UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

TRANSCRIPT

Summer 2016 BOARD MEETING

Wednesday

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WESTIN WASHINGTON DC CITY CENTER HOTEL
NATIONAL BALLROOM A/B
1400 M STREET, NW
WASHINGTON, DC 20005

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I N D E X

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P R O C E E D I N G S

8:00 a.m.

KENNETH LEE PEDDICORD: Welcome to the U.S. Nuclear Waste Technical Review Board's meeting on the Department of Energy's integrated program for management and disposal of canisters containing spent nuclear fuel and high level radioactive waste. I am Lee Peddicord, a Member of the Board. I am standing in for Chair Rod Ewing this morning, who is dealing with a medical situation. I will introduce the other Board members in a moment, but first I want to briefly describe the Board and tell you why we are holding this meeting and what we plan to accomplish.

As many of you know, the Board is an independent federal agency in the Executive Branch of the U.S. Government. I want to emphasize that the Board is not a part of the Department of Energy or any other Federal organization, such as the Nuclear Regulatory Commission. The Board was created by the 1987 amendments to the Nuclear Waste Policy Act to perform objective, ongoing evaluations of the technical and scientific validity of DOE's activities related to implementing the Nuclear Waste Policy Act of 1982.

The 11 Board members are appointed by the President from a list of nominees submitted by the National Academy of Sciences. We are mandated by statute to report Board findings, conclusions and recommendations to Congress and the Secretary of Energy. Copies of some of the Board's most recent reports can be found outside on the document table at the entrance to this meeting room. And they are available on the Board website, which is at: www.nwtrb.gov.

Today's presentations and discussion will focus on the work of the Department of Energy that has already been done, and the challenges it faces in implementing an integrated program for transporting, possibly storing at an interim site, and then disposing of both commercial and defense-spent nuclear fuel and high-level radioactive waste.

These nuclear materials are stored in many casks and canisters of varying age, size and robustness. The difference among the casks and the canisters present a number of challenges for the Department of Energy and its contractors as they work to develop an effective and efficient transportation system, equipment, facilities and logistics for transporting and disposing of spent nuclear fuel and high-level waste.

The nuclear industry and the U.S. Navy have also gained important experience in managing and transporting spent nuclear fuel and other nuclear materials, and offer unique perspectives about what they have learned. We will hear from representatives of both groups today.

Considerable effort has gone into planning for this meeting and arranging the presentations. I especially want to thank Allen Croff, Board Member here, who acted as Board lead in coordinating the staff's input to this meeting, and particularly Dan Ogg, a member of the Board staff who worked with Mr. Croff on doing this.

I also want to thank the Department of Energy for making its contractors and staff available today for the presentations.

Let me now go through and introduce the Board members, and tell you about the schedule and the agenda for today's meeting.

First, in terms of introductions, I would ask that each Board Member when I call upon their name raise their hand so you can identify them. First let me begin with Dr. Jean Bahr from the University of Wisconsin, who is a Professor of

Hydrology in the Department of Geosciences at the University of Wisconsin-Madison.

Dr. Susan Brantley is a distinguished Professor of geosciences and is Director of the Earth and Environmental Systems Institute at the Pennsylvania State University.

Mr. Allen Croff, whom I mentioned earlier, is a Nuclear Engineer and an adjunct Professor in the Department of Civil and Environmental Engineering at Vanderbilt University.

Dr. Linda Nozick, who will be joining us in a few minutes, is a Professor in the School of Civil and Environmental Engineering at Cornell University.

Dr. Paul Turinsky is Professor of Nuclear Engineering at North Carolina State.

And Dr. Mary Lou Zoback is a Consulting Professor in the Geophysics Department at Stanford University.

As I mentioned, I am Lee Peddicord. I am a Professor of Nuclear Engineering at Texas A&M University and Director of the Nuclear Power Institute in Texas.

We have a couple other people who also are not here today due to other commitments.

Dr. Steven Becker is a Professor of Community and Environmental Health in the College of Health Sciences at Old Dominion University in Virginia.

And Dr. Efi Foufoula-Georgiou is the Distinguished McKnight University Professor of Civil Engineering and the Joseph T. and Rose S. Ling Chair in Environmental Engineering and the Director of the National Center for Earth Surface Dynamics at the University of Minnesota. She is not joining us today because she is now moving to the University of California Irvine.

And one other individual, who was recently affiliated with our Board, Dr. Gerry Frankel, Professor of Materials, Science and Engineering and Director of the Fontana Corrosion Center at the Ohio State University, has just resigned from the Board to focus on his research dealing with a new, very major center. And we very much appreciate Dr. Frankel's contributions to the Board and will miss his expertise.

Today, we are also joined by the Board staff, who are here to my left, who are the key individuals in assuring the work of the Board and moving forward with our agendas, our reports, and all the Board activities.

At Board meetings, we want to make clear that the views expressed by Board members are their own and not necessarily Board positions. Our official positions can be found in our reports and letters, which are available on the Board website. If you'd like to know more about the Board and our activities, there is a one-page handout summarizing the Board's mission and presenting a list of the Board members; and this can be found, again, on the document table outside the entrance to the room.

And as I also mentioned, you can visit the Board's website at www.nwtrb.gov for all other information about our Board's reports, correspondence, testimony and meeting materials.

During this meeting, there will be two opportunities for members of the public to make comments, before the lunch break and at the end of the day. We ask if you want to make a comment, please add your name to the sign-up sheet at the registration table. Written comments and other written

materials may also be submitted by providing the material to one of our staff members today, or by sending the material by mail or e-mail to the points of contact noted in the press release for this morning. The press release is also posted on our website. Documents submitted by the public will become part of the meeting record and will be posted on the Board's website, along with a transcript of the meeting and other presentations.

If you make a comment during the meeting, please state your name and affiliation first; and make sure to speak directly into the microphone here in the center of the room so that you'll be identified correctly in the meeting transcript.

We also want you to be aware that the meeting is also being broadcast by webcast and is live. You will see cameras in the room. Depending on where you sitting, you might be part of the webcast; so you may want to choose carefully where you're sitting, depending on your interest in appearing across the world.

I also want to request that the speakers speak loudly enough so that those in the back of the room can hear. It will also be helpful for those who are watching the webcast if the

presenters will summarize each question before answering it. The webcast will also be archived after a few days and will then be available on our website.

To assist those watching the live webcast, the meeting agenda and presentations have been posted on the website and can be downloaded. They will also be part of the webcast.

Now to outline today's agenda, which is also available on the document table in the back of the room. This morning, Mr. John Kotek, Acting Assistant Secretary for Nuclear Energy at DOE, together with his team, will tell us about the canisters and casks used for storing and transporting commercial spent nuclear fuel with a focus on integration. They will also describe the system analysis tools they use to assess and plan for commercial spent fuel transportation, storage and disposal.

Then, in the final presentation of the morning, we will hear from Mr. Kris Cummings of the Nuclear Energy Institute. He will provide the perspective of the commercial nuclear industry regarding cask and canister designs for storing and transporting commercial spent nuclear fuel.

After the lunch break, Mr. Mark Whitney, the Principal Deputy Assistant Secretary for Environmental Management, and other representatives of the Department of Energy's Office of Environmental Management, will discuss efforts to manage and store a large inventory of DOE-managed spent nuclear fuel and high-level waste as part of an integrated national program. They will discuss how current Department of Energy activities support future efforts to transport and dispose of these nuclear waste materials.

Following the environmental management speakers, Mr. Barry Miles of the U.S. Navy will present the Navy's experience and perspective on transporting Navy-spent nuclear fuel.

Now I would ask you to mute your cell phones, just like in church, and we will begin the program. It is my pleasure to turn over the podium to John Kotek for his opening sermon.

Mr. Kotek?

JOHN KOTEK: Opening sermon? To me, it's the first reading, right? I grew up in the Catholic Church.

Thank you all for the opportunity to be here. I really appreciate it; I'm really looking forward to today's discussions.

Before I get started, I do want to introduce a few folks; some of them you'll be hearing from later. I think over the past couple of years, you've gotten to know Andy Griffith from my team. Of course the Office of Nuclear Energy has responsibility for a lot more than just the waste program – big R&D efforts and infrastructure responsibilities in Idaho. So I need somebody to run the program day-to-day, and that is Andy.

And on Andy's team, we've got – I saw Erica Bickford here, and I saw Melissa Bates here. I don't know if I missed anybody else from the DOE NE staff. Oh, and Jack Wheeler is here; there's Jack. And then of course we've got several of our lab experts here. The most obnoxious ones, we've put at the back table. Well, no, Mark Nutt is not really obnoxious. But Rob Howard is back there as well. I saw Steve, Joe, Josh. We've got a whole bunch of folks here to help answer your questions today.

And then it's good to see Ed Davis in the audience. We've been following each other around the country here for several months. So appreciate the opportunity to be here.

You had asked me to address a few things in my remarks -- some of them I'll be able to get to in detail, some of them I think other folks will cover maybe in a greater level of detail than I'll get into today. But particularly in talking about the objectives of the Integrated Waste Management System – we'll spend some time talking about that – you'd asked about coordination between us and EM. We've got some folks from our office and some folks from the EM office who are going to talk about where we stand in that coordination. I'll touch on that a little bit.

You asked about priorities for FY17 and FY18. We'll talk some about that, but of course a lot of that depends on what happens in Congress. We have, in our FY17 budget request, we've asked for the ability to go off and actually implement a consent-based siting process. As you may have seen, the Senate largely went along with our request; the House did not. We don't know how that's going to turn out, but we'll get into that a little bit more.

And then other things you asked us to talk about is how we address recommendations from the Board, and pointed to three letters in particular; but of course there have been a series of letters and reports coming out of the Board, certainly in the year-plus since I've been acting as the Assistant Secretary. So I'll talk a little bit about that.

The way I'm going to address that today is give you an overview of some of the key points of the Integrated Waste Management System, talk a little bit about the organization we've got set up, give you a little status on our current efforts and our priorities for next year, talk a little bit about interoffice coordination, and then talk about how we go about responding when you all send us recommendations.

For the Integrated Waste Management System, our vision, as embodied in the Administration Strategy issued in 2013, is to develop an integrated system that includes elements for transportation, storage and disposal of the nation's spent fuel and high-level waste. We're really trying to drive to a flexible system. And if you've ever heard the Secretary talk about this subject, you'll know he talks about the importance of options – optionality he calls it – and the

ability to be responsive in the event that some part of your system is unavailable or is not working.

We also want to develop a system that of course can ensure safe and secure operations -- that's got to be our top priority – but that can also gain trust among the stakeholders involved. And as we've gone around the country, we've heard a lot of feedback from members of the public who are interested in this issue. And trust is an issue. Confidence in our ability to execute the waste program is an issue. And that's something that we need to work on -- particularly with the state, local, potentially tribal governments involved, but also with stakeholders in communities that might host waste facilities or in communities that might be along transportation routes.

And then of course we believe we need to be able to adapt our operations based on lessons learned – don't get too locked in, but be willing and able to adapt and respond in the face of changing circumstances or information. And so we do think to implement this system, we're going to need a robust set of capabilities, again, across the transportation, storage and disposal areas.

And so what we think this system will look like is it's going to include several elements, starting with one or more pilot facilities for interim storage of spent fuel – and again, initially focused on accepting spent fuel from shutdown reactor sites. I think you all are well aware of the fact that we've got 13 former commercial reactors with spent fuel. We've also got Fort St. Vrain reactor, where there's spent fuel on the site; and in many cases, there are really several cases, that's all that's there. The reactor is gone; the turbine hall is gone, et cetera. All you've left on the site is spent fuel.

We think consolidating that fuel into one or a small number of storage facilities makes a lot of sense. But we do think storage can make sense and can provide flexibility and optionality in the system beyond just dealing with the shutdown reactors. So we also envision what we call a full-scale consolidated interim storage facility that would provide greater capacity and flexibility within the waste management system.

Of course, storage isn't enough; storage isn't a solution. Storage is part of a system; but at the end of the day, you've got to get to one or more repositories for long-term

safe disposal of this material. As part of that, we are considering the development of a separate repository for at least some of the DOE-generated and managed wastes, particularly those that come from the Nuclear Weapons Program.

And then, of course, we also have to have the transportation infrastructure to tie it all together, to move spent fuel or high-level waste by railroad or barge. We've looked principally at rail; but based on what we're seeing at shutdown plant sites and other places, there is very likely to be some element of road and even barge shipment involved as well, even if we do principally rely on rail. So we need to have all of those elements well-developed as we implement this system.

And so this is kind of how it all fits together. We've got the waste coming from commercial power plants needs to be transported, either to storage or to repository facilities. We do see a parallel path for defense wastes, several of which might go into a defense-only repository, some of it which might need to go into a repository developed for commercial waste.

Specific to the question of the various types of canisters that could be involved in a system like this, I will say Joe Carter is going to deal with this in a lot more detail later. But just to introduce this, I think you all know we could have single, dual, or even triple-purpose containers involved in storage, transport and disposal. You could have spent fuel canistered in transportation overpacks, disposal overpacks, dual-purpose overpacks – a wide range of options either currently in use or under consideration.

And then there's also the option of having non-canistered spent fuel or bare fuel in storage casks, transportation casks, dual-purpose transportation/storage casks – you name it. So a lot of options on the table right now. I'll let Joe get into the details later – kind of our current thinking on that front.

Other types of containers in an Integrated Waste Management System – of course we've got containers for DOE managed waste as well, both the spent fuel and, as you know, we've got a very diverse inventory of spent fuel in the DOE system. We've also got the defense wastes that have been generated, principally glass but other waste forms as well. And so our colleagues from EM will talk to you a little bit

more today about the canisters that are in use and envisioned there.

Within our organization right now, as I mentioned earlier, the Administration Strategy issued back in 2013 calls for a new waste management and disposal organization, separate from DOE. Now, we're not there yet. We've made that recommendation, and there's been some legislation introduced on Capitol Hill that would achieve that end. Right now, the responsibility is within our organization. As I mentioned, we in NE lead these integrated waste management system efforts in coordination with other offices. As has been reported in the media, we have been moving towards a reorganization. We're not done yet, but we've been moving towards a reorganization within our organization to set up the waste program as a separate Deputy Assistant Secretary level office.

Right now, organizationally, Andy is under a Deputy Assistant Secretary, a guy by the name of Dr. John Herczeg, who I think many of you know. We want to move that out, and we want to make that organization a direct report to me, as a first step towards creating a standalone organization. But

like I said, we're not there yet; but that's where we are at the moment.

Also, as we move forward with the program, we also want to get our Nuclear Energy Advisory Committee providing us advice, particularly on the consent-based siting piece of the program. And so we're looking at a subcommittee there as well that would be focused on those elements of the waste management system.

So where are we now?

The Integrated Waste Management System of course involves a lot of different planning in R&D areas, just the consent-based siting piece of it, the systems analysis data and tool development, development of a consolidated interim storage facility, development of the transportation capability, and then development of ultimate disposal capability. What you'll see with us, given that we've got a budget that's a whole lot smaller, frankly, than it was when we were back developing the Yucca Mountain proposal, we've had to focus our efforts on certain areas. We haven't gotten what we've asked for in terms of budget here these last couple of years, but it's allowed us to make some really good

progress, particularly in the consent-based siting area. I'll talk to you a little bit more about that now.

We do have work going on across the full range of planning in R&D areas, again, particularly focused on the commercial-spent fuel piece, a little bit less so in the DOE-managed spent fuel and high-level waste. But they're all things that are part of our program planning going forward. It's just a question of where are we now and what do we need to focus on. You'll see that the consent-based siting piece is what we've been focused on here over the last several months, over the last year.

As I think many of you know, we have been engaged and have recently completed a nationwide series of meetings. We wound up holding eight public meetings around the country. They were all webcasts, so we had folks watching in from other locations. We also had issued an invitation for public comment, which closed at the end of July. And so we've received comment from individuals, some of whom came to the meetings, many of whom didn’t. I think all totaled, by number, we had more than 10,000 comments come in – 11,000 Andy is saying. Some of them were kind of postcards and repetitions of the same comment; but we did have some really

thoughtful, individually-crafted comments as well. It was all designed to give us input into the design of a consent-based siting process.

So where we are now is we've been trying to lay the groundwork for implementation of a consent-based process. These meetings gave us a good diversity of inputs and points of view from people at the state level, local level, tribal level, and individuals – NGOs – other organizations that really care about this issue. We asked them a series of five questions about what should a process look like, who should be involved, what role should they play, what does consent look like.

These are some difficult things to wrestle with and get your arms around. We wanted to hear a broad range of public input before we put together a draft of what we think a process ought to look like. Ultimately, what we intend to do of course, is employ that process in dealing with and engaging with communities, state governments, local governments, to find out what would it take for a community, a state, potentially a tribe, to consider being what we call a willing and informed host for a new nuclear waste management

facility – whether that's a spent fuel storage facility or for a preferred disposal facility.

We've received that input; we're digesting that input. We're going to put together a report back that summarizes the major themes of the public input we've received. And I don't want to put too firm a date on it, but thinking that in the next month or two we will have that in a position to go out for public consumption. And we're going to want to make sure that we got themes right; so we're going to ask folks, "Did we capture what you think are the most important issues?"

We'll ask for feedback on that, and we will later put out a draft of what we think a consent-based siting process ought to look like. So that's another thing that we're driving towards by the end of this year. And, again, we'll want to get input from folks: Do you think what we put forward is going to work, so that pending Congressional approval, we can actually move forward and start engaging with communities, with states, potentially with tribes on this issue.

As part of our fiscal 17 budget request, we did include about $25 million that would be set aside for issuing grants

to, again, units of government and potentially others who are interested in studying this issue. Give them the tools that they need so they can go off – and don't just take our word for it but go off and get your own resources, your own expertise, and investigate this question yourselves. And if there are aspects of potentially hosting a spent fuel storage and disposal facility that are of interest or potentially troubling, what have you, to a community, give them the ability to go off and dig into that on their own.

The point, of course, is to not come right out of the shoot and look for somebody to say yay or nay; but give them some time to think about it. Anyone who has heard me talk about this knows I think there are fundamental two questions a community or state or potentially a tribe is going to have to be able to answer. And the first is, can they do this in a way that is protective of people in the environment? I don't know any community is going to want to go forward thinking that this is going to potentially be harmful to their citizenry or their environment. But assuming they can answer that question positively, then the next question is can we do this in a way that leaves us better off for having done so?

We know there are challenges associated with hosting a facility like this. We also know there can be great benefit. And we've seen communities in other countries that have stepped forward and said, yeah, we've done that calculus; and we think we're better off for having agreed to host this facility. And we think we can get there here in the United States, but we don't want to try and force it too fast either. We want to give folks a chance to really be thoughtful about it and engage really on their own terms and, again, on a basis of being fairly informed.

So that's what the next few months look like. And as I mentioned earlier, a lot depends on what direction we had with our fiscal 17 budget request and beyond. But we do think that over the next 10 years, it would be more broadly the focus of our Integrated Waste Management System program is going to need to be on siting, designing, licensing, constructing and operating a pilot interim storage facility with an initial focus, again, on fuel from shutdown reactor sites; development of the transportation capabilities that we're going to need to facilitate acceptance of spent fuel at a pilot facility; advancing towards the siting and

licensing of a larger storage facility to provide flexibility and reduce expected government liabilities.

And of course as we get involved in discussions with communities, we're going to be looking for communities that want to engage in discussion both of potentially storage facilities but also potentially for disposal facilities – again, including both defense and commercial waste.

In fiscal 17, we would see our priority areas – again, assuming we get the okay – to really focus on community involvement in a consent-based siting process. I mentioned the grant program as a key tool there. But also more on the technical side, developing a generic design and a topical safety analysis report for a pilot storage facility and continuing to work on the prototype railcar that we've got under development for commercial spent fuel transport.

Let's talk just a little bit about program coordination and technical integration. Of course we are not the only organization that cares about this issue. Even within DOE, there are other organizations that have important equities at stake here; and then of course there are other parts of the government, not to mention utilities industry and what

have you. A big part of what we do is try to ensure that we stay linked up and that other folks stay informed of what we're doing and we stay informed of what other programs are doing and make sure that what we're doing can all come together as we actually get into the implementation of a system.

Technical integration of in particular various container types entails integration across the Integrated Waste Management System functional areas. And we're also looking to explore synergies that might exist and could be made to exist in the integration between commercial fuel and defense, spent fuel and high-level waste. Again, we've got folks who are going to talk a little bit more about that later.

Within DOE – and you'd asked specifically about the question of coordination with EM – there is a lot of coordination that goes on there. I'm pleased to say we've had some very successful personnel exchanges, for example. We're bringing folks over who have got a depth of experience within the EM program, for example, bringing them into NE. I can also say that Dr. Monica Regalbuto, who I think is well-known to all of you, she worked in NE for a while; she knows the NE staff

well, and she's always trying to steal the good ones. So there's always an opportunity for folks to go over that direction as well, and there is a lot of crosstalk because we do have folks who have worked in both organizations and know each other very well. So we really try to encourage that.

We've got a regular meeting that we engage in, where we just sit down and talk about topics of mutual interest to our organizations. And of course this is regularly on the list. We do have periodic coordination in working group meetings among senior managers in our organizations. The routine communication, for example, between us and them on railcar development efforts, between us and the Navy on railcar development efforts, I think is very valuable. And I think you'll hear from a representative naval reactors a little bit later, and of course our folks can talk about that as well.

And then the typical MOUs and MOAs that agencies or offices within the Government put in place to facilitate cooperation. We've got those sorts of things in place as well.

One question that you had asked is how we go ahead and respond to Board recommendations. I want to touch on that a little bit now. And I've got to tell you, I've really appreciated the time that the Chair, that members of the Board, and that Board staff have spent with me and my team in the year-and-a-half since I've been back in DOE. I think there are really excellent lines of communication. Of course by virtue of the time I spent on the Blue Ribbon Commission Staff, I got to know several of your folks – Nigel of course, but Dan was there at the time, Karyn was very heavily involved in the BRC. So we got to know each other pretty well. I think that helped really make it easy for us to get started.

Nigel and I try to get together on a fairly regular basis just to check in, and that's been extremely valuable for me; so I appreciate that. Andy is starting to pick up those relationships as well, and I think those lines of communication can only help.

When you all give us a set of recommendations, we ensure that that gets out to both our DOE program people and the program folks in the lab who are working on a particular area. What I've tried to do since I've been back is as you

all have been sending us letters, try to get letters back. I think there have been three this year. I know there are some reports going back a couple of years that didn't have a formal response; but I think we're getting more into the mode of giving a written response back – maybe not to everything, but I think we're getting a little bit more into that rhythm.

And we do appreciate the opportunity to engage in these kinds of feedback loops. I know for you all, at times you kind of get a glimpse into what we're doing. And maybe we don't hit everything at every meeting, and so I do appreciate the opportunity when you folks come back to us and say, hey, what about this, this and this –before you maybe need to put it in a letter, ask for a little clarification. I think those sorts of things are an effective way for us to communicate going forward. Sometimes an exchange of letters is important; sometimes conversations can resolve it. And I think we're doing a better job of figuring out what that happy medium is.

And we can get into more of a discussion on that, but what we're trying to do going forward is a process where if you folks are sending us a letter in writing, we're giving you

something back. Like I said, we've got the three we've done this year. To the extent that we've got further communications with you all, we'll try to continue to live up to that.

In summary, we're at an early stage, of course, with the Integrated Waste Management System. For the fiscal 17 budget request, it's the first time we've told the folks on the Hill we want to move forward with implementation. In years past, we've been saying we want to lay the groundwork for a consent-based siting program. In fiscal 17, we've actually asked to go off and implement that; we'll see what happens.

We do recognize the importance of department-wide coordination on these issues and technical integration. And we'll continue to strive to ensure that we get better and better at integrating folks in EM, folks in the naval reactors, and other organizations that have equities at stake here.

We are placing a priority on our spent fuel and waste disposition activities -- as I mentioned earlier, in particular this year on the development of a consent-based siting process and getting public input. And as we look

forward to fiscal 17, we do want to move forward with engaging communities in the development of a consent-based siting process, working towards development of interim storage facilities and continue working on the railcar prototype design efforts.

That's what I had wanted to cover with you all this morning. I'm happy to take questions and, again, appreciate the chance to be here.

LEE PEDDICORD: Okay, well, thank you very much for covering especially the points raised by the Board. Let me open it up to questions from the Board members; and please identify yourself.

PAUL TURINSKY, BOARD MEMBER: Both of these questions relate to the consent-based siting. One is, how are you utilizing international experiences? There's recognition there's differences in societal norms and government structure and all, but will that be reflected in this report that's coming out?

JOHN KOTEK: The initial report that's coming out is just going to summarize the input that we've received and the major themes of what came out. We have had some folks

comment on international experience. For example, we had Kathryn Shaver from the Canadian program come and speak at one of our meetings.

The way we set these meetings up was we'd have local senior officials give a little perspective, a little local flavor; then I would talk; and we would invite typically four panelists to give their perspectives on some element of the program. And so we did try to get people who had experience with hazardous facility siting in the U.S. and abroad at these things. So to the extent that we got input from them or we got input from commenters that goes back to the international experience, we'll incorporate that.

But I think, really, where the international lessons learned will show more will be in the development of a draft of consent-based process where we'll try to learn from what the Canadians and Swedes and others have done.

PAUL TURINSKY, BOARD MEMBER: The second question on the same topic is who owns implementation of consent-based siting? Is it the Government; or is it your contactor, who is going to be developing that site?

JOHN KOTEK: As we are developing DOE facilities for storage or disposal, that's something that we will be out there engaging with communities on directly. There are private initiatives out there that are not government, but we have seen some private companies working with some communities express an interest in playing a role here. That's one of the things that we would need to work with them on to ensure that -- what we're after is a willing and informed host state that can provide us a durable solution to the problem, whether it's for storage or disposal. So we would need to work with them to figure out just how do we ensure, or how do we satisfy the government interest here, to ensure that there's a durable solution here. So that's something we would need to work on.

PAUL TURINSKY, BOARD MEMBER: Do you imagine, as part of a contract with this organization, that there would be requirements?

JOHN KOTEK: Really wide open at this point. We're just not at that stage yet, but that will be an important question we ask and answer. We're just not at the point where we have answered that yet.

Thanks.

LEE PEDDICORD, BOARD MEMBER: Dr. Zoback?

MARY LOU ZOBACK, BOARD MEMBER: Thanks, John, that was a nice summary and update. And I just want to say I think I speak for all the Board, we really do appreciate your responding in writing. It's always nice to know that what we've said has been read and thoughtfully considered.

JOHN KOTEK: Yeah.

MARY LOU ZOBACK, BOARD MEMBER: I want to stay on the consent-based siting. I was intrigued; you said at each of these meetings, you ask the members of the public five questions. Can you tell us what those questions are generally?

JOHN KOTEK: We had questions on what should the role be of various participants in a consent-based siting process.

Andy, do you have the list with you?

We asked questions about – I'm going to ask Andy; he's probably got the list. I didn't bring it with me, but

Melissa has it because she's always prepared. All right, here comes Melissa.

LEE PEDDICORD, BOARD MEMBER: Please identify yourself.

MELISSA BATES: Hi, I'm Melissa Bates at the Department of Energy. One of the questions is: How can the process ensure that the process for selecting a site is fair?

The next one is: What models and experience should the Department use in designing the process?

The next one is: Who should be involved in the process for selecting a site, and what is their role?

The next one is: What information and resources do you think would facilitate your participation?

And the last one is: What else should be considered?

JOHN KOTEK: And so what we would do at these meetings – and those were the same questions that were in the invitation for public comment – what we would do is we would have an opening speaker. Then I'd give a 15-20 minute overview of the issue: Why are you hearing from someone from DOE? What is this waste and where does it come from? What do

we need to do about it – what do we see as a range of options going forward?

And then we would have this set of typically four panelists give their perspectives. Some folks talked about environmental justice; some folks talked the federal versus state power balance. You had a whole range of issues covered there. And then after a Q&A period, we would break the folks down into working groups; and we'd get six to eight people at a table with a facilitator. And we would ask them to focus on those questions, although sometimes the conversation is going off in different directions and that was fine.

But then at the end of an hour or an hour-and-a-half of a breakout, we would ask the facilitators to report out on what were the major points that particular group thought we needed to take away. And that was really, to me, the most valuable and rewarding part of these sessions, was to hear how people – I mean, they really did tend to focus in on the major issues that we think are the ones that will present the greatest challenge going forward. Things about institutional responsibility, questions of trust, the roles

of communities – who is involved and what role do they play. So we got a lot out of it.

MARY LOU ZOBACK, BOARD MEMBER: Just a follow-up.

LEE PEDDICORD, BOARD MEMBER: Mary Lou, could you pull the mic over, please?

MARY LOU ZOBACK, BOARD MEMBER: Did you get public health people involved? They really are dealing risk communication all the time. And I've found they've been an extremely valuable resource because they know how to talk to the public.

JOHN KOTEK: Yes, we've had some of that. That's something that I think we can derive even more from. If you've got particular either individuals or areas in mind, I'd ask you to talk to Melissa maybe at a break and give her your thoughts on that. We'd appreciate that. Thank you.

