United States
Nuclear Waste Technical Review Board (NWTRB)

Transcript

Spring 2023 Board Meeting

Tuesday
March 28, 2023

PUBLIC MEETING
In-Person and Virtual

Orlando, Florida

NWTRB BOARD MEMBERS IN-PERSON

Nathan Siu
Ronald Ballinger
Steven M. Becker
Allen G. Croff
Teresa Fryberger
Kenneth Lee Peddicord
Scott Tyler
Brian Woods

NWTRB BOARD MEMBERS VIRTUAL

Tissa H. Illangasekare
Paul J. Turinsky

NWTRB EXECUTIVE STAFF MEMBERS IN-PERSON

Daniel Ogg

NWTRB EXECUTIVE STAFF MEMBERS VIRTUAL

Neysa Slater-Chandler

NWTRB PROFESSIONAL STAFF MEMBERS IN-PERSON

Hundal Jung
Bret Leslie
Chandrika Manepally
Roberto Pabalan
Yoonjo Lee

NWTRB ADMINISTRATION STAFF MEMBERS IN-PERSON

Jayson Bright
Davonya Barnes

NWTRB ADMINISTRATION STAFF MEMBERS VIRTUAL

Sonya Townsend
Casey Waithe

SIU: Okay. By my watch, it's 8:00 so I think we should get rolling. Hello, I understand that we are getting participants from other time zones so I would have said 'good morning,' but it's morning here in Orlando and, hello everywhere else.

Welcome to the U.S. Nuclear Waste Technical Review Board Spring Meeting. My name is Nathan Siu and I am the chair of the Board. This meeting will focus on the U.S. Department of Energy's evaluations of removing commercial spent nuclear fuel from nuclear power plants and DOE's related activities. Just a note, as we're, as we transition from the COVID pandemic, we're holding this meeting in hybrid format, understand it's been working very well and we'll have a combination of in person and virtual attendance by the Board members as well as presenters.

I'll introduce the Board members and then briefly describe the Board and outline what we do. Hopefully, folks who aren't aware of what we do, this will be a useful introduction. I'll tell you why we're holding this meeting and then summarize the meeting's agenda.

First, I'll introduce the Board members. I'll ask, as I introduce them that they hold up their hand just so that folks can see them. As I mentioned before, I am Nathan Siu and I'm the Board chair. All the Board members serve part time and many of the Board members hold other positions. In my particular case, I'm retired from the U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research.

I'll start with Ron Ballinger. Ron is a Professor Emeritus of Nuclear Science and Engineering and Materials Science and Engineering at Massachusetts Institute of Technology. Thank you.

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

Allen Croff is a nuclear engineer and adjunct professor in the Department of Civil and Environment Engineering at Vanderbilt University.

Teresa Fryberger is retired from the National Academies of Sciences, Engineering and Medicine and is a consultant for the American Chemical Society.

Lee Peddicord is a Professor Emeritus of Nuclear Engineering at Texas A&M.

Scott Tyler is a Foundation Professor in the Department of Geological Science and Engineering at the University of Nevada, Reno.

Brian Woods, not last by least, is the School Head and Professor in the School of Nuclear Science and Engineering at Oregon State University.

We have two Board members who are joining us remotely. Tissa Illangasekare is the Amax Endowed Distinguished Chair of Civil and Environmental Engineering at the Colorado School of Mines.

And, Paul Turinsky is a Professor Emeritus of Nuclear Engineering at North Carolina State University.

Right now, we have 10 Board members and that is not quite up to full complement. Our other Board position is currently vacant and detailed information on our backgrounds can be found on the Board's webpage.

So, being who we are, it’s possible we might express or imply views during this meeting. I know folks don't hold back. Although open discussion is important to our success, I want to make clear that the views expressed by the Board members during this meeting 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’s website.

Now, for a very brief description of the Board and what we do. We are an independent federal agency in the Executive Branch. We’re not part of the Department of Energy or any other federal department or agency. We were created by the 1987 Amendments to the Nuclear Waste Policy Act to perform objective, ongoing evaluations of the technical and scientific validity of DOE activities related to the management and disposal of spent nuclear fuel and high-level radioactive waste.

Board members are appointed by the President from a list of nominees submitted by the National Academy of Sciences.

We’re mandated by statute to report Board findings, conclusions and recommendations to Congress and the Secretary of Energy.

Meetings like today's are an important part of the Board's review of DOE's activities. The Board provides objective technical and scientific information on a wide range of issues related to the management and disposable of spent nuclear fuel and high-level radioactive waste that will be useful to policymakers in Congress and the Administration. For example, the Board provides technical and scientific comments in letters or reports to DOE following our public meetings. In particular, all of this information can be found on the Board's website. You can see the website at the bottom of this screen here, along with the Board's correspondence, reports, testimony and meeting materials including archived webcasts of recent public meetings. If you'd like to know more about the Board, we have a two-page document summarizing the Board's mission and presenting a list of the Board members that can be found on the website and I think we also have it outside on the table outside this room.

The meeting agenda and presentations have been posted on the Board's website and can be downloaded. We will have public comment period at the end of today's meeting. Those attending the meeting in person and wanting to present, provide oral comments are encouraged to sign the public comment register at the check-

in table near the entrance to the meeting room. Oral commenters will be taken in the order in which they signed in. When making a comment during the public comment period, please use the microphone that's available in the front of the seating area, right over there. Please state your name and affiliation so that you will be identified correctly in the meeting transcript.

And, please, I want to remind the DOE staff, National Lab participants in the room, please use the microphone also and identify yourselves if you are called upon during the meeting to respond to a Board question.

Public comments can also be submitted during the meeting via an online meeting platform using the Comment-For-Record form. I understand we already have one comment. If you are viewing the presentation in full-screen mode, you can access the Comment-For-Record section by pressing the escape key. A reminder on how to submit comments will be displayed during the breaks. Comments will be received online during the meeting, and they will be read by staff member Bret Leslie, over there, after the attendees' public comments in the order in which they are received. Time for each public comment may be limited depending on the number of comments we receive. But, the entirety of the submitted comments

will be included as part of the meeting record. Comments and any other written material may also be submitted later by mail or email. The points of contact are noted in the press release for this meeting which is posted it on our website. These will also be a part of the meeting record and we post it on the Board's website along with the transcript of the meeting and the presentations you will see today.

This meeting is being webcast live and is being recorded so you will see some cameras around the room. Depending on where you're sitting you might be a part of the webcast and the recording. The archived recording will be available on the Board's website by April 4, 2023. And, the transcript will be available by May 30, 2023.

Let's get to the purpose of the meeting. This is part of the Board's continuing review of DOE activities related to the management and disposal of spent nuclear fuel and high-level radioactive waste. DOE's Office of Integrated Waste Management defines its mission as implementing federal interim storage for commercial spent nuclear fuel following consent-based siting process. Over the past several years, DOE's been conducting research and development activities that support key future

decision-making in the integrated waste management system. These efforts include nuclear power plant infrastructure evaluations, the development of railcars to transport commercial spent nuclear fuel and the development of tools to perform integrative systems analysis. Of course, that’s just a partial list.

At this meeting, we’ll start with an update from DOE on the consent-based process. We’ll then focus on the DOE's Office of Integrated Waste Management research and development activities. Our review will focus on the technical and scientific validity of DOE evaluations of removing commercial spent nuclear fuel from nuclear power plants including DOE’s plans for addressing remaining technical and licensing requirements for transportation of commercial spent nuclear fuel from nuclear power plant sites and DOE's related integrated waste management program activities.

Okay, so, the agenda. Today’s meeting we will start with presentation by Erica Bickford from the DOE Office of Nuclear Energy, and she’ll discuss the DOE Integrated Waste Management program. Then, online, DOE Assistant Secretary, Dr. Kathryn Huff will be joining us from Idaho. Thank you Kathryn for coming in at that early hour to describe DOE’s waste management disposal

strategy including the use of consent-based siting. We'll have a 15-minute break at 9:45 AM.

After the break, Gerry Jackson from DOE, the Office of Nuclear Energy will be giving an overview of the nuclear power plant infrastructure or site evaluation activities. Then we'll get an overview from Sara Hogan from DOE's Office of Nuclear Energy on its contractor Site-Specific De-Inventory Reports and the contractor's recommended for steps for removing commercial spent nuclear fuel from nuclear power plant sites.

Lunch is at 11:50 AM and it will be for one hour.

After the lunch break starting at 12:50, which is very precise, Bret, thank you [Chuckle], we'll be facilitating a panel discussion on tribal perspectives on transportation and consent-based siting. Honored to have Richard Arnold, Chairman of the Pahrump Paiute Tribe in Nevada; Nelson Andrews, Tribal Councilman and Emergency Management Director of the Mashpee Wampanoag Tribe; and Heather Westra who is a consultant for the Prairie Island Indian Community as our panelists. Thank you for coming.

This will be followed by a presentation by Kaushik Banerjee from Pacific Northwest National Laboratory on laboratory analysis of cooling time requirements and criticality safety requirements prior to transporting commercial spent nuclear fuel canisters. We'll have a 15-minute break at 2:40 PM. After the break, Erica will be back and she'll provide us with an update on the Atlas and Fortis Railcar project. For the final presentation of the meeting, David Pstrak of the U.S. Nuclear Regulatory Commission will give a presentation on NRC's preparations for potential large-scale commercial shipments of spent nuclear fuel.

After that, we'll have a public comment period and we'll adjourn the meeting at 5 PM Eastern Time.

Much effort went into planning this meeting. And let's see -- I do want to thank our speakers for preparing and making presentations to the meeting today, especially those who participated in the Board's fact-finding meeting that was held virtually on February 9 this year. The presentations for that meeting will be posted,... from that meeting, will be posted to the Board's website along with the meeting transcript and video recordings of today's meeting.

A special thank you, again, to our tribal representatives who made time to join us. Thanks also to the Board members, Steve Becker, Teresa Fryberger, Lee Peddicord and Scott Taylor who were instrumental in setting up this particular meeting and are leading the review of this topic.

Thanks also to the Board staff, Bret Leslie and Jo Jo Lee for doing all of the hard work putting the meeting together. I also want to say that yesterday, the Board visited the Crystal River Nuclear Power Plant site and spent nuclear fuel storage facility and we wanted to thank Phyllis Dixon, Holly Van Sicklen and Craig Miller from ORANO for hosting us and providing us with a very informative tour of their site. So again, our great appreciation for that.

So, at this point, if you will mute your cell phones if you've not already done that, let's begin. And I'm sure this will be interesting and productive.

I want to remind the Board members by the way, I think you all got instructions, but to turn the microphone on, push the button and turn it off when you're done asking questions.

Without further ado it's my pleasure to turn the podium over to Erica Bickford who will get the meeting started.

BICKFORD: Good morning everyone. Thanks very much for the invitation to speak to you all today. It's always a pleasure to be able to share the work that our program is doing.

All right. I guess we have a different – getting to our slides.

I am Erica Bickford. I'm the Acting Director of the Office of Integrated Waste Management. We're within the Office of Nuclear Energy in the U.S. Department of Energy.

The NWTRB staff asked me to spend a little bit of time explaining our legal disclaimer. You'll see this several more times today in our presentations. I'll give you just a few seconds to review it on your own. So, the purpose of this legal disclaimer is really to explain that the Standard Contract for disposal of spent nuclear fuel and/or high-level radioactive waste defines the terms under which the U.S. Department of Energy will accept spent nuclear fuel for disposal from fuel owners. So that's usually going to be utilities but there are some exceptions.

Under the contract, the Department of Energy will accept title to the fuel and transport it to a DOE facility. That may be a disposal facility or it could be a different facility prior to disposal such as a consolidated interim storage facility.

Now, as a practical matter, the realities of the spent nuclear fuel management system have evolved somewhat since the Standard Contract terms were negotiated in 1983. So, we are talking 40 years ago now. And so, as a result, the Department of Energy sometimes conducts analysis that may be inconsistent with some of the specific terms of the Standard Contract. And so, what this legal disclaimer clarifies is that, to the extent that there is any inconsistency between some of the analysis that the Department of Energy performs, the terms of the Standard Contract remain unchanged. Those are fixed.

And I forgot to ask, are we doing any clarifying questions along the way or all questions at the end? Okay, thanks JoJo.

