean, this is a full day with a dozen staffers. So there was a lot of preparation of very technical presentations.

Is this coming out of appropriated funds from Congress, or is it licensee fees? And if so, are they -- is this a Part 170 or Part 171? Who is picking up the tab for the meeting?

MR. MUSSATTI: All right, thank you for that. I'm going to call on our Director, Anne, to answer this question.

MR. DOLLEY: I'm sorry, we're having a tough time hearing you.

MR. MUSSATTI: I'm sorry. For some reason, my phone or my microphone keeps shutting itself off and I have to keep turning it back on. I'm

going to let Anne Burrell [Bradford] talk to this question here.

MS. BRADFORD: Hi, this is Anna Bradford, I'm the Director of the Division of New and Renewed Licenses at the NRC. So we have a line in our budget that's for infrastructure work, infrastructure meaning things like guidance and rulemaking and things like that that need to be done in order to carry out our regulatory activities.

And so that is the number that this would be charged to. So it's not being charged to a particular licensee or anything like that.

MR. DOLLEY: Okay, and thanks, Anna. So it would be congressional appropriations, taxpayers as a whole?

MS. BRADFORD: It would be, well, I mean, no. I mean, I don't want to get into I guess explaining our entire budgetary process, but it comes out of our --

MR. DOLLEY: I'm pretty familiar with the budget process.

MS. BRADFORD: Okay. So we get, you know, we're 90% fee-reimbursed, right, regardless of what --

MR. DOLLEY: 100% under NEIMA, right.

MS. BRADFORD: Yeah, right. But in terms

of there's fees that are charged directly to the applicant and then there's the annual fees that cover other non-site specific work.

MR. DOLLEY: Right, Part 171 and 170.

MS. BRADFORD: Right, so it's not necessarily (Simultaneous speaking.) It's not necessarily from the pot of money, I'll say, that comes from the taxpayers, as opposed to pot of money that necessarily comes from things like annual fees. And I'd have to go back and track it exactly, but I can't -- but no, I can't say this is directly coming out of the taxpayer part of our budget.

MR. DOLLEY: I'm sorry, I just didn't follow it all. We can't say who's paying for it?

MS. BRADFORD: So if you want to -- we could talk maybe offline, because I'm not sure budgeting is really the topic here for today as opposed to what research might we want to do for 80 to 100. But if you want to contact me separately, I'd be happy to talk about it.

MR. DOLLEY: Okay, I was asking about this specific meeting. Thank you.

MS. BRADFORD: Yup.

MR. MUSSATTI: Yes, thank you. Our original agenda said that we were going to go to

10:45, take a break until 11:00, and then go to an open discussion. So we've got until 11:15 to ask questions and have that break. I'm tempted to say we've got about seven or eight more minutes to go before we take that break. Was anybody have a comment on that?

MS. LEE: Hello, can anyone hear me?

MR. MUSSATTI: Who is this?

MS. LEE: Oh, good. This is Michel Lee. I was -- I have been trying to get on. What number, star do we call to get on through the operator?

MR. MUSSATTI: Hang on. All right you need to call 1-800-857-9650. The passcode 4903279.

MS. LEE: Okay, so I'm sorry, could you just repeat those numbers again? Usually you just do a star one or star zero.

MR. MUSSATTI: 1-800-857-9650, and the passcode is 4903279. And yes, you are correct, star one will get the operator's attention to put you in line to speak.

MS. LEE: (Simultaneous speaking.)

MR. MUSSATTI: Since you're already here, why don't you just speak?

MS. LEE: Okay, sounds good to me.

MR. MUSSATTI: Name and affiliation

please.

MS. LEE: Yes, this is Michel Lee. I'm with several groups including Council on Intelligent Energy and Conservation Policy. I was involved in the Atomic Safety Licensing Board proceedings for the re-licensing of Indian Point, which as you're all aware, New York State was vigorously involved in.

I would like just to bring up one of the many, many points raised during that proceeding, as it illuminates the issues before you today. And that had to do with baffle bolts at Indian Point. Dr. Hiser during the proceedings testified that the expectation of the NRC was that there would about 1% of deterioration of baffle bolts.

And the issue that was the focus of that particular group of hearings had to do with inspecting the baffle bolts before nuclear reactors were re-licensed. The NRC was supporting Entergy's opposition to having to conduct those inspections. After an agreement was reached between New York and Entergy, a inspection was done before the next ASLB meeting.

And indeed what was discovered was that there was fairly extensive baffle bolt deterioration. Some had fallen out, some were partially falling out. I'm not going to get into the whole baffle bolts

issue, you're well aware of that, anybody who's followed these issues. But it was a perfect example of how perhaps a very reasonable expectation based on limited past knowledge was wrong.

There are miles of buried systems at these reactors. There's no way to do inspection of many of those systems. And there's also an absurd level of disconnect that seems to pervade this entire regulatory system, which is that only safety-critical systems are important. Which disregards the very complex dynamics in which different components and systems and externalities impact any machine over time, particularly -- particularly with the stresses that will be imposed by climate change.

And I'm really would like to just give you all pause, you know, request you pause and consider before you go forward on this reckless path. Thank you.

MR. MUSSATTI: Thank you very much. It's about one minute until 11:00 and at 11:15 we're scheduled to start our second session. So what I suggest we do now is take a 15-minute break and then come back all fresh and ready to go with the next topic.

So at this time, unless I hear otherwise

from the people who get to tell me what to do, I'm going to pause this meeting.

DR. RODRIGUEZ: Hey, Daniel, this is Hector, I would like to clarify something.

MR. MUSSATTI: Sure.

DR. RODRIGUEZ: Some logistics here. Hey, if you used the Microsoft Team links that is in the public announcement, you are connected to Microsoft Teams. If you want to provide a comment or a question, all you have to do is use the icon that is like a hand and that will show me that you're kind of like raising your hand. And I can unmute you to provide your comments and questions.

You don't need to have -- you don't need to be connected to Microsoft Teams and call the bridge line as well. You will only call to the bridge line if you don't -- aren't connected to the Microsoft Teams.

MR. MUSSATTI: Okay, thank you for that.

DR. RODRIGUEZ: I think like that was the question from earlier today.

MR. MUSSATTI: Okay, thank you for that. I think what we're going to do is we're going to pause the meeting now for 15 minutes, come back at quarter after 11:00, and start in with our next session. So

temporary adjournment or recess.

(Whereupon, the above-entitled matter went off the record at 10:59 a.m. and resumed at 11:15 a.m.)

MR. MUSSATTI: Okay, everybody, it's now quarter after 11:00, and we need to get started on our second session so that we can make sure that we stay on top today.

Just a few reminders for everyone about our protocol. First of all, when you get a chance to speak from the public, we need you to state your name and your affiliation. You need to speak clearly and loudly so that our court reporter can transcribe what you are saying. And, as much as possible, we want to stay on topic.

Other than that, you need to be participating with your oral comments through the NRC's bridge line, not through the team's program. The team's chat line that we've got going here, we're using that as a side line for us to do the business that we need to do to make sure that this all runs smoothly.

And it's a little disconcerting when we have speakers that want to come on that have not been introduced by the operator. So please come in through

the operator and let her put you in the queue and get you into the meeting in order.

And in order to get ourselves on schedule and stay on there, I'm going to start our second topic of the day which is Technical Issues for Mechanical Components with our first speaker, Carol Moyer, from the NRC. Carol?

MS. MOYER: Thank you, Dan. Can you hear me okay?

MR. MUSSATTI: Yes, ma'am, I can hear you.

MS. MOYER: Great, thanks. My name is Carol Moyer. I'm a senior materials engineer in the NRC's Office of Nuclear Regulatory Research.

Next slide please. So I'll talk today about materials research primarily for mechanical components, which is mostly metals that make up the primary structures of the nuclear power plant, and our aging research that we have performed and are in the process of performing.

So our research objectives are to improve timeliness of regulatory decision making on the use of new materials, and manufacturing technologies, and in-service inspection techniques through independent and confirmatory research to address materials degradation during long term plant operation and to inform and

enhance the use of risk information in regulatory decision making.

We have several strategic focus areas to support resolution of safety-significant technical issues, maintain our core capabilities to support emerging technical needs related to corrosion, metallurgy, component integrity assessment, and non-destructive examination, to enhance modeling and analytical tools to support efficient regulatory decision making, and to foster collaborations with domestic and international counterparts to stimulate information sharing and cooperative research approaches.

There's a high level summary of our activities in the slides that follow. More information on the work of the NRC Office of Research can be found in this NUREG-1925.

Next slide, please. Long term operation, or LTO, and aging management involves several supporting technologies. An overview of this topic is here, shown. Our objective is to support guidance development and coordinate related research activities to develop a systematic approach for harvesting materials and components and to provide reasonable assurance that aging effects will be adequately

managed during LTO.

The regulatory application is to refine, as appropriate, existing aging management programs and guidance. And we collaborate in these efforts with the U.S. Department of Energy and with EPRI.

A few items of current activities are listed here. We held international workshops on materials degradation for metals, and cables, and for understanding the degradation and approaches for aging management. And we continue to coordinate with our counterparts on metals aging research, concrete aging research, and cable aging research.

We are looking forward to potentially having another international workshop on concrete aging, and we continue international communications to coordinate these activities and setting of priorities.

Next slide, please. I mentioned research partnerships, and this slide breaks that out a little bit further. So we try to make the best use of limited resources by collaborating with our counterparts in other organizations. We can look toward harvesting or sharing of research data, particularly with work on irradiated material which is particularly expense and complicated to do. We almost have to do this in a collaborative approach.

Our domestic partners, as mentioned, EPRI and Department of Energy laboratories, we also have some collaborations with academia, the vendors, owner's groups, technical support organizations and other government agencies.

Internationally, we work with the nuclear plant regulators and their technical support organizations. Often this is collaborated, this collaboration is organized through IAEA or NEA, but we also have direct bilateral agreements. And these partnerships are identified for specific activities on subsequent slides.

Next slide, please. So this slide summarizes some of our approach to materials harvesting from plants that are in decommissioning or components that are taken out of service in plants that are still operating.

The objective is to improve our understanding of material degradation associated with long term operation. These harvested materials can confirm information on aging mechanisms that's generated through other research programs and operating experience.

The application then is to inform our aging management approaches to ensure they remain

appropriate and adequate. And again, our collaboration partners in this work are DOE, and EPRI, OECD/NEA, and other international partners.

So several activities are incorporating harvested components in the research plans. Dr. Rosseel mentioned materials from Zion Plant, and some other recovered materials have been examined as well. NRC has identified broad harvesting priorities, and we're maintaining an awareness of possible harvesting opportunities.

Our research interests include metals, concrete, and electrical cables and components. We're coordinating with DOE and EPRI to explore these opportunities as they align with our research interests. So not necessarily every opportunity that presents itself is of best value to advance the research that's needed.

We are initiating participation in an NEA project to perform harvesting of metallic components, and we're supporting DOE's efforts to acquire irradiated material samples from the Halden Reactor, which, as you know, is in decommissioning, for the DOE Nuclear Fuels and Materials Library.

We're also pursuing opportunities in coordination with our other partners for harvesting

components from decommissioning US and international plants.

Next slide, please. One topic we're researching is primary water stress corrosion cracking. We evaluate PWSCC crack initiation and crack growth rate, or CGR, susceptibility of nickel-based alloys. These are found in the primary circuit of nuclear power plants.

This work will provide assurance of reactor coolant pressure boundary integrity and support reviews of proposed changes to the inspection requirements in ASME Code and associated rulemaking. And we collaborate in this work with EPRI.

We recently completed about 20 years of crack growth rate testing on Alloy 600 and it's well of materials, and Alloy 690 and its well of materials, at Argonne National Laboratory and the Pacific Northwest Lab. The data will be used to evaluate requests for new component inspection requirements and in ASME code actions.

We're developing PWSCC in crack initiation data on Alloy 600 and Alloy 690 to verify probabilistic modeling parameters, and dependencies, and potential factors of improvement.

Looking forward, we plan to complete a

literature survey and an action plan to determine additional research needs and complete crack initiation testing, analyze those results, and document them. And that will extend out several years.

Next slide, please. In the steam generator area, we have the Tube Integrity Program, or TIP program, which has been ongoing for many years. The objective of that program is to assess non-destructive examination reliability and associated tube integrity for emerging inspection procedures and plans.

We will, by this, confirm the adequacy of industry practices used for in-service inspection and review the acceptability of advanced techniques or implementation plans proposed by industry. Our collaborators in this work are EPRI, CNSC, the Canadian regulator, KINS, and KAERI in Korea, GRS in Germany, and the French IRSN.

Current activities include completing a report on eddy current inspections and pressure testing of U-bend tubes with known PWSCC flaws, completing a report on detection of cracking near volumetric indications, and developing the regulatory analysis of industry's proposed tech spec changes for

extending the in-service inspection interval.

Looking forward, we plan to evaluate new lab inspection results related to eddy current detection and sizing, reevaluate a 2016 NUREG/CR which is a contract report for auto-analysis techniques of some of this NDE data, and continue to work with our international partners to incorporate improved inspection and analysis procedures.

Next slide, please. Reactor pressure vessel integrity has been brought up already.

Oh, go back one, please, sorry.

Okay, RPV integrity has been brought up today already and is obviously an issue of significant concern. We are continuing our ongoing research to assess embrittlement prediction formulas and improve our fluence calculations in order to evaluate structural integrity challenges. We intend to then confirm the continued integrity of the reactor pressure vessel during long term operation.

The application of this research is to enhance the guidance for RPV structural integrity and fluence calculations. And at least one of our collaborating organizations with this is the Japanese regulator.

We have completed a scoping study, that

evaluated the impacts of embrittlement trend curve under predictions, to support a decision not to revise Regulatory Guide 1.99 at this time.

We're completing the alternative ETC trend curve basis report and completing a holistic safety review to evaluate efficacy of current regulatory framework.

Looking forward, we will document fluence calculation methodology study for extended beltline and reactor internals and also complete a shallow flaw structural integrity investigation in the next couple of years, well, in this year.

Piping integrity is another issue to be monitored. We are developing, enhancing analytical methods and tools to assess the structural integrity of reactor piping systems in order to confirm the continued integrity of safety critical piping systems during LTO.

The application then is to enhance the guidance for performing piping structural integrity calculations. Collaborating partners on this work include EPRI and CSNI.

Recently, we published a NUREG on weld residual stress validation, completed a CSNI benchmark report on extended finite element modeling, this is

called the xFEM project, investigated and developed xFEM techniques for PWSCC modeling, and completed Phase 1 of the CSNI leak rate and leak-before-break benchmarks. Phase 2 is ongoing.

We also did research on structural integrity and non-destructive examination of CFRP repair, this is carbon fiber reinforced polymer repair and risk significance consequences.

Our planned research in the next year or so is to issue an update to NRC's leak rate code, to complete a CSNI leak rate, and leak-before-break benchmark exercises, and to complete CFRP repair adjustment factor testing, a risk significant study.

Next slide, please. Irradiation -assisted degradation is the catchall term for degradation that can occur to reactor internal components that are subjected to high doses of irradiation throughout their lifetime. The objective is to evaluate irradiation-assisted degradation mechanisms during LTO to confirm the adequacy of the reactor internals aging management programs.

The application then is to support reviews of internals, inspection and evaluation guidance, ASME code changes, and associated rulemakings. Our collaboration for this work includes EPRI and OECD/NEA

projects.

We recently completed cooperative research supporting testing of materials harvested from the Zorita reactor in Spain which is undergoing decommissioning now. And we are assessing further independent testing of some of the materials recovered from Zorita at Argonne National Laboratory.

We plan then to complete additional independent testing and assessment of research on the Zorita reactor internals and to initiate participation in OECD/NEA projects to perform harvesting and test reactor irradiation experiments on irradiated materials in the next couple of years.

Next slide. Nondestructive evaluation I mentioned earlier, NDE, is a critical part of ensuring the integrity of structures. Our NDE research will evaluate effectiveness and reliability of NDE techniques, confirm the adequacy of industry procedures and processes, and then in application, support reviews of ASME code modifications and proposed revisions of the current requirements.

Collaborations in this work include EPRI, IRSN, and about a dozen countries involved in the PIONIC NDE research project.

A couple of current activities, we

recently completed a report on modeling and simulation of austenitic welds and coarse-grained specimens, completed evaluation of flaw detectability under limited coverage conditions, baseline evaluation of eddy current testing for PWSCC-susceptible materials, and a report on NDE reliability issues for the examination of CASS austenitic stainless steel or coarse-grained components.

Planned research includes developing a technical basis to support guidance for ultra ultrasonic modeling and simulation, evaluating the effects of incomplete examination coverage, evaluating advanced NDE techniques, and assessing the capabilities of machine learning and automated data analysis in NDE.

Next slide. We should come to our summary slide next, I think. There we are.

So in summary, NRC conducts confirmatory research to establish the technical bases to support regulatory decisions and development of regulatory guidance documents.

The NRC staff exchanges information with domestic and international counterparts on materials' performance and aging management of nuclear power plant structures and components, and conducts

independent analyses. We exchange research results and operating experience with our partners.

Our research activities are prioritized to address potential safety significant technical issues. Long lead time confirmatory research is an important consideration in proactive aging management.

Thank you, Dan. I'll turn it over to you.

MR. MUSSATTI: Well, thank you very much, Carol.

Our next speaker is Carl Gunter from Beyond Nuclear. Carl, are you there?

MR. GUNTER: No Paul Gunter is.

MR. MUSSATTI: What did I call you? I called you Carl, I'm sorry.

MR. GUNTER: That's all right. I've been called a lot of things.

Thank you. So, you know, so just opening this slide, I'd like to quickly revisit a couple of comments germane as we proceed here.

Mr. Rosseel from the DOE referenced the Zion solutions ongoing work. And, you know, again this is all germane to, you know, building a foundation of research that is needed before the NRC can really assess how it would proceed with even more extreme license extension.

And it sort of boils down, and we've seen this comment come up within the context of the FOIA request that we have in on the Pacific Northwest National Laboratory December 2017 technical letter, but it seems that the NRC, particularly the Nuclear Reactor Regulation Division with licensing makes a, distinguishes between, you know, it would be nice to have more research information versus what the PNNL report said should be required before you proceed with the license extension.

So, I mean, that's a critical evaluation in that, you know, it needs to be recognized that what Carol Moyer has presented is ongoing research that is still in the process of arriving at some analysis. And in large part, a lot of this research isn't even really moving to the point of harvesting.

You know, we just went through the Peach Bottom Nuclear Power Plant 60 to 80 year license extension with Exelon. And Exelon and NRC, you know, basically refused to do the harvesting of the Oyster Creek Nuclear Power Station which had operated for about 49 years and was shut down and in the process of decommissioning.

And so, you know, those two are essentially identical reactors in both design and fabrication.

And so Oyster Creek is now undergoing an expedited license, or an expedited decommissioning, while Peach Bottom was granted its extension without doing the research. That's basically the question.

Next slide, please. This is a pretty busy slide, but I think it's really instructive. This is a poster session from the U.S. Nuclear Regulatory Information Conference in 2018.

And I want to note here that the slide, when you get down into this tiny print, the NRC Office of Research and Pacific Northwest National Laboratory, and again, this is before NRC had removed PNNL 27120, December 2017, before it had removed that report from three government sites.

But in this collaboration, they identify that extended plant operations and license extensions raise a number of technical issues that, quote, "May require further research to understand and quantify aging mechanisms," unquote.

The technical poster elaborated, quote, "Meanwhile, in recent years, a number of nuclear power plants, both in the United States and internationally, have shut down or announced plans to shut down for various reasons, including economic, political, and technical challenges.

"Unlike the past, when there were few plants shutting down, these new developments provide opportunities for harvesting components that were aged in representative light water reactor environments."

So now, that's end of quote, so now we've got three General Electric Mark 1 boiling water reactors decommissioning, Oyster Creek, Pilgrim, and Vermont Yankee. Are there any harvesting, are these harvesting opportunities being taken advantage of? No.

And yet the NRC is proceeding on its license extensions out to 60 to 80 years for two GE Mark 1s without doing the autopsies. In fact, what we've established is Exelon and its representative, Holtec International, have refused to do that harvesting research.

Next slide, please. But, you know, even more fundamental, we have been trying, as public interest groups, to get this harvesting program going since 1996. And we are continuing to run up against stone walling, foot dragging, and to this date, there's still not a plan for how this research is going to be paid for to the degree that is identified in National Laboratory reports that are now being suppressed.