Oh, and back to your point about the written responses to your letters, thank you for that. I appreciate it. I can assure you that even before we got into the rhythm of responding to the letters as they came in, folks, your letters get read or the reports get read. I know our people

look seriously at what you have to say and how that should influence our planning going forward. I think, like I said, getting into this rhythm of actually getting you responses I think is probably more constructive over time. But I can tell you that our folks are very keenly aware and pay a lot of attention to what you say and have for years. So thank you for that.

MARY LOU ZOBACK, BOARD MEMBER: Thank you.

LEE PEDDICORD, BOARD MEMBER: Dr. Bahr?

DR. JEAN BAHR, BOARD MEMBER: Again, on the consent-based siting, when I look at this map, there's kind of a big hole in the middle in the South. I know there are some communities in Texas that actually seem interested in some of these storage facilities. So I'm just curious why there weren't any public meetings in that part of the country.

JOHN KOTEK: Limited resources – we tried to go to places where we could get a diverse range of opinions, perspectives, experiences. You look, for example, we did one in California. They've got a shutdown plant right there near Sacramento, so we figured it would be interesting to hear whether that's top of mind as an issue there. And then in

the Northeast, in Boston, of course you've got several shutdown plants up there, as well as operating nuclear power plants. So we wanted to get a perspective from folks as to how they view consolidated storage, for example, as a way to deal with the shutdown plant sites.

So we tried to go to communities where we thought we could get a diverse range of perspectives. We did make it well-known to folks that if we didn't have a meeting scheduled in their area but they wanted to engage with us in some way that there were other ways to do that. And in particular, Andy and I can point to a trip we took down to San Onofre, down to Southern California.

What did we do – four or five meetings in a day when we were down there – to get people's input?

We want to hear from folks. We can only do so much. So we picked some sites that we thought would give us a diverse range of perspectives. And to the extent that other folks have thoughts that they want to share with us, we want to hear them.

Andy, do you want to add something to that?

ANDY GRIFFITH, DEPARTMENT OF ENERGY: I'd just like to add that we also have very good relationships with state and regional groups that we've worked with on transportation issues. We consulted them on what regional cities they would like us to consider for hosting these public meetings. And they were all included in the eight cities we visited.

JOHN KOTEK: Okay, thanks.

LEE PEDDICORD, BOARD MEMBER: Dr. Brantley?

DR. SUSAN BRANTLEY, BOARD MEMBER: I'm just sitting here looking at this diagram with your planning and R&D with consent-based siting in a box, and I'm kind of thinking about that. You know, at the same time that these meetings were happening, there was also this kind of snafu around the sighting of the deep borehole or the possibility of a sighting. So that's happening in one place, and then we have a box in another place where we're studying consent-based siting.

And I guess it makes me think about the fact that consent-based siting is all about communication and education and how does a research scientist talk to a non-scientist and the back and forth and changing sort of the attitudes of

research scientists. And I'm speaking as a research physical scientists now, where fracking is a big deal in the community of Pennsylvania where I live. And I've had to learn how to talk to people and not just talk at them. And I think all of us scientists sometimes talk at people instead of with people.

Anyway, we've got this separation. What's DOE doing about that -- because putting it in a box and studying it maybe doesn't really solve the whole problem.

JOHN KOTEK: Well, on the specifics on the borehole project, you may have seen we've just put out a new RFP on that with a little bit different approach to working locally. And what we had asked for in the first go-around was for a bidder to show us that they had the ability to use a piece of land and some demonstration of their ability to go forward. That obviously didn't work out in the places that we've looked at.

But what I think we've heard through that process is very useful to us. Of course, that's not a project that involved the use of waste; and so it's a little bit different. But I think when you look at the new RFP, you'll see we're looking

for a little more proactive efforts at siting right up front to ensure that we've got the type of local buy-in.

And we're a small team – a lot of the same folks involved with the borehole project are involved in the consent-based siting effort for us as well. So it's a good learning opportunity for us as well, and to incorporate lessons that we're learning from that into our approach with consent-based siting for storage for disposal facilities. So we have the advantage of being able to incorporate that knowledge into our thinking going forward.

One of the things that you'll see in the new RFP is we're asking these contractors to work with potential host communities to figure out what sort of things do they need to make this more advantageous to them or worth their while for getting involved. And that sort of thinking, I think, will influence our approach on the consent-based siting of facilities as well. But, yeah, a lot to be learned – like I said, fortunately we've got basically the same people involved in both things, so lessons learned in one place will be applied in the other. Thanks.

LEE PEDDICORD, BOARD MEMBER: This is clearly a topic of keen interest to us on our Board. And one of the questions I wanted to ask you is as you were having the get-togethers and the meetings and so on, did the Office of Environmental Management participate in these; or was this primarily an NE-led function?

JOHN KOTEK: This was primarily an NE thing, although one of the people who was supporting this was our EM detail to NE. So we had technically an EM person involved in it, although supporting our staff. But we have coordinated with the EM on the materials that we've used, for example, and the way we talk about the defense waste and the DOE spent fuel and the other things that they're responsible for management of and are getting ready for our disposal facilities, so there's been pretty close coupling there.

And I can't remember if we've had the discussion yet or are going to have the discussion to give them sort of the output of what we heard from the consent-based siting process.

ANDY GRIFFITH, DEPARTMENT OF ENERGY: Yes, they have been tracking this. They will be involved in reviewing the summary of the input report. And, clearly, they're going to

be involved every step of the way as we go forward, especially dealing with the defense waste.

LEE PEDDICORD, BOARD MEMBER: Any other questions from the Board? If not, let me ask if the staff have any questions.

Okay, Mary Lou, go ahead and then Dan, I think, has a question.

MARY LOU ZOBACK, BOARD MEMBER: Just following up again on the consent-based siting since you're the only one here that's talking about it today.

JOHN KOTEK: Sure.

MARY LOU ZOBACK, BOARD MEMBER: As many in the audience know, the Board hosted a workshop last October on deep borehole disposal. And we wrote a report and got that to you all, I believe, in January. And part of the rush on our side was we were hoping to potentially have some influence on that project. And I believe one of our recommendations was that we really felt like because the deep borehole project did not involve real radioactive waste -- at least the field test initial project -- it would be a really good opportunity to practice consent-based siting. And that could

include polling the community before you went in to find out their attitudes and then, after you went in and had discussions, did you change or move the bar or anything.

And of course that requires planning, and that was not part of the RFP or anything else, but certainly standard practice in risk communication – public health – you need a baseline. You need to know how attitudes change and things. And you describe a $25 million research program you hope to get next year. I think that's a great idea. But that kind of pushes the can a little further down the road. I think you could be getting started on things earlier; and the deep borehole project, I think, is a good opportunity to try some things out. And maybe you bring in a panel of risk communicators and just get some advice from them on how this initial project because, admittedly, it did not go well twice already.

JOHN KOTEK: I'm going to ask Andy to talk about that a little bit. As I mentioned, we did just put a new RFP out. I don't know if you have had a chance to see it. It was just in the last day or two, so I understand. Andy can talk a little bit about the changes we made in that to try to encourage more of the type of interaction up front that I

think can help maybe resolve some of the questions or concerns that exist in a community before we get too far down the road and really help a potential risk community shape the way that the proposal is implemented.

Andy, do you want to add to that?

ANDY GRIFFITH, DEPARTMENT OF ENERGY: Remember, the timing of the workshop and the RFP process was well underway by that time; and we made the award in January. And we have to keep in mind that this is a non-radioactive science project and that we don't have a consent-based siting process established yet; that's what we're trying to do with the inputs that we have received and that we hope to define by the end of this calendar year in that timeframe.

The changes that we have introduced – recognizing that it is not a radioactive waste project, but it is related to radioactive waste management program.

MARY LOU ZOBACK, BOARD MEMBER: Wasn't that part of the problem – there was a question of trust?

ANDY GRIFFITH, DEPARTMENT OF ENERGY: Yeah, but okay, so the trust goes beyond – yes, it's the Federal Government in

general, DOE specifically. And those were clearly lessons that we learned when we did engage with communities and listened to what they had to say. And the fact that all the communities engaged -- while we intended the RFP to have greater consultations with the contractors before the proposals were ever submitted, clearly that didn't happen.

The new RFP puts a higher expectation on consulting with the communities before they submit their proposals. In fact, if you look at the instructions, it clearly states that the intention is to have the community, as though they are part of the team, before the proposals are submitted. So I think that's a key aspect of it.

Now also from the project risk mitigation – we're introducing phases where the first phase is gaining that community approval or acceptance. We intend to award more than two or more awards so that we have multiple teams out there, recognizing that even though our expectations are that all the proposals are going to be quality and that they could all succeed, having some competition between teams could help and also gives us a Plan B if the team out in front doesn't stay out in front. So there's some other relevance in there.

But clearly, putting more emphasis on that community engagement and feeling that they're part of the team is really important at the onset.

MARY LOU ZOBACK, BOARD MEMBER: If I could do just a quick follow-up, when you say two or more teams, does that mean two or more localities?

ANDY GRIFFITH, DEPARTMENT OF ENERGY: Yes, unless somehow they end up in the same area. I wouldn't want to rule that out.

MARY LOU ZOBACK, BOARD MEMBER: In the pre-RFP, or whatever it was called, there was a request for a communication plan or some sort of engagement plan; but that was going to come four weeks after the proposal was—

ANDY GRIFFITH, DEPARTMENT OF ENERGY: Right, if you look at the proposals, it asks for a set of information that would be considered to make the award. We had to balance how much burden we put on the contractors as they're preparing the bids because that does take time and costs money out of their pocket versus what they bring after they're under contract. So we were sensitive to that.

Clearly, in concept, the criteria we're applying for the proposals is more engagement -- the more engagement, the better. The more evidence, the more documentation or information you can provide that demonstrates that you have done a good job of bringing the community on board as part of the team, the better. After you're under contract, the first phase really is solidifying that support and that acceptance for the project in that community.

MARY LOU ZOBACK, BOARD MEMBER: Thank you.

LEE PEDDICORD, BOARD MEMBER: Thank you very much to you and your colleagues for these presentations and responses.

We'll move on now to the next presentation by Joseph Carter, Savannah River National Laboratory on "Containers for Commercial Spent Nuclear Fuel."

JOE CARTER: Good morning.

My name is Joe Carter. I'm with the Savannah River National Laboratory. I've got a couple of compatriots here with me today, so I'm going to be the choir master. I'm not going to preach, but I will direct the solos. So as I get to the hard questions, Dr. Steve Maheras is here; he'll take the

transportation questions for me. Mr. Robert Jones from Savannah River, he'll take the canister questions. So I've got a couple of folks that I can call a friend, shall we say.

We'll jump right in. The attorneys over at 1000 Independence Avenue would like for me to make sure you know that we have lots of smart folks here, scientists and engineers; and we don't normally consider the standard contract. And so when we don't, standard contract 1, engineers 0. But in fact, as Board comments, a lot of what we'll make in terms of comments here will be those of our own. They're not Department decisions by any stretch of the imagination. And so as we work through these issues moving forward, they'll have to become decisions; but they're not at this point. So just please recognize that fact as well.

From the agenda – and it's quite lengthy – we added the emphasis here, describe the end use canisters and recently-examined canister concepts. The good news is you did put some limitations on this, or we could go on for absolutely days and days. End use did help to limit what we discuss here. We will discuss some of the recently-examined container concepts and those really are concepts and we'll

get to those. They are nowhere near a state of licensing or a state of readiness to be used, but we will discuss those.

We'll do our best – physical dimensions and capacity and those challenges as presented therein, we'll do our best to try to focus on challenges. We've provided in this presentation a number of data tables, at your request. We will not go through those; I will not spend a lot of time going through any of that data at all this morning. It's here for your use, but we'll try to use this just to illustrate the type of challenges that are, in fact, out there in this, shall we say, legacy issue, legacy family, of casks that have been developed for commercial fuel.

But we'll try to hit all of the main items here in your questions; and the way that we'll do that is by starting with the current inventory, what we think the future inventory may look like very briefly. But we'll quickly hone down onto those physical attributes and get into the issues those lead to directly – to the issues. And then we'll have some comments about new containers as we get towards the end.

A word here – the timing for this presentation was very good in that we were actively working on revisions to two key reports that support this presentation. One of those, commercial spent fuel, high-level waste, radioactive waste inventory report, Rev. No. 4, that is a report that is progressing through the review cycles within the Department; and we're moving towards finalizing that report. It does cover the historical inventory that's been reported by the utilities.

So this was the GC-859 data that brings us up through June of 2013. So we use, for the historical information, that that has been reported by the utilities. And then we take that information and we project it. We projected it for this presentation out to the end of 2016. We've also projected it out further to the end, if you would, of the life cycle of the current fleet. So we projected it out to about 2065.

And it also contains the current dry storage status. Since that is an actual number, it has a date stamp; and it's in May of this year. Since we were working this rev at about that time frame, we just drew a line for a data date and moved forward.

The other report that's also working through is a Rev. No. 2 of the Dry Cask Inventory Assessment. A lot of the charts and figures in this presentation come directly from that report. That report has just been drafted, if you would, and just been turned over to the Department to start their review process. And so both of these reports are key reports, but they are in that draft material. So I want to be clear in where we are with these two reports.

It does use the dry storage status from the inventory report. It uses a vendor-prepared report on canister and cask physical attributes, the ATI report from back in 2013; but we do supplement that annually by bringing it up-to-date with various SARs and certificates of conformance that have been issued by the NRC over that time frame. We issue both of these reports on an annual basis, and they are both fed into the unified database that Josh will talk more about and I believe there will be a poster on during the poster session this afternoon.

So by taking both of those databases, feeding them forward into the unified database, it helps with our integration issues within the Department and within our own program to

make sure that everyone is using a consistent set of data updated annually.

So how did we get here?

One hundred and thirty commercial power reactors have been licensed by the NRC, or AEC predecessors over the years. Nine of those were early prototypes; there's no fuel left on any of those sites. One never operated. One was disabled; that fuel is now managed by DOE. The high-temperature gas reactor, the Fort St. Vrain reactor that John mentioned this morning, fuel managed by DOE. So this map concentrates itself on the 118 reactor sites that have fuel left remaining on site. So you won't see DOE sites on this map; you won't see Fort St. Vrain on this map; you won't see ISFSIs at Idaho on this map. So it's concentrated, per your request, on the commercial reactors.

That leaves us with 118; 19 of those have ceased operations. They do still have fuel on site. Three reactors are on sites with ongoing nuclear operations. Sixteen are on 13 sites without any other nuclear operations on that site. So they're not quite to the point yet that the BRC used the term "stranded" site, but they're all slowly moving in that

direction. Some are moving there faster than others because they've been shut down longer than others.

So that leaves 99 operating reactors today; and 9 of those – at least when we put these drafts together – 9 of those had announced shutdown dates. Five new units are under construction today; that includes Watts Bar 2. Watts Bar 2 is in low-power testing. They are connected to the grid. So if we were to do this today, we would probably move Watts Bar 2 to the operating category. You would have 100 and 4 rather than 99 and 5. But again, we wanted to maintain some consistency here with reports and material and slides; and so we didn't make every update that we could have made in getting ready for this presentation.

If this trend continues, here is where we think that inventory goes over the life cycle of the current fleet, including those five new reactors. We've assumed here that all reactors get a single extension, so a 60-year operating period, unless they've announced otherwise or, in fact, have shut down. The new builds we put on a 40-year simply to truncate this chart – for no other reasons, nothing implied at all by that except we needed to have an end date for this analysis.

We would assume current ISFSI practices continue. So if a utility is loading a particular storage system, we assume they continue to load that same storage system, again, unless they have made an announcement to purposefully change. At 2060, we would expect almost 12,000 loaded canisters if things continue as they currently are; and we would expect just a little under 140,000 metric tons of fuel.

But let's go ahead and concentrate on where we are today. This graphic provides the inventory there. At the end of 2016, with the dry information again in May of 2016, about 30% of that fuel is in dry storage configurations, 70% still in the pool. And then within the dry configuration, there are really three major categories; and so now we'll start to drill down on your questions and your specific agenda items here.

About 10% of the fuel is in non-canister storage casks. There are a little over 200 of those currently in use, and they do continue to be loaded. Everything else is in canister configuration; 12 of those canisters are in metal storage overpacks that are transportation-ready. All other, which is less than 1% of the total assemblies, over 2,000,

are in those welded metal canisters in some type of concrete-vented overpack – sometimes horizontal configurations, sometimes vertical configurations.

And you can see the vendor split into three major vendors that continue to produce and actively market these situations, these storage systems. Those numbers do not add to 100 because there are legacy systems out there, so that is intentional.

Let's continue to drive on down. Non-canistered storage systems -- 4 utilities; 7 unique non-canistered storage systems out there; 204 casks. Two of those, the TN-40 and the TN-68 are licensed for transport. The other systems shown on this chart are not licensed for transport. The TN-40s and the TN-68s continue to be loaded by utilities. So lost in the large suite of welded canisters is not all utilities are in fact loading in welded canisters. They are still using some bare fuel or non-canistered storage casks.

Canister fuel – the bulk, about 90% of the fuel in storage, 30 utilities; 69 sites; 16 unique canistered systems; over 2,000 canisters; over 83,000 assemblies in storage. Up to 51 unique licensed canisters exist out there and could be in

use. I say it that way because we don't always have sufficient information to know exactly which variant is, in fact, in use at each one of these sites. There are many variants to these. They've been licensed for different purposes. They have slightly different configurations or slightly different licensed contents. And so in some cases, we can't tell you whether it's a 32F or a 32FF or a 32 pick your flavor -- difficult to get at all of that.

Forty-three are general license certificates of conformance. Eight of those are for site-specific licenses. So there are a wide variety of differences there. The good news is 51 cans – the good news is they're all right circular cylinders. That's common attribute; that's it. That's about as common as we get.

You can see the length of that cylinder varies considerably from 114 inches to almost 200 inches. The inner diameter varies by about a factor of 2. The loaded weight varies by over a factor of 5. And so these present some challenges. This is, in fact, one of the challenges we have – lifting configurations differ across this suite of canisters. Some use eyelets that have to be put back on the canisters. Some

use lifting lugs. Some use a screw arrangement with a knob, if you would.

So a lot of different configurations here, and there will be challenges. These probably won't rear themselves in licensing and design, but they probably will rear their heads in operations. Someday, one day, somewhere down the road, an operator is going to get the wrong lifting yoke; and he's going to have a bad day. It does present some operational challenges.

They all have some type of basket arrangement to separate the assemblies. You can see that they range in size, starting with 7 PWRs – from 7 to 37 PWR assemblies, from 52 to 89 BWR assemblies. They do have differing materials of construction, and that's particularly true of basket materials and neutron-absorbing materials, neutron-absorbing materials being the broadest range of materials there.

They generally all have a shield plug; and, by regulation, they have two closure points. And so in this graphic, we've chosen to show two welded lids; but vendors do that in slightly ways. Some use rings; some use just welds around the outside. So they're closed in different manners.

They all use different terminologies for these canisters – dual-purpose canisters, multi-purpose canisters, dry storage canisters, transportable storage canisters. So as you're working your way down through these lists and you're making your way, you're going to see a lot of different terminology for these things that are vendor-specific.

They all have unique NRC licenses. Thirteen of them are designated storage-only. Thirty-eight are designated storage and transportation; and although they're designated storage and transportation, some of them still lack a Transportation Part 71 Certificate. So we've tried to be fair and get the designation correct, per the vendor's intent, although those actions are not always completed.

None of these canisters are licensed for disposal, so that's one key point there. Allowable enrichment, allowable decay heat, cooling time, fuel burn up all vary by design and vary by license. In some cases, and I'll point it out in a couple of slides, in some cases the physically same canister has two different licenses for storage, depending upon where it is stored or in which one of the vendor systems they are stored in. And so we have to treat that as two separate canisters for tracking purposes and those kinds of things.

So when you do look at these reports, our terminology tries to make those distinctions and may not completely follow the vendor designations for that reason.

Allowable damaged-fuel cans vary by design, and we'll talk a little bit more about that momentarily. That was one of the questions that you centered on. Again, sometimes those are allowable in what we call the corner positions, where there's a little more space. Sometimes they're not allowable at all. Again, it comes back to the license; and it comes back to specific license content. So in the data tables, we may have provided you a column that says 4, 8, 16 damage license cans acceptable. That's not the total answer. You have to go to the certificate of conformance, and you have to understand the allowable contents for that particular package. It's not simply straightforward to say you can have four damaged fuel cans of whatever you want in that package; that's too liberal an interpretation.

So in presenting this, again, I would urge caution. Call, ask us questions as you work through this material because it can be confusing; and it can be difficult to follow every nuance in the material.

The next three slides – if that first one was the USA Today graphic, these are the Wall Street Journal graphics that try to put these canisters by primary vendor into some type of perspective for you. So what we've provided here are the links by canister designation, the diameters, and then generally the cask diameter that's used for the storage system in these.

I would again point out, some of these are ranges. We try to keep them small, but the licenses allow ranges. The licenses aren't necessarily for a canister of a fixed diameter, a fixed length, et cetera, et cetera. They often allow ranges, and we expect that variation in height or length, if you would, to continue.

This graphic is for the NAC systems. The next graphic is for the Areva systems. Areva is stored horizontally in a rectangular overpack, not a circular overpack. The dimensions for the rectangular overpacks are on the data sheets; we did not include it here on the graphic. And again, you can see the variation in length and diameter.

And then for the Holtec system – and this is an example that I would point out – the MPC-37, we have provided a nominal

length there of the 181 inches. But this is a good example of where the vendors have become a little more sophisticated, if you would, and there's an entire range of lengths that's allowed by that canister. And so it can go well over 200 inches, according to the Certificate of Conformance. And so we have to continue to watch these things; but the MPC-37 is also one of those that can be stored in the UMAX underground system or in the FW storage system -- two different thermal decay limits, depending on which system it's stored in.

And so, again, you have to track everything about the canister -- how it was loaded, where it comes from, et cetera, in order to move forward here, another illustration of the type of challenges that this diversity leads to.

And then Fuel Solutions canisters – similar situation there with lengths and overall diameters. Again, the data tables provide explicit value for all of these canisters. On those data tables, there are three associated with the material presented thus far. The canister data table has those 51 cans included; it has both Part 72 CofC number and, if applicable, the Part 71 CofC number.

In terms of challenges, maximum decay heat for storing and transportation are very often different limits. So this is a case where things have to be tracked carefully; and, in many cases, we'll be waiting to transport those canisters until the transport decay heat limit is, in fact, reached.

Maximum burn up for storage and transportation are also often different limits. This is a case where a transport license modification will be required. The burn-up is the burn-up; we can't change the burn-up. But if the transportation limit is lower than what's actually been loaded, then we'll have to fix that on the transportation side. So there are a number of transportation cask issues associated with these types of administrative changes – largely administrative changes -- although some of them can in fact be technical. Different burn-upstairs have different characteristics, and so we can't rule out an issue that comes down the road that's more problematic than simply administrative. I don't mean to downplay that at all.

Again, a warning – the number of failed fuel cans, debris cans, require particular attention. We've provided the kick-in count number on the data tables, but you really have to

drill down and understand the content that's allowable in order to appropriately use that portion of the table.

Canister storage systems, overpacks – 35 different storage packs are included on the data table. There are specifically licensed canister payloads that are provided for those. So just because I have a storage cask, I can't put any canister in it; I have to put only the licensed payloads in that particular canister.

LEE PEDDICORD: Joe, could you pick things up a little?

JOE CARTER: Yes, I'm sorry, yes I can.

Non-canistered storage – again, 11 casks there, 2 with transportation license.

Storage-only canisters – we've going to qualitative assessment. First of all, there's no storage-only canisters at shutdown reactor sites; that's the good news. So this becomes a timing issue as to when we start to work on these things, as John said earlier this morning. We have done a qualitative assessment of the transportability of those storage-only canisters. The structural design of many of those are not suitable to get a CofC for transportation. So

we'll either have to go the exemption route, or we'll have to look at other options.

Transport container data table. Seventeen there, 11 canistered fuel, six non-canistered fuel. I believe we counted all the TN32 families as one when we did this particular count.

The fabrication status is provided on those – the design upgrade status is provided on those data tables.

The Department has awarded a contract for the fabrication of a rail car compliant to the AAR S-2043 standard. That’s a work in progress, and that design is moving along. And with the recent change in approach, if you would, from an eight axle rail car to a 12 axle rail car and some consideration for some of the larger casks that’s currently underway.

Transportation cask readiness. A question you asked specifically. No real certification issues identified, but there are a number of actions that have to take place. Two of those casks require updates from the 85 to the 1996 IAEA standards. No impact limiters have been fabricated for any of these casks. They’re all (inaudible) fabrication efforts.

Very few casks have actually been fabricated in the U.S. There are a few overseas, but very few here in the U.S.

We do have to validate the as fabricated, as loaded versus the CofC at the time of shipping, so there's a lot of work to be done there.

Six damaged fuel assemblies at Rancho Seco not in damaged fuel cans will have to be addressed. And then there's a number, again, of administrative mismatches that have to be dealt with in licensing space.

So there's a number of licensing cleanup actions, and, again, a list of challenges.

We are looking at the storage-transport-storage issue, or the so-called 72-71-72 issue, participating on a number of industry efforts to look at those.

That's the as-loaded canisters, end-use canisters. I'll move quickly through some potential canisters that we've looked at including standardized transportation, aging, disposal canisters, feasibilities conducted back in Task Order 12, specifications and rationale documents developed by Oak Ridge, interim storage concepts developed in Task Order 16,

and small canisters and operational impacts in Task Orders 18 and 21.

So we've put a fair amount of effort into looking at standardized canisters. Again, no decision has been made regarding those.

Won't go through this slide. This is the data resulting from those studies in terms of lengths and capacities and those type things. Simply point out here, again, decay heat is one of those parameters that will vary significantly, and one of the drivers for us in looking at various sizes of standardized canisters, was ultimately the repository and final disposition which will have a thermal limit associated with each waste package, and so we've looked at a number of different sizes in order to look at a number of different potential decay heat limitations that might be implied there.

We've also looked at two reusable rail transportation casks for shipping non-canistered fuel. You can see the attributes that we provided here. Must go over the rails, so 128-inch diameter. We focused strictly on something for high burn-up fuel, so we focused on high decay heat. We asked for two

concepts for both PWR and BWR baskets, including various configurations. We got a concept from Areva and one from Energy Solutions. Both fit the overall parameters that we specified. They do differ in decay heat allowable and the number of positions for each and the number of damaged fuel positions for each, so interesting to see the vendors come together and take different approaches for these.

So 30 kilowatts on the AREVA proposal. Twenty-four; 61 BWR assemblies. DFCs in all positions. Contrasted to Energy Solutions' 24 kilowatts, 28 PWR or 61 BWR damaged fuel cans.

So, again, different approaches taken, and slightly different results to the same set of parameters.

So, conclusions. I won't go through the numbers again. I'm happy to take questions.

LEE PEDDICORD: Thank you very much. Questions from the Board? Paul.

PAUL TURINSKY, Board: Is there any R&D going on on retrievability of the fuel? I mean, after 50 or 60 years, can we pull it out to transfer, to repackage it for

disposal? You know, one could anticipate some fuel distortion as a result of storage and transportation loads.

JOE CARTER: It’s still a concern. NRC now allows consideration of the canister as the retrievable item in addition to the fuel assembly. We believe we’re protecting the fuel assembly from – obviously from gross degradation. That’s the regulatory requirement, right? They are inerted. They do have maximum temperature limits. They all have to be maintained and those type of things. So we don’t really have any hard evidence that things are altering in storage. And they didn’t alter during the low burn-up storage demonstration that was conducted at Idaho. They pretty well went in and came out 15 years later the same way they went in. So no, we’re not really active on that, Paul, because we really don’t have any evidence of issue there that needs to be dealt with.

ALLEN CROFF: You noted that some utilities continue to use bare fuel casks for storage. What causes them to do that as opposed to going to canisters?

JOE CARTER: I won’t speculate on what motivates a utility to choose one storage system over another. I can simply report what they do.

ALLEN CROFF: Okay. (Inaudible.)

MARY LOU ZOBACK: You mentioned the Atlas –

LEE PEDDICORD: Identify yourself, please.

MARY LOU ZOBACK: Oh, sorry. Mary Lou Zoback, Board.

LEE PEDDICORD: And hold the microphone closer to you, please.

MARY LOU ZOBACK: I’ve got too much stuff. You mentioned the Atlas rail car project that’s going on, and somewhere in one of the presentations they mentioned a load limit of 312,000 pounds. And looking at your table for storage overpack attributes, there were 21 different canisters, and the load weight for ten of those 21 exceeds that Atlas rail car load limit, which I understand maybe could be made greater, but will rail bridges exist – does the existing rail system support heavier loads? And if so, why are the utilities allowed to load exceeding that limit?

JOE CARTER: Well, again, I certainly won't speculate on why utilities are loading in the configurations that they are loading in. Steve, you want to – you're more familiar with the transport issues than I am, you want to take that one?

STEVE MAHERAS: Yeah, sure. I'm Steve Maheras from Pacific Northwest National Labs. There's a difference in that table, first off, between the transportation cask weight and the storage overpack weight. So -

MARY LOU ZOBACK: Okay, so this includes the overpack –

STEVE MAHERAS: Yeah. So the High Star 190 that we talked about earlier would weigh about 100,000 pounds more than the next lowest weight cask. So when we go from eight axles to 12 axles, that will provide enough capacity to accommodate that transportation cask and its cradle and its contents.