Moving on, I wanted to start out with just providing some context. I know we have some new Board members and maybe have some new folks in the audience. For the U.S. spent nuclear fuel inventory that we have and sort of how long we've had it. In

1958, the U.S. began using commercial nuclear power. So, this was, I believe, the Shipping Port reactor was kind of the first one. Now, in 2023, we currently have 92 operating commercial reactors at 53 nuclear power plants. That's because some sites have multiple reactors at the same power plants in 28 states. So, a large number of states have nuclear power.

20 nuclear power plants have completely shut down. We define that as having no operating reactors at the site. There are sites that have had decommissioned reactors, but we don't consider them to be fully shut down. And we have more than 90,000 metric tons of spent nuclear fuel all around the country. This map shows the locations of the commercial reactors as well as research reactors and DOE facilities.

U.S. Department of Energy estimates project a total inventory based on the current reactor fleet and their expected operating lifetime, so not assuming any new reactors come online, to be up to 140,000 metric tons of spent nuclear fuel in the year 2075. So, of course, if we deploy new reactors, extend operating lifetimes, then that will change. But that just gives you a picture of where we came from, where we are at now and where we expect to be. So, this is an important national issue that we

need to make sure that we have solutions for and execute those solutions so that we can safely manage this material over the long-term.

The mission of my office, the Office of Integrated Waste Management, is currently to implement federal interim storage for commercial spent nuclear fuel following consent-based siting process. You'll notice that our focus is on interim storage. That comes directly from congressional direction. However, we want to remain ever mindful that interim storage is part of a solution to management of spent nuclear fuel, the ultimate solution is still disposal. Disposal, likely in a deep geological repository so we want to be clear about that. However, we're not currently authorized by Congress to pursue deep geologic disposal siting and so that's not a part of our current mission. When we get that authorization, we'll revise our mission to include that.

And so, our current mission is about two years old, give or take. This came from a relatively new congressional authorization that was in the fiscal year 2021 appropriations that authorized the Department and provided funding to pursue federal interim storage using a consent-based siting process. At the time, an additional $20 Million was included in the appropriation specifically for

interim storage. And so that's what kicked off all our recent activities. You'll see this is a familiar graphic that you just saw. This is how we're defining an Integrated Waste Management System at the Department of Energy. We currently define it as having one or more storage facilities. We want to have flexibility in the system and be open to multiple facilities. The transportation capability to move spent nuclear fuel and high-level radioactive waste from nuclear power plants and DOE facilities where it's currently stored to disposal and/or storage facilities, one or more disposal facilities and then there's all the interfaces between each of those elements that connect and allow the system to run efficiently.

So, I wanted to spend a little bit of time looking at our staff resources and how our organization has been changing in order to accomplish this new mission. Our program is under the Deputy Assistant Secretary for Spent Fuel and Waste Disposition in the Office of Nuclear Energy. We have a sibling office that is the Office of Spent Fuel and Waste Science and Technology. That part of the office focuses on research and development for both disposal and storage and transportation R&D. Most of the staff in that office are based in Las Vegas, Nevada due to coming over from the Office of Civilian Radioactive Waste Management. And so

that we consider to be our R&D office. Then my office, the Office of Integrated Waste Management, we consider to be our implementing program office.

You'll see, so on the right-hand side of the screen, where we have the Office of Integrated Waste Management. On that side, only three of the names on that slide were in the program about 18 months ago. So, we've had one retirement but then we've added eleven new staff in about the last 18 months, so we've been rapidly growing. We reorganized to have two teams which we didn't previously have. One of the teams, as you can see, is focused on consent-based siting so developing the strategies and approach and doing the outreach and communication for consent-based siting, again focused on interim storage, but we're also thinking about how consent-based siting can be adapted for disposal facilities in the future.

And then, in what we call our Cross-Cutting Initiatives team, I think about this as more of our technical side for implementing interim storage and the transportation capabilities, so the engineering and analysis, railcar development, storage facility, reference concept designs and things along those lines. And, you'll see I'm currently the acting team lead of that group as

well as being the acting office director. So, I am wearing a couple of hats right now. And then, also give a little shout out to our spring intern Annika from the University of Maryland. She joined our group this spring and has been a great addition to our team. We are certainly focused on workforce development, understanding that as we've added 11 new staff which was quite a growth spurt for us, we need to continue to grow into the future and need to be thinking about workforce development and how to bring new people, young people, students, recent graduates into the program to get us to where we need to be.

And here is, just some smiling faces for you to view our new staff. You'll be hearing from two of our new hires later today, Gerry Jackson we hired over from the Nuclear Regulatory Commission and Sara Hogan is a recent Ph.D. graduate that we hired in last spring as well. They've been great additions to our team. Other folks here, you'll see Natalia Saraeva we hired over from the national labs and she's our team lead for consent-based siting. We have added, a detailee from the Office of Environmental Management, John Schultz who's leading our storage program area work. We have a health physicist, and we've hired several social scientists into our program. The rationale for that is that we understand that with nuclear facility siting,

from our perspective it's not principally a technical challenge, it's largely a socio, sociotechnical or sociopolitical challenge. And so we're pivoting our thinking to incorporate social science and what approaches and information sharing and collaboration with potential host communities, so that we can ultimately reach an agreement with one or more host communities to host an interim storage facility. So, they're adding their expertise. They have backgrounds from anthropology, geography as well as behavioral science to help us kind of formulate our approaches and how we are going to conduct our consent-based siting work.

Alright, moving into the current year, fiscal year 2023, our program received a funding increase. We received appropriations at 53 million. I have a note on the slide just explaining that in fiscal year 21 and 22, funding for interim storage at 20 million was appropriated as a separate line item from the Office of Integrated Waste Management. However, as a practical matter, those funds were applied to our program. For fiscal year 23 at the Department's request, we asked Congress to appropriate those as one lump sum, because it makes it a little bit easier on our accounting side for the program and we were using the funds anyway.

On a side-by-side comparison, if you don't know that background, it may not be easy to track sort of what the actual change in funding was, but we were at 38 million before from the 20 million interim storage funds and 18 million for the Office of Integrated Waste Management and we went up to a total of 53 million so we have a net increase of 15 million.

I have here, also on the slide, the specific language that was included in the explanatory statement for our program. As you can see, very similar to what our current mission is, directing the Department to use existing authority to use a site for a federal interim storage facility further directed to use a consent-based siting approach when undertaking these activities. And so that is what we are doing.

In addition there is some focus on transportation preparation directing us to continue site preparation activities which we understand to mean the nuclear power plant site infrastructure evaluations that Gerry’s going to talk about later, evaluating the re-initiation of regional transportation which we understand to be working with state regional groups and tribes on transportation planning and generally to undertake transportation

coordination efforts which you're going to hear much more about today.

So, our fiscal year 2023 planned activities kind of loosely break down under these large headings: consent-based siting is one of our big growth areas, of course. And, this year we're ramping up our public outreach and stakeholder engagement. I'll talk a little bit more about our consent-based siting approach in a few minutes. But, in general, we envision this as a phased process that moves through different steps. The first step is broad public outreach and engagement. The goal with consent-based siting is to find willing and informed host communities. We understand that to get willing and informed host communities, you need to go through the process of providing that information and providing resources and means for communities to either get information from the Department or get information from third-party experts that they may have more trust in or may want some validation of. So, we're in the early phases of consent-based siting within those activities.

We're continuing and expanding on our existing transportation preparation work. If you are new to this program, you may not know that since around the 2010 time period, our predecessor

program which was the Nuclear Fuel Storage and Transportation Planning Project has been planning for transportation and storage of spent nuclear fuel. We reorganized into the Office of Integrated Waste Management around 2016. So a lot of the technical work to implement federal interim storage and associated transportation has been ongoing that whole time and we are just expanding and building on that existing work now.

Similarly for the storage implementation, in parallel with the transportation work, we've had a lot of technical analysis, reference concept designs, thinking about regulatory approaches for licensing and things like that ongoing, and we're now refreshing that work, updating and expanding it to be able to implement a storage facility.

And then our systems analysis work continues to support all of our activities. A lot of that work is mature, but as the thinking or questions or approach to the overall program change, the system analysis updates to answer questions that we may have. And I'll talk more about that later. You'll also hear from Kaushik Banerjee who will talk a little bit about some of our systems analysis work.

So, in my presentation, I'm going to cover some of our consent-based siting work and then I'll go to our cross-cutting initiatives team and I'll highlight a lot of the transportation work but I'll also talk about our systems analysis and our systems engineering work.

So, I mentioned that the fiscal year 21 appropriations kind of kicked off the work that we're doing now pursuing federal interim storage following consent-based siting process. I will let you know that the Department previously embarked on a consent-based siting effort in about the 2015 to 2017 time period and then it went on hiatus. So, when Congress authorized us to pursue federal interim storage consent-based siting, before we went out and launched a consent-based siting effort given that the four year hiatus, we wanted to first go out and get some input from the public, interested stakeholders and others to inform our approach moving forward. We had gotten a lot of public feedback, public comments on documents. We'd had nine or ten public meetings around the country and taken a lot of feedback in, published some summaries of what we heard, but over a four year hiatus we didn't want to just assume that where things left off is where they should continue. So, we first went out in December 2021 with a notice of request for information on using consent-based siting

process to identify federal interim storage facilities. We had some specific questions we asked for responses to for about the consent-based siting process itself, how to remove barriers to meaningful participation, especially from groups and stakeholders who had not historically been engaged. We recognize that not all Americans are actively engaged on issues relating to spent nuclear fuel management and so how do we get more of those folks to participate or to have access? And also, some questions about interim storage as a component of the waste management system. When we conducted consent-based siting work in that 2015 - 2017 period, it was based on the 2013 Administration strategy which included storage and disposal and right now we're focused on interim storage, only.

We also wanted to include a special focus on ensuring issues of equity and environmental justice were integrated into the process and so we asked for feedback and input on the element, as well.

We received over 220 comments that break down roughly in the following kind of demographic areas from tribes, from states or state groups, local governments, nongovernmental organizations, some environmental justice organizations, industry, academia, labor and then many from private citizens including a fair number

of form letters which is common in this space. All of the comments that we received are publicly posted on our website at energy.gov/consent-based-siting if you'd like to go and peruse them. In addition, in September of 2022, we issued a summary report of the comments that we received. If you'd like to read a condensed version. And we also directly applied this feedback into our next steps moving forward with consent-based siting and I'll talk about that next.

So, following the Request for Information, the next action that we pursued with consent-based siting is putting out a funding opportunity announcement. This was the direct result of the input that we received from the Request for Information. Here [are] some specific comments related to the need to provide resources and technical assistance in order for tribes and others to effectively engage in the consent-based siting process.

And so, our funding opportunity was announced last September. It was announced at $16 million. Following the receipt of our FY23 appropriations in December which increased our budget by 15 million. We were able to add another 10 million to that total funding pool and so now it's now at $26 million is available for those awards. We're expecting to make between 6 and 16 awards

depending on the applications that we get. And those awards are going to be cooperative agreements with a performance period of between 18 and 24 months. The entities that were eligible to apply for these awards were really any organization and that was not a federally-funded research and develop center, or a FFRDC, and there also had to be a focus on outreach and engagement activities in the continental United States. We're not planning any facilities currently in Hawaii or Alaska or outlying territories. So those were kind of the parameters that we had.

We wanted to have a good mix of geographies and a good mix of institution types. We didn't want it to be all academic or all industry or all anything else. We want to have a great cross-section and so that's what we are hoping to get. We're currently reviewing the applications; the application period closed in January. And we are planning to announce the awardees later this spring and begin engaging with those awardees over the summer.

I mentioned that with consent-based siting, we're moving through multiple phases. And this early phase is public engagement focused. The Department of Energy's goals for the awardees and engagement with these awardees is (1) to establish a community of practice. So, as I mentioned before, and you might have found

this to be true in your own lives, the general American public is not conversant in issues of spent nuclear fuel management, interim storage, how to find consent for a nuclear waste management facility and related topics. And, so, our goal is to establish a community of practice so that we can be conversant in these topics and there can be experts and experienced individuals out there that may be able to be resources for interested communities. We also want to engage in mutual learning. We don't envision this to be just a process for the department and our technical experts to be talking at people and communities about how great whatever we are doing is, we also want to hear from them what their questions, concerns and how could we work together to address those, find them resources or technical experts that they would be interested in engaging with whether from their communities or neighboring communities. And we also again want to focus on environmental justice. The legacy of nuclear technology in this country can be mixed for some regions especially when it comes to mining and milling activities or weapons-related activities. And so we want to keep that front of mind and approach siting for spent nuclear fuel storage and eventually disposal facilities thinking of how we can ensure that communities will be left better off in the long run for having hosted or even just engaged in the consent-based siting process.