And so, you know, to just go through this quickly, in this timeframe there were four pressurized water reactors, Yankee Rowe, Rancho Seco, Trojan, and San Onofre Unit 1, that ten, I should say 11 public interest groups back in 1996 wanted to do the harvesting on the reactor pressure vessel to get the samples for analysis and material archival of radiation embrittlement phenomenon.

These facilities, you know, in fact, Yankee Rowe was the prime candidate for going through the initial license extension process, to go from 40 to 60 years, until they were challenged on the embrittlement phenomena, at which point they dropped out. And so that spurred us on.

Now, next slide, please. The response of the Agency, however, was to ignore the embrittlement phenomenon and say, you know, we've got enough information already. And we'll certainly have it available in the future to timely address radiation embrittlement phenomenon in a manner which protects public health and safety.

Well, again, we're saying that you've got to have confirmatory analysis in these critical safety related reviews for license extension, particularly as you get more and more extreme with these extensions.

So 40 to 60, the bulk of the fleet is now in that. We still are not doing the fundamental research. There's not even a plan for how it's going to get paid for. And we're now venturing into 60 to 80. We started this discussion on 100 years.

Next slide, please. In fact, you know, all four of those reactors were buried without autopsies on the reactor pressure vessels. Most recently, the San Onofre Unit 1, the vessel was segmented and hauled off to Clive, Utah, where it is being buried.

But the same was true for Yankee Rowe. It was hauled off to Barnwell, South Carolina, as well as Trojan, which was hauled off to the Hanford Burial Ground. And, you know, there has even been suggestion they were going to do a grave site autopsy. But no, it was the kick and roll into a burial for the Trojan. And the same was true for Rancho Seco.

Next slide, please. So that brings us to the energy solution, the design harvesting experience. You know, this in fact was a slide that our Freedom of Information Act has revealed of a meeting between the NRC and several agents looking specifically at the harvesting experience and future.

These were two meetings, March 7th and March 8th, 2017. The public was not invited nor

did the public even know that these meetings were occurring. So we will call that a secret meeting related to a highly controversial project that's being looked at.

Next slide, please. And this again is a slide about the Energy Solutions, the work that they were doing for Exelon, Commonwealth Edison. But I think the key bullet here is that the decommissioning agent for the utility, and it was also doing the harvesting work that has been referenced by the DOE and the Office of Research, is that there is no financial incentive to support harvesting.

Again, we've run up against a concern that, while contract work that suggests that harvesting should be required for the confirmatory analysis, the subsequent license renewal, nobody is willing to pay for it.

And particularly that is a concern for those public interest groups that are trying to address these issues in the context of a very strenuous, narrow review process that's provided before the Atomic Safety and Licensing Board. And so to effectively suppress the scientific evidence, you know, handicaps legitimate license renewal proceedings.

Next slide, please.

MR. MUSSATTI: Paul?

MR. GUNTER: Yes, sir?

MR. MUSSATTI: You're beginning to infringe on the next person's time. And that means that they're not going to have as much time to go. How much more do you have here before you can wrap up?

MR. GUNTER: I can go through it pretty quick.

MR. MUSSATTI: I would appreciate that. I'd like to let all the other presenters have as much time as possible too.

MR. GUNTER: Okay, I thought I was last presenter on this.

MR. MUSSATTI: No, there's two more to go.

MR. GUNTER: Okay.

MR. MUSSATTI: You're the last one that shows on the schedule before lunch, but there's two more on the schedule.

MR. GUNTER: Okay, thank you.

So again, this is the December 2017 report. You can reference it in the material, but it suggests that they gathered their information on scores of knowledge gaps that are identified in the scientific literature, including the expanded

materials degradation assessment, the EMDA that's been referenced prior here. And those are knowledge gaps that are recognized, that disappeared (audio interference).

Next slide, please. This is the revision that came out in March 2019. The references to knowledge gaps have been sanitized in this, and as well as the references that the National Lab had recognized to require strategic harvesting of real world --

(Audio interference.)

So I believe that's the last slide on here. Is that correct? Is there a next slide?

So just to reference this for you, that the expanded materials, the EMDA report, that report, which still stands, it's in NRC ADAMS, the term knowledge gaps is used 40 times in the EMDA just in Volume 2. And there's a couple of examples.

But there is obviously, you know, these knowledge gaps were not deleted. And yet it seems that the Agency and the industry are more concerned about messaging than they are about doing the necessary research. So this type of treatment doesn't fuel public confidence in the technical review process for age management, and particularly these operating

license extensions that are more extreme. Thank you.

MR. MUSSATTI: Okay, thank you very much. I don't think our next speaker, Mikhail Sokolov, from Oak Ridge National Laboratories, is going to be able to handle his whole presentation in ten minutes. Is that right?

Mikhail is probably not even online yet. What I was trying -- are we there?

DR. ROSSEEL: Dan, this is Tom Rosseel. No, that's not sufficient time to give his presentation.

MR. MUSSATTI: Yes. What I was hoping to do is we had gathered about 15 extra minutes worth of time in this morning's session. And I was going to try and squeeze in one more speaker this morning to allow more time for public comment afterwards.

But that's not going to happen. So what I think we need to do right now is, according to the agenda, we'll go to lunch right now at ten minutes until 12:00, and we'll come back ten minutes early at about 12:35. Does that sound reasonable to everybody?

DR. RODRIGUEZ: Yes.

MR. MUSSATTI: Okay, then we're officially in recess until 12:35. Talk to you later.

(Whereupon, the above-entitled matter went

off the record at 11:50 p.m. and resumed at 12:35 p.m.)

MR. MUSSATTI: Welcome to the afternoon session.

As a reminder, when you're speaking, speak slowly and clearly, so that the court reporter can get your information. And as we go through this, if you are speaking as a public member or doing any presenting, make sure that your background noises are eliminated as much as possible.

Try to stay on topic as much as possible. We want to get information related to what we're trying to do, not just to relate information in general. And we can help you with other issues, if you'll just send us an email, and we can work it out with you.

Our next presenter is Mikhail Sokolov from Oak Ridge National Laboratory.

Mikhail, are you there?

DR. SOKOLOV: Yes.

MR. MUSSATTI: All right. And I can hear you. So, you're good to go.

DR. SOKOLOV: All right. Yes, good afternoon.

The topic of my presentation will be about

reactor pressure vessels and, in particular, option for extended operation as thermal annealing of reactor pressure vessels.

Once again, I am from Oak Ridge National Lab, Materials Science and Technology Division.

Next slide, please.

As a topic of this presentation, it's mostly related to subsequent license renewal, and it has been basically achieved by proving that critical materials are able to satisfy current regulatory requirements at such extended life of a nuclear power plant, and RPV is a critical component of the entire plant that defines pretty much the life of the entire plant.

For first units Turkey Point Units 3 and 4, the critical component, the critical material within RPV is the circumferential beltline weld. And it did pass acceptance, but mostly by applying the Master Curve Rule to define reference transition temperature at zero.

It is anticipated that most units applying for subsequent license renewal will use a similar approach to justify regulatory requirements from the RPV point of view.

While it's a really valuable approach,

once this margin is used up, the nuclear power plant will not be able to extend its operation because RPV will reach the maximum allowed at the reference transition temperature.

The only technology that has been demonstrated both internationally and in the United States to extend the life of the RPV, and as a result, the life of a nuclear power plant, is thermal annealing.

And so, I put the very simple cartoon in the righthand showing what it means. In this cartoon, I put, obviously, a red line saying that's the maximum allowed RT, reference transition temperature, that your RPV material can work out to.

And if you see on the lower, on the left part of this cartoon, dark blue exemplifies how embrittlement or the degradation of fracture toughness and transition temperature happened as a result of (telephonic interference). You can really first raise in the transition temperature. Eventually, it starts leveling off. But, from that we know, it never quits embrittling. It continues to degradate as we keep RPV under exposure to neutrons. It slows the rate, but it never quits. So, sooner or later, you will reach this maximum allowed reference transition temperature.

What the annealing does -- and it's exemplified by the green line -- it recovers property of your material, not always fully, but partially or fully, as a result of applying the thermal annealing. Thus, you are removing the major determining property of RPV material to almost original condition, and when you start irradiation, which is demonstrated on this cartoon with a light blue color, then you can pretty much extend life indefinitely of your material, or not necessarily indefinitely, but a really long time after performing annealing, and it is all the issue related to RPV.

Next slide, please.

On the next slide, a little bit of a definition. What is thermal annealing? So, thermal annealing is not like traditional metallurgical anneal where temperature needs to be raised for steels up to 1000C. In the RPV community, it's actually what you need to do is heat the localized area, the beltline area of material, the material that was mostly exposed to neutron irradiation, at much lower temperature, ranging from 340C up to like 500C for a relatively long period of time, between several days and up to one week. There's no point of doing this longer than one week.

And as a result of this treatment, material mechanical properties are partially or fully recovered, but, obviously, resulting fine scale microstructure is different. So, as a result, re-irradiation response can be different due to different starting microstructure. And that's the whole point of thermal annealing.

Next slide, please.

So, thermal annealing, as of now, is the only proven option that can recover irradiated beltline material transition temperature that is lost during radiation exposure, and thus, extend the RPV service life.

The beltline region needs to be heated, as I said, to these temperatures, and there are several factors that affect effectiveness of annealing. I tried to put them in some sort of priority, and I put only major items there. It's a difference between -- that's probably the major effect -- a difference between irradiation and the thermal anneal temperature. Then, of course, time of annealing; material chemistry, and degree of preexisting irradiation damage.

Next slide, please.

So, from an engineering point of view,

there are two types of annealing: wet and dry anneals. And wet anneal is performed at the temperatures at around 340 degrees C. And the advantage of the wet anneal, that reactor coolant water can be heated by existing pumps, such that it's relatively easier to achieve because the heat pump, it's already designed to achieve such kind of temperature.

I know that wet anneals have been successfully applied for two test reactors, SM-1A in the United States back in 1967 and on a BR3 reactor in Belgium in 1984. Both of those were, as I said, test reactors. They operated at much lower temperature, 260C, then existing nuclear power plants, but both of them are irradiated for a relatively short time after annealing.

Next slide, please.

The next slide deals with dry anneal. For dry anneal, as it says, you have to perform at the higher temperature. And what you do, you use air as a heating medium inside the radiant can or you can use electric resistance heating source.

It means that, for dry annealing, you have to remove the core internal structures and primary water. And, of course, it's more complicated, then,

from an engineering point of view than wet annealing, but everything can be done; it just requires one specific evaluation to provide insurance that other portions of the plant are not harmed by the annealing procedure.

Next slide, please.

A lot of work has been performed back in the '90s on U.S. RPV steels to justify annealing, and most of the work was done here in Oak Ridge, showing that annealing at 850 Fahrenheit resulted in very good recovery of upper shelf and transition temperature, maybe partial breakout of transition temperature, while anneal at 340 degrees C, which is more characteristic for wet anneal, is of significantly less benefit.

There was also work done at about the same time by EPRI, by industry, to justify annealing specifically for Yankee Row, pretty much showing the same results as we found in general at Oak Ridge.

Next slide, please.

Not only work was done to justify annealing in the laboratory. In the '90s, a joint DOE/industry-sponsored Annealing Demonstration Project was conducted at the Marble Hill facility, which was a partially completed Westinghouse plant, to demonstrate

feasibility. An indirect gas-fired heating method was used, and it was performed to prove that we know how to justify anneal. And it was done very nicely, and you can find details in those reports.

Next slide, please.

Midland Demonstration Project was a second project. It was dedicated to justify an electric resistance heating method. That's a method that Russians were using on their reactors. It was almost ready to be done, but, as I said, DOE stopped funding for this project and this demonstration has never been done in the United States.

Next slide, please.

So, as I said, we were gearing up back in the '90s to perform thermal annealing for the U.S. fleet. And actually, there is already a guidance. The 10 CFR 50.66 rule exists for performing thermal annealing. And for those who are interested, they can look at this. And it describes various aspects of what you need to do for this.

Next slide, please.

And in the next slide, it's my concluding remarks that technology does exist and has been proven for performing thermal annealing of VVER-type reactors and western RPVs in the beltline region.

The decision to anneal may involve more than technical or cost issues. Even, for example, I just put it for consideration, but even if the thermal annealing is not technically needed, the decision to anneal could benefit extending the long-term operation because that's the only procedure that guarantees that fracture toughness properties are improved, actually, as a result of this treatment. But, of course, there are a lot of issues that need to be resolved related to re-embrittlement rate of this procedure.

And with that, thank you very much for your attention. Thanks.

MR. MUSSATTI: Well, thank you for that, Mikhail. You finished a minute or two early, helping us to gain time for our public portion of this.

And following Mikhail, we have Michael, Michael Burke from the Electric Power Research Institute.

Are you there, Mike?

MR. BURKE: I think you're skipping Frank Garner.

MR. MUSSATTI: Are my notes out-of-date? Have I skipped somebody?

DR. RODRIGUEZ: Yes, Talk 2B.

MR. MUSSATTI: I'm sorry.

MR. GARNER: With your permission, I'd like to request control.

Can you see my slides?

MR. MUSSATTI: Yes, we can.

MR. GARNER: You can see the slides? Okay.

We're going to be talking about potential materials issues that should be monitored for the stainless steel reactor internals during extended plant life to 100 years.

Now the unit we use for damage when we're talking about damage is something called a displacement per atom. You'll see this unit several times.

And that 100 years corresponds to somewhere around 200 to 250 dpa in a PWR, which is totally unexplored territory. And as I'll show later, it's a much lower dose in BWRs.

If we look inside of a Westinghouse-designed reactor, you can see a very large amount of stainless steel plates and bolts. And this material is the material that is closest to the irradiation. So, stainless steels -- and there's a variety of them that are used -- but the bulk is 304 stainless steel which comprises the majority of the non-fuel

structural components. And the physical and mechanical properties, and also the dimensional stability of the steels, are degraded with continuing irradiation, particularly at elevated temperatures. And the changes in these properties is determined to somewhat the safety, but also the economic lifetime of individual core components.

Now the proximity of the steel to the fueled core determines the rate of degradation. And in PWRs, we have a water gap next to the fuel of only a couple of millimeters; whereas, in the BWR, we have centimeters of space. So, there's about an order of magnitude difference in dose, and the rest of this talk will concentrate on PWRs as a consequence.

Now, for many years, we've been investigated first-order degradation processes, the ones that are right in our face. These are largely hardening and embrittlement, cracking and corrosion. But concerns for extended lifetime are second-order processes that we've known about even from the '70s that are slowly growing to first-order importance.

And there's also the possibility that we have unidentified phenomena at higher exposures that we have to monitor for, and we're beginning to see and expect enhanced synergisms between the various

phenomena.

The previously identified second-order phenomena, we'd have a lot of phased-in and distribution developments, mostly with respect to precipitation forming various phases that we know form in the steels under irradiation.

But, even in the '70s, we're seeing magnetic signals for some sort of nanofeatures that we never identified, and we worried that these would be seeds for future instabilities. And we'll show that toward the end of the talk,

The biggest and most in-our-face issue is transmutation-induced helium. And I'm focusing on helium-4 -- we'll talk about helium-3 toward the end -- and also, hydrogen formed from transmutation. But, most importantly, we're finding that our ability to store both transmuted and even larger amounts of environmental hydrogen and the helium bubbles. And in one study conducted about 15 years ago, we saw as much as 600 appm of helium and a very large amount of hydrogen being stored in these bubbles after 18 years in exposure. And as was mentioned earlier by Emma Wong, we worry about helium-4 and perhaps hydrogen on repair welding.

In the fast reactor program, we were much

more concerned with dimensional stability. Irradiation creep was a big concern. But, because of the design LWRs, irradiation creep is not a big concern in my mind.

What we have focused on is void swelling. If you look at this micrograph here, you see these white features. These are empty holes. The material that used to be in those holes has been transported to the grain boundaries. The boundaries have gotten larger. And as a consequence, a component that went into a fast reactor at a very high temperature, much above PWR, has actually increased in volume about 30 percent.

For void swelling, in the fast reactors especially, we have about a 6 percent swelling design maximum. Because if I get above 10 percent, I find a new form of embrittlement. And this embrittlement is being demonstrated here in the major steel that we have, and at temperatures that are not too far above the light water concern.

Now we're seeing a number of emerging phenomena. One of them is an increasing tendency toward deformation-induced martensite. So, I remove my fuel; I go in to do some maintenance. Maybe I bump or scratch the surface. I have the possibility to

induce martensite; high energy phase and it is prone to enhanced corrosion.

But, as we'll finish up this talk, we're now worrying about the formation of an iron-rich ferrite, especially on grain boundaries. And both of the above may -- emphasize the "perhaps" aspect of that -- impact corrosion and cracking.

We're seeing an increasing storage of hydrogen, and that may affect both cracking and martensite formation and it may accelerate void swelling at some temperatures.

The increasing impact, though, of previously negligible solid transmutation products, we haven't worried about solid products before, but there's going to be a progressive loss of manganese and formation of vanadium. And these will increase the ferrite and martensite formation. And if we add that transmutation with radiation-induced segregation, there is the possibility that we're going to have enhanced cracking and corrosion.

Recently, we've become aware that outside of the core, where we might like to do some repair welding, we're starting to find helium-3. And that's coming from the tritium that's in the water that's being absorbed and decaying in the steel. This is a

possibility to be a concern for long-life operation. We've measured as much as 20 to 50 appm of helium-3.

We know that swelling can occur in a bolt. This is one of the first examples where we found swelling in a bolt. You can see the voids very, very clearly. And there is a gradient in neutron fluence and a gradient in the spectral differences along the length of this bolt. As a consequence, you can see that we measured helium-4 in the bolt, and you can see that we measured significant amounts of hydrogen, depending where we were along the bolt or into the bolt.

But, most appropriately, noticed that at the head of the bolt we burned out about 7 percent of our manganese; at the bottom of the bolt about 5 percent of the manganese. And that's not too significant, except for the fact that this is only 20 dpa and we want to go to 200, meaning we're going to lose the majority of the manganese of the steel.

Now, since we've been worrying about void swelling, I'm actually going to give a positive message here. Swelling is a life-limiting phenomenon in fast reactors at higher temperatures, and we worry about whether or not it will be limiting in lower temperature PWRs. Swelling exhibits an incubation

period with a duration determined by composition, processing, reactor variables, but especially irradiation temperature. And if we're at the high temperatures in fast reactors, this swelling rate can be as high as 1 percent per dpa.

Now most of the data that we used to study swelling for LWRs actually comes from EBR-II and FFTF. And these had inlet temperatures of 365 to 370, well above most of the PWR temperature range. But we've been able to go into foreign fast reactors that have much lower inlet temperatures -- DFR in Scotland, a variety of Russian reactors. And very clearly below about 370 degrees Centigrade, swelling rate falls to much, much lower values, more than an order of magnitude, and especially at the lower dpa rates that are characteristic of PWRs.

To this date, we've never seen a swelling in a PWR that is even half a percent. And a most recent measurement just published by the University of Michigan group shows that swelling of only about .05 percent was actually observed in a flux thimble tube. But there is, however, measured about 1,000 appm of helium. The major conclusion, and a positive one, is swelling by itself is unlikely to be life-limiting in PWRs. Other synergisms that aren't yet identified

with voids may -- emphasize the "may" -- contribute to life-limiting, however.

So, the last two issues we'll show are: first of all, it was mentioned earlier by Emma that the industry is working to develop improved methods of repair welding. If we had a crack in steel -- and this is from a Japanese BWR specimen -- and you weld the crack, the helium that's here tends to come along the boundary, and when it cools, you get the original crack replaced with many more cracks. And that's only about 8 appm. And I've already mentioned that in a flux thimble tube many years ago we measured as much as 600 appm of helium.

And the industry has been working -- here is a 60 effective full-power year calculation by an EPRI researcher for combustion engineering a reactor. And this region here that is in red means I will get at 60 years more than 10 appm of helium, and that's not weldable with current technology. There's a number of projects, some of which I've been involved with, which are pushing that limit higher and higher to where welding should be possible in a larger fraction of the core.

To finish up, I'd like to show you something relatively new. And sometimes to get the

data you need, you have to go out of the U.S. So, we're actually going to take a look at something from a Russian reactor. And this is sitting on the outside of the reactor in row 10, which is far from the core, for 41 years and at very low dpa rates.

And the steel that's a little bit more prone to the instability that I worry about, if you look in this micrograph, you can see on the grain boundary ferrite, alpha phase ferrite. Here's another example of it. And this phase is very easily corroded. In fact, if you look at all of these pictures, the white features here on the grain boundaries, the dark features, and this technique on the grain boundaries, I'm not looking at the ferrite; I'm looking at the holes left in the matrix. Because when I prepared the specimen, the ferrite actually corroded away.