The second question that you had was on infrastructure. We are always concerned about infrastructure and finding out whether bridges can take that load. Now we don't have a good answer for you today because that depends on the length of the car, and the height of the car, the width of the car, and of course the weight of the car. Very, very important, even down to the axle spacing on that particular car. So

that’s a work in progress that we’re very, very concerned about, though. The idea that we have to get that rail car in and out of sites is very important to us.

MARY LOU ZOBACK: Thank you. So then just to follow up, you said you wouldn’t want to speculate why utilities store things or load things the way they do, but does DOE have to accept a canister that exceeds its capacity to transport?

JOE CARTER: Well I’ll take you back to the disclaimer. The standard contract doesn’t recognize canistered fuel as an acceptable waste form pending that mutually-agreed upon change. So, you know, we don’t know where that’s going to end up, right?

MARY LOU ZOBACK: Okay. Thank you.

LEE PEDDICORD: Okay. Other questions from Board members? Jean.

JEAN BAHR, Board: Just a clarification. What percentage of the fuel in dry storage is in those non – is in the storage only canisters that cannot be transported?

JOE CARTER: In the storage only canisters? I don’t know that I have that number off the top of my head, but we will get

you that answers. Robert, unless you do off the top of your head.

(Inaudible.)

We can get you that answer, but we'll have to go crunch a number of two.

JEAN BAHR: Thanks.

LEE PEDDICORD: Okay. Other questions from Board members? Any questions from the staff? Dr. Einziger

BOB ENZIGER, Board's staff: I've got two questions. One is with respect to your slide number 19 where you say no certification issues identified that require spent fuel repackaging for transportation. Now in the C of C for the – I think it's the MP197, TN has said if they find any flaws in the canister, that they're not going to transport that canister because the regulation says that you have to be structurally sound if you're going to take moderator exclusion, which they are, and they don't want to go through that. That requires repackaging. So the question is what steps is DOE doing to develop a dry repackaging facility to handle that situation?

JOE CARTER: Well, Bob, we have taken some early, very pre-conceptual design looks at repackaging facilities. We've done, in fact, one back about 2012. We made a couple of looks at it even earlier this year. But, again, it's a matter of priority and emphasis, I think, with our focus on the shutdown reactors, we're not really facing that issue right now. So we have done some work, you know, we've really, in laying this groundwork, we've really taken a fairly comprehensive look at a lot of different issues. We've done the type of qualitative study that I mentioned earlier. And so we think we understand what those issues are, and then we've kind of put them on the shelf until we get there and really need to work on those. So, you know, I can't tell you we have a definitive plan for repackaging by any stretch of the imagination, but we certainly recognize the need for it, or the potential need for it, and we've looked at both wet and dry repackaging concepts and they both have issues, to and fro.

BOB EINZIGER: The only reason I mention it, that is a long-term lead item.

JOE CARTER: It is.

BOB EINZIGER: The second thing is with respect to your slide number 24, and this is the potential new container concepts for reusable rail transportation casks. Is that a canisterized system inside a reusable cask or is that bare fuel inside? Because if it’s bare fuel, we’re back to the question of wherever you’re going, you’re going to have to have a packaging facility.

JOE CARTER: Those were bare fuel.

BOB EINZIGER: So if that system developed, you would be committed to having a repackaging – or a packaging facility at the receipt point?

JOE CARTER: That’s correct. I mean we, you know, again the standard contract does place emphasis on that type of receipt system. We’ve looked at how to get that capacity up with this rail cask. We’ve also looked at what it takes to receive those rail casks and what type of storage system we might go into. Would we stay in a pool? Would we go to canisters? Would we go to vaults? So, again, we’ve tried to take a comprehensive look at how a system ultimately might be configured, okay, depending upon exactly how things are received.

LEE PEDDICORD: Dan?

DAN OGG, Board staff: I've got a question about the Atlas rail car. You said in one of your slides that a design change – I think your words were could be implemented to address larger loads. And my question is are you actually planning to do that, and is it in the works, or is it still just a concept for the Atlas rail car?

JOE CARTER: Yeah, we are.

STEVE MAHERAS: Yeah.

JOE CARTER: Yeah.

Okay. We're (inaudible) basically.

MELISSA BATES: Hi. I'm Melissa Bates with the DOE. In regards to your question, Dan, there have been some recent technical challenges as have been seen with the eight-axle rail car and passing the S2043 standard from the American Association of Railroads. And so we are investigating the possibility of moving towards a 12-axle rail car. We're currently doing that in contract space with Areva. And we are currently looking into what it would take to add the

High Star 190 to that rail car, but that’s still very much in procurement space and not yet finalized.

LEE PEDDICORD: Any other questions from the Board or Board staff? Dan?

DAN OGG: One other question. This is, unfortunately, a very detailed kind of question. But in your table of the specifics of bare fuel multi-lid systems, you listed a TN40 and the TN68 as transport licensed systems. But in that table of canister – of bare fuel-type systems, you did not separate out the TN40HT. Is that included with the group of the TN40, or my understanding is that’s not licensed for transportation?

JOE CARTER: Yeah, I think that’s right, Dan. The HT is not licensed for transport, but the numbers that I gave you for the TN40 do include 40 and 40HT.

DAN OGG: Okay.

JOE CARTER: So that’s a case where we really should have split that out into two separate groups and just did not do that yet. But we should have.

LEE PEDDICORD: Okay. Thanks very much. Lots of information, lots of numbers and data. Appreciate it.

Now we move on to our next presentation by Josh Jarrell from Oak Ridge addressing system analysis tools used to evaluate the integrated waste management system.

And while we're doing that I'd like to note that we've been joined by Dr. Linda Nozick, a Board member from Cornell University.

JOSH JARRELL: All right. Well, thank you for inviting me to talk to the Board. I'm Josh Jarrell. I'm from Oak Ridge National Lab, and I'm the Strategic Crosscuts Control Account Manager for NFST. And today I'm going to talk about some of the system analysis tools that we use to evaluate an integrated waste management system. And as was noted earlier today, the focus of these tools really has been on commercial spent fuel.

So first and foremost here's the disclaimer. DOE does not consider spent fuel in canisters to be an acceptable waste form. But we are looking at alternatives of how the system might operate, and so we do look at scenarios where that canisters may be accepted into the waste management system.

So I wanted to just recap some of the Board questions. Basically they boil down to what tools do you have for system analysis? Are you developing them? Are you using them? And then how are you using them? What insight are you learning?

And then there were a couple specific questions about a routing tool, and then repackaging. And as I go through the talk I'll try to specifically call out at least the specific questions there as well as identify the tools that we're using and how we're using them.

So the bottom line really is that NFST really is developing and using system analysis tools to look at integrated waste management systems. We briefed the Board back in 2012 about the system analysis tool we were using at that time, and we'll call that the Legacy tool. And at the time I think the Board said it was rudimentary was the term they used. And we took that to heart, and we really tried to update that tool to make it useful for NFST and DOE-NE at large.

And so to do that, we updated the tool. You know, we improved the infrastructure. But one of the big pieces was we got information that we didn't have and collected that

data. And by doing that we were able to provide much more realistic insights when we started to actually do these analyses. And that allowed us to look at uncertainties in the system. What happens if this changes, and this changes. And by updating our tools we were allowed to kind of look at that at a fairly good level.

At the same time we realized that the tools we were using really were legacy tools and they didn't give us all the flexibility that we needed if we were going to be able to analyze a waste management system and provide flexibility for scenarios that we just didn't – we don't know about right now.

And so since that time we've been developing a new system analysis tool which I'll talk about that is significantly more detailed. It's modern software architecture. And it allows us – and actually requires us – to get even better information and data.

And through this whole process, our goal is to apply these tools in kind of an iterative improvement process.

So we realized we needed better models, and with that we needed more and better data. Then we got better results by

applying these tools. And it turns out that based on those results, well, we can improve our models. And so we're constantly trying to improve our capabilities in this iterative improvement process.

So, why do we need system analysis tools? Well, I'll talk about the waste management system and how complex it is.

Every stage in the waste management system has nuances and complexities, some things that are time dependent. And we need to understand those properly to be able to model them.

Then I'll talk about the tools that we're using, what we used before, and some of the insights that we've learned.

So just note. The waste management system is complex. It's uncertain. How it moves forward we don't know, but we need a tool that can model these uncertainties. And so at a middle level, each function of the system, whether it be at-reactor storage, transportation, away-from-reactor storage we're calling it or an ISF right now, repackaging, disposal, these all have very specific levels of detail that we need to understand to model how the entire system might work together.

So first I'll talk about reactors, at reactors. So one of the big things is is the reactor operating or shut down? This is at a high level we need to understand this. And I'll just note here that we're going to have a lot of reactors shut down in the coming decades, assuming a 60-year life, and assuming, I guess, no early shut downs, which is maybe not the best assumption right now. But we need to be able to model systems to be able to understand if the sites and rectors are operating or shut down.

And once we know that, there's a lot more levels of detail that we need to understand to be able to model what's happening at these sites. And this plot, I know it's not the prettiest pie chart, but what it's showing is the different combinations of reactors, which is a BWR or a PWR. How many pools are at the site? How many reactors are at the site? How often is the refueling outage? Now all of this matters because all of those things determine when those sites may have the ability to deal with spent fuel issues. Maybe it's loading dry storage systems. Eventually it might be transporting systems off site. And so there's a lot of complexities in how the onsite operations might impact the potential waste management applications.

So once you understand the reactors, and the pools, and refueling, you get to, well, what actual fuel is there. And Joe really talked about this quite a bit. I won't get into this too much more, but just say we have a lot of spent fuel out there. Every year we are loading, across the U.S., somewhere between 150 and 200 dry storage systems, and, you know, we have to continue to make sure we have the most up-to-date data on what's being loaded so we can model the system going forward.

So once we get our hands around the fuel that's at the sites, what sites are where, and are they operating or shut down, we need to understand the infrastructure, and actually I think Steve Maheras talked about this in a comment earlier, but we need to understand what are some of the transportation infrastructures at these different sites.

So some sites have direct rail lines that could be used. Some had rail lines and no longer have accessibility to those lines. Some never had rail lines and everything was barged or trucked in. And so we need to understand that when we start talking about how an entire system might operate such that we can model it accurately.

And, again, it comes back to this thing where it's a complex system and things are constantly changing in time. So infrastructure might change. And here I'll just give a URL to Dr. Maheras's report that is available out there that talks about the shutdown sites specifically and those infrastructures.

So we talked about, and Joe just talked about, some of the casks and canisters that are out there and some of the transportation concerns. I won't reiterate it, but there are cans and casks that are designed to be transportable that may not have active CofCs. And if they're active CofCs, we have to understand, can those casks be procured and developed, and what's the lead time. So when we start talking about predicting when we might need transportation assets, we have to be able to understand this.

So assuming we get the transportation taken care of, one of the questions is where do you take it, what's that look like. And so what we look like is different concepts for away-from-reactor storage, interim storage facility.

So we could have systems that look very similar to the way they're stored at reactors. So you could have vertical

systems. You could have horizontal storage modules. As well as you could have some type of vault system for canisters. And some of these concepts were kind of scrubbed in Task Order 16 report that was out of CB&I, and that is also publicly available out there.

In addition to the canister ISF designs, there's also a concept for bare fuel. There's concepts for pools. So this the La Hague facility in France.

Down here we actually have these bare fuel casks that are actually stored in these vaulted systems. This is at ZWILAG in Switzerland.

And the point is that there's lots and lots of options for what an interim storage facility might look like and how it might operate. For example it only takes canisters of one type. Maybe another storage facility takes canisters of another type. Maybe one facility takes bare fuel, stores it in a pool and canisters. There's just a lot of different alternatives, and we have to be able to accurately model them because what this facility looks like impacts the entire system, both downstream, so where does the repacking facility, if required, lie? Does it lie at this facility? As

well as upstream. So would, if we wanted bare fuel, then, the reactors would then need to load bare fuel. So there would be this impact all the way through the system on what this facility looks like.

So, assuming that we have an interim storage facility, and we've captured the transportation reactors, one of the questions that was brought up was on repackaging. Joe Carter talked about that we could have up to 12,000 canisters at the end of the day that may have to be disposed of, or repackaged, or we just don't know. And that's a lot of canisters to deal with. And one potential is you would have to open those up and repackage them for a number of reasons. And so we've looked at repackaging facilities a little bit. I think Joe talked about this to some extent. Where those facilities might lie.

One of the things I'll just reiterate is one of the big pieces about repackaging is what canister type do you package into. And that's really – generally we think of this driven by a lot of the potential disposal requirements, so what the repository concept is kind of determines what the canister size that could be used.

But I'll note that in 2013, Rob Howard presented quite a bit of detail on repackaging concepts, as well as there was a workshop back then, so that's the – I just added the presentation there so everybody has that URL.

Why is that repackaging needed? Well, there's the potential to have different concepts for a repository. We don't have a known concept, so we're looking at generic designs. And each of those designs generally has a thermal load associated with the waste package, and that drives the capacity of the waste package.

So some of the work that's been done and is out there is looking at direct disposal, which I think the next presenter might discuss, of dual purpose canisters and, you know, what's out there right now, what could be disposed of.

As well as the second bullet here talks about the different options for disposal. Anywhere from concepts in clay or granite all the way up into volcanic tuff concepts. And each of those has its own thermal and potential operational requirements.

And those thermal constraints affect what can go into the repository, and so it might prevent you from sending fuel from one location to the other if you can’t emplace it.

And I’ll just put a note here about one of the benefits for interim storage is that an interim storage facility could kind of act as a buffer between at reactors and repositories such that if a repository needed aging of the fuel before it got there, it could go to an interim storage facility and get off the reactor sites. As well as if a repository wasn’t available immediately, you could move things to an interim storage facility until it was available.

So these are kind of the big functions of a waste management system. But I want to hit transportation one more time because that ties them all together. And each one of those alternatives at every facility drives what transportation needs may be required. So that may be it needs a different number of rail cars because we’re picking fuel up at a different rate. It might mean that we need a different type of cask system because we’re picking up a different type of canister or cask. It might mean that we have different routes because an interim storage facility is here or here.

And so I just note that one of the questions was on the routing tool that we use. DOE-NE has developed a tool called START, and we use that for kind of informing routes. And that was developed basically from the lessons learned that EM's TRAGIS tool. We learned from them.

So, bottom line is, this is the recap of the system, it's a complex system. And so what we've done is developed tools, or updated tools to try to be able to model this complex system in an effective manner.

So I'm talking about three tools, the first being UNF Standards, and its unified database. Joe talked about this as we need consistent data. I'll hit on this very quickly. The legacy tool is the Transportation Storage Logistics tool, TSL. And there's some underlying things, but TSL is an easy acronym for everyone. And then we'll talk about the new tool that we're developing which we call Next Generation System Analysis Tool, NGSAM, and I'll talk about where we are in the process and what those capabilities are.

So just – when we talk about the tools, just realize that all of the tools are requirement-driven as we develop them.

So we have this very complex system. We have to have very good tools to model the complexity.

And we need the ability to model systems that we can't even kind of think about right now. We don't know what the alternatives may be later, but we need our system analysis tool to be able to model them.

And the bottom line is for any tool to be useful, we need to have good data. And here's my plug for UNF Standards, and unified database. We need to have consistent, traceable information to be able to use in our system analysis tool. And so we use a tool called UNF Standards. Inside of it has a unified database where we collect a lot of information about fuel, about the canisters and cask systems out there. And we also do analysis to characterize what these systems might look like in the future, so what the heat load of a canister might look like. What are the isotopics of fuel in 50 years.

So we have this tool, UNF Standards, that allows us to do that. And we do have a poster on it tonight, if you'll stick around for the poster session.

So, I want to first talk about the legacy tool, TSL, that we've updated. Like I said, we briefed this to the Board in 2012, and they said, well, you probably should improve this to be able to use it effectively to analyze the system. And so we added the ability, first off, to have an interim storage facility. We improved the information and the data that we were using in the system. And then we fixed what I'll call software bugs as appropriate, and so we had some inefficiencies in the tool and some issues we've fixed since then such that we really do now believe that we can use this tool to get what I'll call an average level insight. I can't get into the real specific details of how each facility might operate, but at a high level I can definitely understand kind of the high-level lessons learned, insights that we get from analyzing the system.

I'll just note some of the things that we're missing, so I'm going to bring them up later, but a lack of fidelity, of at-reactor logistics, constraints. This goes back to the fact that some sites have multiple pools, and multiple reactors, and different refueling outages. And so our tools basically can go to assume right now they go to a site and they just pick up the canisters. Well, in reality, the reactor sites

may have a refueling outage when the system wants to pick up a canister. And there may be the sites are just not going to want to deal with spent fuel when they're dealing with refueling. And so our new tool that we're developing is definitely trying to include this level of fidelity.

We talked about – I talked about some of the different interim source facility designs. We're trying to – with our new tool, having a better understanding of how the different designs kind of impact the entire system.

And the last thing I'll note is the way that we predict the canisters or casks will be loaded going forward, what fuel goes into each can, which actually drives, for example, the heat load of that can, which may drive when it can be moved off site, is done with I'll call it very simple algorithms. So we're developing better algorithms for that.

So, based on that, though, we have learned a number of things. And I think the most – well, probably the most prominent we've seen since using these tools is that the strategy for picking up fuel, the order and the rate, is really important to the system. The order of the pickup, which we generally term acceptance, really is important. We

looked at oldest fuel first acceptance, which is kind of driven by what's in the standard contract. And then more recently we've looked at a number of different acceptance strategies. And I'll show some results there, but the bottom line is the order of which you pick it up, not even changing how the throughput in a given year, but the actual order is important.

The rate of acceptance, how much you actually pick up in a given year, really is also very important to the system. And some of the things that we look at, so to use the tool you have to have some metrics that you look at, and some of the things we looked at are, you know, when was the final year for each site that all the fuel was removed. If you aggregate all of the years that all of the sites had spent fuel on them when they weren't operating, you know, that's a metric we look at. How big the interim storage facility get, the capacity and some of the costs. So those are the things we look at.

So I wanted to show a few plots. So right here is a plot of the number of shut down sites with fuel on them as a function of year. Okay. And so right now the red line is assuming that the fuel is picked up at 3,000 metric tons

using the oldest fuel first strategy. And then the blue line – my pointer is not very good but there's a blue line right here – it's the same acceptance rate, 3,000, but it's a different allocation. And this allocation was done to minimize dry storage and then basically go after the shutdown sites with a priority as they shut down.

Now what you see is that the red lines, in year 2060, for example, has 60 shut down sites with fuel on them still. Whereas if you went off to the blue line you're at on the order of 20 to 30, depending on what year you look at.

So there's a significant reduction in the number of shut down sites, just by changing the order.

Then, if you look at the – we'll call that, I don't know, yellow-green line, you can see that if you increase the acceptance rate from 3,000 tons a year to 4,500 tons a year, so increase it by 50%, you can even knock the number of sites down even lower.

And the key, what you want to look at, really, is the area under the curve. Okay? That's basically how many sites every year have fuel on them and they're shut down. So I did put a bar chart up here. And this is the area under the curve of

the different scenarios that we looked at. And the red bar is the 3,000 metric tons oldest fuel first, and you see that's at more than 1,800 shut down site years. And just by switching to a different allocation or acceptance order, you can knock that down by more than half. And then by accelerating the acceptance rate, you can reduce that even more.

So the bottom line is, is our tool provides this level of insight that really says, maybe oldest fuel first may not be the best way to go going forward.

Another thing that we've really looked at is what type of canister or cask you pick up the fuel in really does impact the system.

So I talked earlier about repackaging, and there may be up to 12,000 canisters or casks that may have to be repackaged. Well, one of the things we looked at, and this was brought up earlier in the discussion, was bare fuel casks, reusable bare fuel casks that allow access to the individual assemblies, now you have to have a way to store them. But, if you do that, then you can knock down the number of canisters that may have to been repackaged by over half. So

almost 12,000 to on the order of 5,000 if you can move from the current system of using these dual purpose canisters for the most part to a bare fuel cask for transportation. Which, again, you have to have a place to take it, but this is one of these things.

And so this is the URL for the concepts for a bare fuel transportation cask, which was Task Order 16, so it’s publicly available. You all can get to it.

Another one that’s near and dear to my heart has been the standardized canister concept, which is develop a canister that could be used for storage, transportation, disposal, without having to be opened. And this was actually recommended from the Board a while back, 2012 actually, and so NFST kicked off an effort to look at these systems, and I briefed the Board on this in 2013 and 2015. But most recently there’s been a concept that was developed by a team from Energy Solutions with some other partners that looked at a standardized canister that would have accepted four PWR assemblies in a can. And then each of those – then a carrier could hold four canisters. And so we call this a canister and carrier concept. In this system you could have up to 16 assemblies in a single carrier.

And what we learned from this is we really think that this concept may be feasible, at least on paper, from a total system and an operational perspective.

Basically I want to show my last, I think, last graph of the day. What this is showing is the rough order magnitude cost of different scenarios that do or do not include standardized canisters. And on the left side you see a system where no standardized canister systems were used, and everything loads DPCs, and then everything has to be repackaged. In this scenario we assume a 21P waste package. So the repository could accept up to 21P, which is the largest that we considered in these stats. So I'll just note we did not specifically look at direct disposal of all DPCs in the study.

But all four of the other scenarios on the right include some level of these 4-PWR canisters in the system. And you can see these tradeoffs on cost. But the bottom line is, you look at the total, all of these different scenarios actually had a slight – slight – decrease if you look at rough order of magnitude costs. And I don't want to reach too much into the two percent, but the bottom line is is the standardized

canisters could be included into the system for a system wide cost that was about the same.

Okay, and so with these small systems, if the cost is about the same, you get the benefit of all the flexibility that these systems may not ever have to be opened.

So that’s something that we kind of learned using our tools, but in conjunction with the standardized canister effort. And so I just note that we – we think on paper this is potentially feasible, but clearly the next step would be to do some type of demonstration to show engineering is possible.

One of the things that we talked about here was that you have multiple canisters in a single carrier, and this assumes that operationally you can weld and dry these things in parallel. And while on paper we think we could probably do that, we really want an engineering demonstration. So we hope during the next fiscal year, move forward with some type of demonstration related to welding of these small canisters in parallel.

And in parallel, we – parallel and parallel – we’d like to move forward with a little bit more detail in design of the

small system such that if we wanted to move forward with trying to get a certification, or going for procurement, we'd have a better level of detail.

So these are all results that we've kind of learned with the current – I'll call them legacy tools. But going forward we really think that we need better tools. So we've been developing NGSAM, our Next Generation System Analysis tool. This is an agent-based system, so we're using software engineers, not necessarily nuclear engineers running software but actual software engineers that are using modern computing, engineering practices. DOE owns the source code, it's government off-the-shelf capability.

But we really felt we needed a modern system. The current legacy tool is actually written in a language called DB6, which is no longer supported, and there's only so many computers where we can actually compile the code. So we really in the future want a tool that can kind of go from where we are right now to where we could go in the coming years. And so we want a tool that's sustainable, durable. That's a good word.

And so what we did in FY14, we said, okay, can this agent-based system actually be used to model the waste management system? And all we did was a very high level design of moving the fuel from our site to a centralized storage facility to a repository in a very basic manner. Okay, that seemed to work. And so then we started diving into the details at each stage.

So at FY15 we really focused on the at-reactor operations and the acceptance of transportation, those kinds of things. This is what I talked about earlier about not having the fidelity of when these sites would be able to actually do spent fuel-related operations. They're in the business of making megawatts, and so, you know, they would really prefer not to be impacted by spent fuel, and so these windows of spent fuel operations, we need to understand.

This year, FY16, we've been focusing on improving our understanding of how an interim storage facility might operate. This includes all the different concepts from Task Order 16 that I talked about, and just trying to get that in a lot more detail.

Going forward we hope to model repacking and repository in the coming years, you know, but in a very detailed fashion.

But I'll just note, I showed that little bar that showed kind of continuous improvement, well this is part of that. So as we develop the new tool, we benchmark it against the old tool. And sometimes we realize the old tool wasn't giving us exactly what we thought it should be, so there's actually a back-and-forth that goes on, but it's continuous improvement. So even though we're in FY16, we're still trying to make sure that our reactor operations are handled and modeled properly.

But in this development cycle we've still been able to learn some things just from this new tool. And I want to bring those up. And some of these actually were kind of highlighted when we talked about the different – when we talked about the canisters and cask systems. But we talked – there's this issue where some canisters have a different storage and transportation thermal limit. So they may be able to be loaded at 32 kilowatts, for example, but they're now to be transported at 20 kilowatts. Well, that's fine right now because a lot of them have reached those limits and they may be transportable. But if you think about going

forward, are those limits still going to be applicable? So we see that – right now we've already seen that there have been some COCs that have gone up to 32 kilowatts for transportation. So does it make sense for us to predict that in 25 years, Reactor Site A is still loading the current systems because, you know, if they're loading at 32 kilowatts, there may be multiple decades that have to sit there before they're transportable. Does that make sense?

So those are the things we wrestle with as we start diving into these details.

Another thing we noticed was that the – we've generally thought of these things as thermal limits. Well there's also regulatory dose limits for transportation at surface, meter two meters, depending on the different thermal scenarios. And we've seen cases, once we started doing detailed modeling, where the dose at two meters may be above the regulatory dose even though the thermal is below the 20 kilowatts, for example. And so we're starting to think about, well, we need to make sure that we include those dose calculations a lot more in addition to the thermal calculations as we model the systems.

Another thing that we've –

LEE PEDDICORD: Josh, can you bring this to a conclusion?

JOSH JARRELL: Yes, I can. Improved algorithms for predicting canister loading. Right now it's very simple. The vendors are doing lots of different loading patterns, and we want to be able to model those and predict how we'll do those going forward.

I talked about the windows for loading.

And I'll just note last thing is we need better loading maps to model those. So we have about 400 that we can have that I think around 1,800 or 1,900 canisters that were provided by the GC-859 data that had loading maps that were good enough for us to actually predict dose. So we're in the process of collecting more data.

So, recap.

This is basically what I said to begin with. We have legacy tools that we've updated. We've collected more information to allow us to use those tools to provide insights and look at uncertainties in the system.

And in parallel, we developed a new system with higher fidelity data to give us better answers.

And all of this is underlying this concept of continuous improvement and integration, which is you develop better software, better models, you'll get more data, you'll get better results, and that gets you back to you need better models.

So with that –

LEE PEDDICROD: Thank you. Any questions from Board members?

ALLEN CROFF: I think you mentioned at the outset that you started and learned lessons from TRAGIS when developing your new codes. Why not just use TRAGIS or start with it and modify it?

JOSH JARRELL: That's a good question. So DOE-NE did a fairly extensive study on that, and the author of that study is actually Erica Bickford, and I would like her to respond to that.

ERICA BICKFORD, DOE: Yeah, so there – in terms of the question of did NE consider lessons learned from TRAGIS in going into START, actually TRAGIS was originally the RW

program, so the Office of Civilian Radioactive Waste Management. So it was originally, I believe, started – is that right, Mike? It was developed under RW.

(Inaudible.)

Okay. And so there was a familiarity with that tool. It then went through some iterations where the old code had to be reprogrammed to meet new security requirements at Oak Ridge. And in that sort of off time, there had been a lot of developments in commercial software space of off-the-shelf GIS software with routing capabilities that could do similar things, so the Office, in the interim, started looking at what advantages that might offer, and then in comparing the two, the NE program decided to pursue the commercial software type options and see what advantages that could bring to the program in terms of both internal analysis and communicating with external stakeholders, state and tribal folks, and railroads.

And that’s been a really good path for us. In fact we demonstrated our START tool to you all, I believe last summer, and one of the recommendations that you made to us

was pursuing making a public version of that tool, and that's something that we're looking at doing in FY17.

LEE PEDDICORD: Okay. Additional questions from the Board?

I've got one.

JOSH JARRELL: Yes, sir.

LEE PEDDICORD: On your slide 19 you talked about the database and the need for consistent, traceable data.

JOSH JARRELL: Yes.

LEE PEDDICORD: In these, have you identified which of these areas needs the most attention in terms of developing data? Which are most robust? I like the one that says Federal Government Attributes. We'll all be looking forward to that one, I think.

JOSH JARRELL: So, uh, yes. We look at all the data sources that we collect, and some of them are, let's say, more consistent than others. But we have a process which includes subject matter experts comparing the previous data sets that we used as we import the data we have a process. This tool is out of Oak Ridge, and so we have basically an issue

tracking system that we use as we do this. And so at the end of the day we know the actual – whatever that number is and the report it came from. And so that's really important to have the traceability.

But different – I mean it's – some systems we know a lot from and about, some of the fuel, some of the canisters, casks we know a lot about, and some of them maybe not as much. So it really depends, but we try to get everything up to the level that we're comfortable using it. So we have procedures in place to do that.

LINDA NOZICK, Board: I was wondering if you had a document that describes the new systems analysis tool, this last one.

JOSH JARRELL: The NGSAM tool?

LINDA NOZICK: Yeah.

JOSH JARRELL: Yes, we can get that for you.

LINDA NOZICK: That would be great.