Our vision for consent-based siting is eventually we will seek volunteers to raise their hands and express interest in being a potential host community. However, following models from other successful countries and doing kind of voluntary based siting efforts, we want communities to come forward, engage, possibly decide to move forward onto future steps, maybe after considering the options and considerations, they decide this isn't for them and they depart the process. We think either way, we think having multiple on ramps and off ramps is a successful approach.

I have mentioned our awardees for our funding opportunity are expected to be announced in late spring, and we'll start working with them over the summer. Future iterations of consent-based siting will go out looking for volunteers. So, you may notice that sometimes the media representations of what our funding opportunity is, they get the details a little off and indicate that we're looking for volunteers now. That's not the case. That will be a future step of consent-based siting.

So, as ever public feedback continues to inform. We don't consider consent-based siting to be a set-in-stone process. We consider it to be adaptable and phased. As we get more information, then we will adjust our future steps. We continue to

develop our consent-based siting process and plan to issue the latest version of that very soon. We'll again, begin engaging with the first round of awardees from our Funding Opportunity Announcement this summer and in then parallel with that we'll be clarifying our broader strategy for how we plan to operate the Integrated Waste Management system. I mentioned previously there was a 2013 Administration strategy and we have plans to update that to reflect, kind of, current thinking.

If you want to stay up-to-date with our consent-based siting activities, you can check all of our public information at energy.gov/consent-based-siting. We also have the ability to sign up for email alerts if you scroll down to the bottom of that page, you can enter your email address and be on our email distributional list. It's not a heavy amount of emails, probably on the order of about once a month or whenever we have public events or webinar or report that we've released and want to share with everybody. The next announcement likely will be when announce our awardees; we'll be sending a notice and things like that. So if you want to be tuned into the latest and greatest with consent-based siting, I encourage you to sign up there!

Alright, switching gears and moving over to our cross-cutting initiatives team. I'm going to focus again on a lot of our transportation work. I don't want to leave you with the impression that we only do transportation, it was just selected based on the scope of this meeting.

So, starting off Railcar Development. I'm going to be talking later today more in-depth, so I'll kind of breeze through this, but just at a high level, we...the Department of Energy started in 2014 with development of purpose-built railcars for the transportation of spent fuel and high-level waste. This was motivated in part by the Navy's experience. These railcars are designed to meet the Association of American Railroad's S-2043 standard which is the performance specifications for trains used to carry a high-level radioactive material. The Navy was the first to qualify a railcar to the standard, and it took them about 10 years to do it. So understanding that this could be a long lead time activity and would be needed independent of any particular destination for a facility, work began in 2014 on the Atlas 12-axle railcar, as well as a buffer railcar, which is intended to separate the cask carrying railcars from the people-carrying railcars. We've also since designed an 8-axle Fortis railcar. We collaborated with the Navy on the design of a rail

escort vehicle. The Navy was in process of updating – they had previously used a caboose that had been retrofitted and I understand was not very comfortable – with the designing of a purpose built railcar to meet the S-2043 standard and timing worked out well for us to be able to collaborate with them on that. And that is in the photo on the bottom left and in then in parallel with these, we have been developing an integrated security and safety monitoring system which I'll talk more about in the railcar presentation later.

So, that’s just a brief snapshot of the railcars. Similarly, we have been conducting work focused on infrastructure and operational planning. So, we have railcars in process to move the spent nuclear fuel. What are the other pieces of the transportation system that we’re going to need to be able to move these packages of material? The work that is led by Steve Maheras of Pacific Northwest National Lab and you’ll hear Gerry Jackson present on it later today looks at onsite and near-site transportation infrastructure and considerations for what the options are to move fuel off-site. What kind of onsite equipment might you need and what kind of infrastructure refurbishment might be necessary? What are your modal options in terms of rail, barge, heavy haul truck, things of that nature. To date, the

Department has visited 20 sites and completed those site visits. We currently have a report from 2021 that is publicly available, but we are shortly going to be posting an updated version that includes the last sites that we visited. And that should be available, hopefully, in the next month or two.

Building on the work from the nuclear power plant infrastructure evaluations, we have site specific de-inventory reports. Sara Hogan's going to be presenting on this work later today. These are our contractors' recommendation to DOE for how they would propose removing spent nuclear fuel from nuclear power plant sites. We've published five of these reports publicly. You can find them at osti.gov, sorry, six we have published, and you then we have five more in the works that should be released this year. One of the transportation program sort of additions that we have made as we've brought on some new staff resources are taking more of a focused look on security considerations for transports. So, especially where locations for transport don't have direct rail access to the origin site and you might have to use a transload operation, so a heavy haul truck to somewhere where you can load onto rail or load onto barge, what the security considerations for those facilities are. Is this sort of like a dirt lot next to a rail line and you get some fencing and other things? Do you try

and find a fixed facility that maybe already has some of those security features that you can augment. And, so we brought Gerry Jackson on to really help with a lot of that work due to his experience in security.

Similar to that, we're looking at our escort or courier security options. So these are the armed guards that will be transported with the shipments and they'll ride into that rail escort vehicle. We've been considering options of whether, can this be contracted security role. There's questions about transporting loaded weapons across state lines and can a contracted courier service address those, you know, operate within those laws or does this need to be a federal role that can overcome any of those transboundary, state to state, issues? So those are things we're looking at because there's different pathways that you go forward from there once you look at the pros and cons of the different options you have available.

So, another big, big part of the work that we do in our transportation area is engagement with tribes and states. Transporting this material, thinking back to the map that I showed in the beginning, is all over the country. We don't know where the destination facilities are going to be, but many

jurisdictions are likely to be affected. My office funds five cooperative agreements with four state regional groups and a fifth with another entity that provides staff support for the operation of the Tribal Radioactive Materials Transportation Committee, also known as TRMTC. We have some TRMTC members who are going to be speaking later today about their experience. So these cooperative agreements support each of these entities have a committee made up of tribal representatives for TRMTC, of state representatives for the state regional groups. They conduct midyear meetings of their committees. The funding that we provide supports state and tribal participation in DOE's National Transportation Stakeholder's Forum, the annual meeting and other DOE-hosted meetings. These funds can also be used for training and attendance and travel to technical meetings. These awards do not cover any state or tribal staff time, however, just the staff time for staff support to the committees.

As part of our tribal and state engagement, we also are actively involved with DOE's National Transportation Stakeholders Forum or NTSF. We currently are, our staff currently lead three ad hoc working groups under the NTSF, one that's focused on Section 180(c). I know there was a question from the board on the status of 180(c). So, for those who don't know, Section 180(c) is the

section of the Nuclear Waste Policy Act that says that the Department will provide training funds and technical assistance to public safety officials through whose jurisdictions the Department transports spent nuclear fuel or high-level radioactive waste.

From the 1990s to the early 2000, the department was actively engaged with states and tribe in developing draft policies and putting them out for comments and then revising those draft policies, the most recent version of which, was issued in 2008 and then shortly thereafter, the Office of Civilian Radioactive Waste Management that was leading that effort was discontinued. In 2012, following the release of the Blue Ribbon Commission's final report to the Department which recommended resuming those activities. Engagement with the ad hoc working group stood back up and operated from around 2012 - 2017 and we had a policy implementation exercise which was sort of a paperwork version of applying for the funds and doing kind of a proof of concept of how we think the 2008 version of the draft policy would work and what changes might be needed. And then we went on another hiatus for about four years and the ad hoc working group was able to resume last spring and so we are picking this work back up again, but the hallmark of that and a lot of the other work in the

transportation area is sort of stops and starts over time which of course makes it challenging to build momentum and sort of reach your finish line goals.

So, recognizing that and recognizing that there's turnover among federal staff, among the subject matter experts that support our work, as well as state and tribal representatives over time, last year we developed a knowledge management document designed to kind of capture the history of the work done from the 1980s to 2017 on Section 180(c) and to serve as a bit of a primer for state, tribal, federal and others kind of entering into this space. And so that ad hoc working group is currently led by Sara Hogan. And, so, they are reviewing some of the past work that's been done and deciding where they want to go moving forward from here, in order to reach a point where we can feel like we can finalize or recommend language changes to that policy and get it to a point where it can be operational. And that is intended to be a grant program as well as technical assistance.

We have a Spent Nuclear Fuel Rail/Routing ad hoc working group which Gerry Jackson currently leads. This ad hoc working group was set up in 2015 at the request of the states and tribes participating in the NTSF. A lot of states and tribes in NTSF had

experience with DOE highway shipments of radioactive materials from the WIPP program and didn't have experience with rail shipments and had questions about would be similar or what would be different to the WIPP program. And so, we set up this ad hoc working group to address those questions. We started with a Rail 101 Series. We did recorded webinars that are posted on the NTSF website if you are interested. And, then from there, moved on and did a routing workshop. There are specific routing requirements for trains carrying certain hazardous materials including spent nuclear fuel. And so in 2017, we had volunteers from the state and tribal volunteers from the ad hoc working group to sort of chart out hypothetical routes. They used DOE's Stakeholder Tool for Assessing Radioactive Transportation or START which is a GIS routing capable too. And, we included a -- we had an in person workshop with rail carrier representatives who provided analysis from their own proprietary routing tools of how shipments between points A and points B that were, again, just hypothetical, would work and compared those to what the group had found using DOE's tools and found generally good comparability and found good conversations and discussions about different rail carrier operational considerations.

And then after that, we moved onto -- the group has currently been focused and I think is reaching the end of development of a railcar safety inspection protocol. And, so again, in the highway environment, you have the Commercial Vehicle Safety Alliance level VI inspection protocol that was incorporated into the WIPP program and then eventually adopted by the Department of Transportation into law for highway route-controlled quantities. That provides an avenue for states and tribes to conduct safety inspections of those shipments. A parallel mechanism was not readily available for rail shipments due to just very different environments. However, there are rail safety programs available to states, not currently available to tribes. And so, we worked with rail carriers, tribes and states and others to devise a mechanism where the department could record inspection information from regulatory and rail carrier inspections that could be shared with tribes and states along the transportation route to kind of fill that gap that currently existed between the highway environment and the railway environment. So that’s been in process for a number of years and gone through many rounds and reviews and revisions and I think is nearing a point of, if not finality, at least maturity pending some addition of future data that we might have.

Then, lastly we have a Spent Nuclear Fuel Management Communications and Outreach ad hoc working group. This is kind of a communications focused ad hoc working group that's been providing advice and input on communication materials related to consent-based siting. Some of the feedback that we have heard from states and tribes in the past is that, why doesn't DOE ask us for our input on your communication materials because the states and tribes have a lot of familiarity with the audiences that these are intended to be provided for, and they felt that we could do better with their input. And so we're taking that advice and we through this ad hoc working group and using as a mechanism to get input, share draft documents and things of that nature.

Separate from the National Transportation Stakeholders Forum, our office also leads a Transportation Core Group. So, this involves a subset of state and tribal folks that we engage with, typically about the two folks per committee give or take, often as the chairs and co-chairs of each committee or the case of TRMTC, the executive committee members. And we meet twice a year and usually for about a day and a half or sometimes two days and provide more kind of in-depth information about our program, presentations similar to what you will probably see today. We have discussions,

planned for the year ahead, identify gaps in the program that we think we could fill, next steps, things of that nature.

It provides a good opportunity for sort of a smaller working group to have exchange of thoughts and ideas related to coordination related to spent nuclear fuel transportation. And that's been a very successful working relationship since about 2014. We had a little bit of a hiatus with COVID and other things, but we resumed our first in-person meeting in a while earlier this month, in fact. And, we'll have our next meeting in August.

All right, there were also questions from the Board about our Package Performance Study and I want to be very clear that we have hopes and dreams of conducting a Package Performance Study, but it's entirely dependent on having the funding to do it. We ballpark the cost of doing a full-scale package performance study at around $40 million. We don't currently have $40 million to do this. So this is very early planning work in the hopes that we will have those funds to conduct this study. You'll note in our FY 24 President's budget request for our program, it was one of the items that was specifically called out that we would like to do. But, in terms of where we are at with that work, we're again

developing preliminary plans and our plan for our package performance study.