So, we can measure the ferrite using magnetism. Okay? But this is something we're worried about. And what we're particular worried about is that the loss of manganese and the buildup of the vanadium may actually potentiate this process.

So, in conclusion, concerning life extension to 80 to 100 years, we know that the material property changes, and especially the

dimensions of stainless steels have been observed to doses up to about 150 dpa at fast reactors, which is still a little below the 200 we're talking about for 100 years. And these reactors operate at much higher dpa rates and significantly higher temperatures than experienced in BWRs, and especially dpa rates for PWRs.

Now some of these changes that we've identified in fast reactor will occur, are occurring, in LWRs, but they'll be modified by differences in temperature, neutron spectrum, and coolant -- in this case, water versus sodium. So, well-known processes in

PWRs, such as cracking and corrosion, will continue as the exposure increases, but may -- once again emphasizing the "may" -- be modified in nature or rate as transmutation increases and new phenomena emerge.

Now I indicated there's a number of previously identified second-order phenomena. Hydrogen especially is one that we brought out. Magnetic phases is another. These have been found to be non-linear in the development. So, they're accelerating with dose. And we worry, or we should at least consider, that they might become first order in importance at the higher doses.

So, as a consequence, we're recommending that additional research and in-reactor surveillance programs continue. There are already programs established by NRC to identify new processes and their potential synergisms.

However, the positive message, to finish up, is we've spent the last decade worrying about void swelling reaching 1 percent per dpa in PWRs, and my current impression is that's not going to happen.

Thank you for your attention.

MR. MUSSATTI: All right. Thank you for staying on time for us.

I guess, Michael Burke, it's your turn now. Sorry about that before.

MR. BURKE: Okay, Dan. Do you have control of the slides?

MR. MUSSATTI: We should have control of the slides here.

MR. BURKE: Okay, and can you project them for me, please?

And let me just check that you can all hear me adequately.

MR. MUSSATTI: I can hear you well.

MR. BURKE: Thank you, Dan.

Okay. So, I'm Mike Burke. I'm with EPRI

Nuclear Sector's International Materials Research Program.

What I'd like to do today is talk to you about how EPRI systematically follows the aging of plants; how we identify what issues we need to address, and then, how we identify our research programs and implement them that support aging management.

So, if you can go to the next slide, please?

As Professor Garner just indicated, a much better measure of planned aging, rather than the years of service life, is this concept of displacements perhaps in dpa, which really reflects the accumulated neutron fluids. So, as Professor Garner says, in the PWR, you will accumulate much more neutron damage on the internals and the vessel than you will in the BWR. So, a PWR with actually a shorter life may have undergone increased degradation compared to a PWR with longer life. Similarly, if we're talking in terms of thermal effects, time at temperature is more important than just pure time. So, the PWRs, again, operate at higher temperatures.

So, EPRI runs our Materials Research Programs based on these aging effects according to

these parameters: dpa or thermal age and time over particularly by temperature.

And we publish our data from our research programs in those terms. We may supply them to our utility members, and each licensee, however, confirms that their plant is satisfying the conditions of use and that their aging conditions can be correlated with degradation that we see in experimental programs.

We do perform technical work. We fund technical work at research institutes in collaboration with our colleagues at the NRC and with our colleagues at DOE/LWRS. And we've been looking at aging beyond 60 years, and because of this open-ended approach that we take, we believe that, for at least the major mechanisms, they will be extendable to beyond, the data will be extendable to beyond 80 years, if we look at those trends.

If I could have the next slide, please?

And this is quite a busy slide, but I wanted to capture these three concepts here. The first that we originally contributed to the EMDA process in 2013.

Okay. I believe there's some background noise here. Let me just do something internally. Okay. Hopefully, that's better for people.

MR. MUSSATTI: That helped.

MR. BURKE: Yes. So, we use the same approach that's in the EMDA to constantly update our information and knowledge and, also, to then support the projects that we will implement and fund.

We have something called the EPRI Materials Degradation Matrix, which is maintained as a state-of-the-art knowledge of materials aging effects for the specific degradation and mechanisms for each LWR component. We update that document every two to three years, as a form of this document is the basis of the technical knowledge, and then, in the off-years we apply that knowledge to how we're evaluating the aging degradation of the components in the plants for just the baffle bolts, the vessel internals, the vessels themselves.

And we identify what we call our Issue Management Tables, both for the PWRs and the BWRs. And you can see on the righthand side those two latest documents that were updated in 2020. So, we have, at any point in time, a constantly updated table of the operating issues that we're experiencing for our operating experience and the technical research results that are coming from research programs around the world. And if, obviously, we find that there is

a gap in that information that we need to fill, we will respond with research programs to follow that. And obviously, we try and team with the NRC and the DOE to help fund those programs and to help address the severity of the aging.

So, if we can go to the next slide?

What this does is point out four of the categories of our gaps that we have, and we identify our gaps in knowledge or our understanding of the state of knowledge into terms of how we can inspect or monitor for damage in the various components; how we can understand and assess the extent of degradation, and from that, be able to predict the future and to be able to evaluate how much life is left, though, before we get to a critical level. In responding to those calculations, if we find out there is an issue that will call for mitigation of the effect and we can do that, we have programs to try and mitigate the effect. And then, finally, there's, obviously, repair and replacement of components.

And so, let me go through the inspections since the 2010-2013 timeframe that the EMDA was started. A lot of very good work has been gone into, developed for visual inspections and ultrasonic inspections, particularly of the internals. And I

will be talking about the whole process in a little while in another slide.

For reactor vessels, we have the Surveillance Capsule Programs that are still running for the operating plants and, also, consolidated materials to try to extend that database.

Similarly, we have information on the much more highly irradiated internals materials from the studies we've done of extracted baffle bolts, studies of materials harvested from other reactors, and, also, from the flux thimble tubes that go through the very heart of the core and actually see the highest dose. So, we have had programs to follow those materials after significant irradiation and measure the properties and document and trend the degradation.

Mitigation approaches. We have water chemistry approaches to reduce the severity of the effect. What we're showing here is a water-jet peening process, but there are laser peening processes which are used to modify the surface residual stresses to mitigate against residual surface effects in stress corrosion and cracking. An alternative, very simple form of mitigation might just be the removal or displacement of piping supports to avoid the resonances that cause fatigue damage.

And finally, replacements. I'm not sure if it's recognized how much repair and replacement actually has gone on in nuclear reactors, the light water reactors, over the past 20 years. Vessel heads have been replaced with less susceptible material, Alloy 690 instead of the Alloy 600. The pipe elbows have been replaced, and baffle bolts, as I think Professor Garner related to, have been replaced as well. So, replacements have been developed and validated by EPRI's research programs.

How these gaps are translated into research programs can be shown in the next side, the next three slides, if we go to the next one, please, Dan. These are some of the BWRVIP Reports applicable to --

Excuse me?

(No response.)

Okay. These are some recent reports that the BWR side of the house has put out.

MR. MUSSATTI: Okay. Somebody's got their mute button unmuted.

MR. BURKE: Okay. Thanks, Dan.

So, here we're talking about the evaluation that was done by the BWRVIP for reactor internals aging management evaluation for extended

operations; the application of probabilistic fracture mechanics to BWR welds for extended operations, and the update to BWR -- oh, I'm sorry -- the reactor vessel focus on aging management evaluation for BWRs. These are all the 2020 reports and are being discussed with the NRC in 2021.

If we go to the next slide, please?

This is a more detailed rundown of how we deal with aging management in reactor vessel internals. This is for the PWRs. There is a whole suite of reports that have been developed under the guidance of the people running the original LTO for vessel internals: a collection of the data, MRP-211; an understanding of the modeling of aging of irradiated austenitic steels; how we would expect that aging to impact on the life of vessel internals, and how we can set inspection intervals.

And then, from the functionality analyses, you could develop the MRP-227 process for inspections to be laid out for license renewal. We've done this for the 40 years to 60 years, and we're doing this from 60 years to 80 years now. And then, obviously, that would be extended to beyond 80 years, if that was required.

We can go to the next slide.

This is for the reactor vessels themselves rather than the internal at lower dose, but they are a different material. EPRI is coordinating the reactor vessel surveillance programs with consolidated capsules for longer life. And the idea of these capsules is we take existing material that's already at the specific dose, reconstitute capsules, and place them into those reactors, so that we can extend the dose of these materials out to much higher levels than we have intended before. And this provides us added guidance for the aging of the (telephonic interference) steels.

So, we can extend the aging vessel materials, but also we are now adding onto to that research. As Professor Garner talked about, you know, as plants age, we discover features and factors that were not considered to be vulnerable to primary aging and we're extending our research to understand how irradiation embrittlement, for instance, applies not just to the vessel, but to the vessel supports; and also, how thermal embrittlement, the potential for thermal embrittlement alone might be giving us cause for concern in the low alloy steels of the pressurizers for the PWRs.

We continue to consolidate our data to

provide assessments of what information we're lacking and to provide experiments and testing of these materials to provide guidance to plants that are seeking extended operation.

If we can go to the next slide, please?

So, what we intend to do at the moment is to continue our support for extended operations.

We will continue to upgrade the Materials Degradation Matrix. We will extend our knowledge there by the next document in that continuous cycle of updating that I talked about.

After that, we would maintain our list of Issue Management Tables for BWRs and PWRs.

We will certainly seek to extend the MRP-227 process for the management of vessels.

We will certainly seek to extend the aging management of reactor vessel internals.

We will seek to extend our capsule research and even vessel research from harvested plants for the reactor pressure vessels.

We have in the past pursued materials harvesting.

We collaborated with the NRC on how listing materials in the early 2010s from the research reactor, from the research and testing on those

materials, from which we got some very pertinent information for the aging of materials for the pressurized water reactors.

We are seeking to continue to do this work. We have obtained baffle bolt materials from plants. We have obtained flux thimble tubes, which, as I said, are the most highly irradiated stainless steels. We have funded research on those and compiled our database in MRP-211.

I will seek, also, to pursue, once we find out how we can follow aging degradation, we'll seek to have solutions in terms of mitigation to slow down the effects and replacement options for components.

At that point, I believe that's my last slide, and I can turn it over to Dan to go to his question-and-answer session.

DR. RODRIGUEZ: Dan, if you are speaking, we can't hear you.

MR. MUSSATTI: Well, thank you for that. That was some of the best, eloquent stuff I've ever said, too.

I would like to thank everyone for staying as close to on time as possible.

According to the agenda that's up on your screen, we've got until about 1:45 to take on public

comments. That's about 24 minutes.

So, I'd like to ask our operator on the phone, who's first in line?

While she's getting that information for us, please remember to keep your comments short, to the point. Speak clearly. Make them last no more than a couple of minutes, so we can get as many people on as possible. If you have a followup question, wait until the end, so that as many people can contribute as possible.

And I understand we have a new operator. It's not Jennifer anymore?

OPERATOR: No, it's Erica.

MR. MUSSATTI: Erica, do we have anybody on the line?

OPERATOR: Yes, sir, we do. We have a question from Pamela.

Your line is now open.

MS. GREENLAW: May I defer my question until later?

MR. MUSSATTI: Sure. There's no guarantee we'll get back to you, but we'll try.

MS. GREENLAW: Well, okay. Because it's just a little off-topic, in fact, I might put it in the chat because it might be that much off-topic.

It's related, but it's --

MR. MUSSATTI: Well, thank you.

MS. GREENLAW: -- I'd rather defer and let people who may have solid questions.

Thank you.

MR. MUSSATTI: Bless you. Thank you. We'll look for it in the chat.

Next?

OPERATOR: The next question comes from Erica Gray.

Your line is now open.

MS. GRAY: Hello. Can you hear me?

MR. MUSSATTI: Yes.

MS. GRAY: Yes, thank you for taking my call again. Again, I'm calling from Richmond, Virginia and I'm also with the Virginia Sierra Club.

I just wanted to mention a couple of things. No. 1, as it goes forward, the renewal by annealing, I think that's only been until 2019 that that Russian plant actually did a 1,000 megawatt reactor with the annealing. The other reactors were smaller. And so, it's basically a very new process. So, I don't think it has a lot of experience under its belt for that.

Plus, as it goes for conditions, I'm not

sure what megawatt of fuel burnup they were using in those experiments. You know, I live in Virginia, and Surry was the very first nuclear power plant that put their spent nuclear fuel in dry casks. And over the years, the burnup has continued to go up, and to the point where in 2014 Dominion made North Anna, with the Department of Energy and EPRI, the test pilot program for high burnup nuclear spent fuel. That program, by the way, does not finish until, I believe, 2028. And so, you guys are already way ahead of the game.

We don't even know how this high burnup fuel is going to be responding in the canisters that we have developed now. And so, that's a whole new can of worms that I haven't heard anyone talk about with expanding license renewal.

We potentially could be having a really big problem with being able to store this fuel. I don't even know what burnup we're at now. I did read an article by Bob Alvarez in 2016 where, you know, basically, as usual, the NRC has allowed industry to put the cart before the horse and to continue raising the amount of burnup that it can go to. I don't even know what we're at today.

You know, the average burnup, when this all began and when canisters were developed, was

somewhere in the vicinity, if I'm not mistaken, somewhere around 35 or so. Then, they developed this test project that's supposed to be around 45, and it's gone up to 50, 55. You know, if it's left up to industry, in that one article that I read from Mr. Alvarez, you know, they want to do up to 75. This is ridiculous.

I mean, I don't know what you all are basing what on, but you're putting the cart before the horse again. We don't even know what we have.

That's all I have to say. Thank you.

MR. MUSSATTI: All right. Thank you for your comment.

Who's next, Erica?

OPERATOR: No further questions on the phone at this time.

As a reminder, to ask a question, please press *1.

MR. MUSSATTI: Okay. That's unique.

Hector, do we have anything on the chat line that we need to talk about?

DR. RODRIGUEZ: No, we don't have any raised hands for comments from the public or we don't have any questions in the chat to address at the moment.

MR. MUSSATTI: Okay. Erica, could you please turn your microphone up on your telephone for us?

OPERATOR: Sorry, sir, can you hear me?

MR. MUSSATTI: Yes, much better. Thank you.

OPERATOR: Okay. We do have a question over the phone. It comes from Pamela.

Your line is open.

MR. MUSSATTI: Thank you.

MS. GREENLAW: Thank you very much. I hope you call can hear me. Can you hear me?

MR. MUSSATTI: Yes, we can.

MS. GREENLAW: Hello?

MR. MUSSATTI: Hello.

MS. GREENLAW: Okay. Great. Okay. Yes, can you hear me now?

MR. MUSSATTI: Yes, ma'am.

MS. GREENLAW: Okay. Great. I'm going to stand still. I think I lost a signal while I was walking.

Okay. My question about the timing of the investigations that you want to do to extend licenses, does this also include extending licenses for facilities that are creating or fabricating parts and

fuels, and so on, along with the nuclear plants that are producing the energy?

And I ask this because I've poured over the site, NRC's website, looking for rules for the producers of materials and the licensing of those, and it's all about the power plants and nothing about the suppliers or vendors, or anything, anyone who was supplying to the plants.

And so, if you're going to extend licenses for the plants, would that automatically mean you are going to be extending licenses for vendors? I would think they would be part and parcel.

MR. MUSSATTI: Okay.

MS. GREENLAW: Do you understand my question? Do I need to rephrase it?

MR. MUSSATTI: No. We're here to answer your questions as much as possible I guess, but I don't have the skills for that. Does somebody on our team want to take that?

MR. BURNELL: Hi, Dan. It's Scott Burnell. I'm one of the Agency's spokespeople.

The short answer to your question is no. If facilities have a license or other certification from the NRC, it is only for a specific duration, and when that duration is coming to a close, the facility

has to come back to the NRC to seek renewal of either the license or the relevant certification.

So, even when we're discussing license renewals for reactors, that does not automatically extend any other facility's license.

MS. GREENLAW: Okay. I'm going to be specific. Westinghouse's fuel fabrication plant in Hopkins, South Carolina, was licensed for 20 years, a 20-year license. Their application, with the full support of the NRC, is to renew a license for 40 years, which is two full generations during which the public will not have to be consulted about anything that is going on.

And so, I've got a lot of concerns about why, suddenly, they want a 40-year license when 20 years is plenty, considering the issues that they've had. And this is why I'm saying it seems to be tangential, and I know you're going to have your 40-year license extension meeting in February. But I need to know where to read about these sorts of things because, again, I agree, there's a lot of cart going before the horse.

MR. BURNELL: Thank you. I understand your question a little better now.

MS. GREENLAW: Okay.

MR. BURNELL: The staff that are in this meeting are dealing particularly with reactors. The staff that deal with the license for the Westinghouse fuel facility, that's a different set of people. So, we can't directly answer your question here.

As I said in the meeting chat -- well, I'll just repeat it here. Please email me your question, S-C-O-T-T dot B-U-R-N-E-L-L @nrc.gov, and I'll get the appropriate staff together to respond to your question.

MS. GREENLAW: Well, if I could get the website that would cover this issue, that would be even better. I've already spoken -- well, anyway, I don't want to take any more time with it.

But thank you very much.

MR. BURNELL: You're welcome.

MR. MUSSATTI: Okay, Erica, have you got any --

OPERATOR: No further questions on the phone at this time.

MR. MUSSATTI: Okay. No further questions. I'm assuming we also have --

MS. LEE: Actually, I have a question. The *1 does not work, unfortunately, which may be why people aren't calling in.

MR. MUSSATTI: Let me ask you a question. Did you call in on the bridge line number that we gave you or did you just --

MS. LEE: Well, I find it hard to call in when I'm on the phone.

MR. MUSSATTI: Fine. So, who are you?

MS. LEE: Michel Lee, Council on Intelligent Energy and Conservation Policy.

I really just would like some elaboration, if possible, from Professor Garner about the second-order processes that he mentioned. You know, specifically, maybe to clarify what identified phenomena is being found and, also, expand a little bit on the enhanced synergisms among phenomena.

MR. GARNER: I made the distinction between first order and second order based on is it causing us any problems right now or is it just a scientific observation that we should watch because maybe it will get us later. So, all of the first-order ones are ones we've already been fighting. The second-order ones are ones that we've seen evidence of, but they weren't really doing anything bad to us. Okay?

So now, we're watching them because they're non-linear. As the dose goes up, the effect

goes up at a higher rate than a factor of two. And we know that some of the second-order ones can start talking to each other. The formation of martensite, cracking, a lot of phenomena are very sensitive to hydrogen. And so, that's where the synergisms that we talked about come along.

And we also mentioned that we didn't used to worry about the loss of a little bit of manganese. But if we go to a higher dose, we should start worrying about it because we can see that it might be helping the other cracking issues.

I hope that answers your question.

(No response.)

MR. MUSSATTI: Okay. Erica, have we got anybody on the line?

OPERATOR: No questions on the phone at this time.

MR. MUSSATTI: Okay.

DR. RODRIGUEZ: Daniel?

MR. MUSSATTI: Yes?

DR. RODRIGUEZ: This is Hector.

The people who raised their hands now can unmute themselves, if they would like to make a comment or a question.

MR. MUSSATTI: Okay. Does anybody that

raised their hand want to make a comment? Or do you have a question?

MS. WARREN: This is Barbara Warren. Can you hear me?

MR. MUSSATTI: Yes, I can.

MS. WARREN: Oh, okay. So, I have a comment.

I want to mention that the first presentation, immediately, I saw that, when you were talking about -- you showed a slide of equipment, and immediately I saw that the (telephonic interference). I wanted to address the fuel here.

In 2010, the Nuclear Waste Technical Review Board produced a report in which they highlighted, repeatedly and extensively, the fact that there was so little research done on high burnup fuel. And they called for extensive research to be done. That has not been really launched. There's very little research being done. Really one major study. And so, that's a major problem. In 2016, the Nuclear Waste Technical Review Board renewed their request through a letter to DOE for more research on high burnup fuel.

And then, I also want to mention, in terms of the NRC, a proposed rulemaking was proposed to the

NRC. It took quite a few years. And eventually, the staff developed a proposal to be adopted by the Commission. It was put before the Commission in March of 2016. And that was to deal with the issue of CRUD accumulating and causing a special problem in a loss of coolant accident at reactors. The SECY that that was based on was SECY-16-0033.

Unfortunately, since 2016, as far as I know, the Commission never took up that issue. And I would just like to understand -- this is a potentially serious issue that would affect the equipment in a loss of coolant accident at reactors -- why we're separating things so extensively rather than looking at an entire system, and what the effect of high burnup fuel might be on these metal components that you're dealing with. We know that the fuel rods are impacted, for example, by CRUD on the high burnup fuel. So, I would really like to understand why we're not doing a more comprehensive set of research to really understand these systems.