JOSH JARRELL: We have a – we gave a report at Waste Management, Barb, on NGSAM, I believe, that's publicly

available. But we do have NGSAM specific details that we can get you.

LINDA NOZICK: Okay, great,

JOSH JARRELL: Absolutely.

(Inaudible.)

JOSH JARRELL: Yes.

LEE PEDDICORD: Could you report what was said?

JOSH JARRELL: Melissa said there’s more on the poster session on some of this.

LEE PEDDICORD: Good. I’d also like to jump ahead to slide – this is Lee Peddicord  from the Board – 22. The impressive impacts of really a 50% increase in your acceptance rate. Can you then go and identify what are going to be the needs to give you that flexibility. Does this depend on the number of rail cars that are available? And let me ask kind of subtext, we heard about going to the rail cars with the larger number of trucks and so on. Can you actually use that in terms of an optimization parameter that is maybe rail cars that are smaller and smaller casks but have more of

them that allows you to implement or reach this very impressive change in terms of getting fuel off sites?

JOSH JARRELL: So I'll first say that the delta between the red and the blue is really mainly just in the order that you pick up. Just that. Now having said that, by doing things in a different order, you're going to impact the whole system, right, so you may need more of this type of cask or this type of – well, hopefully the rail cars will be fairly consistent. But, you know, those things will change, absolutely. And so that big jump really is just a different order. I can't emphasize enough that oldest fuel first from a system perspective is maybe not the optimal strategy.

But going how you can drive from this red to blue line, there are analyses we can do and we would do to look at what are the impacts of shifting the orders around. And, in fact, I think we have an activity related to shut down sites in this coming year to kind of focus in on that specifically.

LEE PEDDICORD: Okay. Thank you.

Questions from the staff. Bob?

BOB EINZIGER: Slide 25. You have a chart there of costs.

JOSH JARRELL: Yes.

BOB EINZIGER: I presume costs in this slide is dollars. There’s also other costs, and those refer to the dose that is going to be incurred by the workers and also the time that it’s going to occupy in the pool. The dose probably would come if you’re going to these smaller packages to the drying time where most of the doses occurred, and it would also impinge on the allowable dose that’s available at a reactor site for them to divvy up among their operations. So how would this chart change if you looked at this not in terms of dollars, but in terms of dose?

The second thing is with respect to the third cost is time in that time in the rector pool where they’re packaging is a significant precious quantity. As you go to smaller packages, you incur more time in the pool. What’s going to be the cost in time?

JOSH JARRELL: Okay, so let me approach the dose question first and then the time.

So this is assumed cost and does not include let’s say a dose cost, for example. These different scenarios, if you look at the different colors, they correspond in different

locations. So the blue, for example, is at-reactor costs. So what you see is that the at-reactor cost is somewhere on the order of 25%, and really some of those scenarios maybe it changes a little bit, but what we've got from Energy Solutions and their concept really does – there might be some additional worker dose at-reactor, but again, you're trading off your repackaging avoidance down the road. So there may be an increased dose at sites by loading these systems. Again, we think there may be optimizations really to minimize that, but no doubt, from an efficiency perspective there will probably be an increase in dose at sites. But if you can avoid that repackaging dose down the road, then there's tradeoff.

Now we can argue on, you know, that's at-reactor worker dose versus future repackaging dose to people, but it's hard to specifically quantify how costs and dose correspond besides saying every facility will be designed and operated with the ALARA considerations, and so what happens going forward with dose, it's hard. But there is tradeoff between each of these operations.

BOB EINZIGER: It might be worth something to consider in a little bit more detail. If you go on to slide 27, where

you’re talking about the difference in thermal limits between storage and transportation –

JOSH JARRELL: Yes.

BOB EINZIGER: Yeah, the top bullet. From the point of view of the canisterized systems, that difference in limitation shouldn’t be because of the canister, so it must be something that’s doing with the difference in the overpack. Have you looked at what is the reason for those differences in both dose and thermal limits? It might be something, especially if they haven’t developed the – built the transportation overpacks, that maybe a slight design change, or different material could bring the limits up?

JOSH JARRELL: So I agree with you, actually. So we haven’t looked at this in a lot of detail, but, for example, this example – this 32 kilowatt – some of these examples – these transportation casks, for example, you add fins to them, you get from 28 to 32 kilowatts. There are design changes that could be taken in the future to avoid this issue.

Now it’s not going to be across the board that you can do this for everything. I would say maybe slightly more than administrative change, would be a technical change. But

you’re right. And that’s why I brought this up is because it doesn’t make sense to keep assuming these type limits where you’re going to have this large system or even going forward would reactors that realizing that their fuel might be transported actually load their system such that they could be transported. That’s what our system analysis tools, you know, we wrestle with these type of issues. But you’re absolutely right.

BOB EINZIGER: It might be something to consider when you develop your stat specs that whatever you load in storage can be transported.

LEE PEDDICORD: Okay. Thank you very much. Appreciate it. Lots of good information again. We are now scheduled to take a break. Let’s aim to reconvene at 10:50 for the next presentation.

Okay. We are going to reconvene for the next presentation of the morning. And so, let me introduce Kris Cummings  from the Nuclear Energy Institute talking about the integrated approach to storage, transportation and disposal of commercial spent nuclear fuel with a perspective from the industry.

KRISTOPHER CUMMINGS: Great. Thank you very much. So I'm a Senior Project Manager for the Nuclear Energy Institute. I know a lot of you are aware of NEI and who we are, but in case you're not, I know the Board has had some turnover here in recent years or months.

We represent the nuclear industry. Our members are all of the commercial nuclear power – operating nuclear power plants and the shutdown ones. We work on general policy issues, communication on reliability of nuclear power.

I work specifically in used fuel and decommissioning programs. My background is I had ten years with one of the cask vendors and actually five years with a fuel manufacturer, so I'm well steeped in the issues of design. And actually with that cask vendor, I actually was the project manager for that cask vendor in developing a tagged canister when I was there. So it's always nice to come back to these issues.

So I'm not going to go through this a lot because it was covered. I think the most important thing here is we know we're generating spent fuel, used fuel. We have about 76,000. Twenty-eight thousand metric tons of it is in ISFSI

storage. I'm going to point out that number, 37%, because I'm going to come back to it later. Over 2,000 casks loaded. A hundred and fifty to 200 casks loaded per year. Nice to see that we're consistent between industry and DOE on just the numbers. We didn't try to coordinate that, so – but that's good to see that we get the same numbers.

One point that I wanted – one note that I wanted to make is that in the next two to three years you're probably going to see a bump up of that number in terms of the number of casks loaded in the next couple of years. Reason why? San Onofre, Vermont Yankee, Crystal River, some of the recent shut down sites, they're looking to offload their fuel by the 2019-2020 timeframe. That's just an economic decision. There's huge cost savings that you can make by transferring the fuel from the spent fuel pool to dry cask storage and now you don't have to maintain some of the security emergence preparedness that you need to have associated with the spent fuel pool.

Next slide.

Shut down sites without an operating reactor. That's the list of all of them. And there's a total of about 325 used

fuel casks at these sites with obviously some of them going to be loading a few more in the next couple years.

So I wanted to go over our used fuel management key principles. This really is talking about the integrated used fuel management framework and some of the things we really think need to be part of that framework. One of those include a new management entity outside of the DOE. Access to the waste fund outside of the appropriations process, simply because that's caused some of the delays.

We do have a recognition of consolidated interim storage sites as being a potential option for managing used fuel within that framework. And certainly used fuel from shut down sites without an operating reactor, there's some good reasons to make those a priority.

In parallel, we should continue completion of the Yucca Mountain licensing process followed by construction and operation. Very simply that is the law, that is what should be followed.

Community and states hosting Yucca Mountain and/or a consolidated storage site shall be eligible for benefits. That's consistent with the Nuclear Waste Policy Act.

One thing from an industry perspective on the nuclear waste fee that certainly through some of the legal maneuverings that was zeroed out. We feel that that should not be reinstated until two particular objectives are met. One is that the annual expenses exceed the annual investment income. Basically you need to be spending more money on the program than you're actually taking in through the investment income. And second is that there actually needs to be a projected life cycle cost that warrants needing to have the fee turned back on.

And then research, development, and demonstration on improved and advanced fuel cycles closed nuclear fuel cycle.

So those are all things that we think are important in integrating the used fuel management framework.

So here, as you can see, we've got two of the options striked out. The first was that all spent fuel placed in large dual-purpose canisters will eventually need to be repackaged into purpose-built casks for disposal. The second is that we need to construct one or more repositories that can directly accommodate large dual-purpose canisters for

disposal. And third, the spent fuel will remain indefinitely at interim storage facilities and repackaged as needed.

Well, that third one's not certainly doable. Our facilities were designed and built to generate electricity, not be nuclear waste management sites. We've certainly heard from some of these communities, and I think during some of the consent-based siting meetings, that these communities that consented to have an operating reactor did not consent to have nuclear waste continue to be managed at that site indefinitely.

All spent fuel, and option A, with all fuel being placed in large dual-purpose canisters that will eventually need to be repackaged, we don't think that's a viable option, too, which I'll get to in some of my later comments. And that really means that we have to go to the option where we seriously consider building a repository, designing a repository, that accommodates these large dual-purpose canisters.

So how do we get there? Essentially the system must be designed with the following considerations: storage at the reactor sites with subsequent transportation, with possibly

subsequent storage at consolidated interim storage sites. It’s important to consider aging management at reactor and consolidated sites. Our first ISFSI in this country was built in 1985. They went through renewal in 2005, that was 20 years. We’re now starting to see a bow wave in the next two to three years of cask vendors and sites going to the NRC for license renewal. The NRC and the industry has been spending a significant amount of money and attention on ensuring that these canisters continue to perform their safety function, and so what are the appropriate aging management programs, what sort of inspections do we need to have, what do we need to look for to ensure that we continue to safely maintain these casks and contain the radioactive material that’s within these.

Then there’s possibly subsequent transportation to a disposal site. And all these things need to be built within the system. And we really need to look at the system that we have, not the system that we think we want to have or the one that we wish we had.

A few words about aging management. I talked about this a little bit. They’re being developed. We want to make sure that we monitor and ensure that these casks continue to

perform the function that they were designed for, which that primary purpose is to contain the radioactive material within the canister.

Delay in implementing final disposal are driving significant addition costs associated with that. We're looking at a minimum the canisters will be inspected at every single site. We're working with the NRC in hopes that as we get more information on terms of the degradation mechanisms, are they applicable, are they not applicable at certain sites depending on the environment, can we start relaxing some of maybe the initial requirements to inspect these things. But right now where we are with the NRC is that every site will have at least one canister that will be inspected at least every ten years. Some sites may need that more frequently depending on whether they have specific environments, possibly marine environments, that would warrant more frequent inspections.

Increasing costs of disposal due to delay. I don't think this is a surprise that it goes up by about – the estimate goes up by about $2 billion per year. The amount paid from the taxpayer-funded judgment fund goes up by a little under a billion per year. This does not also account for some

things that we think are not in here like aging management that the utilities are now going to have to start doing because they have these casks sitting longer at their sites. And, again, this assumes that DOE begins accepting fuel in 2021 for interim pilot facility.

So I think the safest thing I can say here is these costs will continue to go up. That’s not a surprise to anybody.

So I want to touch a little bit on the past efforts to integrate and how that ties into kind of the next major theme that I wanted to talk about here with relation to the question from the Board about the standardized canisters.

So if you go back and look at the history of some of the efforts on DOE to develop standardized canisters, you go back to the early nineties, the DOE multipurpose canister system, that was a large – what I would call large-capacity system. It went through the feasibility study, design specification, and some preliminary funding. I would say that our systems that are designed now, which actually Josh and Joe Carter did a very nice job of summarizing so I didn’t have to, again, we didn’t collaborate on that – or collude on that – I think it’s a good collaboration.

You know, our systems were primarily based on the MPC sort of concept, larger capacity systems. Then, as I mentioned previously, in the 2000s, DOE came out with the TAD, Transport Aging Disposal, canister system. Again, that went through quite a bit of effort in terms of specification – development of a specification, awarding of contracts to vendors who submitted those applications to the NRC, but then because of changes in Administration, and changes in the approach, by DOE on the repository with Yucca Mountain, those TADs did not go forward because of changes in the approach by DOE on disposal.

The last point I wanted to make is that NEI actually intervened on the Yucca Mountain licensing proceeding. One of our contentions was about disposability of already-loaded dual purpose canisters. So I'm going to touch on that a little bit in a minute.

So, the impact of smaller-capacity canisters. There's a reason why the industry has gone to larger canisters. And part of it is cost. Part of it is ease of use. Another part is ALARA; ensuring that we reduce the amount of radioactive exposure to our workers in the plants. Certainly there's

regulatory limits, but even beyond that we want to limit that amount of accrued occupational dose.

Smaller packages also carry unnecessary costs. Things like new packaging, operational costs to repackage. And one that I think is important is increased number of shipments. I mean, if you just look at the numbers, you go from a 37 or a 32 PWR down to a four PWR, you're talking about an eightfold increase in the number of canisters. So now you're not shipping 11,000 canisters, you're shipping 80,000 canisters. That's an incredible logistical lift to be able to do that.

There's major impacts on the spent fuel pool operations. I would go back to the presentation that Adam Levin gave to the Board about two years ago where he talked about the amount of time that we have in the spent fuel pool. Even with considering fuel reloadings, the various sort of operations that you have to do with fuel inspections, either fuel receipt, within a pool there's maybe a 12 or 14-week window. A dry cask storage campaign, if you do three casks, it takes about two weeks to mob and de-mob. Optimistically you can load a cask about once per week. Some don't do it that quickly. It depends on how many resources you devote to actual loading. Some sites actually do one canister per two

weeks. And then you have the de-mob on the back end which is another week to two weeks, which is all time spent in the spent fuel pool.

So when you combine all that time in the spent fuel pool, we just simply don't have the time available in our spent fuel pools to instead of loading three packages of the large capacity 32 PWR to now have to load 24 canisters. I mean, understanding that you'll have some benefits of economy of scale, and the welding may not take as long, and the drying may not take as long, and the loading of fuel assemblies, the primary time is in the drying, and so you may be able to get some of that time down, but certainly not within being able to accommodate that within our spent fuel pools.

You'll now have disposal of the large canisters that have to get repackaged as low-level waste. That's an additional cost. You know, I'd be interested to know if that's in some of the cost estimates that Josh presented.

And then overall increased risk from handling operations. We've done PRAs on dry cask storage, and typically the areas that have the highest risk are always related to operations that involve human beings. That's not a surprise. The dry

cask storage sits there, it doesn't do anything. So if you have more operations, that increases just the risk calculation within a probabilistic risk analysis.

The NRC's regulatory framework actually recognizes the safety benefit of not repackaging canisters. Earlier this year the NRC actually revised ISG-2 where they recognized that the package is essentially the waste form. It does not now require retrievability on a fuel assembly basis. That's an option there. One of the options that they added was actually retrievability on a canister basis. So now plants can demonstrate that if they can go get that canister, get it in a transport overpack, potentially ship it somewhere, that that now satisfies the regulatory requirements of retrievability.

So direct disposal of high capacity canisters. It is achievable. EPRI assessed the feasibility of that a few years ago. There's two reports up there that you can find on the EPRI website, epri.com.

You know, one of the major issues around whether you can directly dispose of these larger canisters or the high capacity ones has to do with the used fuel heat load. So,

and we talked a little bit about that. And if you just use rough numbers, a storage cask is licensed to about 40 kilowatts. The transport licenses are licensed to about 20 kilowatts. At least for the purposes of the repository that existed at Yucca Mountain, that had about a 12 kilowatt capacity I believe.

However, there's an opportunity for R&D to address uncertainties. One of the things that we've seen recently with the high burn up demonstration program is that there's tremendous conservatism in the analysis that our cask vendors submit to the NRC to demonstrate safety of their systems.

So you may load the cask, or you may certify that a cask is at 40 kilowatts and can take that amount of heat, but one, you don't load that high. Most casks are loaded much lower than that, down in the 20 kilowatt range. I think the highest we've loaded is about 35 kilowatts.

And then there's a lot of conservatism in the analysis that we do. And we think that with additional R&D, and actually some of the work that DOE is doing, like with the UNF-Standards, and some of the data that they've asked for,

would allow us to potentially do cask-specific analysis to actually demonstrate the cask could be loaded earlier than would be potentially doable if you just follow the certificate of compliance.

We've got time in the sense that the current DOE – I'm not going to get the right word, but their strategy document recognizes a repository in 2048. We've had casks loaded for 30 years or so, 20 to 30 years. And so the heat load will go down with time.

And then consolidated storage will also provide an opportunity for additional cooling and aging.

No matter what, extended storage will be necessary regardless of whatever disposal path is chosen. Really the decision is where do you do that at? Do you do those at the nuclear power plants? Do you do that at a consolidated interim storage site?

So answers to the NWTRB questions. What are the perceived impacts to nuclear industry of integrating defense and non-defense wastes? You know, we believe that there could be some costs or scheduled benefits for defense wastes.

However, integration should not delay repository development.

What's the impact on the industry's ongoing efforts to package and store commercial spent nuclear fuel? For the foreseeable future we see that we're going to continue to load these large capacity canisters.

If DOE introduces the small canisters to gain efficiencies, how will this actually be received by the industry? This is where I'm going to go back to that 37%. We've passed the point of no return. We need to recognize that we have these systems out there, there's a lot out there, there will be more out there. We're going to continue to load them. So rather than trying to say that we're going to try to force a particular approach on the industry, let's recognize that we've got these canisters out there and we need to accept that they're going to need to be part of the integrated used fuel management framework.

What could be done to minimize or offset the impact of loading small canisters at nuclear power plants to avoid the need for repackaging later? Well, we should recognize that the repository should be designed for the waste form, the

canisters, not the other way around. Any repackaging, if needed, should not be performed at the nuclear power plant sites. Going back to what I said earlier. We're not repackaging facilities. We generate electricity. We safely store our waste. But we're not in the business of repackaging that facility.

Now, more importantly, though, we think that it can be done more efficiently someplace else. These canisters that are loaded can be transported. I think there's a few out there that we talked about, storage only, that may need to be repackaged at the site, but I think those are few and far between cases. The majority of these canisters have been designed for storage and transportation. The licensing may need to be done, but that's doable. So does it make more sense to repackage at 80 or 100 different – 118 – different sites, or to transport it to a facility that's dedicated to repackaging, possibly consolidated interim storage. Could be a repository. Those are the things that could be looked at. But let's not do those at the nuclear power plants. Let's do repackaging at a facility that's designed and dedicated for it.

So in conclusion, the need to restart the repository program, whether that's something else or Yucca Mountain, does present an opportunity to develop a better integrated system.

We need to have clear goals that need to be established at the outset.

And that avoiding the unloading of already-loaded dual-purpose dry storage systems to the extent practical should be first and foremost among these goals.

So that's all of my prepared remarks, and I'm happy to answer any questions.

LEE PEDDICORD: Thank you very much. Questions to Kris from the Board members? I guess they're getting hungry – no, not Paul.

PAUL TURINSKY: Okay. So NEI – Paul Turinsky, Board. NEI supports moving ahead with Yucca Mountain. You also support direct disposal of dual-canister TADs.

KRISTOPHER CUMMINGS: Correct.

PAUL TURINSKY: Does that mean that the Yucca Mountain licensing case, safety case, should be resubmitted? Or are you talking about an amendment later after if a license is issued? I don’t understand the – they seem to be in conflict without certain actions.

KRISTOPHER CUMMINGS: So the Yucca Mountain repository already envisioned taking the current dual-purpose casks. So there was some debate over how much that needed to be, and we had filed contentions that we felt like that needed to be larger than the ten percent I think that was in the original license application. Those were all envisioned to be repackaged at Yucca Mountain into TAD systems. But one of our contentions was that we felt like the Yucca Mountain repository could accommodate the dual-purpose casks.

Now, when that needed to be done, we didn’t weigh in on it – that needed to be in the original repository application or could you do it at a later point, we didn’t have a particular opinion about that. But we felt that, you know, if you wanted to do it right you could do it up front.

LEE PEDDICORD: Sue?

SUSAN BRANTLEY: These are sort of obvious questions, but I just to make sure. You know, there's all this variability in the casks and the canisters and how it's all stored. I'm assuming that's simply because these are all different companies and it's for competitive advantage or something. Can you just explain to me why there's so much variability?

KRISTOPHER CUMMINGS: Yes. So I would say a large part of the variability has been that the casks have been designed for the fuel at the site. So if you look at all the – let's just take PWR fuel out there. You have it anywhere from about eight feet long to almost 14 to 16 feet long. But I think the STP fuel is 199 inches. Well it doesn't make sense to use that much material for a canister for 199 inches long because that adds cost to a plant that doesn't need that full length when you're not a System 80 type of cask. So in large part I would say these canisters have been tailored to an extent for specific sites. To some extent. That's part of it.

The other part of it has been the innovation side. Having been at a cask vendor for a decade, it is a very competitive market. And they are always coming up with new ideas to save money to utilities, load more fuel assemblies in them, new

materials to get greater heat loads, so that you have greater flexibility in what you can load. The main goal right now within storage is ensuring that you can put fuel into dry cask storage in a safe and efficient, cost-effective way. And so they've been very good at innovating with new materials, new canister designs, greater capacities, to accommodate that mission.

SUSAN BRANTLEY: But, I mean, ultimately we need some uniformity, presumably, in order to get it into a repository, so the industry also has some interest in holding hands and getting some uniformity.

KRISTOPHER CUMMINGS: Sure.

SUSAN BRANTLEY: So is there any, you know, work on the part of the industry to try to hold hands a little and to make it easier, you know, to get it. That would actually solve your problem from the other side.

KRISTOPHER CUMMINGS: So here's what I would say. What we've seen lately is some of the cask vendors coming up with universal overpacks. So you have different canister designs, with different lengths and possibly different diameters. But now you have one universal transport overpack that can

accommodate all of those different designs. I don’t see why that couldn’t also be done on a disposal purpose. I mean in the case of transportation, and you have different lengths, you put a spacer, you know, a steel spacer so that you don’t have a canister that can slide large distances under the transportation accident conditions.

And so some of the cask vendors are now looking at ways to at least standardize the overpack design so that from a point of transportation you now don’t need ten or 15 or 20 different transportation overpacks for the different canisters. So that may be a way that you can standardize parts of the system.

LEE PEDDICORD: Okay. Other questions from the Board? I have one. Lee Peddicord. So a question on NEI industry interactions with DOE and the labs on some of the topics we heard this morning, one being consent base processes and so on, the integrated waste management system that Josh talked about, the transportation issues we’ve heard from Steve and so on, do you have either, I don’t know, formal or informal ways that you interact with DOE to bring industry perspectives in say these three areas? And one particularly,

the integrated waste management system. A real software package.

KRISTOPHER CUMMINGS: Sure.

LEE PEDDICORD: You all have expertise in this area, and so on. Do you get a chance to offer input on these?

KRISTOPHER CUMMINGS: Right. Yes, we do. I mean we have, I think, what I would call periodic interaction with the Department. One of the primary ways that we have interaction with them is on some of their Research and Development activities. And we send a letter every – I think it's three times a year, you know, kind of saying, hey, here's where we see where some of your research can help the industry.

We've had some interaction with the Department on parts of the integrated used fuel management framework, but we're happy to facilitate more of that interaction.

I think when you get down to the point where you say, hey, I'm ready to go pick up fuel. Whether that is in an existing loaded canister or that's in a standardized canister, regardless of that, you're going to have to have DOE or the other entity, whatever it is, it's going to have to have

detailed interactions with that utility on logistics. When are they going to show up? When, you know – our cask vendors do that right now, and our companies that do loadings, they do that right now with the individual utilities that they're providing their services to. So that can be done.

LEE PEDDICORD: So one of the aspects you pointed out was the spent fuel pool utilization and management and so on. Does INPO weigh in on any of this, particularly when you get in the operations of a spent fuel pool, and are you all in communication in sync in terms of messages you think are important from your two organizations?

KRISTOPHER CUMMINGS: I'm not sure if I can answer that. I mean we do have interaction with INPO, but in terms of the specific relationship to the spent fuel pool, I don't know. I'd have to get back to you on that one.

LEE PEDDICORD: Okay. Last question on my part as well, too. I'm a professor, I like giving homework assignments. I can't pass up the opportunity. But the two people I was going to give homework assignments are you and Andy Griffith, and like some of my students, he left class early. And will bear

the consequence of this. Look at people jumping up to volunteer.

So in this opportunity for interaction, we heard this morning from John Kotek about creating a new subcommittee of the Nuclear Energy Advisory Committee, NEAC. And it would seem to me that this is a good opportunity to have a place at the table, assuming DOE is amenable to that, so you could in a consistent way define the agendas of the subcommittee and offer input. So the homework assignment, to Melissa, to tell Andy, to at least have a dialogue with you all so you can express your interest of participating in the subcommittee. Now it’s up to DOE and John Kotek, you know, to name the members and the NEAC Chairs, co-Chairs, but it would seem to me this would be a fruitful step to make sure you have a continuity of communication links. And I would urge you, and you, to take this under advisement.

KRISTOPHER CUMMINGS: I agree. You almost verbatim wrote my note in my notebook for me that I made when I saw that slide presented by John, so I –

LEE PEDDICORD: I hope that note was taken neatly and so it’s legible.

KRISTOPHER CUMMINGS: Well I can't vouch for my handwriting, but –

LEE PEDDICORD: Let me ask if there are more questions? Allen?

ALLEN CROFF: In a couple of DOE presentations this morning, they had a standard disclaimer, I'll call it, that spent fuel in canisters isn't an acceptable form for disposal, which is what the utilities want to do. So how does that get reconciled?

KRISTOPHER CUMMINGS: Uh, legally.

ALLEN CROFF: Oh.

KRISTOPHER CUMMINGS: I think that's all I probably should say. I mean, essentially we've loaded these canisters. There's been lawsuits, and judgments have been made to utilities to reimburse them from the Judgment Fund for the costs associated with dry cask storage.

LEE PEDDICORD: Any other questions from the Board? If not, let's turn to Dan Ogg from the Staff.

DAN OGG: Dan Ogg with the Board Staff. I have a question for both the industry and DOE. Again I was hoping that Andy Griffith could take this question but maybe Melissa can do it.

In essentially every presentation we've heard this morning, there has been a lot of discussion about an interim storage facility, either pilot or larger. DOE has got plans for it. They're doing functions and requirements. They're doing design. The industry has two teams proposing interim storage sites. But my understanding is the design can go forward but no construction can happen until there is some action by Congress. So my question is, both for the industry and for DOE, are you working with Congress on this issue? Have they asked you for input, and if so what kind of input are you giving them to make that interim storage facility the most effective and efficient facility. So questions about interface with Congress.

KRISTOPHER CUMMINGS: Yes. That's occurring. I mean, if you've seen, there's been some proposed legislation for consolidated interim storage sites. That's been there. In accordance with our legislative policies, we do feel that consolidated interim storage can help provide an avenue to

an eventual repository. I think it can also help to test some of the capabilities of the system in terms of transportation, you know, showing that you have the infrastructure to transport spent fuel to a consolidated interim storage site will help give confidence to the public that you can do that. And, you know, we're talking about primarily starting with the shutdown sites. And so that's a defined number of casks. You know, some of them are still loading the rest of their stuff out of their spent fuel pool. So we do feel that it can help along the system, the whole system, of the integrated used fuel management framework.

DAN OGG: Thanks.

MELISSA BATES: And unfortunately that question is like way above my pay grade. But I could take the question back and try and get a response.

(Inaudible).

BRETT LESLIE: Josh and Joe had two instances where they can't get the data or are having trouble getting the data. One has to do with the actual mapping of assemblies and knowing which, you know, let's just say the burn up of

individual assemblage and where they are in the cask would help Josh to do the kind of things he does. So on the GC-859 form, can industry provide the information that DOE needs? That’s one question.

KRISTOPHER CUMMINGS: Okay.

BRETT LESLIE: The second question is in terms of what is actually loaded? My understanding is DOE isn’t necessarily privy to what actually gets loaded in each of the casks. And as each cask is loaded, that information is provided to NRC?

KRISTOPHER CUMMINGS: Okay.

BRETT LESLIE: Could that information also be provided to DOE to allow them to get the data they need to model the system better?

KRISTOPHER CUMMINGS: Okay, so let me address the first part which is the data exists. You know, in accordance with our regulatory requirements to know where our fuel is, where our spent nuclear material is, we have to know where it is. So is it in the pool? Is it in the cask? We know where it is, what location it’s in. We know the operating history of

those fuel assemblies. So we have the data, the utilities have to maintain that.

In terms of your second question, does that get provided to the NRC, my knee-jerk response is no, it doesn’t just carte blanch get provided to the NRC. However they have regulatory oversight. They can come in and they do, through inspections, come and look at some of that stuff and ensure that the casks have been loaded in accordance with their certificates of compliance.

Now, probably the more difficult question is with relation to the GC-859. That is something from the standard contract. There is certain information that DOE can request and there is some information that DOE is not within that. We have been -- within NEI, we have been trying to work with DOE to find ways to have them get that information. We have been trying to do that through the fuel vendors, because obviously they're going to have that information. But, you know, they're a company in the business of being in business, and so there's some of those sorts of things that still need to be worked out as to how can we get, as an industry, that data to DOE, and then secondly, what is a fair compensation for that.