There's been many evolutions of the concept of a package performance study over the last 20 or so years. In one evolution, it was going to be led by the Nuclear Regulatory Commission. In this evolution, the plan is that the Department of Energy would lead this and invite the Nuclear Regulatory Commission, who is the federal authority to certify these packages to participate in the process. The motivation for pursuing a package performance study has a couple different elements. One is that the U.S. hasn't tested sort of a current, full-sized spent nuclear fuel cask in this country. We did a lot of package testing back in the 70s and early 80s. Those packages were all smaller than what we see, likely to be used today. Also the regulatory structure does not require full-scale package testing. You can do scale model testing or computer model testing. And the Department of Energy takes no issue with that. We are not pursuing this study because we have any concerns about the current package certification process that the Nuclear Regulatory Commission performs. However, we recognize that not all members of the public sort of share our confidence. And so our motivation for this is really based on public trust and confidence.

The National Academies of Sciences in their 2006 Going the Distance report recommended pursuing a package performance study to build public trust and confidence and the Blue Ribbon Commission's 2012 final report kind of endorsed that recommendation.

Our current thinking for the package performance test is to test the regulatory test of dropping on a unyielding surface and things like that, but we are also considering possible nonregulatory tests, things that may be a little bit more meaningful for a general public audience and based on what other countries have done, like the UK had an “Operation Smash Hit” is what they called it in the 1980s where they hit what they call a flask, a cask, of spent nuclear fuel; it didn’t actually contain spent nuclear fuel, but with a train.

You may be aware that in the news media, there has been a lot of attention on train derailments carrying hazardous materials and that creates a lot of concern about the prospect of spent nuclear fuel being transported by train. I do want to be clear that the evidence shows that rail is one of the safest modes of transportation, however because rail is often only in the news

when there is some kind of accident associated with hazardous materials or similar, it leaves the public to think that it's a much less safe mode of transportation than it really is.

So, our focus here would be, again, on bringing the public along to understand the safety of both the packages that this material will be transported in as well as the safety of the rail conveyance in general and because of our specially designed railcars.

In the case of the East Palestine, Ohio derailment, news reports have indicated that derailment was caused by an overheated bearing on the train not being detected early enough to stop the train before it derailed. These S-2043 railcars that we're designing have real-time detection of 11 different railcar parameters including bearing temperatures and so we should expect that should a similar occurrence happen in performance of the railcar, there would be an immediate notification that something was amiss with the railcar and that would allow the railcar to be stopped and inspected before any railcar derailment could occur.

So, again, our goals with the Package Performance Study building public trust and confidence, we would anticipate trying to

incorporate as much public participation as we can, possibly working through our NTSF ad hoc working groups with state and tribal representatives to get their input on maybe the design and scope of the testing, using digital platforms, possibly live streaming, other things possibly being able to have sort of a grandstand set up at a test facility so that people could be in observation. You won't be able to be that close due to safety and projectiles and things like that, but trying to make as open and transparent and accessible to the public as we can so that we can reach that goal of public trust and confidence.

A secondary goal of doing the study would also, of course, be to collect data on the test and use that for model validation in the future, as well. So, that's just a bit of a snapshot for our plans for a Package Performance Test.

Now moving away from our transportation focus, I wanted to spend a little bit of time on our other program areas. So in our storage program area, we have a lot of activities going on, the graphic on the screen in the top right just shows a schematic for our reference concept for an interim storage facility that would be designed for 70,000 metric tons of spent nuclear fuel. So, we are polishing that up and Joe Carter from the Pacific Northwest

National Lab has given several public presentations on that recently that have been very well-received and very informative. I think media depictions sometimes of what an interim storage facility is can sometimes represent it as a dump and I think it's helpful to share schematics like that and convey the message that this is a highly engineered facility designed to robust engineering and safety standards. And also, what factors are in in terms of the footprint. What kind of footprint are you looking at? And also communicating that part of the footprint is having a big safety buffer around it so that you can make sure that you meet the regulations for dose limits at the perimeter.

The Department of Energy has directives and orders that provide requirements for conducting certain activities and the Department of Energy has an Order 413 that is specific to project management of capital projects over $50 million. So, for a federal interim storage facility, we would very much expect it to be over that $50 million limit, and so we are organizing our technical documentation to fit into that project management process. The first step of which is called Critical Decision Zero which is the Department's agreeing that there's a mission need to pursue this facility. And so we have assembled all of the technical documentation, a lot of which has been developed over the years

and has been updated and refined for this process. We have assembled some subject matter experts to conduct a technical review and then it will go into a broader departmental review process later this year. And so once we get the Critical Decision Zero, that sets us on a pretty prescriptive path for how the project continues in that project management space. So, that is one of the large efforts we're undertaking this year.

For our storage facility design concepts, we, of course, have lots of reference concepts or draft concepts. We are always refining those, considering especially what types of added capabilities they may need, whether it's a package remediation capability or depending on the volume of material a facility would handle, multiple pathways, so if you have, say a cask handling facility, do you have one, do you have two? Do you start with none and add that in later as you need to increase the processing rate for the facility? Thinking through those types of questions as well as the regulatory analysis and strategy for how you would pursue a license whether you license for a smaller facility and then later do modifications to expand into a larger facility or things of that nature.

We also have some work looking at canister inspection and remediation concepts. You're going to be taking spent nuclear fuel from nuclear power plants, transporting it to a federal interim storage facility. How do you inspect those packages and make sure they're in good condition before you put them back into a storage configuration? And those containers are usually backfilled with helium and so we'll be looking at how to test if there's been any helium leaks.

In our Systems Analysis and Integration area, we have a number of computational tools and data. You're going to hear from Kaushik Banerjee about our UNF-ST&DARDS tools later today. We also have PASO which, we keep changing our acronyms every few years. So, PASO is the Performance Assessment of Strategic Options tool. NGSAM is our Next Generation Systems Analysis Model. And, these help us answer some of the scenario questions that we for the Integrated Waste Management system. We also have some systems engineering work that looks at systems throughputs, also considering, is there a point where we can maybe implement standardization in the system either now or in the future? And also looking at advanced reactor spent nuclear fuel considerations because that's actually an area that's very ripe for possibly implementing standardization. We have a lot of

lessons learned from the history, the 40+ year history of spent nuclear fuel management, and if you could go back at the beginning, what would you maybe do differently to make the back end handling more efficient? And so with advanced reactors, that's something we are actively looking at.

We also release every year an updated inventory report on the spent nuclear fuel and high-level waste inventory. The most recent version of that is posted currently on our CURIE website. That is another information resource that we have recently reinitiated.

For our PASO and NGSAM systems analysis tools, I know there were questions from the Board on these about integration. These are very well integrated tools. These are also very mature tools. We continue to do work with them which isn't necessarily to get them to a point where we consider them to be finished, it's really to add capabilities or be able to answer new questions that come up as the Integrated Waste Management system evolves and moves forward.

The focus for PASO is on, basically what are all the pieces of the puzzle that need to come together and in what order to

achieve an operating facility? What are the long poles in the tent, what's on the critical path? What are the uncertainties with the different aspects? Where do we need to focus more attention? Possibly if item X takes 50% longer than planned, does that put it on the critical path?

And it also provides some cost analysis, cost and schedule analysis for us as well. And we, readily update that tool because we started with more kind of simplistic models and as the program grows in complexity, we need to add some of that complexity. So some of the things that we're adding to our PASO system is incorporating a Package Performance Study into that timeline. Where does that fit into the overall picture because you'd ideally want it to be accomplished well enough in advance of starting large-scale spent nuclear fuel transportation, but not so far in advance that everybody forgets about it before you actually start transporting. And also where that fits in in terms of cost managements.

For NGSAM, we can look at a lot of different analyses, especially system throughputs, so if you have an interim storage facility operating, how much spent nuclear fuel are you moving? How does that translate into a number of railcars that you need? If you

are able to open a disposal facility at some point later, what does that mean for the throughput of the system? And answering questions about if you have fuel moving simultaneously still to storage and to disposal or only from storage to disposal, or some combinations therein. So that's how we use these tools just kind of at a high level to help us analyze different questions about the operation of a system and plan ahead for what kind of equipment assets and operational capabilities that we would need.

I see I am running close to my time, so just want to just quickly talk about how we have a lot of integration between these tools. I mentioned our START tool provides a routing capability. And outputs from START are used as inputs for NGSAM. Kaushik Banerjee, I mentioned is going to talk all about our UNF-ST&DARDS which also provide some inputs for NGSAM. And then, our analyses that we are able to do from PASO help us figure out our order of operations and where we have dependencies in our system and what steps need to be accomplished in order to move on to other things like asset acquisition. As well as what's the, you know, what's the most optimistic timeframe we could open an interim storage facility and what are the uncertainties that lead to maybe later time frames?

So, just looking ahead to the remainder of this year and a good part of next year as well, we'll consider... we'll continue our focus on consent-based siting and associated activities, continue highlighting that we still need a disposal pathway. If we are able to be successful with federal interim storage, that would be a great achievement for the system, but we can't lose our focus on the need for a disposal pathway, as well. We'll continue looking at extended storage research because even at this point, if we start work on a deep geologic repository tomorrow, it would still be many decades before it becomes available, so we'll need to be storing spent nuclear fuel into the interim.

I mentioned we are looking at waste management from advanced reactors and we're also taking more focus on knowledge management activities. In the past it had been a little bit ad hoc depending on people who had just been around for 30 or 40 years, but as we don't have as many of those folks around anymore, we need to be more proactive to our approach to documenting information.

So, sorry I went a little overtime, but happy to take questions.

SIU: Thank you, Erica, I think you are right on time. That is perfect. Let's start with the Board members who are involved in setting up this meeting. So, let's start with Steve.

BECKER: Good morning, Stephen Becker, Board member. Thank you, Erica, for a very nice overview presentation. So, in your discussion of consent-based siting, you noted that the recent funding opportunity was informed by public feedback from the earlier exercise and one area that you highlighted in particular was the comment, "DOE must take proactive steps to ensure that tribes can participate in the process." How has this been operationalized, in other words, what practical steps has this translated into?

BICKFORD: Sure, thanks for the question. So, one of the examples of adjustments or new approaches we've incorporated in our approach is some of the feedback we've heard from tribes is that digital communication methods alone are not always good ways to reach tribes. Not everyone has high-speed Internet access or other computing access. And it was recommended that we also use traditional postal mail approaches. And so for the Funding Opportunity Announcement last fall, we sent letters out to more than 350 federally recognized tribes. We focused on the tribes in

the continental United States, and then when we extended the deadline for the funding opportunity, it was initially going to be closed in December, but we got multiple requests to extend it to January, we sent out another mass mailing to the tribes letting them know about that. And we did get some calls back, some feedback back following up for more information. Other approaches is in our plans for engaging with the awardees. Of course, we don't know at this time what the actual makeup of the awardees, but assuming, or hoping for some interaction with tribes. We have some of our social scientists both at the federal level and at the lab level, considering some cultural aspects of tribes that may lead us to use different approaches for communication and engagement with them. And so that is a very quick snapshot.

BECKER: Thank you, have you gotten any feedback so far from the tribes on the process and whether it's been improved compared to the earlier exercise?

BICKFORD: If by earlier exercise, you mean the Request for Information, I'd say we got some good tribal feedback in the Request for Information. We always hope to get more, of course.

And I think it's probably a little bit too soon, because we haven't placed the awards and really started engaging with those awardees. So, I'd say, we haven't gotten negative feedback and from some of the letters we mailed out, we did get phone calls or email follow-ups asking for more information. So we take that as a positive indication that we're reaching some of the tribal audiences that we are hoping to.

BECKER: Thank you.

BICKFORD: Thanks.

SIU: Lee?

PEDDICORD: Hello, Lee Peddicord, from the – Board member. Again, thank you. Very informative. Very interesting. Two quick questions, I hope. Can you say how many responses you got for your call on the consent-based siting process you talked about? And then, the second one is, you talked about the transportation systems. To what extents have the other DOE transport systems that, you mentioned WIPP, the movement of cores by the Navy, spent fuel there. And then the secure transport systems Sandia runs for NNSA. How much of those are applicable that you can

utilize, particularly on the issue you talked about with security, because some of these others require very high security, as well?

BICKFORD: So, on the first part of the question on the responses that we got, unfortunately federal procurement rules consider that to be procurement-sensitive information, so all I can say is we were pleased with the response that we got.