Thank you very much.

MR. MUSSATTI: Thank you.

Frank (sic), do you have something you want to add to that? That was your topic, wasn't it?

MS. WARREN: Is there something I want to

add?

MR. MUSSATTI: No. I was asking our speakers if somebody wanted to comment. I might have asked the wrong one, though.

MS. WARREN: Okay. Thank you.

MR. BURNELL: Dan, it's Scott Burnell again.

Barbara, thank you for providing us that comment. For more information on that particular SECY that you mentioned, it will be best if you can email me. And again, I'll get the appropriate staff to get back to you on it.

And as we had discussed early on in the meeting, license renewal is a specific process that looks at a limited set of issues to determine whether or not it's appropriate to allow the plant to continue operating for an extended period. And if we find it appropriate, the plant is subject to all of our normal inspection and operating oversight, which would take into account the issue of CRUD that you raised and will also keep track of the performance of the fuel as it reaches higher burnup levels.

MS. WALKER: Kalene Walker.

MR. MUSSATTI: Excuse me?

MS. WALKER: Kalene Walker. I'd like to

comment.

MR. MUSSATTI: Okay.

MS. WALKER: Questions I have: what are some of the key parts of the reactor systems that are not inspectable? And how can you possibly monitor these to prevent failure? Where are the earthquake safety evaluations for partial cracked systems that are not or cannot be repaired or inspected, and why isn't this included in the scope? And thirdly, why aren't you including in scope increased flood risk due to rising sea level/record-level flooding conditions?

And then, I also have a comment that's, basically, to the NRC technical people, just to let you know what your colleagues are doing in the spent fuel management department. They're allowing the canisters, the fuel to be stored in canisters that they know have stress corrosion and cracking issues. They know they cannot inspect these cracks. They can take pictures, but they cannot inspect them. And they know they have no repair technology, and they know there's no systems in place for repackaging of failed canisters. The fuel is too hot to return to the pools and it's never been done.

So, I feel that we're basically going fast down a bad road here. I think the fuel considerations

must be integrated into the overall analysis of any license extensions for any power plant.

Thank you.

MR. MUSSATTI: All right. Thank you.

MR. BURNELL: Kalene, hi. It's Scott Burnell again from the Office of Public Affairs.

You had placed those questions in the chat earlier in the meeting and I had replied that it would be best if you could email them to me, so that we can get back to you with more detail than we can during this meeting. We are starting to run short on time. So, again, if you can email me those questions, we will get you information in as much detail as we can.

Thank you.

MS. WALKER: But I'd ask that the questions be answered by technical staff and not by a public affairs person. Thank you.

MR. MUSSATTI: Okay. Thank you.

PARTICIPANT: Hello. This is Bill McConna (phonetic).

MR. MUSSATTI: We're going to move on to the next topic, so that we can stay on schedule here. It's getting close to 1:45, when we're supposed to begin.

So, once again, I would like to remind you

that, when you are speaking, you need to speak into the microphone, speak clearly, so that we can get a good transcript of what's going on. And let's see if we can get through this with enough time left over for some more extended comments with the public.

I'd like to start with our third topic now, the technical issues for civil structures and concrete, with our first speaker --

DR. HISER: Hey, Dan? Dan?

MR. MUSSATTI: Yes?

DR. HISER: This is Allen Hiser.

Can I just suggest that, the folks that had raised their hand, we will get to your comments. It may not be after the next session, topic 3; it may not be after topic 4, but we will get to it. So, please, stay with us and we will make sure we get your comments.

MR. MUSSATTI: Okay. Thank you. That's a good point. I haven't been monitoring the side chat over there because there's been a lot of other stuff going on. So, I must have missed that discussion with you guys.

Mita, are you ready?

MS. SIRCAR: Yes. Do you hear me?

MR. MUSSATTI: Yes, I do.

MS. SIRCAR: Okay. I'm Mita Sircar from U.S. NRC, Office of Research.

And now, today I'm talking about the current research, not covering all the research that's going on. So, just to clarify that.

Next slide, please.

The regulatory research for long-term operation, our focus of discussion today is radiation effects on concrete structures.

The NRC is performing confirmatory research and we have joint research activities, also, with DOE and EPRI.

We also have plans for harvesting irradiated concrete from decommissioned plants.

And we are working with external organizations and collaborating with them.

And finally, I'll go with the summary.

So, our mission is RES, Research, is to provide technical advice, tools, and the information for meeting the NRC's mission that includes resolution of the safety and security issues; also, helping to make regulatory decisions, and promulgating regulations with the guidance documents.

Our objectives for this is to:

Enhance the knowledge for reviewing

license renewal applications.

There are some situations when some information is available, but we are continuing research to reduce the uncertainty.

We provide technical bases for generic guidance, not plant-specific.

Also, we are continuing research for if there is any update that's needed for the regulatory documents, SLR guidance, and, also, develop Interim Staff Guidance.

So, our plan is to continue focus on aging management for systems, structures, and components for long-term operation of the nuclear concrete structures.

Why we are doing it on this topic?

We have seen in the earlier presenters that they have mentioned about the NUREG/CR-7153, Volume 4, which is also known as the EMDA Report. It's Expanded Materials Degradation Assessment Report. The Volume 4 presents the "Aging of Concrete and Civil Structures". This has identified that radiation effects on concrete had low knowledge and high significance.

Since then, since, I would say, last four or five years, we are conducting research. Knowledge

has improved, but further research can help address future technical issues and uncertainties.

Structures exposed to radiation have a special problem compared to the other structures. This is in the inaccessible area, so inspection of those concrete structures is not possible.

So, to be ready for the advanced and newer technologies and the regulatory implications. By this, what I mean is monitoring using more advanced technologies, sensors, instruments, maybe cameras, more advanced technologies rather than relying on just facial examination.

Our confirmatory research activities.

The first research that we started and completed the report, it was done in Argonne National Laboratory. What we studied is we studied all the information that's available and developed a report on the state of knowledge in radiation-induced concrete degradation and its implication on nuclear power plant structures.

We also have reviewed some EPRI reports, and those we provided our feedback to EPRI on our understanding/research.

We have developed a methodology for radiation transport through the concrete, meaning the

transport of neutrons and temperature through the concrete thickness, or any of the structures that's exposed to irradiation. This work was done in Oak Ridge National Lab and the report also completed last year, the summer.

We have recently completed another work which was done in Argonne National Laboratory along with the University of Colorado at Boulder. In this model, we have developed a model -- in this model, we have developed this model to predict the properties of degradation of the concrete properties which can be utilized in the finite element model for structural evaluation.

We are also continuing in-house work for developing the methodologies for structural evaluation and damage extension.

Another work has started in 2019, and it will continue until 2023. This work is in Oak Ridge National Laboratory. Through this contract with Oak Ridge National Laboratory, we are performing limited testing, modeling, and numerical simulations of irradiated concrete behavior. This has a focus on how the steel and concrete bonding will behave under evaluation of irradiation-induced damage.

So, with this, we are doing a limited-

scope experiment in the Czech Republic, LVR-15, to characterize the effects of irradiation on the bond properties of steel and concrete, rebar.

Also, we will develop a model and validate the model with the data that we get from this experiment. This experiment will also include the University of Tennessee and Oak Ridge National Lab who will study the size effect and, also, develop the upscaling of the modeling strategy to verify applicability and significance of small-scale accelerated experimental data. Because such reactor specimens are small, so we will try to get an understanding how the small-scale data can be applied for the large-scale structural evaluation.

Another interest area is the rate effect. The actual power plant has much lower radiation level than the research reactor. Earlier date from Japanese testing in JEEP-II versus our experiment in LVR-15, there is a big difference. So, this will give an opportunity to see if the rate effect is causing any difference or not.

There are some other areas that we need to develop better understanding. So, here I have some future focus areas. For modeling of the damage and evaluation of the structure:

We need to know better about the confinement effects because the experimental data are all free expansion of the specimen.

Steel-concrete bonding, we are bringing a limited-state experiment and we need the understanding better from there.

Cyclic loading, all the testing are under study. So, how the structure will behave under cyclic loading, seismic, dynamic load.

Rate effects. As I said, the nuclear power plants have much lower radiation compared to the research reactors; scale effect as well.

And the creep effect. There is no data available on the creep effect of the irradiated concrete.

Harvesting it is very important because this will give us in the real structure the knowledge of the effect of damage. So, we are exploring for the opportunities where we can harvest from a plant under decommissioning. And this particular effect of evaluation on concrete, it is more on the PWR reactor than BWR. And, also, aggregate is a variant. Some types of aggregates are more susceptible than the others. So, we are careful about which plant will be suitable for harvesting.

Also, as I said, this makeup of inspection and monitoring of the bioshield, this is inaccessible. So, we need to have a better methodology how to monitor these structures.

Harvesting, as I just said before, it is important to understand the structural, the damage of the concrete and how it affects the structural performance. So, the real-life concrete would be very helpful and beneficial.

An opportunity for harvesting from SONGS has reemerged and we are pursuing that. We have developed a joint working group under our MOU with EPRI and Oak Ridge National Lab, and we are working together.

Next slide, please.

Now for the external collaborations:

Yes, first, as I said, we have a joint research program with DOE and EPRI.

Also, we have bilateral and multilateral agreements with other countries.

There is an International Committee on Irradiated Concrete, and NRC actively participates in that.

We have strategic international partnerships with France, Japan, Canada. Japan has a

very extensive research program on irradiation effect on concrete, and we are closely working together.

We participate in IAEA for IGALL, SALTO, and TSO.

We also work NEA/CSNI. We are participating in VERCORS, which is a containment program, test program, and also ASCET, which is an ASR study.

Next one.

So, in summary:

NRC Research will continue to collaborate with our domestic partners DOE and EPRI on concrete research to reduce regulatory uncertainty.

We'll also leverage our stakeholders to help facilitate regulatory research supporting safety during LTO. And we are talking about leveraging because we are also careful that we just do not duplicate work, the knowledge that already has been developed. We carefully try to take advantage of those.

Regulatory research supporting operational safety will continue to support review of license renewal applications, revision of aging management guidance, and associated regulatory documents.

With this, my presentation is complete.

DR. RODRIGUEZ: Dan, if you are speaking, again, we can't hear you.

MR. MUSSATTI: I keep doing that. It keeps shutting me back off. I'm sorry about that.

Our next speaker is Yann Le Pape, Oak Ridge National Laboratory.

DR. LE PAPE: Hi. I'm hearing an echo. Is that something that can be resolved? Hello? Is that any better now?

MR. MUSSATTI: Yes, it is better.

DR. LE PAPE: Okay. Very good.

So, yes, good afternoon. I'm Yann LE Pape from the Nuclear Energy and Fuel Cycle Division in Oak Ridge National Lab. And I'm going to discuss a little bit concrete aging, some mechanisms of importance, and some potential synergies that we may be interested in looking at in the future.

Next slide, please.

So, as a first word, just to recall with everybody what we're talking about, there are multiple concrete structures in the nuclear power plants with various levels of safety associated with them. Our primary concern goes to, of course, the containment building, but also what's inside the containment building and the bioshield.

One very specific aspect of concrete is that, by nature, it's always built with materials found nearby. And so, all the different concretes that you may find in the very plant are significantly different. In particular, the aggregates that are used are very different. As a consequence, the mechanisms are potentially more or less adverse.

Next slide, please.

So, as mentioned by the previous speaker, a lot of the research regarding the second license renewal was motivated by the so-called Expanded Materials Degradation Analysis Report from 2014, in which a number of mechanisms that are shown here on the left image have been evaluated. And based on this, we had what we could call a priority list of mechanisms for which we needed to get more research.

The circles mark, basically, where we were in 2014, and the arrows mark where we think we have moved and where we are at the moment.

One mechanism is irradiation. The other is ASR. I'm going to talk about these two mechanisms; plus, I'm going to talk a little bit about corrosion now.

Next slide, please.

So, in a nutshell, what is irradiation in

concrete? Well, under neutron bombardment, the aggregates forming minerals tend to amorphize. And the result of this amorphization is that they just swell. And because all rocks are formed with numbers of different minerals, have a specific microstructure, the rocks are more or less susceptible to expansion and cracking. The result of that mechanism, plus the fact that it produces potentially some cracks in the concrete, leads to a degradation of the mechanical performance.

I have to say that all the data I'm showing here are only based on test reactor data and not on in-service data. And hence, I just want to emphasize the need for harvesting here.

So, basically, this is the issue we're trying to solve. Above a certain level of (telephonic interference) neutrons are essentially in a square. There is a reduction of the properties, and this is typically the range of influence that we are expected to see over long-term operation.

Next slide, please.

So, the second mechanism is alkali-silica reaction. That's a chemical reaction that occurs when you have present some high-level of alkali in the cement. It is very dependent on the material that was

used and, also, on the presence of reactive silica. So, fully crystallized, if you will.

What happens is that, with the presence of water, there is a dissolution of that silica and the formation of a gel absorbing water, pressurizing the structures, and, ultimately, creating some microcracking, as is shown on the photos to the right of this slide. These have consequences on the performance, the materials performance, but also potentially on the structural performance.

Next slide, please.

The other mechanism is quite widely known. I'm sure you've all experienced, you have seen that somewhere. That rust on the concrete wall, that's corrosion. Naturally, steel is present in concrete just because you need the reinforcement. Concrete is a poor material in tension.

At a normal state, the steel is passivated because the concrete that is there has a very high pH. But what happens is that, in the presence of chloride, if you are near the ocean or if there is an extensive use of deicing salt, there is a penetration of these chemicals in the concrete, the porosity of the concrete.

The other mechanism is the natural

combination which is much more slower mechanism. But the result of both mechanisms is a de-passivation of the steel layer, leading to the development of corrosion. The corrosion leads to the formation of rust around the rebar, and that pressurizes the concrete around it. And the main results are cover cracking and potentially a loss of bond.

Next slide, please.

So, we have developed a fairly large body of knowledge, and this cartoon tends to show what we have done. That is to say, over a certain period of time of operation, we have a good understanding for most of these mechanisms how one single mechanism would actually have an effect in the future. That's what I've plotted as mono-mechanism.

Now the question is for extended operation, and that's somewhat in line with what Professor Garner said, a secondary effect. It is what happens -- there are synergies between those mechanisms. So, that's what I mean by coupled mechanisms.

Next slide, please.

So, an example of possible synergies are actually multiple. Some of them are already known, actually. So, I'm going to try to develop that in the

next slides, but, just for your understanding, there are some effects between corrosion and alkali-silica reaction. Potentially, there are some effects between creep and fracture. That's widely documented in the literature. There are some potential effects about alkali-silica reaction. That's what we are potentially interested in.

Next slide, please.

So, that's an example. So, that's a little bit technical here. I won't spend too much time for the sake of this discussion.

But you think about alkali-silica reaction and irradiation, for instance, both mechanisms tend to create some swelling over the aggregates. And so, you could potentially think that they go hand-by-hand.

The other aspect of it is that, because of the amorphization of the minerals, those minerals are far more susceptible to be dissolved with the poor solution presence in the concrete. However, to form ASR, you need to absorb water. We don't know if the gel would be stable under gamma irradiation. So, there are plenty of questions here on this slide to address if we want to make a good statement about the potential interaction between these two mechanisms.

Next slide, please.

Another possible interaction is the one between corrosion and alkali-silica reaction. So, in that case, what happens is that, if you remember the photo I showed previously with the ASR showing some pattern cracking on the surface of the concrete, you immediately understand that this potentially will affect the transport of aggressive species such as chloride, and as a result, may accelerate the corrosion phenomenon.

Both mechanisms tend to create some cracking in the concrete. So, how these two mechanisms together could potentially be an interaction and create additional damage and microcracking, that is another question of interest for the future.

Next slide, please.

So, in conclusion, as outlined in the previous presentation, DOE and NRC and industry are actively working in their materials research programs and significant advances, progress has been made in understanding the characterization and, also, the modeling -- I don't have time to talk about this -- to develop some predicted model with some relevant uncertainties, as you can imagine.

I'm not claiming that we have solved all

the questions when we address those mechanisms independently. There are still some gaps of knowledge. I mentioned earlier that irradiation knowledge is primarily based on the test reactor data under isolation conditions. So, the rate effect, as I mentioned before, is a real question here.

There are some unknowns about the neutronic effects on creep. That could actually have a very beneficial effect by allowing more dissipation of the energy.

The bond strength was mentioned earlier.

When it comes to ASR, there is a large body of knowledge, and I'm pretty sure that Professor Sam Johnson will discuss this in the next presentation.

There are still some questions about, you know, the exact role of the mineralogy on the kinetics and the damage development. But, overall, the program conducted for the past five years has shown that the impact ASR on the structural capacities is not something to be too much worried about.

And for the future again, the question of the synergies between different mechanisms -- irradiation, ASR, corrosion, creep, and damage -- are still largely for assessment beyond (telephonic

interference). And we strongly suggest that these questions may be raised.

And I think that's the end of my presentation.

MR. MUSSATTI: All right. Thank you very much.

DR. LE PAPE: I appreciate it.

MR. MUSSATTI: Our next speaker is Sam Johnson from EPRI.

MR. JOHNSON: Yes. Hello, everyone. Can you all hear me okay?

MR. MUSSATTI: Yes, we can hear you. Go ahead.

MR. JOHNSON: Okay. Thank you all again.

My name is Sam Johnson. I'm with the Electric Power Research Institute, and today I'll be talking to you all about concrete civil structures, aging management activities, and looking at that (telephonic interference).

MR. MUSSATTI: I'm not hearing you.

MR. JOHNSON: Hello?

MR. MUSSATTI: Yes, you're fading in and out.

MR. JOHNSON: Okay. Can you all hear me now?

MR. MUSSATTI: Much better.

MR. JOHNSON: Okay. Once again, my name is Sam Johnson with the Electric Power Research Institute.

Next slide.

So, Mita and Yann have already discussed a little bit the EMDA document that was produced back in the 2012-to-2014 time range. It identified the following potential knowledge gaps for assessing concrete up to 80 years of operations. So, the main area gaps were: alkali-silica reaction, concrete irradiation, creep of post-tension containments, and boric acid attack of concrete.

A lot of research has been done on these areas since that timeframe. EPRI, the NRC, and the DOE have maintained joint roadmaps of research for alkali-silica reaction, concrete irradiation, and non-destructive evaluation.

Next slide.

I don't mean to go through all of these, but this is an example, some examples of EPRI research that has been done on a number of aging management topics for concrete structures. This is not all the research that we have done in these areas, but this is just to provide an example that over the last decade

or so there has been a lot of research, not just at EPRI, but also with the NRC, DOE, and industry as a whole on a lot of these topics.

Next slide.

When we take a look at aging management of concrete structures, you can really categorize the activities into four major roles, and this is regardless of what degradation mechanism you might be looking at for these structures.

The first one is going to be the inspection or monitoring of the structure. This is primarily visual inspections for most of your structures and components, looking for different defects and things like that.

And then, the next step is taking it to the analysis and the evaluation. So, collecting the information you need to perform your analysis and kind of a prognosis of the structure.

From there, there are always opportunities you can look at of maybe there are mitigation strategies that can be implemented or modernizations. If your analysis kind of concludes that you might need to be monitoring different parameters and things like that, then certain modernizations can be implemented to help you gain that knowledge moving

forward.

And then, lastly, if needed from the analysis and evaluation, if the repair and replacement is needed, then those activities can occur.

This process is an iterative process. It's not just a one and done. You'll continue to inspect and monitor, which will feed into it. And then, you'll have to keep going with it.

One thing that I'd like to mention is that these aging management activities don't change whether or not a plant might be 20 years old, 40 years old, 60, 80, or even 100. Now the specifics and the details might change over time. Frequency of inspections might change, based off of degradation that's seen in certain areas or for certain components. But the general process and methodology remains the same.

So, next slide.

When taking a look at how the aging management activities are the same or different, and looking at it for civil structures beyond 80 years of operation, the current aging management activities are independent of service life and are based on relevant parameters. And the reasoning behind that is the likelihood of degradation is dependent on the

environmental conditions and exposure time. So, it's not just time that drives a lot of these degradations forward; it's also the exposure conditions that they are subject to.

So, there's not any new degradation mechanisms that will occur after 80 years of operation. Things might get, you know, they can progress over time, but it's also depending on exposure time. So, it's important for utilities to understand that, as time goes on, the likelihood of degradation may increase if they are in certain type of exposure types, especially when looking at things like corrosion, if you're in an aggressive ion environment where there's high amounts of chloride and things like that that can progress over time.