STEVE MAHERAS: Bret, just to augment that a little bit --.

LEE PEDDICORD: Steve, could you --.

STEVE MAHERAS: My name is Maheras from Pacific Northwest. When we go to the sites, the closed ones, right, we ask for the maps of where each individual assembly is within each one of the cans that has been loaded, and then we map that back to what's in the databases. And so we have a continuous dialogue with the utilities at the sites on obtaining this kind of information. And we don't always get it during the visit. Sometimes it takes a little time to get it, but we do, nevertheless, get the information from the sites and incorporate it into the databases that we have.

LEE PEDDICORD: Other questions from the board or the staff? Kris, thank you very much.

KRISTOPHER CUMMINGS: You're welcome. Thank you for inviting me.

LEE PEDDICORD: As is often the case at these meetings, some of the most memorable conversations take place in the washroom. And so I'd like to ask Steve Maheras to come back up and provide just a context of where these transportation

casks fit in the spectrum of things that the railroads move in the nuclear industry.

STEVE MAHERAS: Oh, okay, in terms of cask weights, we have cask weights that weigh in between about 187,000 pounds up to maybe 400,000 pounds; right? That is at the low end of the spectrum of what trains move every day, day in and day out, in this country. It would not be unusual, for example, to see a million-pound load go into a nuke plant; right? And so that's the reason that in our work at the sites, we look at the way that large components have been moved in and out of the sites as perhaps the model for how spent fuel is moved in and out of the sites. So we look at things like how have they moved the reactor vessel off site; that will be a very large load. Pressurizers, et cetera, how they move those large loads in and out of sites as the model, because oftentimes those weights are a great deal bigger than a spent fuel cask.

LEE PEDDICORD: Okay. Thank you. That's why the trip to the washroom, one of the reasons it was so informative. Okay, no other questions for Kris again? Thank you again. As it is the board practice at each meeting, we invite comment from the public and have asked people to sign up. Ruth Weiner has

indicated that she is prepared to make a comment. And let me invite her to come to a microphone.

[Inaudible].

You're going to pass? Okay, so we'll count -- you're still signed up in case you want to make a comment later on. Okay, very good. Let me just ask if there's anything before lunch that either the board or the staff needs to bring up? One of the footnotes that Nigel Mote has mentioned is the food services in the hotel is a bit limited. So there is a sheet out on the table of other dining opportunities nearby. We are going to reconvene at one o'clock. For those of you that want to join the new svelte Jack Edlow for lunch, he will take you for a salad. But we will get together again here at one o'clock. Thank you very much. Have a good lunch.

[BREAK FOR LUNCH].

LEE PEDDICORD: Welcome to our next session. Hope you all had a good lunch. Our next person auditioning for the kettle drum player for our introductory music is going to be Mark Whitney from the DOE Environmental Management Program, providing "An Overview on Integration of DOE-Managed Spent Nuclear Fuel and High-Level Waste" within EM. Mark.

MARK WHITNEY: Thank you. Thank you, Lee. Can everybody hear me okay?

[Inaudible].

Can everybody hear me okay?

All right. Great. I will -- just yell at me if I get too low here. Thank you for having me. I appreciate it. It's really an opportunity for me to present to you all and talk a little bit about the EM program. I'll be talking in kind of a high level. We have a couple of other presentations -- or a few other presentations after this that will get into a little bit more detail. But hopefully this will give you an overview of the EM program for those that don't already know, and also a better understanding of some of our priorities, now and as we move forward.

Okay, just the standard strategic goals slide. Some of you may not know that the EM program, Environmental Management program, was established in 1989. So we're 27 years in, and we just had a 27-year anniversary celebration in our office not too long ago. We didn't have a 25-year celebration -- I'm not sure why -- but 27 years we celebrated. We have completed over 150 billion dollars in cleanup work across

the complex since that time, which is good. A lot of risk has been reduced in that time, significant risk. But we still have well over 200 billion dollars -- 250 billion dollars probably to go. So, a lot of work to do. And really it is true, the most challenging work is probably ahead of us. And we'll talk a little bit about that today because a lot of that work -- most of that work involves high-level waste and/or spent nuclear fuel.

We have reduced the footprint -- the cleanup footprint in that time by about 90%. So in 27 years, we reduced the footprint by about 90%. We still have 250 square miles of cleanup work to do, so property, 16 sites in 11 states across the country, 250 square miles of cleanup work to do. So, a lot still to do. Spent nuclear fuel and high-level waste, of course, for us, those activities are concentrated really at four sites now, Hanford, Savannah River Site, Idaho, and West Valley in New York. We made a lot of progress really at each of those sites over the last couple of years under the leadership of our assistant secretary, Monica Regalbuto, who, by the way, would really have liked to be here today. So she sends her regrets, but also best

wishes for a strong and good meeting over the next couple of days.

Okay, just a quick summary of our funding. Our budget, you can see here how we split up the dollar across our key activities in the Environmental Management program. And with about 40% of our overall budget request going to the high-level waste mission, our liquid waste and our tanks, really at three sites, at Savannah River Site, at Hanford and at Idaho. The priorities for the department that we really have articulated over the past couple years more succinctly in our budget requests and our narrative, the President's request that goes to Congress, and really over the past couple years, those priorities have -- we've highlighted as the high-level waste mission, the tanks mission that I just mentioned, and resumption of operations at the Waste Isolation Pilot Plant in Carlsbad, New Mexico.

The second slice there of the dollar includes our spent nuclear fuel work. And so, really, if you take high-level waste and spent nuclear fuel and add them up, it's probably 50% -- roughly 50% of our overall budget. Our overall budget is a request for FY17 is $6.119 billion. So, over three billion dedicated to high-level waste and spent nuclear fuel

missions. I did want to mention the budget request because the EM program has really received a significant and high level of support from this administration, including our Secretary of Energy, Ernest Moniz, who really understands the program and has fought hard for the program in many areas, including in budget space. So what we've done is over the past three years with his leadership and support, we've increased our request by over 500 million dollars. And we actually have the highest budget request for EM -- in '17, the highest request that we've had in five years. And that, you know, goes back to Recovery Act money. So, significant investment in the cleanup work across the complex.

All right, I'll get into -- just spend a couple minutes on each of the next couple slides, high-level waste, our tank mission, and spent nuclear fuel mission. And then I'll talk -- I understand there was a desire to hear a little bit about the reorganization and potential impacts that may have, some of the reasons for the reorganization, particularly as it comes to our -- high level waste and spent nuclear fuel missions.

So, with our tank waste, it really has been a busy -- really a busy several months, particularly at Savannah River. If

you look at the top slide there -- I'll start there -- we have Hanford, 177 high-level waste tanks underground, ranging from tens of thousands of gallons to over a million gallons each. We have 56 million gallons, roughly, of high-level waste, of liquid waste in those tanks. Good news, we've made a lot of progress retrieving waste over the past several years. We haven't started treating waste yet, but we've made a lot of progress retrieving waste to the extent that we will -- should be closing -- or not closing, but having retrieved entire tank farms -- C tank farm at the Hanford site next year. We have one really tank left, that's C tank farm, it's C-105, that has high-level waste that we're retrieving. We have another, C-111, which we have retrieved and we're working with the state now to certify that it has been completely retrieved or retrieved to the extent of the available technology. So that is significant.

We are moving forward with the double shell tank AY-102. So we have a series of single shell tanks and some double shell tanks as well. Clearly, the priority has always been retrieving from the single shell tanks. In the event that there were a leak, there could be some high-level waste getting into the environment. With the double shell tanks,

you have the secondary containment, but AY-102, several years back we discovered a leak in the annulus between the two -- the primary and secondary shell. So, under an agreement with the State of Washington, we began retrieving that waste within the past year or two. So we should finish that next year.

We're going to be moving forward at Hanford with the next set of tank farms, A and AX tank farms. And we should complete the retrieval of all those tank farms by 2024. Now, we've had some issue. It's kind of a double-edged sword. We need to get the waste out of those tanks, and also we need to treat that. And I'll talk a little bit about our strategy for treating the waste, which is also kind of a dual pass strategy. But, at the same time, we've had a lot of concern over the past several years, really it's been many years, but over the last several years there seems to be an uptick in workers who have reported potential exposures to chemical vapors. Obviously those tanks have a lot of chemicals in them as well because of the reprocessing -- the various reprocessing flow sheets that were used. A lot of chemicals in those tanks.

So, a lot of reports of exposure. It's something we're working with right now. We're working with the workforce. There's also litigation -- active litigation going on. So what we have done over the past year-and-a-half is we have required supplied breathing air for all waste-disturbing activities in any tank. And we've required the supplied breathing through scuba gear anytime folks are in the single shell tank farms. They don't have active ventilation, and so that we felt like where we were at the time was the right approach. So we're working through that, but it also, of course, impedes efficiency with our ability to retrieve waste from those tanks, having the workers in that heavy gear with limited amount of air that they're able to take with them, 60- or 90-minute bottles, does impact our efficiency. So we're working on those issues.

With respect to treatment, we have -- the Secretary of Energy outlined his plan for treating the waste -- the liquid waste in the tanks a couple years ago -- two-and-a-half years ago approximately. And that includes the direct feed approach for the low-activity waste, which is the vast majority of the waste in those tanks is low-activity waste. It's the liquid portion, so it's the most mobile portion of

the waste, of course. And so we feel like we have a sound strategy to actually begin treating waste by 2022. 2023 is the court order that we now have to begin treating waste, and we feel confident that we'll be able to make that date. So we'll be able to start, you know, making progress on the largest volume of the waste and also the most mobile. And it will allow us hopefully to gain some experience as we get ready for the high-level waste portion and the two remaining facilities needed to deal with the high-level waste portion of the waste, which is the high-level waste facility and the pre-treatment facility.

At Savannah River Site it has been a really busy few months, a lot of progress on their tank waste mission. I just note a few things. We did celebrate a lot of anniversaries; the 20th anniversary of the operation of the Defense Waste Processing Facility at Savannah River Site this summer. DWPF has produced over 4,000 canisters of high-level waste glass. We also, pretty much around the same time, celebrated the completion of construction of the Salt Waste Processing Facility. And that facility is on track right now to be commissioned and start up in 2018. It will be very important because as we go through and deal with the waste in the

Savannah River tanks, we need to deal with the salt. We've been dealing with the salt waste through the ARP/MCU, really more of a pilot scale type process. We've been able to deal with about seven million gallons of the salt waste through our MCU, but having SWPF up and running is really going to increase our efficiency and allow us to work through that waste in those tanks much more quickly.

Let's see. We also, this summer, closed the eighth high-level waste tank. So we started with 51 tanks at Savannah River Site. We've closed eight. So we still have 43. So a lot of work to do, but some tangible progress that the site is making with respect to their high-level waste mission there.

A couple of quick notes, also fairly recently -- actually one note on high-level waste, and that is our progress on double-stacking the canisters. We have two glass storage buildings there to put that high-level waste once we put it in glass and put it in canisters. We were -- we had reached capacity, which is about 2200 canisters in one -- the first building. We were working our way through the second building. And we -- a lot of evaluation and analysis was done, and we determined that we could actually double stack.

And I know Ken is going to talk a little bit probably more about this in his presentation, so I won't go into detail. But that's going to push back into the late 20's -- or mid to late 20's when we'll need to build another storage building. And that's important, because that's probably 70 to 80 million dollars that we could save now and put into the cleanup program, and not build that facility until it's needed later on.

In Idaho, four tanks remaining, three that have high-level waste remaining in them, 900,000 gallons, a lot smaller inventory by volume, of course. We have a facility there constructed, that integrated waste treatment unit. It's been constructed for several years now. And we have had challenges in bringing that -- getting that up and running. Working on the commission. The good news is we've, over the past year-and-a-half, we've run probably, what, about 90,000 gallons of simulant through the system through IWTU. We've learned a lot, a lot about design, potential concerns about design. So we have a path forward on that, we believe, as well as about chemical process. And so we're working through. We had intended to begin operating that facility by the end of next month. That is not likely going to happen,

but we hope in the near term it will happen and we can start processing that inventory of sodium-bearing waste at Idaho.

And at West Valley, also a lot of progress just within the past year. We've actually -- we have 275 canisters of high-level waste in the main process building at West Valley in New York. And just within the past year we started moving those into storage -- a storage pad outside of that building so that we can begin the demolition -- the D&D of that facility, which is planned for next year.

Oops. All right. And the Spent Nuclear Fuel Management program at Savannah River, I'd mentioned some -- a couple of recent activities that have occurred, one with the high-level waste program and the canister double-stacking within the last month or so. Also, we restarted the first cycle unit at H-Canyon. And that's important as we continue to get that facility ready to begin processing more spent nuclear fuel. After the 2013 Amended Record of Decision, there's one real operation left now to get restarted, and that's the down blend operation. So that will be key. And that was just reached within the last -- last couple of months.

Obviously, L-Basin, we're focused at Savannah River Site, and Idaho, to a great extent, on safe and secure storage of spent nuclear fuel. And we're continuing to do that at Savannah River and L-Basin. And we want to begin moving that out -- a lot of that material out and begin processing it in H-Canyon. But in the meantime, we are continuing to receive foreign research reactor fuel and domestic research reactor fuel. Seven shipments, I believe, within the past year of foreign research reactor fuel and four of domestic research reactor fuel as well.

At Idaho, again, focused on safe and secure storage, all the EM material -- spent nuclear fuel is in dry storage. We worked very closely with our partners in Nuclear Energy there at the site as the site landlord, the Environmental Management program does. The Navy is currently in the process of transferring fuel from CPP-666 building into storage -- into dry storage. We have a settlement agreement with the State of Idaho. The settlement agreement has a lot of things in it, including a commitment to dry storage for all of our spent nuclear fuel by 2023, getting all that spent nuclear fuel ready -- road-ready for shipment and off site by 2035. So those are some -- it sounds like a long

time away, but it's going to come pretty soon, particularly the 2023 date. So we're focused on meeting those dates, working very closely, again, with our partners in Nuclear Energy as well as with the State of Idaho.

So I've probably gone over just a couple minutes of my time, but if I -- maybe if you don't mind, I'll close on the EM reorganization. We have been implementing the new organization in Environmental Management for a little over a month now, so still pretty new for us. And there are a lot of reasons and drivers for this. You can see a lot of them here. I won't repeat that. But really, it's about for us becoming more field-centric, about increasing efficiency and our effectiveness, clarifying roles and responsibilities, and really clarifying line management authority.

So if we'll turn to the next slide here, you can see the new -- the eye chart here, the new organization. It's very -- it's field-centric. You can see in the middle there the Chief of Field Operations. We have three, really, business lines now. We have Field Operations. We have the Regulatory and Policy Affairs on the far right-hand side. And we really have our Business Services function on the left-hand side. So it's very clear what folks are responsible for, where the

lines are, although we're working through that. You know, folks -- we've been operating under different organizational structure for years now, and so this is a fairly big change. It's actually a substantial reorganization. And so we're still working through that, have some growing pains. And, you know, there still may need to be some tweaks that need to be made at some point, and so we recognize that and we're going to be flexible and make those when necessary.

You can see, as far as high-level waste and spent nuclear fuel -- let's see, does this work -- they both are in this area right here. This is the Policy and Regulatory Affairs function. Underneath that, we have the Waste and Materials Management. And then under Nuclear Materials is where the majority of our work will occur with spent nuclear fuel.

We have created a couple of new offices as well. I keep forgetting I'm mic’ed here, so I don't have to stand here. A couple of technical offices -- the Chief Engineer Office -- that will work very closely on spent nuclear fuel and high-level waste issues, particularly as it involves facilities. They'll work very closely with this Nuclear Materials Management Group and with the management up here. And also Technology Development, as we move forward, that's a new

office for us. It's not a new function, but recognizing that we have over 200 billion dollars to go and work to do and decades left, the Technology Development program that we had was just not adequate. And so really building that program up, both in budget space, personnel resources, and focus is key for us as we move forward. And there will be a lot of interface with that office as well in the areas that we've been discussing for the past few minutes.

So that's really all I had. The summary is what I've already said, which is Ken Picha, Mike Wangler will be going into details on spent nuclear fuel, high-level waste programs, transportation. And my understanding is at the end of all the presentations we'll have a question-and-answer period. So, hopefully that was helpful to you, to some degree, and that I covered at least something that you didn't already know. I appreciate your patience and your time. And I look forward to working with you. Thanks.

LEE PEDDICORD: Thank you -- thank you, Mark. Yes, we'll move on, hold our questions until the end of the next couple of presentations. So we move on to Mike Wangler from the DOE Office of Environmental Management, and he will talk about

the DOE EM Transportation Overview and Integration. And you have a mic all of your own. You're ready to go.

MICHAEL WANGLER: I think I'm mic’ed two or three times up here. Never mind. Old joke. Good afternoon. I'm going to talk to you a bit about the integration of transportation into departmental activities. If you recall on Mark's organizational slide, there were four boxes under Waste and Materials Management. We're at the bottom of that line, so we fall in line with the group that Mark indicated was doing a lot of the work with the spent fuel and waste management. The -- we were given a series, as most of us were, were given a series of questions to answer. And the first one is what is the overall scope and responsibilities of the transportation program? And that's pretty much what I'm going to go through and summarize. And I think there's a fair amount of information on the slides that can help.

Our mission is to provide tools and support and integrate with other DOE entities with respect to transportation. We work with a wide variety of internal and external entities to assist our DOE sites in accomplishing the agency's mission. We work with external regulatory agencies very closely -- external regulatory agencies such as the

Department of Transportation and the Nuclear Regulatory Commission. We help our contractors by providing services -- transportation services at DOE sites and making information and tools available for our shipments. We help the sites to cut costs and avoid compliance issues. And, importantly, we work with state, local, and tribal communities to share information and maintain an open dialogue, as well as providing emergency response training, and thus pave the way for successful DOE shipments.

This chart is kind of a description of the five basic areas and the associated activities. This diagram has remained unchanged for years, so we've had pretty much of a consistent and steady program in the most recent reorganization. We were fortunate in that the program and missions and functions transferred from the old organization fairly seamlessly, and we will continue to provide the support and the integration that we had been doing in the past.

These are the basic building blocks of the program, and I will go over each of them fairly quickly. The first block relates to packaging certification. And this is a department-wide program that provides for certification

packages, packaging quality assurance. We provide packaging assistance. We actually now have an agreement with the University of Nevada at Reno to -- and have formed with them a packaging university so that people can get certification credits related to radioactive materials certification. We have a website which has a wealth of information related to radioactive materials packaging that's called RAMPAC. We do state-of-the-art technology development and RFID technology to help us track packages more effectively. And, as I've mentioned, we do a fair amount of work related to packaging transportation. The Atomic Energy Act gives us a limited authority -- or gives us the authority to regulate ourselves in certain instances. And along with that, the Department of Transportation allows us to use internally-certified packages to move materials -- to move radioactive materials.

In the second box, we have our Outreach and Transportation Emergency Planning and Preparedness. Primarily, in the outreach program through our National Transportation Stakeholders Forum, we share information and collaborate with states and tribal governments and federal agencies along our transportation routes. We share this responsibility with the Office of Nuclear Energy. Clearly,

the Office of Environmental Management has its own transportation routes that we follow. But as the -- NE program -- nuclear energy program matures, they will be developing spent fuel transportation routes and will become a more active role in providing transportation routes. We also coordinate with our other DOE program offices and site operations along with impacted tribes.

The Emergency Preparedness Program is a well-established premier program for training of emergency responders along our transportation routes. We -- as you can see from these numbers, we've trained a lot of individuals. And we will continue to train many more individuals as the individuals who have already been trained come and go along the -- our transportation routes. In our regulations and standards program, a slide of which you may not have in your folder, it was taken out at one point, and I put it back in because I thought it was an important slide; but we can make sure that you get a copy of it. This is the area from which we derive our authority for departmental policy -- for development of departmental policy as well as our internal regulations.

We have three major activities in this area. One is an existing safety order. It's called "Packaging and Transportation Safety." And with this order we basically put ourselves on par with the external communication, the commercial sector, in that we require ourselves to follow the regulations of the Department of Transportation, the hazardous materials transportations.

The second order relates to departmental materials transportation and packaging management, and this provides some requirements on what kind of services have to be used, such as tracking services, such as services such as developing the work orders to actually have transportation services covered. It includes references to our Motor Carrier Evaluation Program and so on.

In the next group, the next program area, our transportation risk reduction is our Defense-in-Depth Program. It has two primary modes of activity. One is our Motor Carrier Evaluation Program, which has played a vital role in maintaining DOE’s excellence in transportation safety. It also, because of the program, our recordable accident rate is much, much lower than the industry average accident rates. We're able to, over a three-year period, pretty much

cover a review of all of our carriers. We currently have 39 carriers on our list. 31 are activity national carriers, 7 active local carriers, and 1 carrier on a temporary non-status basis.

Additionally, we work with the sites as part of our Transportation Safety Operations Compliance and Assurance Program. We work with our sites and help them to evaluate, to look at their site programs every three years to ensure that the sites meet the two extant orders.

Under operational tools and assistance -- whoops, sorry, I can't see from this angle very well -- we work with several organizations to ensure communication of our activities. We have a Transportation Management Council and a Transportation -- or a Packaging and Management Council. Each of them have a different focus, one clearly on packaging. The other one on other transportation activities.

These programs help us to work with our DOE contractor subject matter experts to provide support to address specific site needs. Additionally, we work with the Energy Facility Contractor Group to promote excellence in all

aspects of the operation, management, and integration of DOE facilities in a safe and environmentally sound, efficient, and cost-effective manner through the exchange of ongoing information, and there is a transportation subset of the EFCOG that looks specifically at transportation and packaging issues.

Now, with respect to the types of shipments, have a couple graphs here. In the upper left, this is a graph of all of the hazardous material shipments by program office. Clearly the office of Environmental Management currently is the largest of the offices and has the most activity in this area.

If you look at the graph in the lower right, that is a breakdown of the EM activities, and you can see the vast majority of our work currently involves low-level waste with much smaller amounts of other hazardous materials, mixed low-level waste, and a category that we call "Not specified" because we get a number for it but we can't put out a category out of that particular activity.

Now, with respect to department-wide integration and some questions, the organizations within and external to the

department with which we integrate include this list of activities. Because we're departmental asset, we work with all of the major shipping offices, including Nuclear Energy and Science, as well as the National Security Administration. And to effectively do our job, we have to work with external agencies, such as the Department of Transportation from whom we derive our internal regulatory authority.

We work with FEMA and the Federal Radiologic Preparedness Coordinating Committee on emergency preparedness activities. We work with the General Services Administration on tariffs for our transportation and shipping activity. We work with the Nuclear Regulatory Commission, along with the DOT, for our regulatory authority. We do some international work with the International Atomic Energy Agency, and we work very closely with our field offices and provide integration and assistance to them as they need it.

We are a member of the Transportation Research Board, so we try to maintain an active presence with the Hazardous Materials Committee of that organization, and, again, importantly, we work with our state regional groups and our tribal caucus to ensure that our major external stakeholders

understand what we do and have an input and a say in how we do some of these activities.

With respect to department-wide integration, there were a few questions that were a little bit hard to answer; what shipments of spent nuclear fuel and high-level waste have occurred or plan to occur. We have a few shipments annually a year, and they go to the Savannah River Site. Primarily those are Foreign Research Reactor Spent Nuclear fuel Acceptance Program, as well as the University Research Reactor Spent Fuel Program.

So what integration occurs for such shipments? Well there are a series of categories. I referred to the requirements. Our shippers have to follow -- are required to follow the requirements of the hazardous materials regulation in Title 49, the DOT requirements, as well as the packaging requirements in Part 71 of the NRC's regulations for fissile and so-called type-B quantities of radioactivity materials.

As part of our shipping activities, we either provide a transportation plan or a factsheet to federal, local, state, and tribal governments along our routes, so they have an

understanding of what it is we're shipping and why we're shipping those materials.

Again, for our transportation emergency planning, we provide training along the waste transportation corridors and we coordinate with nuclear energy on these activities so that they can leverage the work that we've done in developing our training courses. And finally, we provide package certification functions within the department, either through active certification of packages of fissile and type-B packages, or else we can work with program offices such as NE or even our WIPP Program, which are required to use NRC-certified programs. We can do a preview or a pre-review of the safety analysis report for the packaging before they're actually submitted to the regulatory agencies. And what factors based on EM's performance operational activity are important to consider meeting future needs for transport of these materials? I think they can be succinctly summarized as safety, security, and compliance with all applicable regulations, internal and external.

Okay, that is the end of part one of my presentation. Part two now relates to WebTRAGIS, and we were asked to

demonstrate and discuss the capabilities of WebTRAGIS. WebTRAGIS is a browser-based geographical information service tool for modelling transportation routing. It has numerous options for route calculations, and I'll demonstrate all these capabilities shortly.

It provides access to network databases for highway, rail, and waterway infrastructures in the Continental U.S. It provides population data for all transportation segments using a land scan USA population distribution data model, and it's been deployed as a browser application, where we can display map and user interfaces -- where the map and user interfaces are accessed through a browser while a routing engine in the background is located at Oak Ridge National Laboratory.

Historically for TRAGIS there were two predecessors going back to the late '70s and the '80s. One was called "Highway," and one was called "Interline." Interline was the rail transport. TRAGIS combined those two. The original TRAGIS combined those two in the mid '90s, and a client server version of TRAGIS; that is, WebTRAGIS was released in '99. The last version of old TRAGIS was released in 2006.

The sponsors for WebTRAGIS have included the Department of Environmental Management, The Department of Defense, the OCRWM Program. The Office of Civilian RAD Waste Program funded the first version of WebTRAGIS. Currently the Federal Rail Administration is funding a rail-specific railroad enhancement for TRAGIS, and we work also with the National Nuclear Security Administration for some specific work. Current development and maintenance of the program is currently -- the program is currently supported by the Office of Environmental Management.

Now the highlights updated networks for multiple modes, new layer display options. We can block off certain routes by blocking out an area we don't want a route to go through. We can give route specifics. We can get displays of critical infrastructures. We can get new population reporting capability with the current version.

To use TRAGIS, all users have to register. Our basic requirements are federal sponsorship, no foreign users, no commercial users. The Highway Routing Network, as you see here, has 21,000 links, 15,000 nodes, represents over

273,000 miles of road. Some of the attributes that are considered in TRAGIS are toll indicator, commercial traffic prohibitions, urbanized areas, over a hundred-thousand people, Highway Route Controlled Quantity preferred network, including state designations, and that's a big job.

We have other Hazmat and radioactive restrictions. We have bridge and tunnel restrictions, to the extent that we know about them, and we have the WIPP Route designations built into the code. Rail routing, unlike highway, no single railroad provider -- there's no single railroad provider across the U.S., unlike highways where trucking companies can serve an entire nation. Railroad corporations own their own right-of-way. A railroad cannot operate over another company’s line without tracking right agreements. Connecting tracks do not necessarily exist where all lines cross. So these factors have also been put into the rail networking. And as a result, we have, again, over 94,000 links, 35,000 nodes and over 143,000 miles of rail line. And here you can see the rail attributes, the number of tracks, the frequency of passing sidings, subdivision names, crew change locations, et cetera.

In outing considerations, we have to take into account such items as line ownership and trackage rights. We do maximal use of more heavily traveled line, but we look at interchange points between railroads, listing of interchange locations, and we try to minimize the number of railroads on a route. And finally, WebTRAGIS also has a waterway network. Again 4,600 links, 4,000 nodes, representing 160,000 waterway miles along the coast of the U.S.

After WebTRAGIS is run, there is a lot of information that one can get from TRAGIS. We can get a link-by-link summary and route listed by state. Details can be rolled up into individual state summaries. We can zoom in and out on particular areas or links that we want to look at. Each link has an estimated travel time, distance, population distance, based on some input parameters, and we can get a population density mileage summary by states that's suitable for input into RADTRAN.

RADTRAN is our risk assessment tool, and we frequently use RADTRAN for our environmental impact statements. And TRAGIS is an important input to that; that is, it provides the -- once a route or several routes have been determined, we can take the output from TRAGIS, and specifically the population

data, and put it into RADTRAN and determine the risk along the route.

Now with that, I'm going to walk transport myself to the next station and do a transportation -- or do a designation. Okay. I've already pulled the map up. I've already gone through the user name and password stage. That's fairly common for anything. So what I thought I would do now is run a few nodes so you can see what the capability is. The first one I'm going to do is a rail node from Gowanda, New York, and you're probably wondering why Gowanda. And that's only because Gowanda, New York, is near the West Valley site, which we are transporting by rail some big pieces.

And these are all pull-down menus, so I can do state, node in the state, usually a city. I can select a company if there is more than one available. Now in this case I'm going to get BSOR. And then we're going to go to Texas, to the WCS site, and it's going to be dedicated train, for example. And once we've set up these basic input parameter, we basically -- okay, which one am I missing. Oh, select company. All these things have to be entered or I can't run them. So the Texas/New Mexico rail.

So once I have all the parameters set up, I run it. I will take 30 seconds or 40 seconds. And having done that, it produces a map of a potential route from downstate New York, neat West Valley to WCS. It's not the only route. We're in the process, I think for these particular shipments of deciding what the route would be. But this is a tool that we use to help us decide on what rules. If we were to decide for example that we don't want to go near Topeka, Kansas?