For your questions about how other DOE transportation programs, yeah, through the National Transportation Stakeholders Forum, that's led by the Office of Environmental Management which is the overarching headquarters office for the WIPP program. So we've had lots of exchanges about WIPP. There's the WIPP policy or Program Implementation Guide, the PIG, the WIPP PIG. It's sort of a foundational document that was developed between states and DOE. And so, states really see that as a good model.

For the Navy program, they're the only rail based spent nuclear fuel transportation program we have. So, we certainly look very much at their model and consider them to be sort of the benchmark that we'd be trying to emulate. There are some key differences in the Navy system as compared to ours. Some operational

differences. They only have two packages. They only transport from a limited number of locations. They do not provide advance notice for their shipments due to national security type considerations. They use enlisted Navy personnel for their couriers which is very advantageous to them so they don't have to ask these questions about contracted security versus a federal officer and things like that. But they have been conducting also public training exercises with communities on their transportation routes and we very much see that as a model for how we could conduct training exercises. And also, thinking about potential opportunities to be a joint training in the future with their railcars and our railcars and things like that. So, certainly collaborate a lot with the Navy. Of course, they’re a mature program and we can benefit much more from them than they can from us most likely. So, we have to be sensitive to that. But in general, they’ve been great. The collaboration with the rail escort vehicle, for example, they invited us to their training exercise that they did in Moberly, Missouri last September. We’ve collaborated on the Association of American Railroads put out the S-2043 standard for revision a couple years ago. And so the Navy and Department of Energy staff jointly collaborated on providing comments with things that we thought should be changed, which was based a lot on the Navy's operational experience with the S-2043

railcars. So, we're certainly learning a lot and paying close attention to what the Navy's practices are.

For the Office of Secure Transportation that handles kind of the weapons or other kinds of special nuclear materials shipments, we have spoken to them in the past. And from those conversations, those lead us to think that their operations are very unlike what we would expect to do, you know from everything from their shipments are not in commerce so they're not subjected to Department of Transportation regulations where we expect our shipments would be in commerce and would follow all Department of Transportation regulations. They do not conduct really public outreach and engagement and training along their transportation routes which we would expect to provide advance notification of our shipments and do extensive public outreach and engagement along our shipments.

Theirs is mostly a highway-based shipping campaign these days. We're planning on rail. So, it's important to be aware of what else is out there, but we have found that the way that we plan to operate our system is significantly different from the Office of Secure Transportation and so not a lot of commonalities.

SIU: Teresa?

FRYBERGER: Hi Erica. I also enjoyed your presentation very much. I have some questions about your funding opportunity. I'm a chemist and so I'm used to scientific ones, and this is kind of new territory for me. And so, I guess, did you put out an RFP that outlines criteria and specifics that is on the website?

BICKFORD: Yes, so for this is a financial assistance award, so more similar to grants. They're specifically called cooperative agreements. The only difference in the federal space between a grant and cooperative agreement is that a cooperative agreement has a statement of substantial involvement. So, it's meant to be a collaboration between the funding entity, which is the Department of Energy and the awardee. So, all of those details were included in the funding opportunity announcement.

FRYBERGER: Okay, so I can look at that for that. But I guess I'm, could you maybe give me a feel for the kinds of activities that you expect awardees would be conducting and maybe what the outcome of the projects would be?

BICKFORD: Sure and to be clear, we didn't what to be overly prescriptive, because we wanted to leave avenues for people to propose things that we hadn't thought of. But, the different forms that we anticipate it could take is they could be community-based, so within a specific geographic area engaging you know, maybe it's a university and kind of operating maybe similar to an extension, a university extension model and doing outreach in the local community, holding town halls, public meetings, maybe technical webinars, things of that nature. They could be more nationally focused organizations, so for example some tribal organizations that are more national and not necessarily focused in a specific community.

Our vision is that we will provide sort of a menu of information resources that we can share, possibly facility tours and things like that. It's always helpful to go and see, this is what spent nuclear fuel storage looks like. This is what we're talking about, as you all experienced yesterday going to Crystal River. And so that is kind of, in our thinking at this point, of the opportunities that we are going to be prepared to provide but we're also simultaneously going to prepared to be responsive to other requests that may come up. There may be some analysis that we could support to answer questions, again with an 18 to 24

month of operation period. It wouldn't be anything very extensive, but maybe, oh, you have a report that answers this question. We have a slightly different question, is that a simple thing you could do?

And then we also plan to receive feedback from the awardees on, these are where the misunderstandings or misinformation about this material, these are the concerns. Are concerns motivated by safety and security? Are they motivated by air quality, water quality, things like that? Property values?

Discussions about what kind of benefits communities would be interested in, whether they are job oriented whether they are facilities, educational, other types of economic opportunities. Would communities be more interested in a narrow mission in terms of, okay, we are agreeing to may be hosted this facility, but we want to operate in a compact and shortest period of time. Or, would communities be interested in more broader missions for facilities that they might consider hosting. Just those kind of trade-offs, questions about different models for community benefits, payment in lieu of taxes, educational resources, training programs. Kind of, I know I am kind of going all over the place, but we really do not want too narrowly confine it at

this stage, we want to be wide-ranging and try and cover as much ground as we possibly can to inform our movement to the next phase of consent-based siting.

FRYBERGER: No, this is really preparation for planning the consent-based process and also sort of greasing the wheels in some of the communities.

BICKFORD: And it's also trying to bring all of the folks that we engage with up to a common level of understanding in this issue. We fully expect that we may have applicants that are like, okay, we live in a community with a nuclear power plant. We've got all the basics of nuclear technology down. We have these additional questions that we want to ask. Other communities could be like, we don't know anything about nuclear technology. And so we are trying to kind of create a little bit of a level playing field before we move on to future phases is the goal.

FRYBERGER: Okay, thank you.

TYLER: Scott Tyler, Board member. Thank you Erica. I really appreciate the excellent presentation. I was really pleased to see at the end of your presentation the discussion about

knowledge storage, storage and capturing some of the things that have been done in the past and I'm wondering, I think on the same slide, there was a mention of WIPP. So is there some, do you have some plans to engage the WIPP siting process knowledge, which is probably a bit more senior these days, given the timeframe in the process for your interim storage facility planning?

BICKFORD: Yes, absolutely, we certainly looked at different models for facility siting, both have been successful and unsuccessful in the U.S., probably WIPP is one of the successful examples. And as well as the repository siting processes, both with the first repository and the second repository siting processes. We do have subject matter experts that were involved in those activities in those days and we do have a good understanding of the WIPP process. One of the lessons learned or key takeaways we have taken from that process is how much of a role having a congressional champion was in that process in terms of getting that through, as well as the unique facets of the Land Withdrawal Act and the regulation by EPA and things of that nature.

We certainly looked at that, but there is probably more investigation that we could do, especially in terms of what local

on the ground sentiment was versus -- the various roles of local, state level engagements and involvement versus sort of the federal or congressional level of involvement and how those came together to get that project sited, because we've certainly seen a lot of other project proposals that have some breakdown in those various places. So, yeah, that's a great example to look into.

SIU: Erica, Nathan Siu, Chair. Regarding the systems analysis tools, PASO and NGSAM, and so forth. You said that they account for uncertainties right now, or you're considering uncertainties in the analyses. Do you believe that the uncertainty of the analyses covered major disruptive events?

BICKFORD: No. Right now it's a little bit of an idealized system. It assumes unconstrained personnel and financial resources which is unrealistic. But going in, it sort of if everything goes well, this is what we can achieve. And so from there, you make adjustments to be like well, no federal project ever has gone perfectly to plan, or probably no commercial project either. So accounting for, okay, this is the best we could possibly do and now, what's a more realistic process, because we are currently subject to annual appropriations and

that creates a lot of uncertainty. Our current congressional authorization allows us to site and prepare a license application, but we would need additional congressional authorization to be able to construct and operate a facility. And so planning large projects that are going to require a ramp up, a significant ramp up in appropriations, as well as additional authorization from Congress, are huge potential disruptive points where we may get to that certain point and not have the next thing we need to come through.

SIU: But you would think technology is capable of dealing with it. It's just a matter inputting into the models or does it require something more in the models that you have?

BICKFORD: Our current plan for federal interim storage is what we call a like-for-like approach, so taking the spent nuclear fuel from the nuclear power plant facilities, transporting it and putting it back into a similar configuration in dry storage. So from a technical perspective, we are not -- that is not the biggest concern because that is very mature technology, there are questions from aging management and other standpoints of what kind of documentation or inspections or things that we would need to do. We're also looking at nuclear

power plants. There are daily inspections for their facilities that are done by humans. When you get to a much larger facility, with much more spent nuclear fuel at a higher dose rate we are looking at alternatives using those robot dogs or something like that. So, there are those types of questions as well as what will the processing capabilities of a facility could be and whether you use cask handling or robotics and things like that and what those mean for the system. So we're looking at those capabilities, but the technical side of the interim storage is not expected to be the most challenging aspect.

SIU: Okay, thank you. Steve?

BECKER: Steven Becker, Board. So you know and we know that effective communication is really at the very heart of consent-based siting. And, we also know from experience that risk communication related to radiation and nuclear technology is extraordinarily challenging. In describing how you are building your consent-based siting in-house team, I heard you mention anthropology, environmental justice and behavioral science all of which are very important. Do you envision having an in-house component related to risk perception and radiation risk communication?

BICKFORD: Yes, that's an excellent point. We do have a health physicist on our team who has some experience in public communication around radiation risk and things of that nature. We're also adding a new communications support role to our team who I think is on-boarding yesterday so not yet fully up to speed, but we certainly recognized that communication, effective communication is a core component of this effort and we're actively focused on adding more communication expertise and capabilities to our team. At our national lab side, we have a number of communication experts that have been helping us also analyzing things like audience segmentation, how do you tailor the information that you are sharing based on your audience and what their background and level of understanding is, especially as we engage with our awardees from our cooperative agreements and things of that nature. But absolutely, risk communication and again, I'm just going back again to the recent train derailments. A lot of people sort of drawing analogies between what's happened with those events and similar events with spent nuclear fuel with widespread contamination, which is not supported by the historical experience and the evidence of the safety of spent nuclear fuel transportation. So, certainly recognizing and for the Package Performance Study, that is planned to be one way to

address some of that risk communication method. If we can show people in like 4K high definition a spent nuclear fuel cask being hit by a speeding train and that there is no release from that collision, I think that could go a long way to addressing. Because, as you know, when it comes to nuclear materials and radioactive materials in general and the public perception of the risk, is much different from the actual experiential risk that we have had. We've been transporting spent nuclear fuel and radioactive materials in this country for 70+ years. There's never been any transportation incidents involving injury or loss of life due to the radioactive nature of the material. And yet, the public perception is much different than that.

BECKER: So, as you move forward and develop communication materials, are there plans, do you envision doing actual audience testing with the materials?

BICKFORD: Yes, we would like to. We have some constraints on us as a federal agency. We're not able to survey things, because there is a Paperwork Reduction Act. And so, we are using the tools that we have available including using our national laboratories and other contractors to collect public information to try and meet those needs, yes.

BECKER: Thank you.

SIU: Okay, even though I am considerably nice, I think we do have to move on. Thank you very much, Erica, that was very nice.

Next speaker is Dr. Kathryn Huff. I understand there may be some audio issues but we will try and see how it works. I do appreciate her joining us from Idaho where the time zone is two hours different than us. The topic as you can see on the screen is, the DOE's Strategy for Management and Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste, Including the Use of Consent-Based Siting Process.

Okay, I understand we have a couple minute break, so I guess, well not a break, but we have to see if the contractors can bring on Dr. Huff. So just sit there and, a pause, a pause in the conversation. In the meantime, I guess if there were any burning questions from other Board members or from the staff, Bret, you have a question for Erica. Erica, you can just use the mic there.

LESLIE: Bret Leslie, Board staff. Erica, great overview. Had one question, you indicated that DOE is not authorized for

disposal. Are you implying that Nuclear Waste Policy Act does not exist or are you just saying that you are not appropriated to move forward with disposal?

BICKFORD: Thank you for giving me the opportunity to clarify that Bret. Yes, the Department of Energy is not authorized to do site-specific work on disposal, at any site other than Yucca Mountain. And the Department is not appropriated to do any work on Yucca Mountain. And so in the absence of that, we're not currently authorized to pursue disposal at other locations. The previous Administrations have determined that the Yucca Mountain site is "unworkable" due to opposition from Nevada and I think the Department's plan at this point would be to pursue alternative sites. But, at the time that we are authorized to do that.