Mitigation strategies. So, if utilities are looking to operate plants beyond 80 years of operation, one thing that they might want to consider is looking at mitigation strategies such as cathodic protection systems or other types of strategies that they could be implementing now that can help prolong the life, the useful life, of the structure.

And then, also looking at modernizations. So, are there enhanced ways to perform inspections and monitoring, such as using sensors for structural

health monitoring, things like that, that can provide utilities more information on what's going on with their structures and components? That can help them make more informed decisions moving forward.

So, next slide.

So, this is kind of an overview of the topics of interest that EPRI will be kind of focusing on moving forward. And it's really on enhancements and optimization of aging management activities. And this is really looking at four different areas as well of enhanced inspection technologies, which might be advanced visuals, monitoring technologies, or advanced non-destructive evaluations. So, we can get more detailed information of what's going on.

Also looking at data management. So, what's the best effective way to manage the data that you're receiving from these enhanced inspections, which could be electronic databases, data visualizations. And EPRI as a whole is looking at these with digital twins, which can provide more information for us.

Data utilization. So, maybe potentially looking into risk-informed inspections and things like that, and then, looking at the predictive analysis.

And then, trending across the industry.

We have great communication with our member utilities, with industry stakeholders, with the DOE, and with the NRC. We'll have increased and continued communications on those, and as other research is performed, looking to take that information and leverage it across our members and across the nuclear industry as a whole, as well as operating experience from plants, and as we learn more, being able to share that with others, so that they can take advantage of that information as well.

And I believe that is my last slide. So, that is all I have. Thank you.

MR. MUSSATTI: Okay. That's great. Thank you, Sam, for that.

Our next speaker is Paul Gunter from Beyond Nuclear.

Are you there?

DR. HISER: Hey, Dan, I think it's Victor Saouma, not Paul Gunter.

MR. MUSSATTI: Okay. All right. I seem to have my list jumbled up a bit. We have gone through a couple of iterations on this, and I think I've got a blend of it here. Please bear with me a bit.

Dr. Victor E. Saouma from the University

of Colorado. He's a C-10 Technical Advisor.

The floor is yours.

Did anybody hear that?

DR. HISER: Yes, we heard you.

MR. MUSSATTI: Okay. Well, we're not hearing Victor.

DR. HISER: I think he needs to be unmuted.

DR. RODRIGUEZ: I added him earlier today. Let me double-check to make sure that he's still on the list as a presenter.

DR. HISER: Yes, he shows up as a guest now.

DR. RODRIGUEZ: Yes, but he's under attendee or presenters?

DR. HISER: Attendee.

DR. RODRIGUEZ: Oh, he probably logged off and logged on again. Give me a second here. I'm sorry.

MR. MUSSATTI: We're doing well timewise. So, there's no worries.

Allen, do we have Paul on --

DR. RODRIGUEZ: He should be able to present now.

DR. SAOUMA: Okay. Can you hear me now?

MR. MUSSATTI: Yes, we can.

DR. SAOUMA: Okay. Thank you.

Well, just for the record, I'm making this presentation as myself associated with the University of Colorado, not as a technical advisor to anybody.

So, I would like to thank the NRC for inviting me. Indeed, this is the mission of a researcher, of someone who has dealt with concrete issues with three nuclear reactors and who has spent many years working on concrete aging, testing, and finite element modeling in a leadership position. (Telephonic interference) presentation later today.

Next slide, please.

I will briefly address each of these posed questions. My presentation will not be technical. It will be too early for that. However, I will take a broader view of the issue.

Next slide, please.

I agree this is a far-fetched idea, but I have learned not to underestimate the persuasion power of either the industry or its advocates.

So, yes, let's talk about extending the life of a reactor up to 100 years. Never mind that, from my limited experience, we are still having problems in regulating 40 years of operation.

But, doing so, let's also keep in mind that these are very complex and very delicate -- yes, delicate -- structures. By the time they're 100 years old, the underlying technology would be at least 110 years. Just think about it. Think about the technology of 1921 applied today in 2021 for an old house. Isn't our knowledge of seismicity and material much better than 1921 today? Would you trust a contractor to fix your old house with a 1921 code?

Next slide, please.

I will not dwell on the potential problems, as they're well-known and have been previously mentioned today. In my humble opinion, the main one is associated with the types of aggregates used. Some will make the containment building prone to ASR; others, the reactor vessel prone to irradiation damage. In both cases, we have swelling of the concrete and ensuing undesirable cracks, cracks enough in the ones that can be seen or possibly not seen, and the reactors suffering from AAR today. Think about the impact in reducing seismic resistance. Not good.

Incidentally, I have a tangible proposal. Why doesn't the NRC conduct a campaign of biopsy and properly tested concrete samples from all its reactors

to determine whether they are prone to ASR? This is simple, it can be easily done, as long as truly qualified control records are used.

Next slide, please.

I wonder, before we address 100 years or even 80 years, let us see how well we are doing in addressing the safety of the containment building suffering from ASR before first license expiration that is 40 short years.

Indeed, it's no secret that Seabrook is a perfect case study for me, as I have reviewed many, many, many documents related to it. Maybe it is part NRC procedure, but I was surprised that, for all practical purposes, the NRC has not regulated, but left it to the plant's owner to write a license amendment request with no effective leadership role by the NRC. Not surprisingly, its license was extended, and it was thanks to a small citizen advocacy group that more stringent monitoring requirements were painfully placed.

Next slide, please.

However, there's a point I want to hammer. It's 100 years. It's a lot of years, well beyond what reactors were originally designed for. What is at stake is enormous. And given the increased margin

of error, and both the historic and (telephonic interference) uncertainty in projecting into 60 years from now, we need to overemphasize safety beyond current guidelines. Simply put, we need to replace reasonable assurance by strong assurance, if you want to go to 100 years.

Furthermore, science has to take back a front seat; engineering close behind. This is of concern, as the NRC is also losing some of the highly regarded scientists and engineers, and I'm not sure that it is still hiring the best and the brightest who would be up to this huge challenge; that is, provide the regulator with sound scientific, rigorous, reviewable advices.

Indeed, in the previous slide, I took the liberty of mentioning Dan Naus, Herman Graves, and Abdul Sheikh. All three were highly regarded in the scientific community. They published papers in peer-reviewed journals, but were absent in the review of Seabrook. Who are their current counterparts? In fact, I do not know of a single person at the NRC today who has published a peer-reviewed paper on AAR, not to be confused with a report or a paper or even a consultant in that case.

So, what is important in having yet

another EMDA if we do not even apply the known scientific knowledge under the excuse that you must continue to be shackled with 40, 50, 60, or 80 years obsolete code? I would say we need to restart from scratch. Industry has most certainly recouped its investment and anything beyond 40-60 years is a bonus. Well, there has to be a price for that bonus. It is called safety, scientific vigor, discipline, or control-alt-delete, and let's reboot.

Last, but not least, I am not a zealot. Sorry, I take it back. Last, but not least, I may be a zealot, but I'm also a pragmatist. Any possible extension of collaboration effort with scientists first and foremost, followed -- and emphasize "followed" -- by engineers, good engineers even better, and then regulator and stakeholders such as utility companies and EPRI -- all of us with open minds, scientific reality, and safety of the public in our minds?

At the end of the day, and based on what I've heard today, it's a question of trust. If there is so much opposition, it is because a segment of the public, and some social like-minded, like me, occasionally, do not trust the work of NRC. I would urge NRC to be more transparent, open, and certainly

more open-minded.

Next slide, please.

Finally, should you want to better understand what I meant by the dichotomy between science and engineering, I invite you, humbly, to consult the following books of mine.

Thank you. And back to you, Dan.

MR. MUSSATTI: Well, thank you for that.

According to the schedule here, we do not have any other presenters here. I thought we did have Paul, but he is not presenting.

I'm getting feedback from somebody's microphone. Would you shut your microphones off, please? Thank you very much.

It is time now for the open discussion portion. And once again, I'd like to remind everybody to keep your comments short and to the point, no more than a couple of minutes. And again, no followup questions until we get towards the end.

We're a little bit ahead of schedule because these last two provided us with a little bit of a bonus. We should have gone about another six minutes on this last one. So, thank you very much for that time back. It will be useful when we get to the public comment period.

At this time, Erica, do we have anybody that is on the phone waiting to speak?

(No response.)

Calling Erica. the operator.

(No response.)

Am I even broadcasting?

DR. HISER: Yes.

MR. MUSSATTI: Okay. Thank you. I thought I was. I don't have an "X" on my microphone, but I can't seem to get a hold of Erica.

So, let's go to the chat. Hector, do we have anybody that's raised their hand and would like to make a comment?

DR. RODRIGUEZ: I have here Kalene Walker. I'm not sure if that's from the previous, but I'm allowing her to unmute.

Kalene, do you have any comment or questions?

(No response.)

MR. MUSSATTI: Kalene?

DR. RODRIGUEZ: We can go with the next person. I have Alfred. I don't know, again, if that's from the previous or now.

Alfred, you can unmute yourself right now.

MR. PARISH: Hello. Thank you.

Yes, I'm Alfred Parish, just a guy in Oakland, California.

And can you hear me?

MR. MUSSATTI: Yes. Yes, we can.

MR. PARISH: Oh, okay. Yes.

So, yes, I just had a quick comment and a simple, probably irrelevant, question.

First of all, I just want to thank you guys for doing all of this work. I've been doing nothing but reading about nuclear power since COVID took my job away in March. So, you know, I have some small idea of the incredible minutiae you must be plowing through right now.

And as someone who is worried about climate change and knows that renewable power is a scam, I really want these reactors renewed. Like we desperately need them. So, yes, like keep up that good work.

So, as for my question, you know, every other country has its regulator and they all work very differently. My understanding is that most other countries, they don't do these large processes with long 20-year licenses. They do shorter licenses with a kind of semiautomatic review process.

And I know we have the oldest reactors,

but I was wondering, is any sort of work being done with them to find out have they addressed these long-life issues? Is that in their automatic review processes? Is there anything that can be learned from them?

MR. MUSSATTI: All right. Who is the best person to answer that? Allen?

DR. HISER: This is Allen Hiser of the staff. Let me take that.

MR. MUSSATTI: Okay.

DR. HISER: As you said, our plants are the oldest around the world. There are some countries that have plants that are more than 40 years, but the population is not as large as ours.

We interact on a fairly regular basis with other regulators. I think Mita mentioned an IAEA program called IGALL, which is International Generic Aging Lessons Learned. There, we share experience with aging operating experience; we share aging management programs to manage aging. And we have a pretty good forum within that program to share the activities related to aging management and long-term operation.

You also mentioned that other countries do 10-year reviews, and those are called periodic safety

reviews.

MR. PARISH: Yes, yes, exactly.

DR. HISER: The purpose of those is a little bit different from what we do. The aging management that's a part of the NRC license renewal program is one piece of the periodic safety reviews. We have had IAEA compare the things that we do and what is required in the PSR process, and the conclusion was that, with all the other regulatory activities that I talked about, the regulatory process essential elements, that we provide the same level of quality of regulation as other countries do with the PSR.

We do interact on a bilateral basis with many of the larger countries in terms of the number of reactors that they have, and we share operating experience and regulatory experience through those fora as well.

MR. PARISH: Okay. Thank you. I'll look that IAEA thing up.

And again, thank you for all your really good and hard work. We need those reactors. And thank you for your patience, putting up with all the crazies.

Okay. Bye.

MR. MUSSATTI: Thank you very much for your comments.

MS. HILDT TREAT: Hello? Hi. This is Natalie at C-10. Can you hear me?

MR. MUSSATTI: Yes, I can.

MS. HILDT TREAT: I'm sorry, Erica tried to announce me a little while ago, but I think she hadn't turned me on yet. So, I was in the queue to make a comment, if now is a good time.

MR. MUSSATTI: Okay. Please, please.

MS. HILDT TREAT: Thank you.

So, for the record, I'm Natalie Hildt Treat, and I am the Executive Director of C-10. C-10 Research and Education Foundation is a nonprofit organization that is concerned with the health and safety of people who live near the Seabrook Station Nuclear Plant in coastal New Hampshire.

Thanks to a decade of work, and with Dr. Victor Saouma's tireless efforts as our technical expert, we succeeded last fall in convincing NRC's Atomic Safety and Licensing Board to order stronger requirements for how Seabrook manages the degrading concrete meant to protect our community from harmful radiation.

Although getting new license requirements

for the management of alkali-silica reaction was a partial win for public safety, our group has serious concerns that neither the plant owner, NextEra Energy, nor the NRC understands the full extent of the problem, and there are no federal guidelines on how to detect/manage ASR at the nation's nuclear plants.

As you heard, Dr. Saouma has questioned the safety of Seabrook's concrete for the current licensing period, much less decades into the future. And because ASR can take years to manifest itself, there is no way of knowing where it is silently lurking. But Dr. Saouma has told us that it's likely that the degradation is already impacting the concrete at other reactors. We don't know, and there's no cure for this slow, pernicious concrete cancer.

So, we urge the NRC to focus on the science, as Dr. Saouma said, for the current licensing basis. Should we be considering 100 years? No, we don't think so, and we believe that's the wrong question to begin with. There are no circumstances where we, C-10, can countenance the concept of having plants that were designed for 40-year lifespans remain in service for up to a century.

And aside from concrete safety, there are numerous other concerns that have never been

adequately addressed by the NRC and that are purposely being excluded from this discussion; namely, nuclear waste and the impact of climate change.

So, economic calculations will ultimately determine the fate of these atomic reactors, and the NRC, which is charged with protecting people and our environment, should not prop up these aging and outmoded power plants.

So, thank you for listening. I hope the NRC will give appropriate weight to the comments of experts like Dr. Saouma and the public from which you have sought input.

MR. MUSSATTI: Thank you very much, Natalie.

Erica, are you back on the line?

OPERATOR: Yes, sir. It seems someone on the Microsoft side muted me and I had to press *6. So, that's why you didn't hear me.

But there are no further questions on the phone at this time.

MR. MUSSATTI: Okay. I heard somebody start to speak while I was talking with Erica.

Oh, have we got somebody that's raised their hand or part of the teams?

MS. WU: Hi. Yes. This is Angela Wu from

the staff.

There are five additional hands raised. First, we'll start off with Jan Boudart.

You are now allowed to unmute your microphone and ask your question.

MS. BOUDART: I raised my hand a long time ago, and I don't have a question at this time.

MR. MUSSATTI: Okay. I'm sorry, we seem to have a gap in here with not a lot of people. If your question is still relevant to one of the earlier sessions, feel free to ask it.

MS. BOUDART: I can't organize myself that fast. Sorry. I'm going to go off. Bye.

MR. MUSSATTI: All right. Don't feel alone in not being able to organize yourself.

Who's next?

I'm getting some feedback from somebody who's got their microphone on.

But I need to find out who's next on the chat that raised their hand.

(No response.)

We have nobody else on the chat?

PARTICIPANT: Dan, according to the information I have --

(Telephonic interference.)

MR. MUSSATTI: Okay. One at a time. Who was speaking? Was that you, Allen?

DR. HISER: No. I think it may have been Angela.

MR. MUSSATTI: I think Angela was one, but somebody was on the Teams as well.

MS. WU: (Telephonic interference) hear me?

MR. MUSSATTI: Barely. You've got a lot of breakup in you.

MS. WU: Okay. Let me relocate.

MR. MUSSATTI: Oh, perfect. Perfect.

MS. WU: Can you guys hear me now?

MR. MUSSATTI: Yes.

MS. WU: Perfect.

I have unmuted Barbara Warren.

MR. MUSSATTI: Okay. Barbara, go ahead.

MS. WARREN: Okay. I just unmuted.

My name is Barbara Warren. I'm with Citizens Environmental Coalition.

I just wanted to ask a really quick question. Regarding the concrete issues, when you're evaluating these, are you (telephonic interference) --

MR. MUSSATTI: We lost you.

MS. WARREN: -- (telephonic interference)

when you do the evaluations? So, do you have a master list of the type of concrete that was used in all these reactors?

MR. MUSSATTI: I don't know what the answer to that question is.

Does anybody on our little team here know the answer to that?

MR. BURNELL: Hi, Daniel. It's Scott Burnell again from the Office of Public Affairs.

MR. MUSSATTI: Yes, sir.

MR. BURNELL: Barbara, you broke up a bit while you were asking your question. If I understood it correctly, it boils down to, does the NRC have a list of the types of concrete used at U.S. nuclear power plants? Do I have that correct?

MS. WARREN: Yes, yes.

MR. BURNELL: Perhaps Allen Hiser would be able to help us with that question.

DR. HISER: I would refer it to the structural engineers. Mita or Bryce or Andrew?

MR. PRINARIS: Allen, this is Andrew.

For some plants, we do, and it is, in part, written in the final Safety Analysis Report which we refer to when we do our evaluations.

MR. MUSSATTI: Okay. That was helpful.

So, she could go to a final evaluation that's in the ADAMS site and be able to see a relevant list?

MR. PRINARIS: Some of these are public and some of them are redacted. So, if you have a specific question, the best way to approach it would be through our Project Manager for that specific plant. Ask the specific question you were asking: what are the ingredients or what are the contents in the concrete for the specific plant?

MS. WARREN: Oh, so there's nothing central that you have available?

MR. PRINARIS: Well, the FSAR addresses concrete and addresses ingredients of concrete. And if you do go to, for example, Turkey Point Safety Evaluation Report that was issued a couple of years ago, to the best of my recollection, I believe there is a discussion in that document regarding the particular question.

MS. WARREN: Okay. Thank you.

MR. PRINARIS: You're welcome.

MR. MUSSATTI: Okay. Is there anybody else on the line?

MS. WU: Yes. This is Angela Wu from the staff. We have seven hands raised.

Next, we have Carlos Fernandez --

MR. REESE: This is Robert Reese, and I'm on the phone. And so, I don't know if it's an appropriate time for me to make a response and a question.

MR. MUSSATTI: Well, you sort of walked over the last person. What's your name again, sir?

MR. REESE: My name is Robert Reese, R-E-E-S-E.

MR. MUSSATTI: Robert, if you'd hold --

MR. REESE: I'll wait.

MR. MUSSATTI: Yes, if you'll hold on, you're next in line after we get this person that Angela was trying to get a chance to speak.

Angela?

MS. WU: Yes. So, the next person was Carlos Fernandez.

Carlos, your microphone should be unmuted now.

MR. FERNANDEZ: Thank you.

No, the question I have is around the repairing and latent -- the long research going on, inspection, monitoring, analysis, evaluation, mitigation, modernization, but I haven't seen a single slide on new materials for actual remediation or repair of concrete cracks or other defects, and so on.

Just checking, you know, and whether they were looking at (telephonic interference) and cement composites, self-sealing cement composites for those purposes. So, I was wondering if the NRC is looking at that or is planning in the future to have some interest in these types of materials.

And that's pretty much it. Thank you.

MR. MUSSATTI: Okay. Thank you.

Does anyone want to say anything to that?

MR. PRINARIS: I'll take that. This is Andrew Prinaris again.

MR. MUSSATTI: Thank you.

MR. PRINARIS: All licensees -- and I can speak from the license renewal perspective or subsequent license renewal perspective. We did use this type of remediation or correction action with this during our process for license renewal. And we assess whether it is appropriate. Then, we make decisions.

MR. MUSSATTI: Okay. All right. Let's go back to Robert, who's on the phone and wanted to ask a question.

Are you there, Robert?

MR. REESE: Can you hear me?

MR. MUSSATTI: I think I can hear you,

yes.

MR. REESE: Okay. First, my name is Robert Reese. I'm calling -- I'm with the Lower Richland Community Action Committee, and it's with a neighborhood in Columbia, South Carolina, well, the outskirts of Columbia, South Carolina.

Our community is a fenceline community that has a nuclear plant, paper plants, a coal plant. And, you know, it's a majority African-American, poor community.

And our current nuclear plant has been seeking a 40-year license renewal for the last few months. And the community has been vehemently opposed to the 40-year renewal. And this is the first 40-year renewal since their previous 20-year renewal. So, if we had community members that were vehemently opposed at 20 years, we're vehemently opposed to 40 years, and it would just be a logical leap to say we would be vehemently opposed to 100 years.

The plant has changed management and ownership several times in its 50-year history. And we just don't see where this would be a wise and prudent move to allow a plant to have a 100-year window of operations.

And I think the scientists who have come

on to talk about just how concerning it is, even with the materials that are being used, but all of the other things that could go wrong within that period of time. And so, I want that to be first known.

And then, secondly, I want to see if there's any indication around the impact of the Executive Orders that were signed by President Biden on yesterday for an immediate review of any policies that don't advance environmental justice. How would that impact any of these decisions or any of the other decisions that you made within the last three or four years? I don't know; that was a pretty general question, but I am wondering if anybody has really thought about the impact of those as yet.