[Inaudible].

We decide we want to go there, then it will have to find a different route to get us around that particular node. As you can see, it's a completely different route if we block off a node. And that's one of the features of this is, is that we can block off as small or as large an area as we need to do our analyses.

Now I'm going to do a couple of highway runs.

[Inaudible].

Yes.

[Inaudible].

Say again. I'm sorry

LINDA NOZICK: What does it tell you about those tow route? You physically can see where they go, but what does it tell you about exposure or accident rate or characteristics so you can actually may a decision?

MICHAEL WANGLER: This does not.

LINDA NOZICK: Oh, I'm sorry. Linda Nozick, Board. You'd think after all these years I'd be trained.

MICHAEL WANGLER: This does not actually do that. We use other tools to look at accident rates and actually determine what the risk would be. The program primarily makes use of class-A tracks, of the highest quality tracks, the fastest tracks that we can use.

LINDA NOZICK: But it doesn't say anything about how many people live within a certain distance?

MICHAEL WANGLER: Yes, it will.

LINDA NOZICK: Where's that?

MICHAEL WANGLER: Okay. I'm sorry.

LINDA NOZICK: Where it describes that?

MICHAEL WANGLER: I was going to describe that -- I was going to do that later.

LINDA NOZICK: Okay.

MICHAEL WANGLER: But I will do it now. I can take either one of these routes; for example, if I clicked on the summary, and in the screen below it will give you a summary of information by state, either standard results, detailed results, or route population for one, and this will provide population data that's 800 meters on either side of the track. Buffering buffering, buffering, buffering, buffering. It shouldn't be. Oh, wait pardon me?

PAUL TURINSKY: [Inaudible] least travel time, least mileage.

MICHAEL WANGLER: It's usually -- the basic optimization is on fastest travel time over the best tracks.

PAUL TURINSKY: Okay.

MICHAEL WANGLER: Okay, come on. You know, I love you, but you've got to give me something here if you want me to

continue to love you. Okay, so what this does is, by node, it will give you the population count, and if you want to know where a particular node is, you click on it and it will show the node, and if you really want to know -- since it really expands it, I can draw it out so you can see exactly where on the -- well, this will give you the bandwidth over the population, and then by clicking on particular segments you can see what the population is between those particular nodes, in that segment between those particular nodes. This one happens to be somewhere near Lackawanna, New York. So you can get a lot of information - - out of this information.

One of the things that you can also do is, as you're doing these and you're looking at risk analyses, you can begin to populate the map with critical infrastructure, such as fire stations. You can see where the fire stations are.

They're indicated by plus signs along here. Additionally, there's a number of other ones, schools for example, you can begin to see where those are along the route. And if you in your analysis you decide that you don't want to go along that route because of some of the structures, some of the

critical infrastructures along the route, you can block out that portion and it will take you over a alternate route.

Under the route details, this gives you a lot of information about duration, which state, which railroad company is in that state, distance traveled, and how long you're in a low density, medium density, and high density areas. These three categories of correspond to RADTRAN, which is the program this feeds into at times to rural, city, and suburban -- rural, suburban, and urban areas. And if you really want to get a lot of information, you can see exactly what the input parameters are.

This, for example, dedicated train was the parameter that was used here. And this will give you the actual route in words if you want to see them, rather than graphically. So let me just pull out now.

LEE PEDDICORD: Mike, I think in the interest of the schedule, we'll have to forego it for another demonstration.

MICHAEL WANGLER: Okay.

LEE PEDDICORD: But maybe we can see and learn more about this at a later time, when there's more time available.

MICHAEL WANGLER: Okay. Let me just close by saying that the transportation -- you can see what happens when you start putting in the critical infrastructure. It really clouds up the map. But the highway portion and the waterway portion are basically the same. It will give you routes. I was going to do one from Oak Ridge to Clive, Utah, to NNSS and to WCS and show you what those routes were, and you get much the same information related to population, distances, and things of that nature.

So with that, if you need any more information or would like a further demonstration, just let me know, give me a call, talk to me afterwards, and I'll be more than happy to do it.

LEE PEDDICORD: Thank you very much.

Thank you. Very interesting. Again, we're going to, I think, hold questions, at least that was the idea. So we'll move on to the next presentation by Ken Picha on the DOE Managed Spent Nuclear Fuel Integration.

KEN PICHA: All right, can everybody hear me? Okay? All right. Good. So Mark Whitney sort of did an overview of EM, a little bit about our spent nuclear fuel and high-level waste programs within the Office of Environmental

Management. I'll go into a little bit more detail. We had some interesting dialogue with the board staff about what you all wanted to hear about. I think in the EM program we're not perhaps as far along as perhaps some people thought we were with respect to readiness of our materials to get to a repository. But we I will tell you about some of the activities we are doing and where we are.

And essentially I'll just start off by saying that in both programs we essentially, when the RW program ended in 2010?

'10.

'10. Okay, good. Thanks, Steve. We pretty much in EM kept our programs going that were looking forward to an RW kind of a repository, sort of waste acceptance, technical waste acceptance requirements for treated high-level waste. We were continuing those, and I'll talk a little bit about that in the high-level waste section. But for both spent nuclear fuel and high-level waste we continued and are continuing to implement the old RW QA program so that we knew had some reference standpoint for our pedigree of our processes. So that we've held onto those, because we thought that that was important, that's not always been a winning strategy with

our sites to say why are we spending money to do this. But we've continued to do that, and we think that will pay dividends on wherever we head ultimately here.

So is it possible to go back to Mark Whitney's slide deck or is that too hard, before I launch into here, just to give some perspective? Thanks. So I'm just going to -- okay. There you go.

So I just wanted to point out I am actually a senior advisor in this area called "field operations." Mark pointed that most of our spent nuclear fuel and tank high-level waste activities that of are of interest to you all are within this organization. A lot of the management that probably would be in my place here are either on travel or leave or other things. Unfortunately they couldn't make it. But in a previous role I sort of had responsibility for tank waste and nuclear materials organization. So that's why you're seeing me. All right, thanks I just wanted to give a little perspective. Can you go back. Thanks.

So basically this is just an overview of our mission and direction. We're certainly headed towards trying to implement, where we can, the administration strategy for

management of and disposal of used nuclear fuel and high-level waste, based on the Blue Ribbon Commission. And the other thing I'll talk about at the end here is spent nuclear fuel working group, which is something that we started about a year-and-a-half, two years ago, to provide some integration of DOE-owned spent nuclear activities across DOE. But we also, for instance, have the navy as part of that, so it's a little more than just purely DOE.

So here's basically the highlights of our overall mission and vision. I don't think anything there is particularly surprising there. I will say I think we meant to say safe NSF management, because that's certainly one of the things we want to make sure we're doing. So we don't want to just manage it, we want to manage it safely.

So this is a slide that we're trying to provide an overview, sort of the four sites where we're managing spent fuel, DOE spent fuel. And you'll see there that we're at different points, depending on where the sites are and where they have specific milestones that are driving them to complete certain things. For instance, at Idaho up here, Mark Whitney mentioned that we have a requirement to get all fuel into dry storage by 2023, but we also have a requirement under

the Idaho Settlement Agreement to have spent fuel and high-level waste road ready by 2035. So that's that date there.

I guess I can't move it, but these bars below are not -- you see they're dashed. They're not trying to show specific hard dates or timeframes. They're just notional timeframes to say this is sort of the window we have to work to try to get to those milestones. For Saint Vrain, even though it's in Colorado, it was attached to part of the settlement agreement, and so the requirement to have that fuel road ready also applies.

At Savannah River we don't have any specific milestones to have fuel road ready or out of the state. Certainly the state would like us to have it out of the state as quickly as we can. But that's why that's shown as basically a dotted line. We're doing some analyses right now, and I'll talk a little bit about that later on here in terms of what we're looking at there at Savannah River. But there's no hard milestone.

Same thing at Hanford, we don't have any hard milestones to get spent fuel out of the state there, so you can see the dates sort of line up with Savannah River there. The one

thing that we do have to do at Savannah River, I'll mention, is all the fuel -- and you'll see that in a later slide -- is in wet storage right now, so whatever, if we go to some kind of dry storage, if we don't end up processing it all in H-Canyon for instance, which I doubt we would do, we'd have to do some drying capability as well. Whereas at Hanford it's all dry storage.

Sources of the DOE-own spent fuel, you can see them here. We have some core debris from Three-Mile Island, certainly our production reactors and reactor at Hanford and I think residual from some of the reactors at Savannah River, and then the commercial power. We don't have a whole lot of that, but we have some from a Shippingport, which is one of the first commercial facilities. Peach Bottom, I guess they have some thorium uranium fuels, some R&D on it, so we have some of that. I think most of that fuel is at Idaho. And then I'm not sure exactly the history of that, but somehow we ended up with the Fort Saint Vrain's fuel when they shut that commercial gas cooled reactor down whenever it was, late '80s or so. So those are the sources for the commercial.

For the foreign research reactor, basically we've got fuel from 41 countries. That program ends in 2019, with some exceptions. So as you can imagine, being late 2016 now, I think there's going to be potentially more countries coming to the front, saying, "Hey, we would like you to take our fuel." And then, of course, Mark mentioned the domestic research reactors from some of our DOE laboratories, universities, and things like right up the street here at NIST, their reactor.

I'm going to talk a little bit about each of the sites here. As I mentioned, all the fuel at Hanford is in dry storage. Most of it is in -- I think that's the canister storage -- is that the canister? I can't tell. But this is certainly the canister storage, the inside. Most of it is N Reactor fuel in there, and it occupies a certain number of the slots. This was originally built to store vitrified high-level waste from the waste treatment plant, which Mark showed you a slide of that still being constructed. So we decided to take advantage of that on our objective to close out the K basis to move that fuel. So most of it is in MCOs, underground in these areas here. The rest of it is in a secure area adjacent to the canister storage building. And

you can see that by mass, most of our spent fuel is here at Hanford. But by volume, it's not so much, so.

At Idaho, we probably have the biggest variety of fuels. We have CPP 666, and I think we've got a picture of that coming up. So we have fuel there that it's basically no EM fuel now, but the Navy has some fuel there that they're taking out and moving it to their facility for dry storage. There's Advanced Test Reactor fuel there, and then there's EBR 2 fuels that are being stored there. And then a lot of the -- I'll say I'll call them cats and dogs, but some of the fuel that I mentioned before, some of the commercial fuel, certainly the TMI fuel, is stored in dry storage there at Hanford.

The one site that continues or the one activity that continues to generate fuel that we accept there is the Advanced Test Reactor fuel, and so we're very aware of that and they continue to send fuel to us for storage. So that certainly puts the pressure to try to meet this date here getting into dry storage by 2023. And as Mark said, even though 2035 sounds like it's a long ways away, if you start backing it up and looking at doing all the project planning

and those kinds of things, it's not all that far away. Whoops.

So this is sort of an overview of the INTEC facility and shows some of the individual facilities. I know those names don't mean -- probably those numbers probably don't mean too much to you. But the other fuel I forgot to mention now that's been at Idaho probably about 13 years is when West Valley shut down their processing, whenever that was, in the '70s, they ended up with some fuel there, and so that fuel got shipped to Idaho. I think, around 2002/2003, so that's there on site as well. And then that's just a depiction -- of the ISFSI -- if I can pronounce that correctly at the Fort St. Vrain Power Plant in Colorado. Can I have some help. There you go.

This is just showing some of -- this is an area in INTEC where there's different casks. They package different fuels into these dry storage casks, and I couldn't really tell you specifics about what's in each of these, but if you're interested, we can get back to you with the details on that.

So, over a period of time we, from about mid '90s to mid 2000s we consolidated a lot of the non-aluminum clad spent

fuel here in Idaho. All the EM-owned spent fuel was in dry storage as of 2010. We've closed five of the six wet storage pools there onsite, with 666 being the last one, and then we're working both with the Navy and Office of Nuclear Energy to help manage the fuel shown here.

One of the things that we do with some of the EBR fuel, that we continue to do, although it's small volumes, is we retrieve some of that, package it, and send it to the materials fuels complex where they have an electrometallurgical treatment capability for some of that fuel, and so they're processing some of that, but not at a particularly high rate. And then the other thing is the Navy has been, over period of, I don't know how many years, five years or so, Hitesh, do you know, or Steve. I don't know. Some period of time they've been working with us to transfer their fuel to their facility at the old Naval Reactors Facility for dry storage.

And these are just some of the dates where we got out of the wet storage facility. I won't spend any time on that. I think I've covered this primarily, so, you know, we have an effort here to figure out how we're going to make the fuels, get them from our remaining fuels, DOE's remaining fuel from

wet storage to dry storage and then certainly how we're going to satisfy this 2035 date here.

One of the things that we were working on for the Yucca Mountain Program was a Standardized canister. I think we had four versions of those, four dimensions. But those were the ones that I think were considered in the Yucca Mountain license application that we were considering for all the DOE fuel, except for the MCOs at Hanford. So we've not really advanced this at all beyond that. I understand we maybe purchased a few of these for research and testing purposes, but we didn't really do any mass procurements. That was just our vision at the time, and we've sort of put that on hold until we have a firmer path forward.

At Savannah River I mentioned that all the fuel we have there is in wet storage and L Basin and Mark mentioned that. I'll say late '50s facility, so anything that old, almost as old as I am, I know it's got aches and pains, a so one of the challenges that we have with that is infrastructure issues. We've had to replace some of the roof areas on that. We've had to replace some of the racks and some other things there. So keeping that safe requires an investment in facilities. So it's just one of the challenges we have, that

even though we're trying to, quote, finish a program in terms of the EM mission, we still have to do some investment in some of the facilities to allow that to happen safely.

Per or NEPA decisions, we decided to have all the aluminum clad fuel -- sort of -- go to Savannah River. ATR fuel certainly is aluminum clad, and that stays at Idaho. But any fuel from foreign research reactor or domestic research reactor returns that's aluminum clad goes to Savannah River. So they've been continuing to get fuel shipments. I think so far this fiscal year they've had seven foreign research reactor shipments into L Basin, and four domestic research reactor shipments.

Oh, the other thing I wanted to mention is this last bullet here. Through, I want to say early 2000, maybe 1990, Savannah River was also receiving HFIR fuel from the Office of Science Reactor. We haven't been doing that for a while. So HFIR - their storage capability is starting to get backed up, so we're in the process of working with the Office of Science to figure out how we can receive some additional bundles of HFIR fuel. As it turns out, the storage racks there, necessary for those in the L basin they're special for those. They have to be designed a little differently

than the standard ones for metal test reactors. So we're in the process now of working with them to figure out how we're going to be able to continue to support shipments. They're pretty good until about 2020, but it's certainly on the horizon. We know we have to take some actions to start accommodating their fuel needs.

Because of a confluence of things that were happening at Savannah River, we did a NEPA analysis to look at things like resuming processing of some of the metal test reactor fuels, as well as look at some material from Canada. We have a contract with Canada to bring in to process and down blend its target material as part of the molybdenum 99 production at either the NRU or NRX reactor there at Canada, and some other fuels that we were looking at. There was some sodium bonded fuel that was posing some potential -- not sodium bonded fuel, sodium -- what was that fuel? Yeah, HFIR fuel too.

We were looking at would there be merit in resuming operations in H-Canyon to process this, and we decided that there it was. There was benefits to doing some limited processing, so it was all the Canadian materials we were going to be bringing in. I want to say a thousand bundles of

fuel, existing fuel in L Basin, and then a hundred HFIR cores? Two hundred HFIR cores. Thank you. So we decided to do that in 2013. Mark just mentioned we're running a little behind that. They just started the first cycle again this year. so we were hoping to get that done a little bit earlier, but we've had some hiccups, both operationally and some equipment issues, but we're hoping to get started in earnest here the end of this year.

Talked a little bit about the Foreign Research Reactor Program already. I'll just mention that, as I said, the program ends in 2019, so we do have at least one country that they've asked for an exemption. I don't think -- this is actually a program that's run by the National Nuclear Security Administration, so they handle this under their Non-Proliferation Program and budget. They actually take care of all the transportation. We receive it and store it safely. But they handle that. And I should mention -- I'll talk about DR in a second. But that program ends in 2019. We doubt that they'll be very amenable to extending that for any other purposes. So I think they've made that known through the research reactor technical conferences and other things. If you're interested, you know, you got to make sure

you get on the list here. I can't get the dexterity on this thing.

The DRR program is funded and managed by the Office of Nuclear Energy. Again, they handle all the transportation, and I should mention that right now we're only accepting fuel -- I should have mentioned this under the Idaho slides. We're only accepted aluminum clad fuel right now, because all that goes to Savannah River. Because of the settlement agreement in Idaho, we can't bring in fuel into Idaho, except the Navy can bring in fuel. But DOE cannot bring any fuel into Idaho until certain requirements are met. One of those requirements is the startup of a facility that Mark mentioned, the Integrated Waste Treatment Unit. We have to get that operational, starting to process real waste before State of Idaho would let us start bringing in fuel. So right now we're a little bit constipated in terms of people have stainless or other kind of clad fuel. We're not taking shipments of those right now. Okay.

So I think this morning you all heard from the Office of Nuclear Energy and their path forward with respect to implementing the strategy for used nuclear fuel and high-level waste. I won't belabor that since that was probably

discussed. The one thing that we are having some dialogue with -- is the potential for a separate disposal for defense high-level radioactive waste. Certainly that could have some benefits for our DOE fuels. I recognize that there's pros and cons with that. So right now -- this is just sort of an exploratory area right now. I can't seem to get the pressure right here.

Spent Nuclear Fuel Working Group, it turns out that -- I was a little bit surprised when there was really no way, once the RW program went away, for us to coordinate on spent nuclear fuel activities across the DOE complex. This is actually, I think, an idea by one of the guys at DOE Idaho said, "Hey, you know, wouldn't there be a value in having some discussions amongst all the programs that manage spent fuel on the sites," and we said, "Yeah, there would." So I believe it was November of 2014 we had our first meeting in Idaho, and so you can see the parties that are part of this, Office of Science because they have HFIR; Nuclear Energy, because they have ATR; naval reactors, because they certainly interface with us; and NNSA through the nonproliferation agreement or activities and the foreign

research reactor fuel, and so we met for the first time in Idaho.

And since that time, we've had three meetings, Steve, or four? Four meetings. And I think they've been very productive. I'll talk about -- maybe -- talk about some of the things that we've developed. In fact, I think the folks that participate in those, from the sites and the programs, have been very enthusiastic about it. In fact, they've come and identified hey we ought to look at this. For instance, even though it's not specifically mentioned here, one of the things that they said we need to establish -- we ought to establish an aluminum-clad spent nuclear fuel users group, and so it was just a subset of that group. They said, "We want to do that." And so they started that in June of this year. Next week I think a group of folks is going to be at Savannah River as part of that.

The other thing that we identified is that we're not sure that we have all the technical requirements ironed out and any of the uncertainties with respect to dry storage of aluminum clad fuel. So another thing that this group is doing is working with the laboratories to understand what it would take to be able to get aluminum clad spent fuel into

dry storage. So we've got a number of initiatives that are going on there. And I think it's met with very good acceptance across the programs that are participating.

Bottom line, safety, safely storing our fuel is a high priority. Unfortunately, we're not, at this point, doing a whole lot of fuel handling activities, other than the foreign research reactor, and spent domestic research reactor returns, other than some of the things at Idaho that I talked about. And then we believe that the spent nuclear fuel working group has been a good forum to share lessons learned and tackle specific initiatives for fuels across the complex. I believe that's it. No questions yet.

LEE PEDDICORD: Not yet. So let's move onto your next presentation.

KEN PICHA: So I'll turn around and -- no -- and do the tank waste. So for high-level waste, I guess I've been involved with high-level waste on and off since 1991. So I guess I have a reasonable breadth of experience here. Now whether I have the technical knowledge is another thing. We basically have four tank waste sites. The highest volume is at Hanford, where we have -- and this diagram basically shows

you the four sites and some of the quantities, the curries and the volume in the tanks, including what we would project to have in terms of completion of all our activities at the time the treatment is complete.

What's a little bit misleading here, as you can see there's about 10,000 canisters of high-level waste at Hanford. Those are 15-foot canisters, so it's about 50 -- if you compared them to the 8000 at Savannah River, it would be actually about 50% higher, so you'd be talking about close to 15,000 versus 8,000. At West Valley, we've completed the treatment campaign there. There's 275 canisters, and I'll talk a little bit about where those are. And at Idaho, in some respects we've made the most progress. We've closed 11 tanks there. We have four more to close. There's about 900,000 gallons of what we call the sodium-bearing waste at Hanford -- excuse me, at Idaho, liquid waste. But the real high-level waste is this 4,400 cubic meters of calcine that are stored in six or seven underground bin sets and calcine is a particulate kind of material that is in stainless steel silos that are then encased in a concrete structure, and some of them are completely underground and some of them are partially aboveground, and I'll talk to that in a minute.

The one thing I will mention is, early on, I think that the people that were involved in designing the treatment strategies came up with a very smart approach, and that is they recognized, I guess as late as the '70s or '80s, when they were putting together the treatment strategies, that there would be a premium for high-level waste disposal, and they recognizes that if you were going to treat all 55 million gallons or 30-some-odd-million gallons here as high-level waste, that the volume of that would be huge.

So they undertook a process to, basically at Hanford, Savannah River, and West Valley, where they had neutralized the waste, to segregate into a low-activity fraction and a high-activity fraction. So if you look at these totals, at those three sites, the canisters, they only represent about less than probably 10% of the volume, but ideally 95% of the radioactivity, with most of the low activity -- the separated low activity from the tank waste being disposed of onsite as low activity waste, and so we've got -- except at West Valley, where they're low-activity waste, because of the act, they were able to dispose of it in Nevada. But at Savannah River and Hanford, that low activity waste is going to be disposed of onsite.

As for the tank waste strategy, this is our general strategy for high-level waste, and I just talked about the separations here. We've also had decided that at Savannah River, Hanford, and West Valley, the high activity fractions would be treated via the vitrification process, and certainly we've demonstrated success with that a Savannah River and West Valley, and we think that that will be a successful approach at Hanford, once we get the facilities up and going.

At Idaho, where we have the calcine, the bulk of the waste has been converted to the calcine material, and at present, we have, through the NEPA process, there was a Record of Decision to use a technology, a HIPing technology; however, as we were going through the department's project management process, one of the things that that requires us to do is an analysis of alternatives, and so we started that process to look at whether or not that still made sense.

We ended up looking at starting the process to look at retrieval first, and we only basically got through a set of alternatives for retrieval, and we didn't actually get to how we want to package and disposition the calcine, because we recognize that retrieval may affect how we want to do

some of the processing. So we sort of took a separate process, two-step process, so we're back to now looking at retrieval. However, the record of decision is still the record of decision, until we amend that.

And then the other part of the tank waste program here is Mark talked at Hanford the tank retrievals. He said we're almost done with C tank farm and then we're going to be starting on A and AX tank farms. Obviously getting waste out of the tanks to treat is a big deal. We can't get every gram of material out of the tanks, so we've come up with, I'll say, a process for determining that the residues, when you treat them and stabilize them, we can say that that no longer has to be managed as high-level waste. And at two of our sites, Hanford and Savannah River, there's a congressional statute that covers that, and that -- I'm sorry, that's Idaho and Savannah River. And at Hanford we use AEA act authority under a DOE order provision to make that determination.

Okay, I've already mentioned this. This is probably canister storage building number one at Savannah River. It was full. As Mark mentioned -- well I'll mention. When I get to Savannah River, I'll talk about the double stacking concept.

And then basically in our tanks our 177-plus 50, plus 5 or 6, 200-plus tanks, usually the waste is in one of these three forms. Sometimes we have tanks that are basically we call them all-salt tanks or we have some that are mostly supernate, but, frankly, if you have these two, usually it's both supernate at the top, and then salt cake. And there are some tanks are just sludges, you know, the metal oxides and whatnot when you neutralize the waste, and some have all three of these, a mix really more complex.

Mark talked about some of the accomplishments we've made with DWPF, so I won't continue those, but right now it's the largest RAD waste vitrification plant in the world. When we complete WTP that will certainly dwarf it in terms of capacity. And then this is the Idaho Integrated Waste Treatment Unit that we're trying to get operational to handle the 900,000 gallons of remaining liquids in their 15 tanks. Actually, four that aren’t closed. Okay.

At Hanford we started the waste treatment plant probably about 2001, that project, and we started some of the earnest construction in 2003, or thereabouts. We identified some technical issues, and we were going full bore on all the facilities that comprise the waste treatment plant until

about 2012, when we identified some technical issues that look like in the pretreatment facility here, which is the largest of the four main facilities there that it was going to take a while to address and figure out a path forward. But because we had no treatment capability at Hanford, we said why don't we figure out a way to come up with some kind of a strategy to at least start treating some waste and go after the most mobile component, if you will, the salt waste or they call it low-activity waste out there. But it's basically the supernate and some of the salt waste there. And so, however, it's not just something you can take from the tank and send it directly to a low-activity waste, which is basically the Pretreatment facility. You can really take it there directly, because you still have to have some radioactive separation so that it can be handled in this basically, contact handling facility.

So we had to come up with a temporary -- excuse me not temporary, an alternate approach this low-activity waste pretreatment system, which until the Pretreatment facility comes online, allows us to do some of that capability and let us start doing some treatment. We're targeting 2022. There's a permit or agreement requirement with the State of

Washington to have that done by 2023 to get this capability in place with the low-activity waste facility in and the two melters there. And that's having both melters up to their capability. And then they'll be disposed of onsite in this Integrated Disposal Facility.

But the other thing this LAW pretreatment system does is it allows -- once the pretreatment gets going, it would be potentially a single point failure. If you can't separate the waste, then you got no way to feed either the low-activity waste or the high-level waste facility. So this will provide some backup capability, although not at the full throughput that we want to have with the full capability of the WTP. So that's where our efforts are focused on right now at Hanford, is this low-activity waste process. We call it the direct feed-LAW. You might see as DF-LAW is the acronym that they use. And so that's sort of where our focus is right now on the Hanford Tank Waste Program.

Savannah River, this is just a conceptual picture of the tank waste program. I think the things to note here, as Mark mentioned, that we've already closed 8 of the 51 tanks down here, and we removed what we call bulk waste removal out of

four more, so you can say that 12 of the tanks don't have much volume in them. As you can see from I think from the earlier drawing, down here, whoops, keep hitting the wrong buttons. Sorry. With about 8,000 canisters to go projected, we're about halfway through the treatment campaign for the high-level waste.

And over here -- I'm sorry, he mentioned the salt waste processing facility. Most of the volume of the material, I don't have that picture up here, but if you say 37 million gallons, probably 35 million gallons of that is salt and supernate, and two million gallons is sludge. So all that salt and supernate gets processed through these facilities. Right now they're going through these interim facilities. They're low volume. They were meant to basically provide some kind of interim capability for pretreatment and separation until we could get the SWPF online. But almost as importantly, they demonstrated the technology that we're using, going to be using in the Salt Waste Processing Facility. So we're at lease confident in the technology because it's been successful. We have to finish the commissioning of the Salt waste Processing Facility. Construction was complete earlier this year.

And then the low-activity waste I mentioned gets disposed of on site. It's probably kind of hard to see in this picture, but that is a 30-million gallon, basically, structure that's modified water tank design that we'll be using to dispose of those materials. And so the first one of those we're hoping to commission early, probably spring of next year and start that in place. Smaller designs of that are shown down here. These are about two-and-a-half million gallons.

And this is sort of a picture of our stainless steel canister at DWPF. It's obviously one that you can see the heat marks on it there. Basically ten-foot tall, two-foot in diameter canister. I think 304-L stainless steel. We have requirements to get it to 90% fill height. I think that's more than average. I think we're get them higher than that, and so we have mechanisms to check how full they are. And we certainly have a lot of requirements in place to demonstrate what we thought were going to be Yucca Mountain requirements, in terms of tightness of the composition of the material and those kinds of things.

West Valley, West Valley I mentioned earlier, they completed their treatment campaign. They ended up with 275 canisters. They only had about 700,000 gallons of waste to treat, so it

was a more manageable treatment program. When they started their program and when they were doing their vitrification campaign, they stored all their canisters in the old main process building there. However, to complete D&D of that facility, they had to move those canisters out. So what they've done is they've constructed an engineered pad on one area of the site, and they're in the process of taking the canisters out, putting them into these overpack things here that will go into a five kind of carousel cask, and they're fabricating the casks on site. They've actually made pretty good progress. They've got about half of the casks that they'll need filled. I think they said by Friday they would have 140 of total canisters or 28 of these packs moved from the old main process building to the pad storage. Well I screwed that up. I'm going back to Savannah River.

Mark mentioned the double stacking. I'll just mention it here. It turns out that when the design -- I don't have a cut away, but there was one canister per, basically, one of these holes, and we realized that by removing a cross brace underneath and allowing the canisters to rest on sort of a structure at the bottom, you could stack two canisters on top of each other. And so what they had to do or what they

wanted to do is arrange them such that the lower activity canisters were on top for shielding purpose, so that's what they're in the process of doing. And as Mark said, it does allow us to defer another canister storage capability.

Now what we're probably not going to do is build another one of these buildings. We're probably going to do something like we had here at West Valley. They've already looked at an early conceptual design of a pad and a cask capability, so that's what we're targeting to do for the remainder of the Savannah River DWPF canisters.