LESLIE: A follow-up question, if I may. You've indicated that you are updating the 2013 strategy and I may have missed it, do you have a timeline for when that will be finalized and is it going to go out for public comment or what's the plan?

BICKFORD: Just another clarification, it's not necessary – it's going to be a strategy for integrated waste management. It may or may not be considered an update to the 2013 version. It

will certainly have commonalities with it, but we are not necessarily sort of using that as a starting point. That effort is in process. It will need to go through reviews within the Department and likely within inter-agencies so I am hesitant to give any kind of timeline on that, just because of the elements that are outside our control, but I would hope in the next 12 to 18 month period that we could put something out there.

SIU: Bret, how are we doing with the audio?

LESLIE: Continue the line of questioning.

WOODS: Brian Woods, Board member. Thanks again, Erica. I'm new Board member, so for the first presentation, it was a great start for me. But, I do have a question about the Package Performance Study and you've mentioned that we have not done for our current full-sized cask, we have not done any testing yet. But then you talked about UK's Smash Hit, and I'm just kind of curious, does the UK or any other nations, do they have any studies that they've done that are similar to our full-size casks and if so, do we have any plans to leverage the data that they collected?

BICKFORD: Yes, absolutely. I know that there's a facility in Germany which I will not try to say the German name, but the acronym is BAM that is capable of doing full-scale package testing and there has been testing there. And, I believe the U.S. has collaborated in some of those testing efforts to obtain the data and that has been shared with the Nuclear Regulatory Commission and used for model validation and things of that nature. And, so just to go back to the Package Performance Study, it's not because the Department has any concerns about the current procedures used to certify the packages used in the U.S. It's really to address the public element. And so in my view, all the data in the world is not able to build that public trust and confidence as much as seeing a high definition video or seeing in person the actual experience of smashing a package with a train. Also, that experience from the UK was, I believe in 1984 and I don't know if the size of that package was off the top of my head. I'm phoning a friend, Steve Maheras from Pacific Northwest National Lab.

MAHERAS: So, the cask that was used in Operation Smash Hit is what they called it, was a relatively small... believe it or not, a box. And so the box was about 6 x 6 by maybe 10? Interesting package, though, one of the few in existence that's an actual box

as opposed to a more traditional configuration of a cask, a cylinder.

BICKFORD: Yes, and I would also add that the packages that we expect to be transporting in the future just based on the configurations that fuel is in and nuclear power plants, the size of those transportation casks when loaded now range from about 90 tons to 210 tons, which is a much larger, I'd say than most other countries typically use. Other countries were a little bit quicker to the standardization than we were. We also have some packages in this country that are certified for rail transport that have 144-inch impact limiters. So, for a cask, the impact limiters are kind of the dumbbell elements on the end that protect the end edges of the cask and 144 inches generally exceeds the width and height that most rail infrastructure in the U.S. can accommodate. So, as ever the U.S. went bigger, everything's bigger in America and so that creates some unique challenges and considerations for us that other countries generally don't contend with.

WOODS: Thank you.

SIU: Okay, my understanding is that Dr. Huff is indeed online. There may be some problems with her hearing our questions, but we can type them in. But I think it sounds like Dr. Huff might be able to talk to us, at least.

HUFF: Hello everyone. I hope you can hear me. If you can't, I'm sure that Anjali will let me know. I'm so grateful to be virtually with you today. I'm sorry I can't be there with you in person. I'm glad that you have some of our NE leadership like Erica Bickford there. Dr. Bickford, I think, did a great job in the last presentation though I missed some of it, I understand there are some technical difficulties.

But, I'm really – I'm just going to talk very briefly about the work that's being done by the Office of Nuclear Energy to further our climate and clean energy goals to give you bigger, broader perspective where we stand. So, you can hear me, but you can't see me. I guess. I do have my camera on for what it's worth. But --. You all probably have some vague idea of what I look like so hopefully it should be sufficient. I'll keep my points to a minimum since it's just audio.

I'll say this, the Nuclear Waste Technical Review Board serves a critically important purpose for us in the Office of Nuclear Energy. Ultimately, you all and your advisors there on this panel and I understand Richard Arnold and other friends from various tribal nations are there as well as folks from the national laboratories and the Nuclear Regulatory Commission. I'm grateful that you're dedicating your time to this effort because it's important for us to solve our nation's biggest challenges including mitigating the biggest impacts to climate change and ensuring our energy security for the future. Not just for the future of our nuclear energy, but meeting the escalating challenges of energy security. President Biden is serious about doing everything possible to get the U.S. powered by clean energy using every tool available, and that includes nuclear energy. It's true, not just in the U.S., but worldwide. IAEA and the UN Commission for Europe note the importance of doubling our nuclear energy capacity by 2050. Our own assessment, the President's report on Pathways to Net Zero as well as the Pathways to Commercial Liftoff to accelerate clean energy technologies, a set of reports released very recently from DOE emphasize that we may need as much as twice or three times as much nuclear capacity in 2050 as we currently have today. I do encourage you to take a look at those Liftoff reports. There are a few technologies

highlighted. In terms of how to get to the kind of commercial scale deployment that we need to get to Net Zero by 2050, these reports try to capture the commercial pathways that are going to be required. One of the three technologies highlighted in this first phase of reports is advanced nuclear energy.

These reactor designs are going to be very important. They have very important capabilities including adjustment of their electricity output, expanding the benefits of nuclear power to new markets including the applications beyond electricity generation, small modular reactors and microreactors could be online within the decade. And, communities and developers could take advantage of existing infrastructure and highly skilled workforces as they identify locations to deploy these reactors. Too many skilled workers are at risk of losing their jobs when a coal plant retires. And, we think that nuclear reactors are perfectly suited to help those folks transition to employment in a new, cleaner energy future.

Here in the U.S., nearly a third of the coal fleet retired during the 2010's and a quarter of the remaining capacity has announced plans to retire. Our common reduction goals will add pressure to accelerate the pace of those retirements and repowering a coal

station with nuclear power provides economic opportunities to site owners and surrounding communities. These benefits are especially important for disadvantaged communities that had been disproportionately impacted by fossil fuel pollution.

We're thrilled to support demonstration in multiple reactors including the NuScale Reactor through the Carbon Free Power Project which will deploy a six-pack of small modular reactors here in Idaho, where I am today, in this decade. The ARDP program is also supporting Terra Power's Natrium reactor and X-Energy's Xe-100 design. Multiple other reactors are being supported by my program including Holtec's SMR 160, advanced reactors like the Kairos PB-FHR, and others are supported outside of that with smaller grants including the GE BWRX-300 which just had an incredible announcement last week regarding its deployment domestically and abroad, coming soon.

The Bipartisan Infrastructure Law and the Inflation Reduction Act have set up these reactors for future commercialization and, they can't act fast enough. Advanced reactors must expand opportunities to deploy nuclear technology and provide benefits to communities in order to meet our climate goals. While DOE is supporting these advanced reactors and fuel cycle development, we

also are working towards better supporting advanced reactor developers in their management of the backend.

We would like to make sure that advanced reactor spent nuclear fuels such as TRISO particles and graphite pebbles, high-assay low-enriched uranium, burnt up fuel and metallic fuels or molten salt fuels will differ from spent nuclear fuel from the current and light water reactor fleet and we would like to make sure that those fuels are -- that we're prepared for handling them. And that existing reactor vendors have plans for management of their storage. They may have different requirements for storage, transportation, treatment and disposal than our uranium-oxide spent nuclear fuel. And early identification of some of our key challenges will be key to developing effective waste management solutions.

We are looking forward to engaging more with a number of advanced reactor developers in this important effort and our office is developing higher level strategies for assessing R&D gaps for storage, transportation and disposal of these reactor fuels.

This strategy focuses on the TRISO and metallic spent nuclear fuels that are representative of the Xe-100 high-temperature gas

reactor and the Natrium TerraPower sodium-cooled fast reactor. But we'd like to cover other fuel types, as well. As you know DOE has supported a NAS report on waste aspects for advanced reactors and these recommendations will inform our work going forward. We've also supported work from our Argonne National Laboratory which has some similar but different conclusions. The challenge presented by these types and forms of spent regular fuel is real opportunity for world-class R&D, collaboration with industry and a proactive approach to successfully deploying advanced reactors to meet the nation's climate, energy and security goals while meeting communities where they are and meeting their expectations for responsible management of intergenerational equities like the spent nuclear fuel generated by these reactors. I think importantly and something that I'd like the Nuclear Waste Technical Review Board to consider as we think about advanced reactors is, of course, the content of spent fuel from high assay LEU reactors will be somewhat different with a different value proposition around recycling. And we are aware of that and contemplating it in our fuel cycle office.

You heard from Erica somewhat, I think, about our consent-based siting process. We'd like to realize the full potential of these nuclear technologies and DOE is working toward an integrative

waste management system toward one or more federal consolidated interim federal storage facilities. We are working towards the transportation infrastructure needed to move that spent nuclear fuel on high-level waste as well as a pathway to permanent disposal.

The Nuclear Waste Technical Review Board has previously specifically called for improvements in the safety and security of rail transport of spent nuclear fuel and we have been responding to those requests from the past. We have spent time enhancing the design and construction of spent fuel transport casks to better withstand severe accidents and hostile acts. We've been improving emergency response capabilities and procedures for spent fuel transportation accidents and increasing the level of oversight and regulatory requirements for spent nuclear fuel transportation including paths forward for advanced rail transport.

So, throughout all of this, we looked towards countries like Sweden, Canada, Finland and others who've had success using participatory siting processes, guiding community consultation, national public debates and investment in regional economic co-development. We suspect this is the democratic way forward for

siting nuclear waste facilities and the only one that we can expect to truly succeed.

DOE's current focus is on siting one or more federal consolidated interim storage facilities which will enable some removal of spent nuclear fuel from the existing power plant sites and promote new jobs and economic opportunities for those new communities.

Lessons learned from this effort should help with the development of other facilities such as deep geological repositories, but also the siting of ordinary power generation across our country will probably learn from this consent-based siting effort. We expect to enable broad participation, center equity, and environmental justice, make the needs of people in communities central to the siting process.

This process is intended to be phased, adaptive and collaborative and it may take time, but we'd like to get it right. There's time built into the process for mutual learning with communities and our intent is to ensure that equity is centered. All entities in the United States have a voice in this process and those voices

are brought into the process itself as decisions are made, not after, but before and during.

And so, we're in a place where we are excited to be releasing funding into the world through our funding opportunity announcement recently that has closed. And the applications are in review and we hope to award six to sixteen consortia to help expand the capacity for understanding what consolidated interim storage is so we can move quickly toward an interim storage facility that reduces the numbers of interim storage facilities in the country very soon.

With that and recognizing that you probably are tired of listening to my voice rather than seeing my face, I will stop talking and I understand that if you have questions they will be entered to me in the chat.

SIU: Thank you for your talk. Again, I will ask the team members first to ask questions and JoJo will put them in the chat.

HUFF: I can suddenly hear you.

SIU: All right. Wonderful. Let's roll. Anybody? Lee?

PEDDICORD: Good morning, good very early morning to you. This is Lee Peddicord, a member of the Board. One of the intriguing things as you went through this very impressive list of activities being carried on is when you talk about transport and particularly looking at what has been done in other countries. While you didn't mention it, I am sure you are looking at the situation in France. There they transport spent nuclear fuel routinely from their plants to the reprocessing plant in La Hague and the spent fuel has typically had much less cooling-off time than what we're going to have in the U.S. by many years. They typically they transport maybe after 5 to 10 years and as I say, they do it by rail. So, are you finding, I hope, some good lessons learned out of this French experience in terms of spent fuel?

HUFF: It's wonderful to see you, Lee, and thank you for this question and I would say that I personally am quite conscious of the proliferation issues, actually, of the choice to have such a, sort of, distance between La Hague and some of the generation sites that sort of existing facilities. And I think there is an open question as to how the American public will interact with the train transport. I expect that Erica Bickford, actually I

know you just heard from her and she's probably still in the room, may have an answer on this topic as to what specific lessons we've learned from France, specifically recently. But, I know that there's no country that does not contribute to her understanding of our transport situation in the U.S., so I suspect she may have some thoughts that are more specific than mine.