MR. BURNELL: Hello, Mr. Reese. My name is Scott Burnell. I'm, again, with the Office of Public Affairs.

When it comes to Executive Orders, the NRC does review them to see whether or not they're applicable to the Agency's activities. So, we will be looking over all of the Executive Orders that President Biden signed yesterday and any future ones that he may sign that have an effect on how the Agency does its business.

And just to clarify, you were speaking

about the Westinghouse fuel facility in Columbia?

(No response.)

Are you still there, Mr. Reese?

MR. REESE: I (telephonic interference) --

MR. MUSSATTI: You're breaking up, Mr. Reese.

MR. REESE: No, I'm here. I just put myself on mute and I just had to unmute again. But, yes, I'm here.

MR. BURNELL: So, you were speaking about the request from the Westinghouse fuel facility to renew its license?

MR. REESE: Yes.

MR. BURNELL: We just wanted to make sure we understood the context of your comment. And we had addressed that a little earlier in the meeting.

What we're talking about today are topics for license renewal for nuclear power plants, not for the Westinghouse fuel facility. But if you have any further questions about Westinghouse, please feel free to email me at S-C-O-T-T dot B-U-R-N-E-L-L @nrc.gov, and I will get the appropriate technical staff to get an answer to you.

MR. REESE: And could you just repeat your email address one more time for me? And I apologize.

MR. BURNELL: That's quite all right. S-C-O-T-T dot B-U-R-N-E-L-L @nrc.gov.

MR. REESE: Thank you.

MR. BURNELL: You're welcome.

MS. WU: Thank you very much, Scott.

This is Angela Wu again from the staff. We have a total of nine hands raised.

I would like to ask that, if you have already asked your question, please lower your hand.

Next, we have Michael Fluss.

Your microphone should be unmuted.

(No response.)

MR. MUSSATTI: Michael, are you there?

MS. WU: Michael, did you still have a question?

(No response.)

MR. MUSSATTI: Well, let's move on to the next one and roll back to him later on. Maybe he's got some kind of a phone problem.

MS. WU: Sounds good.

Next, we have Connie Kline.

MR. MUSSATTI: Connie?

MS. WU: Connie, your lines is available for questioning.

(No response.)

Okay. Moving on, we have Jan. I know you asked a question earlier, but if you still have another one, you're still showing up with your hand raised. Jan?

MS. BOUDART: Okay. Here I am.

I wanted to revisit Kalene Walker's question. What parts of the nuclear power plant are not available for inspection and what do you do about those?

MR. BURNELL: Thank you. Again, this is Scott Burnell.

Kalene has already emailed me those questions, and I'm working with the staff to get her some answers. If you can email me as well -- and I can provide my address again, if necessary -- I'll make sure you're included on the response.

MS. BOUDART: I know your address, and you can just add me to the list. Thank you.

MR. BURNELL: I need your address. Or if you could email me, so that I know your email address, that would be helpful.

MS. BOUDART: Don't sorry, Mr. Burnell, I'm emailing you.

Okay. Bye-bye.

MS. WU: Thank you.

Next, we have Victor.

Your microphone should be unmuted.

DR. SAOUMA: Yes, I just want to go on record and express my concern, if not dismay, (telephonic interference) earlier, the continued technical leader at EPRI, because we are talking about extending to 100 years, and it just seems to be oblivious to the potential problem. And the other one is pretty much, "Oh, it can be done, and there may be a problem, but I think it's conditional." And it is conveying certainly the wrong message.

And that's what I had to say. I am very concerned when I see a petition like that by industry.

Over.

MR. MUSSATTI: Okay. Thank you, Victor. Roger.

Do we have anybody else, Angela?

MS. WU: Yes. It looks like, Michael, are you ready now?

(No response.)

MR. MUSSATTI: Is he unmuted?

MS. WU: Michael Fluss, did you have a question for us?

(No response.)

MR. MUSSATTI: All right. How about

Connie?

MS. WU: Okay. Connie?

(No response.)

MR. MUSSATTI: All right. I think I'm going to ask Erica if there's anyone on the phone that has a question.

OPERATOR: Yes, we have a question from Erica Gray.

Your line is open.

MS. GRAY: Hello. Can you hear me?

MR. MUSSATTI: Yes, we can.

MS. GRAY: Thank you for letting me talk again. I'll try to make this brief.

As you all are talking today about all these technical things from, you know, concrete, embrittlement, annealing, but the reality is, you know, if the plant's not run by good people, and if actual inspections are not taking place, and if issues are not addressed, we can end up with more issues like Fort Calhoun, which was given their life's extension, only to close because they ended up being (telephonic interference).

And right after that, the NRC came down hard on OPPD after it discovered a hundred deficiencies in the wake of the historic Missouri

flood situation. So, the reality is it's going to be a lot more than just those pieces and parts.

And the reason why the public deserves to have some confidence is you guys can't even put up the information for the public. Right now, I'm in Virginia. North Anna and Surry are in the queue for the next licenses, subsequent license renewal. Yet, the Radioactive Effluent Reports still are not up for 2019 for North Anna.

And I would like to also mention that Calvert Cliffs still has just 2018 reports. Peach Bottom still has 2018 reports. And for whatever reason, Perry totally has no reports up at all.

So, I don't know how we're supposed to have confidence in anything you all do if you all can't do the simple things about what you all can do online for the basic technical little things to let the public know what's going on.

And as it goes for my last comment here, it is I live in a state where North Anna Nuclear Power Plant is on a known fault line; has had its design basis exceeded in our 2011 earthquake just six months after Fukushima. What are you all going to do to enhance the safety as we move forward with this subsequent license renewal?

Thank you very much.

MR. MUSSATTI: Who wants to take a shot at that one?

MS. WU: Thank you so much.

Hi. This is Angela Wu from the staff.

It looks like, Michael, are you ready again? What you need to do is just unmute yourself, now that I've allowed you to do so.

(No response.)

Michael Fluss, did you have a question? What you can do is unmute your microphone where it's probably muted right now.

(No response.)

MR. MUSSATTI: Try *6, if you're on your telephone.

(No response.)

MS. WU: Okay. While we wait for Michael, it looks like we have an additional hand raised.

Gogrnpwr@comcast.net, did you have a question? You can unmute your phone.

MS. KURTZ: I think that is me. Can you hear me?

MR. MUSSATTI: Yes, I can. But we need your name first, please.

MS. KURTZ: Yes. Sandra Kurtz. It's

K-U-R-T-Z.

MR. MUSSATTI: Sandra Kurtz.

MS. KURTZ: Uh-hum. And I am part of, a member of Blue Ridge Environmental Defense League and its chapter, Belefonte Efficiency and Sustainability Team.

I live in Chattanooga, Tennessee. And as you no doubt know, that's Tennessee Valley Authority territory. And we are surrounded by seven nuclear reactors. All of them are aged and up for relicensing.

So, my question really is about the process for concrete checking. We have a dam here that has concrete creep and they are cutting cracks in it in order to keep it going a little longer. So, I'm thinking that that concrete creep is of concern.

My question really is about the timeframe and timeline. If you were to extend, give out permits for 100 years for licensing, when would the research be done? I saw one of your reports is, one of the studies at Oak Ridge National Lab is until 2023. It seems to me that no permit should be given or no licenses extended until the research is done. So, what is the timeframe?

DR. HISER: Yes, this is Allen Hiser.

And just to be sure that I'm clear on your question, it relates to renewing licenses for 100 years, correct?

MS. KURTZ: Yes.

DR. HISER: If we were to come to that? Okay. The oldest plant that we have right now is about 50 years old. So, it would be until the early 2030s before any of those plants could come in for a license to go to 100 years under the current rule. So, 2023 is within that timeframe that we could make decisions on appropriate aging management and things like that.

One of the purposes of this meeting was to try to get research started, if we need to start research. I think 10 years ahead, this is an appropriate time to be able to do that, if we choose to implement research to gain that information.

So, I hope that answered your question.

MS. KURTZ: Yes. Thank you.

It seems to me that the NRC could save a whole lot of money by just going with the other alternative energies that are safer and cheaper.

Thank you.

MS. WU: Thank you so much.

It sounds like just Connie and Michael

were not able to unmute their microphones to ask their questions. If you're able to access the chat, feel free to ask your question in the chat.

At this time, all those who had their hands raised have been called on.

Thank you. Back to you, Daniel.

DR. RODRIGUEZ: Daniel, you are muted.

MR. MUSSATTI: Thank you. This thing automatically mutes itself when I start talking, I think.

I think what we need to do now is take that much-needed break that we've got listed as the next thing on the agenda. And if we can come back at quarter after 3:00, we'll be right on schedule.

So, at this time let's go into a recess.

(Whereupon, the above-entitled matter went off the record at 3:01 p.m. and went back on the record at 3:16 p.m.)

MR. MUSSATTI: Let's start the next session then. Let me pull up my script. Okay, our last topic is technical issues for electrical and INC components and our first speaker is Darrell Murdock from NRC.

Darrell, are you there?

MR. MURDOCK: Yes, Dan, I'm here.

MR. MUSSATTI: All right, the floor is

yours.

MR. MURDOCK: Thanks, Dan. As Dan mentioned, My name is Darrell Murdock, I am with the U.S. NRC Office of Research. Can you go to the next slide, Dan, please?

So, I will give you a quick update on our ongoing cable aging project that we have ongoing here at the NRC.

The objective of this project is to evaluate the effectiveness of the most commonly used condition monitoring methods that can be used to track the aging of the cables.

The motivation for this project is to determine which one of these condition monitoring methods are capable of tracking the aging of the cables as the cable ages. For this project, we are working closely with EPRI, DOE, and the AMS Corporation.

As far as the update of the project, we completed the thermal and radiation aging of the cables included in the project in November of 2020.

Currently we are in the process of completing the last three condition monitoring testing intervals.

And here, by September of 2021 we should

be able to complete the final report that discusses the assessment of the condition monitoring methods and the cable aging, and by December of 2021 we should complete the simulated LOCA tests on the cables that were included in this project.

So, that is my update and back to you, Dan.

MR. MUSSATTI: Okay, that was pretty quick. Our next speaker is Andrew Mantey from EPRI. Andrew, are you there? Andrew?

I'm suspicious that Andrew thought he had a few minutes to go and take care of some personal business while you were talking and his timing is a little off. Either that or he's got a mute button problem.

DR. HISER: I don't see him as a participant, Dan.

MR. MUSSATTI: He's not listed on our participant list anymore?

MS. WU: He's listed as Drew, Drew Mantey.

MR. MUSSATTI: Okay, is he on the list?

DR. HISER: I stand corrected.

MR. MUSSATTI: Okay, let's give him 30 seconds or so. We've got time on our hands, we gained a lot of time with Darrell. We'll give him a chance

to speak.

Either that, or what we could do is move on to Paul Gunter and then come back to Andrew since we've got this lag in here. What do you think, Allen?

DR. HISER: Yes, I would go ahead and go to the next speaker.

MR. MUSSATTI: Paul, are you available?

MR. GUNTER: Yes.

MR. MUSSATTI: Why don't you take the next 15 minutes and then we'll go back to Paul once he gets back from wherever he went.

MR. GUNTER: Okay, can you put up my slides, please?

MR. MUSSATTI: They're working on it.

MR. GUNTER: Thank you. Okay, our reference to this session is largely with regards to the national laboratory report, which was quite inclusive of systems structures and compliance to include electrical cable.

And I think I would start just by saying that the Pacific Northwest National Laboratory report that was published in December 2017, taken down, and then re-revised and re-published by NRC in March of 2019, it did look at the condition monitoring which is currently the method that is used for qualifying

cable.

And the one thing that I'd note and remember is that the PNL folks, when they looked at it, they had some concerns that it didn't necessarily always reflect and in some cases even contradict the field conditions from real-world aging.

So, that should be noted. And similarly, we've noted that Zion Solutions, they did some electrical cable harvesting during the decommissioning of Zion and they had noted that they had difficulty getting some of the specifications for harvesting out of the Zion, particularly with the length.

They had trouble getting 30-foot lengths out. So, there are going to be complications and there are going to be costs and in fact, EPRI had noted, again, that March 7th, March 8th 2017 meeting that their experience with harvesting is that it takes longer and costs more than anticipated.

And it acknowledged the pedigree of harvested materials. This is going to be particularly true of electrical cables given there's so many types and characteristics out there in the industry.

Next slide, please.

So, again, we're maintaining that there are many hundreds of miles of electrical cable for

power instrumentation and control for safety-critical operations in nuclear power-plants, particularly noting the safe shutdown capabilities.

So, this is very critical in terms of knowing the operability and projecting its performance on safety-critical operations.

The scientific literature, including the PNNL 27120 original report, as we've been discussing, as well as its revision in 2019 identify electrical cable with a, quote, high, unquote, harvesting priority for this expansive system that is deeply buried in nuclear power stations.

That is a PNNL 27120 quote, generally complicated by the diversity in the materials, cables, jacketing, and insulation in formulations that were used in vintage materials, unquote.

The 2017 technical letter also identifies that utilities have been, quote, able to perform time-limited aging analysis to show with a reasonable assurance that electrical cable would be able to perform their necessary function under design event through a first round of license extensions.

That's a 40- or 60-year timeframe. The technical letter goes on to say, quote, however, as utilities approach a decision on subsequent license

renewal, there is a general consensus that available data on long-term performance of cables is sparse, and in some instances, contradictory, unquote.

Now, what we find and what concerns us is that this finding is among the many findings that were deleted in the revised document.

However, both PNNL 27120 and PNNL 27120 Rev 1, they both identify that an assessment of electrical cable insulation, harvesting and testing is a priority for license extension applications, noting, quote, that it needs input from utilities, unquote.

And here again, the concerns again rises to this particular system.

To the contrary, utilities are proceeding with expedited decommissioning operations that ignore strategic harvesting and testing opportunities to provide the confirmatory analysis to subsequent license renewal applications that would apply even more to more extreme license extensions.

And again, I need to identify the there's a difference between strategic harvesting and opportunistic harvesting.

So, merely replacing electrical cable, while that can be useful, it may not provide the research value particularly for license extensions

that the National Lab identified and put a high priority on.

So, the industry and its research associates and the regulator of the National Labs have yet to develop and demonstrate that comprehensive plan to be funded, and how and who is going to pay up.

And again, we're going to note that the cost of license extension comes at the accountability to reliable safety conclusions. And again, that's going to come about with this whole strategic harvesting effort.

But to proceed with extending reactor operating licenses that only become more extreme is dangerous and irresponsible.

So, Beyond Nuclear maintains that projecting aging management programs for safety-critical systems and structures up to even more extreme, 100 years of operation, must first begin by observing and measuring the foundation for ensuring safety margins during the initial 40- to 60-year extension and the subsequent license renewal of 60- to 80-year periods.

That's the work that needs to be done and we're seeing operating facilities going through that licensing process right now without benefit of the

research like Oyster Creek, a 49-year-old boiling water reactor that is going through decommissioning right now on a proto prompt plan that is an expedited decommissioning.

And we've even gotten affirmation from the NRC and Holtec that there's no plan to do strategic harvesting in the take-down of these plants. That would also include Pilgrim and the Vermont Yankee.

So, without establishing that science-based foundation, the NRC and the industry have no justification for exploring even more extreme license extensions.

Next slide, please. So, again, this is the December 2017 report, if you Google this report you're going to find it on our website.

It's been, again, taken down from the other government websites and the NRC in our FOIA process has repeatedly redacted this report. It is 53 blank pages, except for this cover right here.

And it's alarming that had somebody somehow in three different government agencies published this report and it was public for more than eight months.

So, we're thankful that we're able to put this document side by side with the revised document,

it's very illuminating. And I encourage you to download this report and take a look at it. But PNNL 27120 has this finding.

These long-lived components broadly divided into concrete and electrical cables are generally difficult, if not impossible, to replace and would require a significant investment if across the board replacement is considered.

As a result, recent assessments such as EMDA have included a significant emphasis on identifying knowledge gaps related to these long-lived non-metallic components.

The emphasis here is on the fact that these knowledge gaps have been deleted from the revised edition of this report.

Next slide, please. This is my final slide. Again, now we're looking at the March 2019 report, where Rev 1 deletes that finding, that concrete and electrical cables are generally difficult, if not impossible, to replace.

Why? Why did that have to disappear? We're not talking about a long frame of time that if the research were being done those gaps would have been filled. We don't know that.

The rhyme and reason of why these

deletions occurred is not explained or even, if you did not have the original document, you wouldn't know that there is this scarcity for electrical cables.

But again, the revised document also deletes the finding, quote, assessments such as the EMDA have included a significant emphasis on identifying knowledge gaps related to these long-lived non-metallic components.

Again, I emphasize that if you didn't have the original document and hadn't read in EMDA, you wouldn't realize the emphasis and why that notation in the original report was deleted to give particularly the public a paper trail for building its arguments and incorporating them into license challenges, you wouldn't have that.

But PNNL 27120 Rev 1, Table 1 does however maintain that strategic harvesting priority of electrical cables is high and needs input from utilities. We're still looking for a requirement.

I don't believe that opportunity is characteristic with the priority that's needed for raising the safety bar for public safety in these extreme license extensions.

Thank you.

MR. MUSSATTI: Can you hear me now? Thank

you, Paul, especially staying on time all day long on all three of your presentations. I really appreciate that.

Is Andrew Mantey available now?

MR. MANTEY: I'm on the Webex Teams. Can you hear me now?

MR. MUSSATTI: I can hear you now.

(Simultaneous Speaking.)

MR. MANTEY: -- working very well.

MR. MUSSATTI: Well, that's modern technology for you.

MR. MANTEY: Yes. Okay, I'm ready.

MR. MUSSATTI: Okay, go for it.

MR. MANTEY: Slides, please. Good afternoon, I'm Andrew Mantey, I work for the Electric Power Research Institute in the Plan Engineering Group.

I am the primary researcher in the area of cables and other passive equipment and I'd like to talk to you a little bit about the work we've done in the area of long-term operations.

Next slide, please. In the area of cable aging management, the things the most affect cable aging are the operating environments where the cables are located such as radiation, exposure, and

electrical stress, mainly voltage cables.

Temperature and radiation levels have been studied by EPRI in some research you'll see later and we've identified that many cable locations inside containment are fairly low temperature and radiation.

But there are exceptions to that which we call local adverse environments, and what we see from those areas where there are local adverse environments, it would not lead to an overall large amount of cable replacements over time.

One of the main subjects on cable aging is the actual resiliency of the polymers used. there are several different polymers used, cross-link polyethylene, ethylene, propylene rubber, commonly called EPR, and silicone rubber are all fairly resilient from aging.

They're the insulation materials. There are other older plants that have other materials that maybe have less thermal resiliency but they would only be challenged over long-term aging if they were in severely adverse environments.

The picture at the right gives an example. Now, these are cable jackets that we're looking at and I'll preface this by saying the insulation that was underneath those jackets, even where you see

severe cracking, was good.

But there are two materials there, Chloroprene, otherwise known as Neoprene, are the ones that are spontaneously cracking.

And the black cables that you see in the picture are chlorosulfonated polyethylene, often called Pipeline, which is a Dupont trade name, and in the same conditions, so no real signs of aging at all.

But they're just a primary indication that you have to look further because as I said, the jacket doesn't determine whether or not a cable can do its function, it's the insulation underneath.

So, aging management programs look for perfect conditions like this local adverse environment and then go from qualitative visual to more quantitative testing to determine if their cable has degraded.

Overall, our cable aging management programs are designed by periodic walk-downs to located these adverse equipment environments and determine, based on the condition, whether more quantitative means are necessary.

We use condition monitoring on those cables to identify if the cable insulation is degraded and to what level.

And then the corrective action program that the members have in place would determine the extent of degradation, required actions, and set of conditions, which could include replacement, mitigation, or more detailed condition testing.

Mitigation, repair, and replace cables will be done as needed is our recommendation to maintain overall plant safety and reliability.

Next slide. So, how is the EPRI research set up to support aging management?

We developed guidance back in 2009 for developing a cable aging management program that would be required by GALL for all members going into long-term operation, which have been used to identify cable condition and identify adverse environments and levels of cable degradation.

The guidance that we've developed also supports periodic cable lockdowns, as I stated above, and we've focused a lot of research on development of condition monitoring tests to identify degraded insulation in the worst environments, which is identified in the relevant GALL aging management program guides.

Another area that we've focused on is in the 2012 timeframe, we reached out to other industry

research organizations such as the Department of Energy's Lightwater Reactor Sustainability Program, and the Nuclear Regulatory Commission Research Group.