At the Integrated Waste Treatment Unit, where we're going to be treating the sodium bearing waste, we'll convert it through a steam reforming process to a particulate material, and they're also using a canister that is basically a ten-foot tall -- it's a little bit wider in diameter. I'm not quite sure how the design got established, but 26 inches in diameter. And then they're storing them in these kind of a dry -- I forget the word that they use for these, but I think they use the word "cask." But it's 16 -- well, sorry – vault - there it is. And they use an air pallet to move these things around, even though they're several tons. The problem is we haven't yet produced our first canister, so

we're hoping to get that done here probably -- I'm not even going to speculate. But as Mark said, we're probably not going to meet the date. Most assuredly we won't meet the date at the end of this fiscal year.

And at Hanford, they adopted a higher canister, taller canister for their high-level waste, and as I understand the logic for that is at one point the thinking was that they were going to be on the hook for having to pay for disposal costs on a per-canister basis, and so the fewer the canisters the less they would have to pay. But it turns out that we think that that can be accepted, and the repository design was set up to accommodate a 15-foot canister. The repository is set up to do that, so we can handle that, we think, or we thought we can handle that. Obviously we'll have to look at the design to accommodate those canisters, because we're going to have a lot of them, about 10,000. And then I guess for handling purpose and disposal purposes, it was decided to go with a squattier canister for the low-activity waste material.

So, some of the integration activities in the high-level waste area, the contractors, it's been helpful to have URS/AECOM be the common contractor at Hanford and Savannah

River. And for a while they were at West Valley as well, because they could do some things internally, particularly between Savannah River and Hanford, where they've got more active programs. They were doing some leadership transfer, so people from the contractor of Savannah River were sending people out to Hanford, and then vice versa to help facilitate lessons learned and some other things.

And then certainly we've tried to do some technology integration through headquarters, and through some other activities, and then some temporary assignments. We had somebody from Hanford on a detail to headquarters for a period of time, and then we had a person from Savannah River at headquarters, then, right now we have somebody from the Hanford tank office, called Office of River Protection, on detail to Savannah River, the Salt Waste Processing Facility as they go through commissioning to both augment their staff but also identify lesson learned, things that work, and things that don't work to bring back to Hanford when they start commissioning their facilities, particularly their direct feed LAW- low activity waste facilities.

And then the other area that we have in terms of integration is a tank waste corporate board. We've had several different

versions of this. We started off with something called the High-Level Waste Steering Committee in the late 1990s, and that was a way to involve managers at headquarters in the field to look at common programmatic areas across the tank waste program. And RW had the Yucca Mountain process going, we were going through the initial license application process, and some of the Yucca Mountain EIS development activities, it was a good opportunity to talk about things. In fact, one of the things it did is we actually had somebody go on a detail to the Office of Civilian Radioactive Waste Management at their offices in Nevada so that we could have a better integration with that program. So these are some of the things that we're looking at, the key issues there that we're looking at for the tank waste program under the Tank Waste Corporate Board. And I believe that it's it.

Okay. I wasn't paying attention to time.

LEE PEDDICORD: Questions from the board to Ken or to any of the previous speakers this afternoon?

PAUL TURINSKY: I'm not sure who to ask this to. It's two questions, but they're related.

KEN PICHA: Mike.

PAUL TURINSKY: One is, other than the Hanford preprocessing plant, where do the major technological challenges lie? And the related question is, of that $6.1 billion budget, how much of that goes into R&D to improve processes and safety, things like that?

KEN PICHA: I think I'm on the hook for this one. It's a good question. We have been trying to ramp up the technology development budget. It's, frankly, not very high right now for all of EM. It's about, I'll say, centralized integrated Technology Development Program is probably only about $20 million.

Now, having said that, that's ones that sort of headquarters has that they it can sort of leverage as it deems appropriate. However, the sites do some of their own technology development; for instance, at Hanford Office of River Protection, the manager out there runs something called Grand Challenge Program. He's done that for the last three years. So he's soliciting ideas to help his program. And one of things was, was to look at improved glass

composition for low-activity waste to reduce the number of canisters there. I didn't tell you, but that short squatty canister, they were looking at almost a hundred thousand of those. Well that's a lot of waste to be moving, so if they can get some advantages, they're looking to maybe get down to, like, 60, or even maybe less thousand canisters, which is still a lot of canisters, but it's a 40% reduction, if that's possible.

And then the contractors also do some of their own technology integration things. There's a person out at ORP that is their chief technology officer, but he came from Savannah River when I was talking about leveraging resources back and forth, so it's looking for opportunities to share things. We're looking at a test bed right now at Hanford to look at whether or not it's possible to potentially treat some waste, and maybe potentially get it offsite just a little bit just to demonstrate technology. So if you look all the contributions from what the sites are doing and what the individual program offices, it's greater than 20 million. Is it a hundred million, I doubt it. But maybe closer to 50 million. And I forgot your first question. I'm sorry.

PAUL TURINSKY: Major technical challenges.

KEN PICHA: Oh, major technical challenges.

PAUL TURINSKY: Other than Hanford.

KEN PICHA: Other than Hanford, certainly the calcine, how we get the calcine material out of the silos that I mentioned. And I'm sorry I didn't have a picture of that. They were not designed with retrieval capabilities, so it was get the waste -- get the calcine material in and close it up. And so trying to figure out how -- what's the best approach, because it's got most of the radionuclides, in it so it's very hot material. So getting that out is certainly one major technical challenge.

I would say in some of our performance areas for the low-activity waste, tech-99 is a driver for performance, and we think that that's not an issue, certainly for the glass, But, trying to get at Hanford particularly, getting the waste, driving it into the glass is one of the things that we're looking at, because they don't use -- for their low-activity waste, they use a vitrified product. At Savannah River we use a cementitious material, and also performance of tech 99.

Now, we demonstrated that for the materials so far, we actually have run this by the NRC. We think we are good in that area, but those are probably two that come to mind directly.

LEE PEDDICORD: Other questions from the board? I have one, Lee Peddicord, from the board. One of the things presumably would be, I guess, a small volume, but you didn't mention in Idaho the impact of the TREAT restart.

KEN PICHA: I'm sorry. The what restart?

LEE PEDDICORD: The TREAT reactor restart.

KEN PICHA: No, I didn't mention that. Maybe somebody this morning mentioned that.

LEE PEDDICORD: No. Nobody mentioned.

KEN PICHA: Oh, nobody mentioned it.

LEE PEDDICORD: If they're going to restart a reactor, it's going to generate spent fuel.

KEN PICHA: Correct. Andy, do you?

ANDY GRIFFITH: Andy Griffith, Department of Energy. Yeah, that's an easy answer. It has a lifetime core. Because it's a pulse reactor, the fuel will last as long as we want to operate the facility.

LEE PEDDICORD: Okay. Thank you.

Other questions? Dan?

DAN OGG: Yeah, Dan Ogg with the Board staff. Ken you mentioned at Idaho you've got a planning effort to make fuel road ready, you said, to meet the 2035 date in the Idaho settlement agreement. So my question is, as you apply project management tools, et cetera to making fuel road ready, have you identified sort of the critical path items; for example, getting the Idaho spent fuel facility up and running, or getting transportation packages for the spent fuel - critical items that need to be dealt with sooner rather than later in order to meet the 2035 date? Have you done that, and what actions have you taken?

KEN PICHA: No, I don't think we've got that with any kind of real granularity, Dan. I think we're just starting to talk about that and what needs to be done in place. I mean, I showed that one slide that showed the conceptual, the

notional activities. I mean we know what we need to do. I'll say we had one sort of cut at that we looked at one time, and we decided that, well, we need to probably go back and make sure that we have things better understood in terms of assumptions and things like that. So we've sort of tabled that. I probably over characterized the work that we've done there.

DAN OGG: Okay. A different angle on the question would be maybe at some point you do need to move that fuel --

KEN PICHA: Absolutely.

DAN OGG: -- out of Idaho, and there's going to be a sequential set of steps in order to do that.

KEN PICHA: Correct.

DAN OGG: And maybe have you even prioritized what needs to be done first so that you have that sort of queued up and ready to go.

KEN PICHA: I'm not thinking -- we have not been involved in that activity. I think perhaps some of the Idaho folks have been thinking more about that. It's just something we haven't really discussed as a group or with headquarters.

LEE PEDDICORD: Bob.

BOB EINZIGER: I've heard a lot about operational integration, lots of things you're doing, but I haven't heard a thing about knowledge integration. What are you doing to make sure that the lessons you learn at Savannah River, maybe a better material to use or better processing, is taken over to Hanford? Or how are you knowing that the examination methods that they're using at Hanford in the canister storage building, that information is getting transferred? How do you know that the gaps you're filling and doing research on won't fill a gap at Hanford, or that there's a gap that you're all missing because you're not talking to each other? I haven't seen any anything on knowledge integration.

KEN PICHA: That's a good point. We probably haven't devoted the knowledge management kind of integration consideration that is worthwhile. In fact, a specific example, I was involved in the DWPF startup back in the early '90s, and I went to look at my records for lessons learning and went, "Oh, you know what, I don't have that." So I'm trying to, you know, recall what some of those were to share them with the Hanford folks. So I think that's something that we need

to make a more concerted effort to look at knowledge management and how we can more, say, formally make those kinds of lessons learned, because right now it's more knowledge, individual knowledge base and what people can share.

And, you know, the contractors share some stuff because historically it's been a -- you know, all those URS and AECOM were offshoots of Westinghouse, and Westinghouse was involved in early development of Savannah River, DWPF, and on the tank waste side at Hanford as well, and they were certainly involved as West Valley. So a lot of those people -- in fact a lot of the West Valley people ended up, when they shut down their vitrification program, transitioned to Hanford. So, I mean, there's some of that people base, but the formal structure is not there.

BOB EINZIGER: Well I was surprised to hear, because some of the things you said, because back in the early '90s and late '80s, when money was flowing freely in the Yucca Mountain Project, we had whole groups of people looking at ways to handle low-level waste and residue from the tanks, and put it into grouting, and a whole group that did nothing but compositional variation with the glasses, how to increase

the loading. And it seems like the wheel is getting reinvented again.

KEN PICHA: Well I wouldn't say the wheels are getter reinvented. The other thing is we still rely on laboratories that have some of the institutional knowledge on that. Savannah River National Laboratory is our national laboratory. Certainly they've been engrained in the DWPF process. They developed the glass chemical process model. They are supporting the Hanford folks on the WTP side of things. So I would not say that we're starting from ground zero, but it's just not been -- that I can tell, it's not been a formal process to share some of those lessons learned.

LEE PEDDICORD: Bret.

BRET LESLIE: Ken, I wanted to ask this question earlier when John Kotek was here, because he was talking about integrated waste management system that had a parallel path for the defense waste. And given your 2035 timeline and the strategy timeline of a repository not until 2048, it would seem to indicate that if you wanted to meet the 2035 deadline you would need to have consolidated storage of some of your fuel

out of Idaho. The problem is, is that, as I see it, is your waste acceptance criteria that were used for the DOE standard canister, the MCO, only had the requirements for Yucca Mountain and transportation but never really looked at what the requirements would be for storage under Part 72. So I think that's probably another issue that you need to bring into thinking about what does that really mean? If you want to make it road ready, the only place that it could be go to is a repository under your current legacy of how you develop these things.

KEN PICHA: Well, I think part of it also falls to -- and I used the term "road ready" because that's the term of art that we use. The actual language -- and I don't remember in the settlement agreement, it's not road ready. It's some other --

BRET LESLIE: Out of Idaho by 2035. Only high-level waste needs to be road ready.

KEN PICHA: Okay. All right. Good point. Good clarification. So, yes, that is something that I think is just entering into our discussions with the Spent Nuclear Fuel Working Group, is what do we need to do particularly for Idaho,

because they're the ones that have got the driver. The other sites don't have a specific regulatory driver.

BRET LESLIE: So one other quick question, which you've mentioned the Spent Fuel Working Group is thinking a little bit about aluminum fuel and drying. Is part of that discussion the implications of if you're packaging it into a multi-purpose canister for disposal that at least materials other than the spent fuel might be going into it, and so how does that play into your drying scheme?

KEN PICHA: I have not been involved in any of those discussions, and I doubt that they're at that level of thinking at this point.

LEE PEDDICROD: Allen.

ALLEN CROFF: Allen Croff, Board. We mentioned Spent Fuel Working Groups and Tank Waste Working Groups, is there a transportation and action working group involving naval reactors, EM, and NE, where you exchange strategies and plans.

KEN PICHA: I'm going to have to defer to Mike or somebody else on that one.

MIKE WANGLER: Mike Wangler, Department of Energy. Once upon a time there was, and a number of years ago that stopped existing. I'm not sure why. But it sounds like a good idea and something that needs to be restarted.

ALLEN CROFF: What was the group a few years ago called?

MIKE WANGLER: It was -- I think it was called the Senior Executive Transportation Forum. It was a group of -- it was the SES level staff in nuclear energy, environmental management, environment safety and health at the time, and other offices that were supported by their staffs to -- and had met periodically, monthly or quarterly. I can't remember anymore. It's been a number of years. But it met to look at issues that had come up over the timeframe since the last meeting, to discuss them, see if there were workable solutions in the meeting. If not, task the staff to work the issues to see if there could be a solution.

LEE PEDDICROD: Nigel, last question.

NIGEL MOTE: Nigel Mote, Board staff. I'd like to talk to you about planning for integration. We've all, I think, got used to different lengths of high-level waste, vitrified waste canisters and the standardized canister came in different

sizes as well, so there's a multiplicity of what might be considered standardized sizes. I'd like to come back to your slide 11, where you had mentions of the canisters for the sodium bearing waste. That's a facility that's not yet operating, and I take it the canisters are not yet built.

NIGEL MOTE: Correct.

NIGEL MOTE: But the 26-inch diameter compared with 24-inch diameter for the others, and you noted that was different. Where does the responsibility lie for looking at these differences and making sure that they're aligned? So the difference may be justified, but presumably there's a process that says, if this is going to be different, what are the implications for packaging, transportation, storage at maybe remote centralized storage facility, and then handling into the repository. And I realize that this waste is not yet defined as high-level waste, but it may be. So if you go on the assumption that it's not high-level waste, and then it turns out to be, you've gone past the point of no return if the waste is already packaged and in those canisters. How does that decision-making process work?

KEN PICHA: Well certainly when we had the RW Program we would go through -- we had to meet certain requirements. We pass down, you know, something called the waste acceptance product specifications. Is that right, Dennis, the right term? And that tiered off some RW, the waste acceptance system requirements document. And so we had to demonstrate that our treated product, our canister waste form, would stay within those bounds, and so that provided some surety that that would be the case. We still have, for instance, the WAPS in the Savannah River contract and the Hanford contract, so those vendors -- I forgot to mention this during my discussion -- so that we know for treatment of waste at those two sites that we're still meeting something that would meet a RW Yucca Mountain-like facility, and we decided to keep that intact. And we asked those programs to continue so that if we have to diverge at some point, or continue to something that is Yucca Mountain the second, we know where we are. And so we can do that.

We've certainly, as you said, Nigel, we thought that the treated sodium-bearing waste, because we had done some analysis, again, some DOE requirements could exit high-level waste classification, but we have not done that yet, and

that's certainly a valid point. In terms of how that particular decision was made on those canisters, I'd have to get back to you. I'm not sure how that was made.

NIGEL MOTE: Would that have gone through the Tank Waste Corporate Board or an equivalent oversight body?

KEN PICHA: No, on that specific one that was probably decided when we weren't really having an activity Tank Waste Corporate High-Level Waste Steering Committee, so. And even still, we would probably -- the Tank Waste Corporate Board is not a decision-making body on individual designs. However, having said that, if in a meeting it came up and that they said, "Oh, yeah, we're proposing to use a 26-inch diameter canister." Why you doing that? They're all 24-inches. So that certainly could have led to some other actions follow up.

LEE PEDDICORD: Okay. Well thank you to the speakers, from EM; Ken and Mark and Mike. We are going to take a break now. We'll reconvene at 3:20.

[BREAK].

LEE PEDDICORD: Okay, good afternoon. We will reconvene for our last session of the afternoon. One of the things I want to mention is that after this there will be a poster session in Ballroom C. Everyone is invited to that.

For our next speaker, we are going to be having Barry Miles who comes from an organization that knows something about transportation, the Nuclear Navy. And he's going to talk about the Naval Spent Fuel Transportation Program. Barry, all yours.

BARRY MILES: So thank you, Lee. Make sure I can do this right. Yeah. Okay. So as Lee said, I'm the deputy director of the Reactor Refueling Division, that Naval Reactors, or we also call that the Naval Nuclear Propulsion Program. I'll probably slip up and use those two interchangeably.

I'm also responsible for the shipping containers that we use in our program to ship spent fuel and new fuel, and my group handles all aspects. We do the design, the analysis, the certification, procurement, manufacture, logistical use, and ultimately we need to dispose of the containers.

So I'm going to cover five major areas, try to get through this fairly quickly. I'll do an overview of our program, about three slides on that. I'll talk about our fuel shipments. I'll discuss periodic container accident exercises that we hold around the country. I'll talk about our newest spent fuel shipping container that just came into service this year, the M-290, and I'll finish up, talk about dry storage, and in the future, go into the repository.

So we're an integrated Navy and DOE Program. We wear both -- our admiral that's in charge wears both the DOE hat and the Navy hat. We have total responsibility and accountability for all aspects of the use of nuclear power in the naval ships. That includes research, development, maintenance, repair, officer selection, transportation, which I highlighted in all caps When somebody else from the organization gives this discussion and uses this slide, they don't have that capitalized like I do, but I'm a little parochial in that area. And it's a cradle to grave responsibility.

Our admiral is a four-star admiral, which is the highest rank in the Navy, and his tenure is eight years, which, for those of you who have been in the service, that's a very

unusual situation, but it kind of gives credence to the importance that's on that position. Everything that's up here is now codified and public law.

So this is what we're all about. We were started in 1948 by Hyman Rickover, and he was in the program -- he ran the program for over 30 years. We now have a hundred operating reactors – we’re one ahead of the NRC and commercial nuclear power at this point. That includes all aircraft carriers and all submarines in the Navy are now nuclear powered. That wasn't the case until the last few years. So we have a total of 85 warships that are nuclear powered, and that comprises about 45% of the Navy's major combatant force.

We also have four training reactors. We have two land-based prototypes up in Upstate New York, where we do research and development and train sailors, and then we have two older submarines that we've taken and made them what we call "moored training ships" and used them as a training facility down at the mouth of the Cooper River near Charleston.

So this kind of gives an idea of the breadth of our organization. It all starts up here with the fleet, those 85 warships I mentioned. We oversee and regulate all of these

activities, including the use of nuclear power in our six shipyards. We run nuclear power school in Charleston where we train the sailors and officers about nuclear power. After they get the classroom training, they go to one of these land-based prototypes or reactors, one of those four, and we end up training about 3,000 students a year at those four reactors.

We've got two prime contractor laboratories, one in Pittsburgh, the Bettis Laboratory, one in New York, Knolls Laboratory, that work solely for our program, not for anybody else, about 3,000 to 3,500 folks at each place. And we have a facility in Idaho that's been mentioned earlier, the Naval Reactors Facility. It's on the Idaho National Laboratory where we temporarily store our spent fuel today.

This field office is -- the admiral has a field office that all these places, not on the ships, but all these other -- most of these other places, a total of 16 field offices. That kind of gives him a direct report. It gives him eyes and ears in the field, immediate knowledge of problems when they come up. And then we have the headquarters, which I'm part of down at the Navy Yard here in Washington, and we've got about 480 folks at headquarters. That also includes not

only engineers but support staff, admin, procurement folks, supply folks, et cetera.

So I want to now do a overview of our shipments. And by the way -- I should have mentioned this at the beginning -- most of the earlier presenters listed disclaimers. I failed to list my disclaimers; number one, is only in the last couple years has the program allowed me to get out and talk to a group as esteemed as you folks, so if you'll indulge me on that I'm not as experienced at that. And the second thing is, I am going to skip a few of the slides that you have the program in the sense of time. I've talked to Lee, and I'll skip several of those, which I think we don't need to talk about, and mainly focus on our operations, since we're probably the only organization that's been shipping fuel continuously over the last 60 years. Now we'll talk about the fuel shipments themselves.

We've been shipping by rail for 60 year, as I just said. Two type of shipments, new shipments that haven't been put in the propulsion plant yet, and then used fuel, which we call "spent fuel" -- I'll use that interchangeably -- that's come out of the reactor. One big difference between us and commercial shipments, the ones from the nuclear power plants

in the future is that we are all classified shipments. We invoke the national security exemption and the Department of Transportation Regulations in the 49CFR.

But even though we are classified shipments, we ensure that we adhere to all DOT requirements except for three things. I've listed the two that is obvious in the public. We don't put a placard on that says, you know, yea verily, there is fuel inside this container, although it's kind of obvious, I think, for most of the containers. And we don't provide advanced notification to the states. And the third thing we don't do is, on the shipping papers, the DOT would prescribe every constituent in the cargo if we put certain constituents in, it's obvious what we're shipping, so we leave that off for the shipping papers, and we have our couriers who go with every shipment carry all of that information. So if there's ever an incident, an accident, a problem, they can show the responsible authorities what exactly is in the shipment.

So where do we do our nuclear shipments? Pretty simple for us, real simple compared to what you saw earlier on some of the other presentations. Everything originates on new fuel from our reactor factory in Lynchburg, Virginia, and from

there it goes out to our various shipyards that will be fueling ships, and that's it. That's pretty much the routes we use. It's all by rail so it's very fixed.

We have two types of nuclear shipments. We either use boxcars, and inside the boxcar will be individual modules in another container that's tied down, and we'll ship three to six boxcars per a consist, or we'll ship an entire core on a flatbed rail car. So that takes care of the nuclear shipments. So let me get to what I think mostly you're interested in, is the spent fuel shipments.

As has been mentioned earlier, when we defuel a ship, we ship the spent fuel by rail to our facility in Idaho for examination. We examine for two major reasons; one, to make sure the design -- the use of that particular fuel met the design; and then, also, to look at features that would enable us to increase the lifetime of the fuel. So for perspective, the Nautilus went to sea in 1954. The reactor operated about two years before we had to refuel it. Today the reactors we put in our nuclear-powered submarines last the entire life of the attack submarine, upwards of 33 or 34 years. So we never have to refuel a submarine in the future, a nuclear attack submarine in the future.

That's great because that reduces our cost. It reduces radiation exposure. It reduces the amount of spent fuel generated that we have to transport, store, and eventually dispose of. And that fuel is now temporarily stored out in or facility in Idaho, awaiting either geologic repository or an interim site.

So here's the routes for the spent fuel shipments, a few more routes, because we're originating from all the shipyards on the coast, and we're all going to Idaho. And you might wonder why a couple routes here, we have two different carriers. CSXT uses this route. Norfolk Southern, which is coming from one of these two shipyards that uses the other route. But, again, it's very minimal routes. And up at the top you'll note that this is our current metric. We've now shipped 850 containers of spent fuel to Idaho.

So let's talk a little bit about the safety of the shipments. This is based on three major factors, the rugged nature of our fuel, the robustness of our shipping containers, and our shipping practices. So first the rugged nature of the fuel. Obviously with this group, you know this

is solid. It's not explosive. It's not corrosive. But the key difference between our fuel and commercial fuel is that our fuel is designed for combat shock so that it can survive -- a reactor not only can survive more than 50 Gs of shock, but it actually can keep operating. It won't shut down under 50 Gs. I don't know exactly what commercial fuel is designed for, but I believe it's in the neighborhood -- and somebody could correct me -- of one to two Gs, roughly.

So the other thing is our sailors live right next to the reactor, and they work next to the reactor, so we have to design the bonding of the outside of the fuel to ensure that all the long lived radioactivity stays inside the fuel. No fission products are released, which is a key factor. And these two major factors also make the fuel very well suited for transport and eventual long-term storage.

The second piece of the safety triangle is our robust shipping container. These are the two shipping container we use today. This top one is the M-140. It's used for submarine spent fuel. And the bottom is the M-290, which we just put into service this year, is now used for aircraft carrier spent fuel. They're both type-B certified containers to the Nuclear Regulatory Commission requirements in

10CFR71. They're at least ten inches thick, solid stainless steel, and the M-140 container weighs about a third-of-a-million pounds, and the M-290 container weighs about a half-a-million pounds.

Because of the massive amount of steel we put in there for structural reasons we get, obviously, the benefit of really good shielding. Our on-contact radiation levels that we measure in the worst case is about one to two millirem per hour, and that's two orders of magnitude lower than the Department of Transportation's safe limit of 200 millirem per hour.

We just did the initial shipment of this container with spent fuel from the Enterprise carrier in Newport News out to Idaho, and our maximum on-contact reading didn't exist. We only got background on the on-contact. So we listed the reading for regulations as .02 millirem per hour because that's the lowest reading that our radiacs can record. So we get very low levels.

And lastly is our shipping practices. We frequently inspect our railcars and maintain them to a very high standard. We constantly monitor the location and the status of all our

shipments using the same system that's used by the DOE for weapons shipments. The C-com system out of Albuquerque, New Mexico. We make advanced arrangements with the railroad operations folks and the police. We do periodic outreach with the public, primarily through accident exercises, and I'll mention a little more about that shortly. And then we escort all of shipments with specially trained Navy couriers who give us 24/7 surveillance, and they also are available for immediate emergency response in case of an accident or derailment. Whoops. Sorry. You might have guessed I skipped that one.

So let's talk a little bit about the accident exercises. We've conducted ten full-scale accident exercises since 1996. You can see from this chart that we try to spread them out all over the country to try to hit each region, and we go back and look at other areas that we haven't been the next time we do an exercise.

The last one we did was in 2015, last September, in Granger, Wyoming. That was a unique one because we wanted to do one in an extremely remote area. If you're been to Granger, you probably think, well if I want drink I've got to go to Rock Springs or I've got to go to Green River. I love the names

out there. It kind of gives you a feel for you're really out in the country. So that was an interesting exercise, because responders were coming 50 or 60 miles away to the accident. So we've done ten.

The next one we're going to do -- we're planning on this. It's not completely finalized -- is in Upstate New York, here within a few miles of those training facilities I mentioned to you earlier, and we intend to do that exercise next summer.

So what's planning like for one of these exercises? It's about a year process. We go out a year ahead. We pick a site that's good both from the railroad standpoint and our standpoint. From their standpoint, a safe place, minimum disruption to their operations. From our standpoint, we've got to have a place where we can put up a very large tent for observers, have room for our media crew to work there, and a place that's accessible. So we do that about a year ahead of time, select the site. And then starting the spring before the exercise, we go through several major planning meetings. We have are a couple of meetings to develop a scenario, where we work with the responders and come up with a scenario that they want to go do. Then we all sit around a

tabletop and we exercise what they would do in that situation, modify the exercise as a result of those interactions.

Then we go out and we do a full-scale exercise in the field, and we'll bring in an empty spent fuel shipping container and we'll almost always do a railroad crossing accident, because that's the most likely thing that's going to happen on a spent fuel shipment, is a collision at a railroad crossing, and then we'll run an exercise, we'll learn everything we're going to learn about that exercise, and then we come back. Everybody comes back a month later, all the responders, and we do, to be honest with you, a show, a demonstration for outside folks. And at that demonstration we'll invite responders from the region around who wouldn't respond but would be close enough to come observe and take a half a day and observe. We'll invite the state officials that care about shipments, the Hazmat emergency response-type folk, and then we'll invite folks from agencies in Washington who care about shipments.

At our last demonstration in Wyoming in September, we had folks from the NRC, DOT, FRA, FBI, and we always invite you folks. We'll be sending you a letter middle of spring, and

it will be to the board and staff, welcoming you to send whoever you would wish to it. The demonstration is by invitation, but it's certainly with your group, it's broad, and as many who would like to come. Dan Metlay has been to at least one or of our exercises, as has Carl DiBella previously, Mark Abkowitz has been to them. And I've missed some people, and I apologize for that. But we welcome to have you attend. So that's the basic process of the exercise.

This is a typical scenario. We had spent fuel coming for the one we did in Wyoming, we had spent fuel coming from Newport News going to Idaho with two of our carriers. They went through a railroad crossing, a big dump truck coming down a hill lost its brakes, hit the train. Of course, we simulate that it hits the rail car containing the container. It causes the rear trucks to derail on the railcar. We simulate that. The driver's injured. We also had some diesel fuel leaking out of the dump truck to add another dimension to the response.

Communications start between, us the shipper, the railroad -- Union Pacific in this case -- the state, and all the responders. They set up a unified command. At one point on

the unified command, that's not Navy run. We're just there to assist. Unified command is set up the same way any hazardous material accident would occur. Typically the Fire Department, the senior person from the Fire Department would usually take command and run the show. We're there to assist, but they run the show.

We usually bring in, in this case we had local media that we simulated. We also had local media that we invited that were in one of our tents. But we also had local media that played in the scenario. We had the standard resident who walks up, of course nowadays you've got the cell phone going. We're right on the internet, so this whole thing really becomes pretty much a public affairs event, and that becomes a big, big part of the exercise, how you deal with that. Our couriers do a survey. They confirm that there's no change in the radiological condition of the containers. And then at least one other organization responding does a survey to make that determination. In case the Rock Springs Regional Emergency Response team did a confirmatory survey.