BICKFORD: Erica Bickford, U.S. Department of Energy. Yes, actually, when I first came to the program back around 2013, 2014, when it was the Nuclear Fuel Storage and Planning Project, there was a contractor project called Task Order 19 that was looking at international experiences with transportation and one of the specific questions was, why in France the design of their transportation packages is different than ours? Their impact limiters do not extend beyond the size of the cask. They're flush with the cask and there were some questions because that has implications for clearances for transportation and things like that. And so I know that they looked at it I see Steve Maheras is here to maybe add some more specifics. My understanding at the time was the key difference between France's regulatory requirements for transportation is that they don't require that the fuel stay intact during transportation. The fuel can be

damaged during transportation and still meet their requirements whereas in the U.S., regulations require that the fuel maintain its structure during transportation and that contributes to significant differences in the transportation package design between U.S. and France. Steve, do you have anything?

Another key difference I will say is France is also security differences. So their spent nuclear fuel is transported, as I understand it, in what we called manifest freight so with everything else that is transported by freight rail and they don't have armed guards traveling with their shipments. And so that’s just a security difference that they’ve elected to make as compared to what the U.S. requires. So those are just some key differences I see. I think Steve Maheras from Pacific Northwest National Lab has something to add.

MAHERAS: Yeah, sure. So, on an international level too, we’re working with the IAEA in a document that will describe things that have been learned in past transport activities. Now, this will include France, Russia, Netherlands, the U.S., etc. So, it’s a little bit broader document than what you are referring to just with France, but it will capture the things that we’ve learned over time in these campaigns.

HUFF: I suspected they would have excellent answers, thank you, both.

SIU: Are there questions from the --?

TYLER: Yes, thank you Kathryn. This is Scott Tyler, Board member. I very much appreciated your presentation. Just a, maybe a question or a suggestion, I think the Board is quite excited about the new generation of advanced reactors that are coming on board and how that may fit into the waste disposal in the long-term. And I think it would be helpful to begin talking about from a standpoint of consent-based siting and public information, how much waste would we be expecting to be added to the existing pool that we have today, so that we can begin to get the public thinking about with these new reactors on board, what would the additional loads be likely for spent fuel in the future? Just a long-term planning and informative process at that point.

HUFF: It’s a fantastic question and, of course, there is lots of ways to answer it and largely, it takes significant systems analysis. I think if we look at the simple scenarios in which we take our today’s 2,000 metric tons a year of light water reactor

fuel and we imagine a scenario that, just sort of, baseline has small modular reactors, light water reactors, sort of similar and we double the capacity of nuclear power in the country, then we're approximately doubling, maybe slightly more than that because there's some different fuel utilization characteristics, small module reactors, but you can imagine a scenario in which we go to a rate of 4,000 metric tons a year or if we triple the amount of nuclear fuel, you know, of nuclear reactors in the country, you may then see 3,000, 5,000, sorry, three times that, so 6,000 metric tons per year at minimum, right?

Some of it if you have some kinds of advanced reactors including potentially recycling, you may have a reduction per reactor per megawatt hour you produce, maybe slightly less volume and so it may come out in the wash depending on the mixture of reactors that you look at. And, but, most importantly, we'd really like and I think you all are aware of this, the driver for a lot of our decisions around spent nuclear fuel management storage and handling and our predictions for sort of how we'll manage the repository are more driven by the type of fuel than the real volume of it because it's a fairly small volume in general and so I think there will be multiples of the existing rate if we see

the kind of doubling or tripling of nuclear capacity that we'd like to see.

But, it's really the characteristics of that fuel that we need to make absolutely certain that we're addressing appropriately. And, I think in particular, as we look at a future in which there are high assay LEU advanced reactors like sodium cooled gas reactor from Natrium or X-Energy Xe-100, there may be a desire to recover that remaining uranium that's left in these high assay LEU spent fuels because there's a better economic argument for doing so. And so now you have a question of the wastes from any potential reprocessing process. And so we need to be prepared for all of those outcomes, but it will probably look like at least a doubling or tripling of the volumes or the masses from spent nuclear fuel that we will be dealing with, at minimum. Does that help? But, we need to do a systems analysis and really, really understand the population of reactors we will be deploying and we have a number of different possible pathways before us today.

TYLER: Thank you, thank you very much.

SIU: Teresa, please.

FRYBERGER: Hi Kathryn. This is Teresa Fryberger, new Board member. It's very nice to meet you, if only virtually. As, I think I'm right, but I don't believe there's any overarching plan for nuclear energy in this country that takes into account the role and the overall energy picture, expected impact on carbon emissions and climate change as well as the waste management and the whole fuel cycle, but we're focused on waste management and disposition. And it seems to me that having a plan like that for the U.S. is really key to making things like consent-based siting work, as well as many other things, it just seems like a big hole. And I guess I am wondering if there's any plan for a plan and how that would come about or would that be your office leading that or are you already doing that?

HUFF: Yes, I would like to direct your attention to three documents, two of which I mentioned in my talk. One is the President's 2021 Pathways to Net Zero. In that document, we did a ton of analysis in the Department of Energy and across the interagency to identify specifically how different deployment schemes across our sort of full range of clean energy technologies can get us to Net Zero by 2050. Nuclear is in that and it includes the following facts: (1) we must maintain the existing capacity of nuclear power through 2050. We cannot drop

below 94ish gigawatts or else we will really put significant pressure on the other sources of clean energy that they can't really abide in a firm, clean power system. And, we may need to go all the way up to doubling the amount of nuclear depending on how the other clean energy technologies deploy, whether we make significant advancements in a hydrogen economy or significant advancements in long-duration storage. Both of those things directly effect how much nuclear we need to deploy. So that's in a document published by the President and the State Department in 2021 called Pathways to Net Zero.

Last week, the Department of Energy, in collaboration with my office, the Office of Technology Transfer and the Loan Programs Office deployed a set of reports called the Liftoff to Commercial Deployment. So, these are liftoff.energy.gov. These are great reports that describe precisely how we are going to get there to full deployment and it actually has a stretch goal to get us to tripling the amount of nuclear power, because ultimately there's a recognition in these reports of the importance of the cost of the total energy system which was like under assessed in that other set of reports in 2021. These liftoffs to accelerate clean energy technology commercialization reports, there's three of them. One is advanced nuclear, one is long-duration storage and

one is the hydrogen economy. We'll have new phases of additional technologies added to this set of reports and they intend to be precisely this, an industrial strategy to tell the world how we see each of these technologies as potentially fitting into our clean energy goals and what it takes to commercialize them. How we get private industry to invest alongside the government. And, so, I would direct you to those reports.

But, finally, yes, it does fit within my office to tie those things to the spent fuel concerns and questions that are addressed sort of more in this vein. So I think it's a really good question, but I would direct you to those two reports as well as some assessments by the International Energy Agency which say something very similar around the globe, right? The International Energy Agency assesses that a doubling of nuclear power by 2050 is the [inaudible].

FRYBERGER: Okay, thanks. I'll look at those.

SIU: Thanks again Dr. Huff. I do appreciate your suggestion where the Board may also look as you know, we're thinking about our work plan, as well.

Okay, with that, I think we need to move on to our break. I apologize due to the technical difficulties, the break is going to have to be shortened. We will try to reconvene in a few minutes, maybe 10:00. I know that is a little bit quick for you, but as soon as we can after 10:00.

Thanks again, Dr. Huff.

[BREAK]

SIU: Thanks everybody. If we can start getting seated, Gerry says he can catch us up, but we have folks online, as well, so let's try to get rolling. Okay, thank you for being so understanding, next up is Gerry Jackson after he ties his shoes.

JACKSON: There we are, okay, are we ready? Good morning. I would like to thank the Board for the opportunity to present to you this morning. My name is Gerry Jackson. I work for the Department of Energy, NE. I work for Erica Bickford. Erica mentioned earlier about our disclaimer. I'll give you a minute or two, not even, to look at that. I'm going to talk about Nuclear Power Plant Site Evaluations this morning. I'm going to give you an overview and

we'll do a deep dive into the actual technical piece of how we go about the evaluation.

So, why do we do this? Why do we go to these sites and take a look at these plants? The purpose of the evaluation is to confirm and gather information about the site, look for gaps in information, what we need to know about the site, get the inventory of the site, document conditions at the site. And as I go through this presentation, I'll go into a deeper dive in each one of these subjects: evaluate the site transportation, what the experience they had in the past, what's the current situation and what current experience did they have; look for gaps in information about the information for the shipment of the spent nuclear fuel and GTCC, greater than class C waste; and look at the available information to evaluate options for transporting this spent nuclear fuel.

Aspects of the transportation that is evaluated, look at the characteristics of the fuel. What are we talking about? Compare the inventory versus what's there. Does the burn up and heat decay meet the conditions in the certificate of certifications for the cask, CoC's rather. Look at the onsite infrastructure. What's on the site? What's available to the site? What's near-

site infrastructure? What's available locally with respect to rails, boats, a barge access, road access, locations and capability of transportation infrastructure? Each site is unique. When you go to one site, you've been to one site. It was great that the Board could go yesterday to Crystal River to take a look at that ISFSI. Each site evaluation is a case-by-case review. And so what we do with this information? We take this information and it goes to the UNF-ST&DARDS? Kaushik's going to give us a brief on that later and some systems modeling.

A quick snapshot of the location of spent fuel around the country. Down here in Crystal River. We are going to try and get to two more this year and I'll touch on that a little bit, but again, a quick snapshot of where the fuel is around the country.

So I'm going to go into a deeper dive on the evaluation process itself. There's an extensive amount of work that goes on before we even get to the site. We go and we have a list of questions submitted to the power plant about two or three months or so before the site evaluation. We coordinate with the site with respect to security access, who is coming, clearances and whatnot, as required. We also understand requirements for photography, for taking and sharing information, what information

we're getting from the site. We start to coordinate with our federal partners, Federal Rail Administration who will be coming with us on the federal rail side. We look at Department of Transportation, U.S. Coast Guard, Department of Homeland Security, U.S. Army Corps of Engineers. And then, we also reach out to our state regional groups... depending on where you are in the country, we invite the state regional groups to attend. And then tribal partners. We start looking at the logistics, how we are going to get there. Where we are going to stay. What are we going to do? Where are we going to have the meetings? And this process, is a four to six month or so process.

We start looking at the information before we get there. Where do we get this information from?

There's a lot of information out there that we start to call for that particular site, spent nuclear fuel inventory that's onsite. What does the onsite infrastructure look like? When was the site built? Who owns it now? When was it transferred? What changes were made? What modifications were made? What's onsite now as far as handling facilities, moving equipment, heavy haul cranes, that type of thing?

What is the transportation experience of the site? How did they get the heavy equipment in? Have they moved material off site? How did they do it? What was their experience with the, what we call high-wide-and-heavy transportation of this material?

And where do we go with this information? There's a lot of information out there. U.S. Nuclear Regulatory Commission, their database on the nuclear power plant, facilities interface, near site transportation infrastructure reports, service planning documents, industry sources, Atomic Energy Commission statement, AEC, the forerunner of the NRC, license renewals, licensed irradiated fuel management plans. Again, there's a lot of homework that we go through and take a look at before we even get to the site.

Additional information, independent spent fuel storage installation managers. Is it a decommissioned site? Has the plant been removed and now we just have independent spent fuel storage installation? What are the conditions of that site? What's onsite? One of the things, I think, was interesting we learned yesterday at Crystal River that the cask handling system is not onsite that it's brought into the onsite when they want to move the casks around. That's something that we take into

consideration as we start to do our evaluations. What is available locally for heavy lifting? As we drove past the cranes yesterday, we looked and I think there's a 30 ton capacity on those cranes out by the coal pier. That's not going to be enough to lift our casks, so what else do we have to think about as far as heavy lifting equipment.

And Google Earth, we do a lot of work with Google Earth doing visuals, layouts of the sites. We also get that information from the site. Again, Crystal River was great yesterday. They gave us an overview of what the original footprint of the site was, what the current footprint of the site is and what the planned footprint of the site is going to be. That's all going to help us as we do and develop our reports.

So, I say we do a little deeper dive into what's being moved and what are we looking at when we go to this site. So, we take a look at the inventory. What material is actually on the site? What characteristics of the spent fuel bundles? Where they're located... How they're loaded. We look at these databases, the most recent database through December of 2017. It's shared with the UNF-ST&DARDS and again we're going to get a presentation on that later. What type of cask is it in? What type of storage

facility do we have? Do we have horizontal storage, vertical storage, in-ground storage? What type of cask do they have? And there's a wide variety of casks out there. What are the storage features? Are there damaged fuel assemblies? Is that something that we have to take into consideration?