And we've discussed the different EMDA gaps and who would have the appropriate tools to do the research to evaluate those knowledge gaps that were identified in Chapter 5 of the EDMA 2014 version that we heard about earlier today.

We continue to maintain that inner relationship, we provide technical input on each other's plans, we maintain this roadmap that shows the progress of the research being performed, and planned research, and maintain an awareness of the full scope of research being done in the different research organizations.

We also established early on a Cable Users Group which EPRI uses to monitor industry operating experience, the progress of members in implementing their aging management programs, discussing ongoing operating experience, et cetera.

And we update these aging management program guidance based on the research that's performed by EPRI and the other research organizations that have an impact on aging management programs, as well as from feedback of the operating experience

which could identify the need for additional research or changes in how condition monitoring should be performed on cables.

I included a picture on the right that shows XIE3 degradation mechanism, water treeing, to show that we have done a lot of research in this area of submergence to understand this phenomena and to track the condition of cables in that wetted environment.

Next slide. So, like my colleagues, I put together a list of research that we've done in the area of aging management program implementation, for our failure mechanism research, which focused a lot on medium-voltage cable aging failures, but also new insulations that became available.

And you can see the research that we did on radiation and temperature to install cables at nuclear power-plants, where we monitored radiation and temperature levels over a period of time and then evaluated the results.

Condition monitoring, many members have implemented the medium voltage test methodology of very low frequency, tan delta, and we've evaluated the test data over time to ensure it was properly quantifying levels of degradation and preventing in-

service failures.

It's been effective in doing that, et cetera, as well as work we've done in the area of mitigation and replacement strategies.

Next slide. So, our aging management activities, as I stated earlier, it starts with inspection monitoring. And in this picture you can see very low frequency tan delta testing being performed.

Those results are analyzed and evaluated and you can see in the second picture from the left a result of a cable that tested poorly at the top of the picture and the test after the cable was repaired in the bottom of the picture to show how it had come back with the repair to the condition of the other cables in that circuit.

If we couldn't through repair make a change, there's also mitigation and in medium voltage cables there's a process called rejuvenation, where you can see in the picture that there's a severe water tree in the insulation but it hasn't converted to electrical tree, it hasn't failed.

So, you can inject the fluid through the strands of the conductor that permeates its way out to the outer jacket of the cable, and then it

polymerizes.

It combines with the water molecules in the water tree to create an improved insulation that allows you time to make an effective repair replacement at a later date.

And finally, you can see on the far right the final option of repair and replacement where a new cable is put in, and in this case, they added extra length of cable in case they needed to make a repair in the future, and properly bundled it and kept it above the water line in a man hole along the circuit.

So, you can see how the different aging management activities that are the makeup of our aging management guidance for implementing an aging management program for cables reacts with different scenarios and maintains overall reliability.

Next slide. So, the path forward would be enhancements and optimization of our aging management programs.

One of the areas that we'd like to improve our condition monitoring is in the area of low-voltage cables and we're currently in a multi-year project performing field pilot tests on a methodology for low-voltage cables.

And it's kind of a small picture but if

you look closely, the curves on the left-hand side of the picture show the techniques that would identify if the cable is degraded or not.

And these techniques, you can see, are non-linear in nature in the top one, the second one shows that as the cable charges it absorbs energy, and then that absorption energy decays off and you're just left with the leakage curve.

And then the other curve shows that when you de-energize it, it degrades in a similar fashion, parallel to that.

But the bottom curve shows a cable that's very highly degraded and the response for the first test becomes strictly linear, and for the second test, after the initial absorption there literally is no change once the cable has been energized, unlike the response of a good cable.

This allows us to use advanced time domain reflectometry and frequency domain reflectometry to determine if there's any localized defects or whether the occurrence is more global.

The top shows no indications on both of those scans, whereas the bottom test shows when the cable was degraded there were two places identified, one on each technology, at the same location that

reinforced the fact that this is a localized degradation that you could mitigate or repair potentially without replacing the whole cable.

So, condition monitoring improvements, other advances in monitoring technologies. We'd like to do something that's continuous monitoring are things we'll look at moving forward, and we think that's one of the main improvements that we can see is better data of the level of degradation.

But then you take that and you have to get into the data management, and we've developed a tool that we hope to use to identify degradation, to catalog it, to use EPRI guidance on aging assessment, to identify type of degradation that's going on, and it would make it easy for a member to retrieve their data for future inspections.

That's important because inspections go on all the time but license renewal inspections are on a ten-year frequency and you don't want to lose the information of past inspections for the person who is performing future inspections.

So, if you document both good and bad conditions and then things change, you have a reference to where it was in the previous walk-down.

Next, you want to look at areas that you

can utilize the data that you've received to use risk-informed approaches to improve the effectiveness and the overall efficacy of your techniques.

Additionally, for predictive analysis, you can see in the picture below different cable tests that were done on different insulation types in the population, how those tests compare across the industry versus an individual plant.

It's data that would be powerful for improving feedback on how particular populations of cable are aging as well as what that overall data means.

Using a lot of data versus an individual member's data is a much more powerful tool for the industry to use to evaluate degradation.

And then finally, we look for increased communication between utilities, the regulators, and the research.

The Cable Users Group I mentioned is an ability for the industry to come together and is often attended by the NRC and DOE researchers on the LWRS program.

And then likewise, other communications such as our coordination collaboration group where we maintain the research needs and who's performing them

and when the research is expected to be completed is another way to provide that feedback loop that we need into our aging management programs.

Next. So, I just wanted to briefly address cable harvesting. It's been a very popular topic today and I would be the first to admit that there is great advantages of using harvested cables to evaluate the condition of reactors.

The main value of harvesting from our perspective is that the research we do is performed on cables of the same type and vintage that are in the plants.

And that can be done through harvesting but we also have the ability to use condition monitoring of cables in the nine locations versus cables in adverse locations to do the same thing.

We can't do all the destructive tests like we want to do in the laboratory but it does provide a secondary path to obtain the results that people want to understand how these cables are actually aging.

And with that, I'll turn it back to you.

MR. MUSSATTI: Okay, thank you for that, Andrew. We're pretty close to on schedule here. Our next presenter is Leo Fifield from Pacific Northwest National Laboratory.

Leo, are you ready?

DR. FIFIELD: I'm ready.

MR. MUSSATTI: Go for it.

DR. FIFIELD: Thank you for having me here. I'm glad for the opportunity to present so of my thoughts on the topic of today.

My name is Leo Fifield, I'm a material scientist at Pacific Northwest National Laboratory, a DOE laboratory in Washington State.

And I lead the cable system research for the LWRS program that you've heard about today, along with my colleague, Robert Duckworth at Oak Ridge National Laboratory, and Bill Glass also at PNNL, who leads our cable NDE effort.

And in our research we collaborate with many partners, including other researchers including at the NRC and at EPRI and at universities, including at Iowa State University, University of South Carolina, and with industry partners like service providers, material suppliers, et cetera.

I'm going to just give my thoughts on the topic today related to electrical systems.

Next slide, please. Now, electrical and instrument control systems at nuclear power-plants is important for safety and efficient operation of the

plant.

Here are some thoughts from an NEI document on second license renewal. The notion here is that provided operators can continually maintain, replace, repair, and upgrade systems such as cables.

There's no reason, no operational reason, why license renewal processes couldn't proceed and I would say why cables can't continue to be used into the future.

Effective aging management programs require certain components, however, they require a technical understanding of the effects of aging on the components.

They require effective inspection and assessment techniques and methods to mitigate aging systems and strategies for repair and replacement of systems when needed. Here's a diagram showing the cables.

As was mentioned before, there are miles of cables in each plant going throughout the plant, different kinds of materials and cables in many different situations, including in adverse conditions and non-adverse conditions.

Next slide, please.

So, these are just some of the themes and

concepts important to the consideration of long-term operation, including up to 100 years that I'd like to talk about.

If we continue the use of aging cables, so of course, you can go and buy new cables, modern cables, but we're talking about using cables that have been used in the plant for decades.

So, when license renewal came along, cable aging management programs, those are in place at plants to help manage these systems.

The mitigation of aging or the halt in aging when it's discovered, the arrest in aging or slowing it down is a technique that can be pursued. Rejuvenation that Drew touched upon to extend the life of the cables that have been degraded is one option.

Monitoring is, of course, very important and is part of the cable aging management, but effectively monitoring the health and the status of cable systems is enabling.

I'm going to talk more about these in subsequent slides. I think we have an opportunity to use modern technology to simulate and understanding what's happening with aging systems.

And laboratory resources, like an integrated test bed at PNNL and other laboratory and

pilot scale systems can help to develop and demonstrate assessment techniques and to understand aging effects, as I'll talk more about. And then there's another concept I'll call validation.

Some of these terms can mean different things, different contexts, but here I mean validating assessment methods and validating the expected conditions of cable materials.

Next slide, please. Cable aging management programs, like all aging management programs, are an important part of long-term operations and license renewal.

They use operating experience of the specific plant and of the industry, including generic aging lessons learned that were mentioned before the licensee event reports, along with the information about the cables in a given plant. Each plant uses their aging management program under that guise.

They inventory their cables in their environments and they look at testing history, historical records of testing and guidance for standard organizations such as IEEE, guidance for acceptance criteria of testing such as from EPRI and industry to prioritize their cables of concern and their cables for testing, and ultimately plan for

cable environment mitigation repair, replacement, rejuvenation as needed.

Here's just a common aging diagram and it can apply to cables where maybe there's a lot of initial failures due to maybe manufacturing defects.

And then as components age, they can wear out and wear-out failures naturally go up over time as aging happens.

But many failures of components also occur not just due to long-term aging but to material defects, to workmanship issues, to changes in environments.

And so it's not just the age of the cables but testing to understand the state of the cable is key for any age of the plant, not just for 60 years or 80 years or 100 years.

It's understanding the current status of cables and doing proper monitoring and testing that's going to enable you to have confidence in their performance.

Next slide, please.

So, aging happens and when it's identified, as Drew mentioned, through walk-downs and through periodic assessments, it can sometimes be halted or attenuated by changing the situation.

This can be anything from replacing shielding that may have been inadvertently removed between a hot spot and a cable tray, steam line and a cable tray.

Shielding can be replicated to mitigate that aging before much damage occurs. Barrier coatings can be applied to cables to stop aging in its tracks.

Operational procedures might be updated based on if they inadvertently affect the age of the local cables. That's what I mean by mitigation changes can be taken to stop aging, really, before it proceeds.

This is in contrast to rejuvenation, as also mentioned earlier, which can -- when a degradation has occurred, a treatment to cables can reverse the loss of properties and enact the recovering of the mechanical and structural properties, and maybe can even recover or enhance and bolster dielectric electrical properties and materials.

Now, rejuvenation has been used extensively in fields outside of nuclear to treat especially water aged cables, but there's an opportunity as new technologies, treatment

technologies are developed to treat not just water damage cables but also thermal radiation damaged cables to extend their life, either indefinitely or until a more appropriate time to replace them in the future if needed.

Next slide, please. Now, I mentioned that monitoring is of course key for cable aging management.

Knowledge of cable system health at a given time enables planning for efficient repair and replacement as needed, and confidence in continued operation.

And multiple techniques are used to assess cable health, not just one technique, and they can help to understand cable status.

And I think as we continue to develop modern techniques like dielectric spectroscopy, spectrum, time domain reflectometry, tan delta and others, we can move towards online and continuous monitoring of cables and implement, for instance, distributed sensing of environments like temperature and radiation in environments that can give a real-time knowledge of cable system health.

So, in this slide I touch upon the fact that we're talking about long-term operation of

cables.

These existing cable systems were designed long ago but modern technological tools can enable online or continuous monitoring, and enable better understanding of the materials so that we can continue to use these older systems in the modern age.

So, that includes digital tools that are now available that have not been available in the past. Data from monitoring can help provide content and validation of models, analytical models, and data treatment models.

Data can be used for predictive maintenance decisions, artificial intelligence, machine-learning can assist in decision-making for efficient decisions regarding when cables do need to be repaired or replaced.

I think digital twin, digital thread technologies, and other approaches can be fed with data as we increase our monitoring frequency and the monitoring available, and fed with our increase of scientific understanding to enable the following of cable health and better and earlier prediction of any cable status change that needs to be addressed through mitigation, rejuvenation, repair, or replacement.

Next slide, please.

I mentioned the test bed, by that I mean like a laboratory twin or a physical twin of a fielded system.

Or a simulated environment in the laboratory that can be used to develop and demonstrate cable monitoring techniques to assess representative samples of materials in an environment where you can control the environment, you can do accelerated aging, and validate testing methods before doing pilot studies in plants in a way where you have the freedom to explore conditions that you can't do in an operating plant in order to understand how those materials and monitoring tools can be used in the plant aging management.

Type testing and representative cable, cables and splices and connectors can be done, for instance, using an elevated temperature environment or a wetted environment, or a radiation environment, and understanding that aging in a way where you can control the variables.

And finally, I call the last topic validation. Online continuous monitoring can enable real-time assessment of cable health that you can use to assess your expectations of the aging materials, validate your models, validate your understanding.

This can include your evaluation of harvested materials.

If you know the condition of the materials before they're harvested and you characterize and test them, it can help validate or challenge or support your current understanding of the material aging and your expectations for its remaining useful life.

I think there are some strategies such as condition-based, qualification, risk-based approach to continuing cable use, use of risk insights to inform prioritization of cable testing, repair, and replacement, opportunities that we have that again are enabled by more data and more monitoring of environments in the health of cable systems.

And increased understanding of how the materials change with exposure and service to help make informed decisions that can be efficient for the cable aging management so they can do planned replacement and repair and avoid the unexpected need to replace or repair cables.

One final comment I have is I think something we could benefit from is more sharing of data, a online library of articles, reports, data that could be available is one opportunity we have as we go forward.

We have a lot of collaboration, as Drew mentioned, between organizations but if we had more of a public data library, for instance, for cable data, I think that would help with model development and with understanding.

And with that, I'll end my remarks.

MR. MUSSATTI: Okay, thank you for your remarks there, Leo. We've come to the end of this session here and we're real close to on time.

It's time to open it up to the floor again. First of all, let's go to the telephone lines. Erica, do we have anybody that's interested in talking?

Erica, you need to unmute yourself. Okay, while Erica is working on that, I think I will go and ask Angela if there's anybody that's got their hand up?

MS. WU: Daniel, no hands raised.

MR. MUSSATTI: This happens a lot towards the end of the day. Erica?

OPERATOR: This is Erica, can you hear me?

MR. MUSSATTI: Yes, I can hear you now.

OPERATOR: Sorry about that. We do have a question from Pamela. Your line is now open.

MS. GREENLAW: Thank you very much, I

appreciate it. Is this the final comment period for us today?

MR. MUSSATTI: We're going to have a little roundtable with all of the presenters and let them talk for a few minutes and you guys get to listen in, and then we'll see if we've got time to take some comments on that afterwards.

But basically, this is the last formal time for talking.

MS. GREENLAW: Okay, I'll try to be brief here. Concerning all of the issues that we have listened to today, people have been very well prepared and they know what they know.

They also have expressed that there are too many gaps that must be filled and I was very disturbed to find that the revised copies that Mr. Garner was referring to do no explicitly explain whether or not a particular gap was filled or partially filled.

So, my question about that is maybe more transparency for what your process is and what the public can expect? Because if we can trust -- we just need to be able to trust that what we read is correct.

And then my next thing is actually a

question that was actually a statement.

So, my question is what is going to be done concerning having meetings about the 100-year licenses that are not technical but do delve into economics, environmental burdens, cybersecurity, and considerations for criteria that would exempt nuclear plants that are poorly sited, especially in light of climate change.

I think these are topics that the public would be very interested in knowing about. We wouldn't need an all-day session, I don't believe, unless you wanted to put them all together.

But I know that often when I come to meetings by the NRC, for the public they're one-offs and we're not happy about one-offs. We want to hear follow-up, we want to hear more detail.

So, as you plan, we'd like to hear what you are planning even if you can't set dates in stone to say within six months we will have another series on XYZ.

Are you able to do that? Will you commit to looking into that?

MR. MUSSATTI: I think I'm going to turn this over to Scott Burnell.

MR. BURNELL: Thank you, Dan. And

actually, Pamela, for the court reporter, could you please repeat your full name and affiliation?

MS. GREENLAW: I'm sorry, Pamela Greenlaw, G-R-E-E-N-L-A-W. I'm not going to give you a group affiliation because I actually don't represent any group because I don't have that authority.

I'm not that high up in what I'm a member of, if you understand what I'm saying, or any groups I'm a member of.

I'm not an official spokesperson, but I am a private person and a stakeholder as a private citizen and as a person looking out for my neighbors.

MR. BURNELL: Thank you for clarifying that.

Many of the issues that brought up are handled in areas other than license renewal. Cybersecurity for instance is something that the NRC discusses with the industry on a regular basis.

Many times those meetings are public and they are available, and other times the topics are such that they have to be non-public meetings. But when it comes to some of the environmental issues that you raised, those would be covered in individual plant application reviews.

And again, as we said at the beginning of

this meeting, we're not talking about any applications to go from 80 to 100 years at any time in the immediate future.

We're about a decade away from even seeing any of those applications come in, if there are any. So, as we go forward --

MS. GREENLAW: That's the plan. The plan is for you to have --

MR. BURNELL: If plants come in asking for subsequent license renewal, there will be environmental reviews that cover some of the issues that you've raised and you'd have the opportunity to comment on our process we're putting together, our environmental impact statements.

There's also an ongoing process to consider what we call the generic environmental impact statement, which covers, as the name implies, issues that apply to any plant that might come in for renewal.

So, the best way to keep up --

MS. GREENLAW: That's not what I'm talking about.

I'm talking about those generic things that would apply to these very long extended licenses that I think should be covered before any particular

plant says, oh, yes, we forgot to tell the public we submitted an application two years ago and, oh, yes, okay, I guess we have to tell you now.

MR. BURNELL: The processes that we have in place include -- I'm sorry, the processes that we have in place explicitly include informing the public when we receive application, if we accept an application for review, when we start an environmental review.

All of these things are stated publicly. If you happen to use social media, you can follow us on Twitter and on Facebook.

We post reminders about public engagement there, and our website also has an opportunity to sign up for email lists where, again, you can be kept informed on these issues as we go forward.

MS. GREENLAW: Okay, yes, maybe after the meeting, how to sign up for those website reminders would be good.

We have a problem in South Carolina where we have people in rural areas on broadband, they're unfamiliar with the Federal Register, which I'm a member of.

But they do manage to find out if there are enough friendly ways that things have to be

published. So far, it seems that the Federal Register was the official site, which very few laypeople go to.

So, I'm glad to hear about the Facebook and the other website thing directly into one's email box.

Thank you.

MR. BURNELL: You're welcome.

MR. MUSSATTI: Okay, have we got any other people on the phone?

OPERATOR: Yes, the next question comes from Erica Gray. Your line is now open.

MR. DOLLEY: Hello, Can you hear me?

MR. MUSSATTI: I can hear you.

MR. DOLLEY: I have been on the meeting call all day so I just wanted to pipe in again because my last comment, no one really got a chance to try to answer that because they called on someone else to come in.

My question was I live in a city within 30 miles, 35 miles as the crow flies from North Anna. That plant is located on a known fault line. It's in the Virginia seismic zone.

Its had its design basis exceeded. It is in the queue to get subsequent license renewal.

I want to know what is the NRC going to do

to enhance safety at a reactor because that's the only reactor that's ever had its design basis exceeded.

What is the NRC going to do to require, what kind of enhancements are we going to have moving forward with that subsequent license renewal?

MR. BURNELL: I can address that, Dan. Again, it's Scott Burnell.

As we said earlier on in the meeting, this is a session to discuss forward-looking topics and we're talking about plant-specific reviews. That's for another time.

I can say that Dominion did submit a full seismic hazard reanalysis after the earthquake and the NRC did determine that Dominion did its work properly, and that the plant, as designed and built, is capable of withstanding the earthquakes that can reasonably be expected at that site.

That being said, the review for the North Anna renewal is ongoing and as we move forward, there will be opportunities for Ms. Gray and others in the area to comment on the NRC's review.

MS. BRADFORD: Scott, this is Anna Bradford. Can I just add something specific there?

We are, as you mentioned, doing the North Anna specific subsequent license renewal review and

there will be opportunities for public comment.

I think next month is the public scoping meeting for the environmental impact statement for that review, and this is an issue that you can raise there or at other stakeholder interactions during that license-specific review.

I would encourage you to please participate in those meetings.

MR. MUSSATTI: And those meetings will be in your own backyard, Pamela.

MS. BRADFORD: Virtual backyard.