The previous exercise in Indiana is a little more interesting. They were a little more -- I don't know -- I don't want to use the wrong adjective, but they had four

people to do confirmatory radiation surveys, and that's fine. So we go through all those, confirm there's no change, simulate rerouting the railcar, and continue the shipment.

And then this is what the scene looks like. Here's the railroad crossing. Here's the truck that came down. The train is coming this way. When the railcar containing the container was right here, we timed this, and it was actually orchestrated pretty well. We did not hit it, but we came real close, and we had sound effects, et cetera, because we do have a video crew taking a video that gives all the observers --

[Inaudible].

Oh, yeah. Yeah. But we didn't hit the train. But we had a really aggressive guy, and in the past we've had -- who really made this turn out pretty interesting. Not too interesting.

And then this is the observer tent of all of the observers that were invited, and we conveniently, since a train will always go several hundred feet when they decide to stop, because it's a lot of mass, we position everything so this conveniently stops right in front of the tent, and so that

they can, you know, observe it. This is for the actual media. We like media, but we do kind of keep them together. And this is our video crew.

That covers our accident exercises. Lee, how am I doing? Running out of time?

[Inaudible].

All right. Let's talk about our new spent fuel shipping, the M-290. Now the interesting thing is you already saw this picture. I didn't realize that one of my DOE friends must have stolen this picture, because I saw this was on one of earlier slides as a transportation cask. I don't know why they didn't put up their own example, but anyway, that's great. That's good. This is very large, and you will see that in a moment. So 31 feet long, 9 feet diameter in here, closer to 10-plus on the impact limiters, 520,000 pounds fully loaded. That was quite a challenge. This's why we have a 12-axle railcar. DOE is going to go to that. As they mentioned earlier, they plan to do an 8-axle rail car, but I think the problems they had in getting the 8-axle is actually now going to be an opportunity for them, because now they'll be able to carry any of their containers when

they go to 12-axle. And we've delivered 20 of these so far, and we plan to buy a total of 39.

[Inaudible].

Both. One on one. Yes, ma'am, both. So for perspective, we need 16 containers to defuel the Enterprise, which is being defueled now. So here's one being moved from its railcar to the loading facility back here. The thing I want you to take away from this is that you're going to need at least a 300-ton crane at any facility that uses our M-290 container.

And then I like this one a lot because it gives you a perspective on the size. The folks up on the catwalk and down here, it's a pretty nice-sized container. I'm pretty sure it's the largest spent fuel shipping container ever certified in this country, and I would guess it's the largest in the world, but I have not done the research on that, so please don't quote me on that.

What we wanted to do in the navy is make the biggest thing that we can ship and operationally handle and transport on the rails that minimizes our operations at the shipyard and at the other end, and it also, from a public standpoint, minimizes the number of shipments we have to make.

So that covers -- one last subject is our dry storage and repository efforts. I mentioned earlier all the fuel is shipped out to Idaho, and it's put into a large water pool. Since 2008 we've been move the fuel out of the water pool into dry storage.

I want to show you, real quick, several photos of some of the equipment we're using. These are the baskets -- this is a typical basket that we use, and we'll put the spent fuel into the baskets. Obviously all these pictures are going to be something that haven't been used yet. We put two or more baskets into one of our canisters. This canister is essentially the same as the standard DOE dual-- multipurpose canister. And the reason is, because back when we were working on Yucca Mountain, we were working collaboratively together, RW and Naval Reactors, and so we came up with the same design.

The closure design for the MPC is exactly the same as our closure design. So that was one of the advantages of working on that together. Ours is a little bit longer than anything you saw earlier. We have one that's 210 inches. I think the largest that was mentioned earlier was 196 inches. It weighs about 100,000 pounds loaded, 15-inch lid. Take that canister

and we put it in a concrete overpack the same way that's done in the commercial industry. These are about 38-inch thick concrete, 2-inch thick inner liner, weighs 380,000 pounds. We have open inlets at the bottom, open at the top, so we rely on that for our cooling path to keep the canister cool.

Here's an overpack being built at our facility. They're all built right onsite. Too hard to build them somewhere else and bring them there. As you can see, there's an awful lot of rebar in one of these overpacks. We move them around two ways, either an air pallet or this big crawler, which one of the overpacks weighs about 857,000 pounds. And then we put them in a building that's a little different than commercial utilities. They normally store outside. We put all of ours in a building, and as of today, we've got 128 concrete overpacks on the pad. And what I want to mention about that is because we designed those canisters to be multi-purpose canister, storage, transportation, and eventual emplacement into a repository, with the rules, which we intend to help kind of make that happen, for the new repository are the same, then we don't ever expect to repackage our fuel. So we

essentially have 128 packages that are road ready, ready to be shipped to a repository.

How will we ship the repository? Use the same container we use for aircraft carrier fuel, the M-290. We designed that as a multi-purpose container. The canisters fit inside here. We will control that shipment to the repository or in our storage site and then we'll hand over custody at the receiving end. Lastly, we're working on a new escort vehicle, that yellow caboose you saw earlier is just a regular caboose, not really designed to be an escort vehicle, but that's what we have available. We're working with a company in Oregon to design it. It's going to be designed to meet those latest AAR requirements that were mentioned earlier today for shipping high-level waste or spent fuel. We're about 90% complete on the design as of today. We'll finish it this year, and we'll go out on procurement next summer, and we'll have it delivered and tested first in early 2020, and then we'll buy four more, and that will satisfy our needs for about 50 years.

The key point here is that I've been in contact and discussions with DOE the last year-and-a-half, and we're just going to give them our design when we get it through

all the testing, and so they'll be able to just go on a build a print and won't have to do any research, the design, or development effort. Provided our schedule can mesh up with their schedule. That's a little bit up in the air right now. I think that concludes what I wanted to cover. And I'd be glad to answer any question you might have.

LEE PEDDICORD: Thank you, Barry. Any questions from the Board? I have a couple. One, I guess is an observation. You didn't mention, but I would assume - this is Lee Peddicord from the Board - that one of the attributes of your naval fuel that is very amenable to the latter mission is it is very robust and it' designed for rapid transients. You have interesting duty cycles you impose on your fuel. So that must give you an added level of confidence when you're talking about long-term storage.

BARRY MILES: I'm sorry, what was the last statement? The third disclaimer is I'm hard of hearing.

LEE PEDDICORD: So my comment is your fuel is designed to really undergo rapid transients, with the various requirements you have.

BARRY MILES: For operation; yeah. Right.

LEE PEDDICORD: So that's a robustness built into your fuel.

BARRY MILES: Yes, sir.

LEE PEDDICORD: So that gives you additional confidence.

BARRY MILES: Yeah. And that's the real advantage for us, in that we have fuel that, by its very nature, can readily meet the Nuclear Regulatory Commission hypothetical accident requirements. So I'm pretty much require, at least up until now, there will be some changes when we start shipping examination fuel, that we actually cut up out in Idaho. Everything we ship to date, my requirement is that the fuel out of bond can't yield, not fail, yield. And I require the stresses to stay below yield, so the design has to accommodate that. The only reason I can do that is because it was built so ruggedly.

LEE PEDDICORD: The other question I had is, you know, you're defueling the Enterprise, first the carrier, 16 transports, but, of course, the Enterprise is special; eight  reactors or so on.

BARRY MILES: Right.

LEE PEDDICORD: When you're doing the more recent ones with two plants, how many -- is it still going to take 16 shipments to do those?

BARRY MILES: No, it won't take 16. It's an interesting question, and you don't realize why it's interesting, is because there are some nuances right now that we're working on the final design of that package. I'm responsible for that analysis and certification, and we're having some issues that we're not sure we're going to come through. And depending on how they come out, we may have one less module per container than we would like to have. I would like to take -- excuse the word -- cram as much fuel into that circle as I can. That's the best from me as an -- from running a spent fuel transportation program and an operations program. But there's some issues on the drops, and so the solution will be to put a little less fuel in.

To answer your question, we'll end up, I think, in the neighborhood of seven to ten per carrier. For submarine by the way, though, we can -- most submarine cores -- and it varies, we can put a whole core into one M-140.

LEE PEDDICORD: And can you say - what's the next carrier to come out of service to decommissioning?

BARRY MILES: It will be CVN-73 next year.

LEE PEDDICORD: Okay. Thank you. Sue.

BARRY MILES: And I guess that’s the, Jeff, you might have to help me, that's Washington?

[Inaudible].

BARRY MILES: Yeah, good. I got that right. Thanks.

SUSAN BRANTLEY: Railcars are in the news right now a lot, because we're shipping all this shale oil around and we've had accidents, and should anybody be worried about the fact that we're going to start moving more and more nuclear fuel by rail, or, you know, you're moving something in North Dakota.

BARRY MILES: You mean, not our program. You mean the rest of the country?

SUSAN BRANTLEY: Right.

BARRY MILES: Because we're actually shipping less and less as time goes, because unfortunately we have nuclear power warships today, and that's going down. So, I would almost rather have my friend, Andy Griffith answer that question. Andy.

ANDY GRIFFITH: Thanks. Andy Griffith, DOE. Yeah, it's a great question. But that's really the core of the American Association Of Railroad Standard 2043, and that is to do everything within the current state of technology to minimize the risk of derailment. So it has a wide array of sensors so that it can detect when a rail car is not performing properly and has an advanced set of breaking capabilities so that it can bring the train to a controlled stop if something goes wrong. So that's -- you know, it's one thing to have a robust cask, but I think it's an even better thing to avoid that robust cask ever leaving the train.

BARRY MILES: And the only thing I would add to that is -- totally agree with Andy -- that's the answer for trying to minimize the derailment you have, is to meet the latest standards. But I'm kind of old fashioned. I can't envision a derailment that's going to cause a breach of an NRC-

certified container. I'm not saying it's impossible, but all the studies show that the likelihood of a breach of one of those containers is incredibly small. Nonetheless, we don't want to have a wreck, we don't want to have a derailment, and so we're doing everything we can to minimize that. Melissa.

MELISSA BATES: Yeah. Sorry. I’m Melissa Bates, DOE. A little bit more specific to your question, I just wanted to make you away that DOE is currently working on a study with the Federal Railroad Administration, the NRC, and DOT to specifically look at implications of crude oil shipments, with the increased potential number of shipments of spent nuclear fuel on the railways. So it's not concluded and it's ongoing, but I just wanted to let you know that work is going on.

[Inaudible].

Yeah, in the relative sizes of the consists.

MARY LOU ZOBACK: I'm Mary Lou Zoback, Board. First of all, I'm sure I speak for everyone of how envious and in awe I am of your program. I mean you're doing it. You're doing it successfully. But I particularly want to commend you on the

disaster scenario exercises. I'm a seismologist, I work in natural hazards. With FEMA we have similar types of exercises. But I think what you all have learned and put into practice so many times in terms of public engagement, it's a really good model for DOE and their consent-based siting, the ways of working directly with the local people, giving local people the responsibility for adapting the exercise. You come in with initial suggestion, but they're the ones that really determine what the exercise will look like in their community. But I just thought that was incredibly impressive, and I couldn't believe you carried out so many.

BARRY MILES: Thank you. And, actually that was one of the major points that I would make when you say what advice would I give to the DOE. And I already talked to Melissa and Erika Bickford about do you guys plan to run exercises, and they do plan to do that. And what we do, from the very beginning we, even from the site selection, we bring in and let them be part of that. Not having the suits from Washington come in and tell you what we're going to do. And we have them develop the scenario just like you said. And then they buy in and it gets very interesting for them.

MARY LOU ZOBACK: Congratulations.

BARRY MILES: Thank you.

LEE PEDDICORD: Any other questions from the board?

JEAN BAHR: Yeah. Jean Bahr, Board. One of the things that we've heard about at some of our meetings and have been looking at is some of the high burnout fuel and its potential degradation properties and long-term storage. And I'm guessing that fuel that's been in a submarine for 33 years would qualify as very high burnup fuel. I'm just wondering if there's something that can be learned about the fuel characteristics and long-term storage from examination of your fuels now that you have some that have been in storage for a fair amount of time, as well as having that long-term use.

BARRY MILES: I'm not sure I'm going to answer this the way you want many to answer it. But, first of all, as far as initial shipping, we don't have a problem because it takes us so darn long to get to the fuel in the ship. It's embedded into the ship's the best you can because you want to protect it. So we are not pulling the fuel out until, you know, close to a year, and maybe two years for an aircraft

carrier. And what we find, as far as shipping, that the decay heat has been reduced enough that it easily meets our requirements.

JEAN BAHR: I'm thinking more of the physical characteristics of the fuel. Does it have different.

PAUL TURINSKY: The fuel is quite different.

JEAN BAHR: So it's so different that it's not a good analog.

BARRY MILES: I'm afraid that's what we're getting at, and I really can't get to that because it's basically one of our crown jewels is the design of the fuel, and we don't discuss anything about the design.

MAY LOU ZOBACK: Here on the internet

BARRY MILES: However, the only thing I would add to that is that people who are cleared and have a need to know, you know, can contact us and we can provide information that way.

LINDA NOZICK: Linda Nozick, Board. So I just have one question about the exercises. Is there a mechanism to take lessons learned from each of those exercises and pass it

along the other fire departments or other emergency response personnel along the route that you frequently travel?

BARRY MILES: Well we don't have a uniform method of doing that. Anything that affects the railroads we have a way to get that information out to the railroads, and we do that. That's something to think about. We don't -- our lessons are often unique to the particular situation, like for example, I mean, from the simplest lesson is when we did one of these, you find simple things like -- and this will shock you, but some emergency centers don't have the right contacts and the right phone numbers, so they learn that. That's a very simple.

LINDA NOZICK: I bet there's quite a few.

BARRY MILES: Pardon me?

LINDA NOZICK: I bet there's quite a few.

BARRY MILES: And so that's a very simple lesson learned. And most of -- a lot the lessons are on the communication links and the public affairs piece, and I don't know of a good mechanism to disseminate that to everybody.

LINDA NOZICK: Some of those lessons learned strike me as they're also common to the chemical industry, and other movements of material; that is, special characteristics, and there's a lot of it on the rail system.

BARRY MILES: I don't really want to talk about those things, because though are so much more hazardous.

BARRY MILES: That's true.

LEE PEDDICORD: Bob.

BARRY MILES: I think my commercial industry folks nodded to that, so, over here. Yes, sir.

BOB EINZIGER: Bob Einziger, from the board staff. These canisters that you're going to use for dry storage are 316-L, and unless you have some new novel way of making these large cylinders, they're going to have a weld in them, and if that weld is not stress relieved, and you may stress relieve them, I don't know. There's the issue that comes up that's facing the commercial storage of chlorine induced stress corrosion cracking now.

BARRY MILES: Right.

BOB EINZIGER: I know the Navy is the expert in this field in aqueous solutions. It's a little bit different in air. I was wondering - has this been considered as an issue and result from the Navy standpoint, or do you have a method of getting in and inspecting these canisters?

BARRY MILES: You mean after they're loaded and welded up?

BOB EINZIGER: Yes. I'm looking at the outside while they're in the storage overpack, sitting on the pad.

BARRY MILES: Right.

BOB EINZIGER: 30 years down the road.

BARRY MILES: We're aware of that issue. We've got the reports. We're looking at those they thinks. We haven't found a smoking gun that would concern us, but it's still something we're looking at. It is an important issue.

BOB EINZIGER: Is this something where there might be some benefit from interaction between the navy?

[Inaudible].

BARRY MILES: That's one of the big advantages because we have the big dry desert environment, which minimizes -- our

preliminary look was that -- and, again, this is a thing we're continuing to look at, is that we have less of a technical concern than a lot of the plants that are located on the seaboard, which a large number of those.

BOB EINZIGER: But so far no research has shown any de minimis on the amount of salt that will eventually result in this-- it may take a lot longer, and who knows when the repository is going to be built, hopefully before this happens. But I was just wondering what was going on.

BARRY MILES: You hit the key point. It will take a lot longer, and so depending on how things go, that's something that, in fact, are in our considerations, depending on how long we are where we are in Idaho.

BOB EINZIGER: If there’s something that the Navy's doing that shareable and could be shared with DOE and the industry, that would be nice.

BARRY MILES: Yes, sir, we will do that.

LEE PEDDICORD: Nigel, did you have a question?

NIGEL MOTE: Yeah. Nigel, Board staff.

Hi.

Very nice presentation. Thank you. You'll know -- although I think some of the discussion was before you came here today -- that the commercial industry is looking at or commercial industry and the DOE is looking at the possibility of the needing smaller canisters depending on the geologic environment of the repository. How would you address that, given that so much of your fuels is in large canisters, essentially the same size as the large canisters on the commercial sites?

BARRY MILES: Well, let me see how to answer this. We are more than hopeful that there will be a place we can send our stuff that will take our size of a canister. We sized it based on the requirements that were public and required at the time that we did the design, which was the Yucca Mountain requirements. We don't have any other criteria that's been established, so we're continuing on that path. So our desire and intention would be to work towards a receiving facility that would allow us to ship those large canisters. Technically they're designed to be able to cut open -- we have cutting machines, and they're designed to be open, so you could repackage, but that would be an extra

expense, exposure, et cetera, that we're hopeful that we won't have to deal with.

NIEGL MOTE: OK, Thanks.

LEE PEDDICORD: Bret.

BRET LESLIE: Bret Leslie, Board staff. I had one question on the M-290. I know NRC went through the review and certified for transporting the fuel from the Enterprise to Idaho. Are there any other certification that would be needed to transport the fuel once it is in the spent fuel canister?

BARRY MILES: Yes, sir. In fact, we'll need additional certifications for each new cargo. We're working right now on the certification package for the Nimitz class carrier fuel, and that's actually very urgent, and we're working very hard and heavy. And if you ask me what's my biggest problem today, that is it, is getting through that analysis. We'll get there, but it's a lot of long hours and a gnashing of teeth. So we will go and get every cargo certified, both by our headquarters certifying agency, and we'll get an NRC comparable cert for each cargo. And then the next thing we're going to work on will be the spent fuel canister. That's going to be about 18 certifications, because there's

18 combinations of different types of fuel that will go into those containers. So, yes, that's -- if I weren't so old I would have lots of job security.

LEE PEDDICORD: Dan? Okay. Any other questions from staff or the Board? So Barry, thank you very much. Good to see the Navy's still at it. Okay, our last presentation of the day will be from Andy Griffith who snuck back in after he missed his homework assignment earlier. And he's going to talk about planning for a separate repository for defense waste. Andy.

ANDREW GRIFFITH: Thank you. Can you hear my okay.

LEE PEDDICORD: Yes.

ANDREW GRIFFITH: How's the mic working. All right. Thank for having me here this afternoon to kind of bring you home to round out your agenda. I think this day reflects an excellent conversation, like you typically have at your meetings, and I'd just like to reemphasize something that John Kotek  mentioned this morning; that is, as you go back and contemplate and reflect on the presentations today, you have any follow-on questions as you're drafting your letters and your observations, recommendations to us, please don't

hesitate to ask any questions if something comes up that wasn't quite sure or you weren't sure of. Because, yeah, we want to support your efforts as much as possible.

So I'm here to talk about the defense repository. There is, I think, quite a bit of work going on, and I'm not going to get into a lot of details today, because we are formulating how the work that we have done, how we can share that publicly and solicit feedback. But I do want to talk a little bit about how the defense repository fits into the integrated waste management system, because, clearly, it's one or the key components of that, and also how the consent-based siting process relates to the facility.

So, as you all know, the whole opportunity for us to look at developing a defense repository started in March of 2015, when the President made a finding based on a DOE analysis, and this goes back to the Nuclear Waste Policy Act, where the same criteria that was used to make a determination to comingle the defense waste and the commercial waste was revisited based on what we know today, and the conclusion was that there is a benefit to pursuing the development of a defense repository concept, and that the secretary does have authority under the Atomic Energy Act to pursue this. So

until that point, we really didn't have the option to evaluate this alternative. So this kind of freed our hands, so it enabled us to take a closer look at that.

Let me just point out, Martha Crossland's is here in the audience. She was a key part of the team of attorneys on the Office of General Counsel that reviewed this, made sure we're standing on firm legal ground. Also, Steve Gomberg, Joe Rivers -- I'm sorry, Joe Carter, and others, Nancy Buschman who is on detail to my staff from the Office of Environmental Management. They're all part of the team that's looking at the concept of a defense waste repository going forward.

So some of the key things we're looking at for this concept, you know, what kind of geologies are available. Again, we're looking at the full range of generic, geologies because you can't really narrow it down until you have a site. So, in the meantime, we're trying to look at the concept, how could we apply the different varieties, the geologies so that we don't start the process. Once we have a site, we have some momentum going on the analysis before we identify a site. And that's key to the consent-based siting process, because as we're going through the paces of developing what a

consent-based siting process might look like in the U.S., once we start that process, we want to have something meaningful to base a conversation with a community, a state, a tribe on what the concept of a defense repository looks like so that hopefully we have authorization to begin the process in 2017, consistent with our budget request for 2017.

So as we start the discussions with a community, with a state, or tribe, and if they express interest in what does the defense repository look like, we can talk to them about, okay, well because your location has such as such a geology, these are kind of the design parameters, this is how we would go through the characterization of that geology, the nature of your community, you have certain transportation linkages, whether it be by rail or truck, because the defense waste inventory does lend itself to truck shipments perhaps more than the commercial spent fuel.

So these are the types of things that we're doing some homework on so that if the communities step forward as part of the consent-based siting process, we would have something of substance that we could base a discussion with. And so, as I said, we're looking at how can we share that publicly

here in the not too distant future. So, I mean, and this is not like any other components of an integrated waste management system.

We're working on a generic design for an interim storage facility, and its associated topical safety analysis report, so if a community that was willing to learn more without any commitment on what hosting that type of facility is, we have something of substance on what would a generic interim storage facility look like.

Other aspects here. Yeah, I guess this kind of goes back to a comment that you made earlier. We're not going into any conversation with a community, a state, or a tribe where it's kind of a fixed mandatory requirement. The idea here is that we want to come to that conversation with some information that we've worked on, recognizing that it's not complete. We have to go in with an open mind, and the intention is that the community that's interested in learning more comes with their own questions and their own thoughts, their own ideas, and clearly, their own values, and so as we start the conversation, again, with no commitment, as we start the conversation, we can see how their priorities, their values can be adopted by our program

so that meet somewhere in the middle and, ultimately, make a more durable solution and a better product, a better outcome.

You know, the example of the inventory, one of the things about a defense repository, fundamentally and technically the concept is that with the older and colder defense material, the design of the repository is simpler. It doesn't require as much on -- it doesn't require engineered barriers to the extent that, say, the Yucca Mountain Project did when they submitted their license application to NRC.

And as a result, because the design of the repository may be simpler, that the regulatory burden might be less. You know, recognizing, of course, that EPA and NRC, given the history of the regulatory development that led to those requirements for Yucca Mountain they're very much tailored to Yucca Mountain. So I think there's a recognition that any new repository in a geology other than volcanic tuff like Yucca Mountain needs to be developed in a kind of geology neutral performance-based approach. And so that is identified by the Blue Ribbon Commission, as well as adopted by the administration strategy, that regulation has to be developed. And so that's part of the conversation. With any

kind of community, it's part of the development of a defense-only repository.

So what that means to specific inventories, inventories such as naval reactor fuel that's freshly defueled from a submarine or aircraft carrier, that's not really falling into the older colder type of category. That likely would have to be disposed of in a comingled repository with commercial fuel in the future as that's being developed as well. However, some of the older fuel, like the glass waste, the high-level waste that Ken Picha spoke of, again, that has a lower source term, lower heat generation, more amenable to the older colder type of concept.

So without drawing -- while they're might be some natural technical distinctions that we make, the inventory that's included in the defense repository, one of the topics of conversation with the community might be, there might be good reason why they -- and it might be tied to the specific geology, why one defense waste form might be more appropriate for that geology rather than a different waste form. So these are all types of considerations that we'll have to factor into the conversations. And we're just starting this process. The process, by definition, will be

phased and adaptive. We expect to learn things from those initial conversations. We hope that the community will learn from the information we bring into the conversation, and that the idea here is that through each phase we get smarter, we take a step forward, don't take any steps back, and we continue to develop a solution for the problem, because, you know, it's a big issue.

And, you know, the key thing about the defense repository is, yeah, there's a lot of focus, a lot of, if you will, media attention, industry attention on finding a solution for the commercial spent fuel that's accumulating around our reactor sites, and especially the shut-down sites. We want to be sure we keep focus on the defense waste and be responsive to the communities that have hosted defense activities throughout the Cold War. So we also want to keep a focus on this to be responsive to that interest of our stakeholders as well. So with that, I'll open it up to questions.

LEE PEDDICORD: Thank you.

ANDREW GRIFFITH: And that's between us a the poster session.

LEE PEDDICORD: Questions from members of the Board. Andy? How about from the staff? Dan.

DAN METLAY: Dan Metlay, Board staff. So I would expect that one of the things that a community who would be interested in participating in this process would ask is what is your site suitability criteria going to be for a defense repository?

ANDREW GRIFFITH: It's a good question. It's very consistent with the report the board issued last year. Yeah, we're setting up kind of initial considerations, a set of initial considerations of what types of things should be considered for any kind of repository, not just for a defense repository, but also a commercial waste repository. So that's another product that we've been working on to bring to the conversation with any community willing to have a conversation with us.

LEE PEDDICORD: Good. Dan.

DAN OGG: Yeah, Dan Ogg, with the Board staff. Andy, you've mentioned a few ideas about how to approach the separate repository effort. It's a little unclear to me what you're actually doing right now and who's doing it. Do you have

some FTEs here at headquarters that are working on it, or somebody at the labs that are working on it?

ANDREW GRIFFITH: Yeah. And, pardon me, I'm sorry for not being, you know, more -- providing more detail, but we're basically right in the middle of process of determining how we can share this work in the right vein with the public and interested communities.

DAN OGG: And so are you -- you're actually now doing things like looking at criteria, selection-type criteria, or field investigation techniques that may need to be done?

ANDREW GRIFFITH: We're looking kind of higher-level process of what it would take to plan out the development of a defense repository. And we're careful not to use criteria, because that has kind of a regulatory edge to it. We're couching it more in terms of consideration. So we are looking at those types of things. And, again, you know, the really drilling down to the detail is -- there's only so much you can do in generic space, and that once a community steps forward and we're talking about a specific geology, it helps us kind of drill down into more detail.

DAN OGG: And finally, if we have more follow-up questions on this, who should we talk to? Who should we contact?

ANDREW GRIFFITH: Myself or Bill Boyle or Tim Gunter.

DAN OGG: Okay.

ANDREW GRIFFITH: And then Nancy Bushman at headquarters is kind of the key person linking that effort with the consent-based siting process and coordinating things here in Washington. So those are the main contacts.

LEE PEDDICORD: Anymore questions from the board or for the staff?

BRET LESLIE: Bret Leslie, Board staff. So I'm not quite sure I understand. Right now you're just planning but you're not pursuing, but you would pursue if you were appropriated because you would infer that's authorization to move forward.

ANDREW GRIFFITH: Yeah, that's true. I mean, we're in the generic concept development standpoint -- step of the process. In the 2017 budget request we asked for just over $15 million to pursue this further, with appropriate resources. The House mark, as John Kotek mentioned this

morning, did not except the department's proposal, and the Senate, while they support, in general, without really any restrictions our budget request, they did not support our request for defense funding, and so that kind of is keeping us in the more generic development space. So, yeah, there's still, as you would expect, as John Kotek indicated, there is a lot of uncertainty, especially in this area. But, you know, we are committed to the process. There is some work we can do. There is Senate Authorization Act language that's been drafted. I believe it's public. But they are asking us for performing an economic analysis or analysis that scopes out this concept more thoroughly. Whether that ends up in the actual appropriation act or not, or an actual authorization act that's signed by the President or not is still uncertain.

LEE PEDDICORD: Okay. Anymore questions from staff or board? Well thank you very much. I mean, this kind of sharing thoughts early in the process. We appreciate you're doing that as well because it's very helpful to us.

ANDREW GRIFFITH: Glad to help. Stay tuned.

LEE PEDDICORD: We will. Thank you. So at this point, we have an opportunity for public comment. Again, Ruth Weiner reserved her option. But, okay, thank you very much. The other thing I would like to note is that during the course of the day, we received a letter from James Fannon from Glen Mills, Pennsylvania, with some inquiries, comments about today's meeting. And as we always do with correspondence like this, this will go into the public record associated with the meeting. It will appear on the board website, and we will consider the letter as we are collectively deliberating on the results of the meeting. But we appreciate people being in touch with us and passing this along.

So at this point let me ask Nigel and Debra, are we ready for the poster sessions? I know we're a little bit early. So I think we will take advantage of hitting poster sessions a little bit early. Let me, on behalf of the board, thank everybody who came today. We appreciate your interest and participation. Thank you to the speakers from the DOE offices, and the dialogue. This is extremely helpful to us to try carry out our mission, and so this kind of discourse is incredibly helpful to us. So, again, thanks to everybody

who participated. Let me turn around to the people that looked at my back all day that kept the trains running on time and everything working. We appreciate them as well too. So thank you again. Look forward to seeing you all down the road.