MR. MUSSATTI: Virtual backyard. Okay, who's next on the phone?

OPERATOR: The next question comes from Don Safer. Your line is now open.

MR. SAFER: Thank you, can you hear me? Hello?

MR. MUSSATTI: Yes, Don, go ahead.

MR. SAFER: Okay, thank you.

All right, thank you, I've been on the call all day as well and I wanted to get back to the original question that was posed that's on the screen right now: should the NRC begin to consider the potential technical issues and the development of guidance documents to support license renewals to

authorize operation for up to 100 years.

If so, when?

My answer to that for you, and my name is Don Safer, I'm in Nashville, Tennessee, Member of the Board of the Tennessee Environmental Council, and also spokesperson for the Council on Nuclear Power Issues and spokesperson for the Tennessee Chapter of the Sierra Club on Nuclear Power Issues, and also a member of the National Sierra Club Nuclear Free Team.

And so I think that the whole premise of this meeting absolutely goes towards the absurd. These reactors should absolutely not be considered for operation up to 100 years.

They should be closed down right now. Gregory Jaczko, the former Chairman of the Nuclear Regulatory Commission, has said on the record that not a single one of our operating reactors is safe right now.

And he should know, he was the Chairman when Fukushima happened. It's the first time I've heard the name Fukushima on this call and I think everyone should have a reality check when they're even considering going to 100 years with these reactors.

Now, I've been around long enough that I was around when the original construction was going on

on the reactors in the Tennessee Valley Authority.

And they absolutely told us that these reactors were designed with a life of 40 years, and that was all they were designed for at the time.

And the TVA has seven operating nuclear reactors, three of them are GE Mark 1s at Brown's Ferry, and the same reactor design as Fukushima.

And I will remind you all or tell you if you don't remember or don't know, that when that GE Mark 1 design was being finalized, three of the top engineers at General Electric resigned because they said this design was absolutely unsafe and it should not be built.

And of course, their resignation did not end up with that result and what we had was the Fukushima reactors melting down, blowing up, and the nuclear experts that I listen to said -- Arnie Gundersen, for one -- he was not surprised that the GE Mark 1 was the reactor that blew up and melted down because of the deficiencies of that design.

Now, those reactors in Brown's Ferry right now are working on their extended licenses, so they're going to 60 years.

Those licenses will expire in the 2030 timeframe and the thought of running them another 20

years, let alone 40 years, is absolutely, to my thinking, unthinkable.

The other reactors that TVA is operating are Westinghouse ice condenser designs at Sequoyah and Watts Bar. That design was originally designed by Westinghouse to be put out in the ocean, offshore from Jacksonville, Florida.

It is called ice condenser, that means there are 3 million pounds of ice, chipped ice, hanging in baskets around that reactor core so that they could theoretically make the reactor containment thinner to save money.

I have been at meetings at Watts Bar and Sequoyah and have asked engineers at Sequoyah about the design, and the smile that I got and the indication, yes, it's a quirky design, is just -- and then asking people would you ever build another ice condenser design and of course they say, no, nobody would build an ice condenser now.

Only TVA would actually finish an ice condenser, which they did to the Watts Bar Unit 2 in 2016. But the thought of running those for 100 years?

If you run Watts Bar Unit 2 for 100 years, the foundation will be 140 years by the time that

license goes for 100 years, because it took them 40 years to finish that.

So, the whole premise of this meeting is beyond reasonable and I wish that the Nuclear Regulatory Commission would spend more time getting real about the nuclear waste, the high-level waste that is building up at every reactor, and the plans for interim storage and the plans for this high burn-up fuel and the fuel canisters.

There are so many really troubling aspects and to have the NRC be wasting the taxpayer's money or the rate payer's money on nonsense such as this meeting, it's really beyond belief.

Now, the other thing that I would like to state, and I'm wrapping up here so I appreciate your patience with me, is that the scope limitations that you mentioned in the beginning where you would not consider anything external to the reactor are absolutely unreasonable as well when you're considering the fact that the environmental conditions of the areas where these reactors are operating have changed in the decades since they were originally licensed.

The earthquake at North Anna is one but the flooding, the probable maximum floods in areas,

particularly Oconee, that's being considered now, that dam that's above Oconee, I don't know it very well but I've heard people question the dam's safety there, and certainly dam safety above many of the reactors is an issue.

So, I think that in the very least, the entire environmental impact statement needs to be revisited and the analysis done from square one.

And then the last thing I will say is it has been very interesting to hear about the research that EPRI and NEI, the Nuclear Regulatory Commission, the DOE have been doing, but in my experience in examining some of the research, the research from these agencies and nonprofits are also suspect.

They're heavily biased, heavily pro-industry, designed to support whatever it is they're studying. So many times, actually out front it says this study is to make sure we can do X,Y, or Z.

And so these studies that EPRI is doing, that NEI is doing, that DOE is doing, are all designed to find no problems. That's just the way it seems to be work and not designed to make sure the public is safe.

And the last thing I will say, because it was brought up by one of the speakers, is that

renewable energy in 20 years will be so advanced and energy storage will be so advanced that we will not have a need for these reactors.

And I think even the subsequent license renewal should not be considered, let alone the subsequent subsequent license renewal.

And that's, I guess, the end of my comments, thank you for the opportunity.

MR. MUSSATTI: You don't have one last thing to say?

MR. SAFER: Say it again?

MR. MUSSATTI: You don't have one more last thing to say?

MR. SAFER: I could talk all day but I don't think you want to hear it.

MR. MUSSATTI: No, we appreciate your comments and I appreciate the depth of understanding that you seem to be carrying around with you.

Well, right now, we need to move on, we've only got about a half hour left at the very most.

And what we want to do is we want to have a roundtable-type of a discussion with the presenters for the day if there's any last thoughts they want to do. Unfortunately, that means that --

MS. LEE: I'm sorry, but again, your *1

system does not operate properly for some people so I would like to ask two short questions and I would like to get around to the answer.

MR. MUSSATTI: No. What we're going to do is we're going to move on to let the presenters talk one more time.

If you would like to ask a question, please put it in the form of an email to Scott Burnell.

MS. LEE: What we will be doing is forwarding the email to our Congresspersons, who are well aware of the kind of run-arounds you constantly are giving the public.

You're saying that the public is going to be potentially exposed to this for a century and you don't have five minutes for two questions?

MR. MUSSATTI: No, we don't.

MS. LEE: Because of your own system failure? That's outrageous, I'm sorry.

MR. MUSSATTI: I'm sorry.

MR. BURNELL: Dan, you went on mute for some reason. We have made every attempt to conduct this meeting as efficiently as we can. We have encountered technical issues.

We are doing our best to maintain the

schedule as it was laid out. As Dan said, we're going to give the presenters one last chance to offer their comments, and if time allows we will then come back to people for comments before we close the meeting.

MR. MUSSATTI: So, among the commenters, who's got their hands in the air?

MS.WU: Hi, this is Angela from the NRC. We have six hands raised, Barbara Warren, Kalene Walker, Pamela, Ace, and Jan.

At this time, are we taking questions, Dan?

MR. MUSSATTI: At this time we're talking to the presenters.

We're asking the presenters if they would like to come back and say I've got an interesting idea based on what you just told me, I had never thought of it like that before, or here's something else I need clarification on based on what you said to try and get a little bit of cross-pollination from all of these experts that were here today.

DR. HISER: Hey Dan, maybe start with the Topic 1 presenters and then work your way through?

MR. MUSSATTI: We could do it that way. Let me pull up the slide for that so I can remember who everyone is. On deck we have Mr. Earls, Ms. Wong,

Mr. Gunter, and Mr. Rosseel.

Do any of you want to add some last insights or comments that you had either forgotten to present or that have just occurred to you based on what you heard?

MS. WONG: Hi, Dan, this is Emma from EPRI. I just want to say thank you to everyone for letting us present at this meeting. We have no additional comments from anyone at EPRI. Thank you.

MR. MUSSATTI: Okay, that's helpful. Let's move on to talking to the people from the second group. That would be Mr. Moyer, Mr. Gunter, and who else? I've got to change pages now.

That would be Sokolov, Mr. Garner, and Mr. Burke. Any last comments? I'm suspicious that everybody has reached some sort of a saturation point here and we're just all trying to wrap up this meeting.

Onto the next group, Mr. Sircar, Mr. Le Pape, Mr. Johnson, Mr. Saouma. Okay, and to beat a dead horse, Mr. Murdock and Mr. Mantey, Mr. Gunter, and Mr. Fifield?

MR. GUNTER: This is Gunter, I'm going to defer to the public.

MR. MUSSATTI: Thank you, I was hoping

somebody would do that. I think that's a good idea.

Has the young lady that was talking and wanted to speak before still staid on the line? We have time for your two questions. I didn't think she stuck around. Do you?

Okay, what I would like to do now is turn the meeting back to --

MS. LEE: I'm sorry, it took a while to unmute.

MR. MUSSATTI: Okay, you were on mute trying to figure out how to get back on?

MS. LEE: Yes.

MR. MUSSATTI: Please, we'd like to hear from you.

MS. LEE: Okay, here are the two questions.

The first is whether the NRC has ever conducted a comprehensive internal evaluation of the history of its own assumptions to validate whether those assumptions are correct?

And if so, which assumptions were identified as false or inadequately supported? That's the first question.

The second question is the same exact question but comprehensive independent evaluation.

MR. MUSSATTI: I do not know the answer to

those questions but I think they're valid. Do we have anybody on our panel that would be interested in answering?

Scott, do you want to start that? Anna?

MS. BRADFORD: And I apologize but my connection blanked out there for a minute. Would you mind repeating that question?

MS. LEE: Sure. So, two questions, one relates to whether there has ever been a comprehensive NRC internal evaluation.

The second question is the exact same question but whether there's been an independent external evaluation.

So, the question would pertain to the history of the NRC assumptions that have been identified as false or inadequately supported, or validated, I would add?

MS. BRADFORD: Let me see if this response is going to help. When you say internal evaluations, I'm not sure if you mean --

MS. LEE: Let me just put it in context that's less formal.

To identify to any entity, whether it's a hospital, whether it's the NRC, whether it's a builder that does major construction work for many buildings,

one of the issues is were our assumptions correct or did it turn out that some of our assumptions made 10 years ago, 15 years ago, 20 years ago turned out to be flawed or inadequately supported?

So, assumptions, for instance, would be things such as vulnerability to earthquakes, vulnerability to flooding, vulnerability to terror attacks, any of those things.

And I know the answer to this but if I'm wrong, that's great. Has there ever been an analysis of the NRC's own acumen in prognosticating the future?

Because from my experience for the last 20 years, it seems to me there are a lot of flawed assumptions that get revealed later on.

MS. BRADFORD: I will answer it this way.

I've been at the NRC for about 20 years and I feel like we continually assess our own performance and our own calculations and evaluations, and adjust as we go.

So, no, I can't point you to one report that looks back at the assumptions we've made over the last ten years and evaluate whether they were good or not, but I can tell you that we are continually looking at the things we've assumed and evaluated to determine if what we did was acceptable.

MS. LEE: And that would apply to every single agency. And as we know from basic experience over the last 20 years, things are not always accurate. Right?

Because human beings make mistakes and human beings do not have full access to information. And that's why you do surveys and that's why you do audits.

The NRC, as far as I can tell, never has an audit of its own performance that's comprehensive. And I think I would urge you to ask Congress for the appropriations for such an audit.

MS. BRADFORD: Thank you for your comment. Dan, do you want to move on?

MR. MUSSATTI: Is there anybody else that wants to talk? Raised hands?

I'm going to assume no and I'm going to invite Anna Bradford to make some closing comments.

MS. WU: Hi, Dan, I think your audio is a little low. I'm hearing some feedback. we have a couple of hands raised, if this is the right time to walk through each of those questions and comments?

MR. MUSSATTI: Okay, I don't have any problems on my end.

MS. WU: Great.

(Telephonic interference.)

First, we have Barbara Warren. I'm going to unmute your microphone. Barbara, did you have a question or comment?

MS. WARREN: Yes, a simple question. I was asking about other analyses.

So, let me just ask this, regarding Turkey Point, I'm a little confused because it seems like right now you're saying you're doing this evaluation for the future.

But you already made a decision on Turkey Point to extend the license there, so how was that done?

In other words, do you have something written up that explains how you proceeded there since right now you're asking us our opinion about how you should evaluate things?

I'm trying to understand how Turkey Point happened, how that required got finalized to give them the extension.

MS. BRADFORD: Barbara, this is Anna Bradford from the NRC. Let me clarify. Turkey Point subsequent license renewal was to authorize them to operate for 80 years.

What we're talking about today is should

we think about the research that would be needed if an Applicant has to go to 100 years?

No licensees are currently requesting to go to 100 years, we're just trying to be proactive and do some thinking about it now.

So, Turkey Point has not requested, and we're not thinking about, extending their license to 100 years.

But if you do go on our website, there's a lot of information on there about the Turkey Point license renewal and you can see the documents they submitted to us, you can see our evaluations and the documents that we've put out, you can see summaries of public meetings, you can see the environmental impact statement.

So, there's a lot of information on there if you'd like to go look at that.

MS. WARREN: Well, that's certainly helpful. Does that mean that if a request for a 40-year license comes in, whatever we say now has no impact on giving more 40-year license extensions?

MS. BRADFORD: Each plant has to put in a specific request for their plant if they want to extend their licenses.

So, we're certainly not making any generic

decisions about whether a license should be extended.

Does that answer your question?

MS. WARREN: So, each one is independent?

MS. BRADFORD: Yes.

MS. WARREN: All right, thank you very much. I appreciate it.

MS. BRADFORD: Sure.

MS. WU: Thank you so much, Barbara. Next, we have Kalene Walker. Kalene, feel free to unmute your microphone for your question or comment.

MS. BRADFORD: Angela, this is Anna Bradford again. While we're waiting, I want to correct something I said earlier.

The person that was asking about the North Anna license renewal, I had said that we're having a public scoping meeting next month but I had my dates mixed up.

So, I just wanted to share that the public comment period for the draft supplemental environmental impact statement is expected to be this summer.

And so I would encourage people that live near the plant to look out for that and participate in that public comment period.

So, I just wanted to correct that, Angela.

If we want to move on to another question, that would be great.

MS. WU: Thank you so much for the clarification. Okay, so Kalene, we'll keep you unmuted, feel free to jump in if you can get your unmute button off, but next we're going to move on to Ace Hoffman.

You can unmute your microphone. Okay, we're going to move on to Jan Boudart. I see you have a comment or question.

You can unmute your microphone for any questions or comments.

MS. BOUDART: Hi, this is Jan Boudart and I'm from the Nuclear Energy Information Service. I wanted to emphasize something that Don Safer said.

I wrote down it's interesting to hear about research from -- all of these research projects are heavily pro-industry.

Here in Illinois, we had a house built, and I recall it, the number was 1146 and this provided for a research project that would ascertain that nuclear power-plants were safe.

I'm not saying this well. I wish that I could tell you the exact words for this but that was supposed to be a research project. But the conclusion

of the research project was in the name of the project.

Now, that was Rita Gross but nevertheless, people research with something in mind. And the research that's being done on nuclear power-plants.

For example, Ernest Momie said we have to do something about a high level of nuclear waste because it's the bottleneck to keeping the nuclear power-plants going. Right, the point is to keep the nuclear power-plants going.

There is not research done on shutting them down and the result of shutting them down, the result of doing nothing instead of doing something.

The research is terribly faulted in this way because what if you don't do anything? What if you shut them down and don't do anything, or you don't build a small modular reactor?

Not doing something should be included in the research but usually, it isn't. It's research on how can we make better reactors? Instead of one of the alternatives being to make no reactors, and to find another method of producing energy.

So, I have to agree with Mr. Safer that the research done by the NRC and the nuclear -- NEI or something like that -- these are all done to promote

nuclear energy instead of being really independent research on the problem.

They want to promote nuclear energy and the research is directed at figuring out how to do this. It is not independent research.

That's all I have to say. I hope we get to hear from Ace.

MS. WU: Awesome, thank you so much, Jan. It looks like, Ace, you're ready to go?

MR. HOFFMAN: Yes, can you hear me?

MS. WU: Yes, we can.

MR. HOFFMAN: Okay, great. Thanks very much for allowing the public to have a voice in this rather long hearing, and I've caught most of it. So, hopefully I'm not asking anything that's been covered.

First of all, at San Onofre, a cable about the thickness of your arm broke and it caused a shutdown in the last couple of years it was operating.

The cable had been pinched between a refrigerator-sized breakout box that it was running to and the floor, and it took 30 years for that to wear through.

So, more and more of those. A bathtub shape was illustrated earlier in the day and to go to 100 years is just literally asking for trouble. I

believe at San Onofre one of the main steam pipes was found to be much more worn than they thought.

Something like 90 percent of it was worn away and they didn't discover this until after the plant was closed.

And the point here is there are numerous parts of the plant you simply cannot inspect and I would especially say that there are an awful lot of wires and cables and controls that cannot be inspected, and you don't know where they're really going.

You don't know what the root is and there's no way you're going to be able to do anything. You can't just ignore all of these. And then, of course, there's the problem with degradation.

I didn't hear anything about the degradation in the cement from tritium, which rather surprised me. So, I think there's a lot missing.

And wrapping up, just one more comment, which is that if you're going to discuss whether or not we should do this, you have to take a holistic approach of looking at what are we going to do with the waste?

How are we going to transport it? Are there too many population centers between where it is

and where we want it to go? All of these are reasons why you couldn't possibly run a reactor.

And also, terrorism, war, and aging, and that kind of internal violence that we saw in the first week of January.

There could be all kinds of problems that make a dangerous technology unworkable, and you need to consider all of those, not just whether or not you think the plant is safe.

So, thank you again very much and you can mute me now.

MR. MUSSATTI: All right, I think it's time to turn the meeting over to Anna so she can say thank you to everybody and we can end the meeting on time.

DR. HISER: Yes, Dan, this is Allen Hiser.

Let me just talk a little bit, trying to summarize, and I thought it would be fairly easy to summarize this meeting but it's been so long and there's been so much input.

We've heard a great deal on the technical issues from some of the presenters and from the public. So, at NRC we'll go over the court reporter transcript and the chat comments, and we'll start to summarize things.

As indicated on the screen, we do have another meeting in four weeks, February 18th. The purpose here is to seek public dialog related to license renewal for nuclear power reactors, specifically the possibility of extending the time period for renewed licenses from 20 years to 40 years.

You can see the discussion topics under there. This is also posted on the NRC public meeting website so I encourage people to look at participating in that meeting.

Once we have summarized this meeting, we have the meeting on February 18th, we will pull all of that information together and we will determine appropriate next steps. And I'm sure that will be fairly well publicized.

I guess just one last comment, I know there are still people who wanted to make public comments.

Please send those to me at my email allen.hiser@NRC.gov, along with Scott Burnell. And Hector, if you can also find his email address on the public meeting notice. And that's all that I have.

Anna?

MS. BRADFORD: Yes, thanks Allen.

Again, this is Anna Bradford, I'm the Director

of the Division of New and Renewed Licenses at the NRC, and my Division has the lead for license renewal and topics related to license renewal.

And I just want to close by thanking all of you for participating in today's meeting. We had a lot of good discussions, we heard a lot of different views.

We generally appreciate hearing from groups like Beyond Nuclear and BREDL and private citizens that live near plants. It helps us make better decisions.

And I also will apologize, there were some technical challenges with microphones, with making sure people could unmute and all that. We appreciate your patience.

It can be difficult to manage a virtual meeting with 150 people, that's the number we had at one point. So, again, I appreciate your patience with that.

And I want to emphasize again that we don't have any plans to revise license renewal durations to allow operation for 100 years right now and we do not have any requests from licensees to approve them to operate up to 100 years.

We're just in the very initial exploratory

stage which is why we wanted to your input now while we're at that early stage.

And as Allen just mentioned, we do have that public meeting scheduled for February 18th to discuss specifically the possibility of extending the time period for renewed licenses from 20 years to 40 years.

And I invite you all to participate in that meeting as well. And then following that meeting, the NRC will do some internal deliberations on how to present those topics, either by terminating further consideration for now or by initiating additional activities in one or both of these areas.

So, again, I thank you for participating. If you do have follow-up questions or comments, as Allen mentioned, please feel free to send it to him or to Hector or to Scott Burnell, whose email address you would have heard today.

And again, thanks for your participation and have a nice evening.

MR. MUSSATTI: All right, everybody, thanks and have a good night.

OPERATOR: This concludes today's conference, you may disconnect at this time.

(Whereupon, the above-entitled matter

went off the record at 4:55 p.m.)