Loading maps. How is the fuel loaded into the casks? Review of casks, the location of each cask, the spent nuclear fuel assemblies in the cask. Where are they loaded? Dose rates are calculated. All of this goes into how the canister may be shipped. How we're going to look at taking that and putting it into a transport cask moving it.

So, as we look at the casks that are on the sites, we take a look at the canister transportability. What are the dose rates? This is to assist us in determining the possible transport can or canister that it's going to go into. I think you can see there's discharge and burn up rates. We start to do calculations as to what the conditions of, what they are and when we start to ship the material.

This is a quick snapshot of what type of transportation cask models that would be used. You see there's a wide variety of

casks, everything from the small HI-STAR HB to the HI-STAR190 size, weight. Transportable requirements are all different. We have to look at each site and determine what we may use, what cask may be used for that transportation. Again, if you've been to one site, you've been to one site.

Site conditions. So, like I said a little deeper dive into each site. We start looking at the rail. What's the condition of the rail. Who owns the rail? Is the rail being used? What's the rail being used for? What's being transported on it? Who owns it? Again, rail in this country is privately owned. It's not like the road, so what's the condition of the rail?

On-site roads for heavy haul. What's the condition of the road systems. We saw yesterday at Crystal River that the ISFSI is up high. If you're going to use a heavy haul lift down to a railhead, you're going to have to consider how to transit and move the material on the road. Other sites, may be Black Bar [Big Rock Point] up in Michigan, they had to build a road to move the spent fuel casks from the spent fuel pool over to the final storage facility. So, we were looking at the heavy haul site road conditions for the site.

Is there barge access? We did a drive-by yesterday at Crystal River to look at the barge facilities. What kind of conditions are the port? Is the port facility going to be able to handle heavy haul transport? Are we going to need cranes? What kind of cranes? What kinds of barges? What's the depth of the water. And, as we do all this, we also communicate and work with our federal partners, U.S. Army Corps of Engineers, U.S. Coast Guard. When you're talking about the Coast Guard, if something like this were to go forward, working with our partners, was is the area Maritime Security Committee look like. What does the local Coast Guard group and what does the local Coast Guard station have ...information on the shipping and what we're going to be doing. So we tie a lot of our partners together.

On-site equipment. What is on the site? Again, yesterday we learned that at Crystal River they didn't have a heavy handle equipment. That would have to be brought in by Orano. In this particular case, Big Rock Point, you have a horizontal transport system onsite. You've a transfer station at Trojan, the rail site at La Crosse. So again, you look at each one of the details of the site for all of the modes, intermodal, multimodal transport.

What type of staging area? What kind of footprint do you have? You're going to have to bring in heavy haul equipment. You're going to have to build a consist. You're going to have a lot of people on site. What do you have to do to support those types of operations?

Once we've done the evaluation on the site, we're going to move outside of the site. We're going to go to the local community and start take a look around and see what's out in the community with respect to, what's the rail? Again, rail is privately owned. Do we have a Class 3 rail? Do we have a Class 2 rail? How do we get to a Class 1 rail? Who owns those rail lines? What would we have to do, and again, it's a team approach. So, we'll have the FRA with us, the Federal Rail Administration with us. We may have our state partners who understand the rail infrastructure who understand the road infrastructure. We'll have our regional groups. We'll have our tribal representatives. And as we go around the community and we start looking at all of the different options, again is it a national line? Is it a rail spur? Is it an active line? Is it an inactive line? We calculate what we have to do to maybe get that line up to speed. What would that rail spur need to get it back to serviceability. And then, as was mentioned earlier, one of the things that I start to look at is, what are

the security requirements? We're going to move material and have a location for temporary storage as we build the consist for the rail, what are the security needs? How do we communicate that to the community? What would their expectations be of our security requirements? What would we need from them?

Local roads and highways. Heavy haul lift. What's the conditions of the road? Is this road going to be able to take multiple trips of heavy load tractor-trailer lowboy cask movement over multiple days, multiple periods? Are there going to be road closures involved? Are we going to have clearance situations? Are we going to have weight situations with bridges. So what are the characteristics of the roads that we're going to be looking at as we determine the options to move spent nuclear fuel?

Similar with barge access. Is the pier facility satisfactory? Does there need to be work on it? What are the local environmental conditions we'd have to think about with respect to depth of water, access, security operations? So again, a multimodal review of near-site infrastructure around the power plant.

We look at potential transload sites. The slide here is just a sampling of what we have done and gone out and looked at some of the sites. Railhead near Connecticut Yankee. That would be a rail that would have to be looked at for structural integrity. Is that going to be able to be used? So again, and we look at each one of the rail conditions. For transload, maritime movement, heavy barge movement, not only how the material goes out, we look at how material came in. So at a site, how did they bring in some of the components ..were the heavy components moved in by barge? What lessons learned can we have from material coming in or if you decommissioned a site and you are moving heavy equipment out by barge, what lessons learned can we have going out that way?

You see a reactor pressure head at Maine Yankee going out, steam generators, Kewaunee and La Crosse, the reactor pressure vessel on a rail movement.

Google Earth is your friend. GIS databases, we use a lot of information from GIS out on the nuclear power plant. We look at the different layers of information that’s available: highways; bridges; rail networks; transload; navigable waterways; tribal areas; maritime security zones. Again with the Coast Guard, what’s the maritime security zone look like? So, Google Earth and

GIS databases give us a lot of information as we develop the report.

So, Google Earth imagery. Oyster Creek, Intercoastal Waterway, what's the maritime traffic in the area going to look like? Is that going to be an issue? What are the inlets? Barnegat Inlet I know is a pretty challenging inlet. Eight foot mean low water means you will not get a heavy barge through there. Oyster Creek channel, about 8 foot. So what kind of barge or what can you bring into that area?

So, again, using Google Earth, using GIS databases, using navigational charts to understand depth of water channels, access, buoy systems. We'll take a look at that entire process for all aspects, not just the maritime piece.

The site visit. It's a multidiscipline, multimember team. It's multiday, usually three days. 20 in person site evaluations. 20 have been done so far. I was on one last fall as a member of the NRC. So, I'm looking at it from the other side of the coin now. We have a good team representative of our state partners, our federal partners, tribal partners, state regional groups and we'll start to do the homework before we even get there again

passing clearances and understanding what the requirements are, safety concerns.

It's a three-day process. The first day is going to be spent at the nuclear power plant going through and taking pictures and looking at all of the things that I presented earlier. What are the rail systems look like? What are the heavy haul systems look like? What does the onsite infrastructure look like? Gathering that information, taking pictures as appropriate. And at the end of that first day, you actually, you go back to the location you are staying, usually a hotel, a conference room and you sit down and you consolidate your notes. You take notes. What did you see? What did you see? What do we need to be concerned about? What should we follow-up on? So, not only it's an all-day site visit onsite, you go back to the hotel room and you start doing more work. You start gathering that information.

The second day you go out. You start looking at the near-site infrastructure you've identified... you've preidentified sites that you may want to go visit. What's a good transload site? Maybe we should go look at that barge. Is there a railhead that we should go look at? So, then you go to those sites. You take the pictures. You do the evaluation. Heavy haul truck lift. Is

there a bridge that we need to be concerned with and in some cases you get a state representative who may be affiliated with the highway transport program for that state and they can tell you about what's the permitting going to look. Are we going to need a heavy haul permit? If you are going across state lines, maybe you have two representatives from two different states. What does the state permitting look like? What is the escort? Are they going to hand off escorts? Are they going to want an escort with their state patrol?

It's the same kind of conversation... rail infrastructure, heavy haul truck routes.. rail and barge transload locations. What does that all look like? And, again, at the end of the day you go back to the hotel, you start to gather your information, document what you have looked at. Again it's a large team and you start to compare notes.

On the third day, community meetings, a set of community engagement. If there's a community advisory panel that we want to meet with, again, part of the homework is to reach out to the community and see what they want to do as far as engagement. Is there a public meeting schedule? Can we sit in on a public

meeting? What can we do? And, again, homework at the end of each day.

So, what you see there are some pictures out there. We stand on the side of the road. You go to pilings. You go to railroad yards. You walk up and down railroad track. You take a look at the rail infrastructure. You talk to the experts. You talk to the local law enforcement people who may be with you.

Again, states and tribes. The SRG's representatives may be there. They have interest in what we're talking about. We have the Southern State Energy Board, Western Interstate Energy Board, Council of Midwestern Governments for Midwest and Eastern Regions, state representatives attend. And, again, we walk up and down the railroad tracks and literally look at the condition of the rail tracks. Who owns them and what's being used on them. How often do you get traffic on these rail sites.

We may have state police representatives. Again state Department of Transportation representatives, some environmental, not environmental, emergency response folks or hazardous material, rad safety people may be with you. Again, it's a broad spectrum of team that engages.

Tribal representatives. It's, we are very fortunate and we have Richard Arnold who has been on a couple and I know I was on one with Richard in Indian Point and it's great to have that type of representation and understanding of the tribal conditions and tribal cultural concerns. We work with the U.S. railroads, the Federal Rail Administration representatives. They bring great information. They know who owns the track, how often the track is being used, what track improvements may be necessary. What track restrictions may be in place. They can also give us some information on what may have to be done to upgrade the track to get it to a satisfactory condition that we can start to move the material on it. They understand how the linkages from the Class 3, Class 2 and Class 1 are related so that we can start to plan how the route of the rail may go to move this spent nuclear material.

And the community engagement, the local community engagement. Again meeting with advisory panels if they exist. If we can set up the schedule and have that meeting, we want to listen to the community. We want to give our presentation, talk to them, answer questions, talk to them about our responsibilities, a lot of what Erica had talked about in her presentation is how we want that

community interaction. We're just not going to go there and say, we are the federal government, we're here to help. That's not what we're here to do. We're here to listen as well, give you information, listen to your concerns. And get some valuable information back, information that we may not have understood. And again, we'll take that back and start to compile that or incorporate that into our information.

Some of the results. So, we do all of this, and we get some information back. So, what's at the site? What's the actual number of spent nuclear fuel assemblies at the site? You see across the bottom the list of sites that we have been to and the number of assemblies at the site so we can start to develop some information on the number of fuel elements and then the canisters. We start to look at the canisters at the site. We start to develop the identification of those canisters, start to plan about what transport situations we may need for those particular canisters. Some sites have multiple canister types so we have to have multiple planning considerations for multiple types of shipment.

And then canisters by transport type. Again, more information that we develop is going to go into our planning calculus of the

logistical requirements for the number of casks on a site. So now you start to think about if you're going to move three or four canisters, five or six canisters over an extended period of time. You're going to move them to a site for a transload over a period of time. You can start to develop a timeline for how long it will be to do the de-inventory at a particular site.

So again, if you've been to one independent spent fuel storage facility, you've been to one. Multiple types, Fort Calhoun is similar to what we saw at Crystal River. You have the vertical concrete casks at Maine Yankee. You have underground storage at Humboldt Bay, HI-STORM UMAX at San Onofre. Again, all different types of canisters. They're going to require all different types of logistical information for how you're going to lift it, how you're going to transport it, how you're going to put it into a cask, what type of facility is going to do the transload. So each one of these sites is going require that type of in-depth review that we do.

Again, what information is onsite? Like I said, yesterday we learned that Crystal River does not have a handling system onsite. It would have to be brought in to do that. There's transfer casks at some locations, some towers, some horizontal

transport systems. Again, every site is different. I believe when we went to Indian Point, they had two crawlers that were able to move the spent fuel canisters onsite. They had the pathway laid out so we know how the crawlers were going to come, move and lift. But then we have to determine where they are going to move the canisters to. What kind of transport canisters they are going to be in. So, not only is it the material that we're looking at the spent nuclear fuel and logistics, but what other things around that that are on the site.

And, again, what I start to look at is the security requirements. We heard yesterday something about comp measures. If you're going to go to an independent spent fuel storage facility, you're going to open it up. You're going to take down the gates. You're going to open up facilities. You're going to have people on site. What do the security requirements looking like for that? That's not in these reports, but that's something that we're thinking about, as well.

Barge and slip onsite rail line at Maine Yankee and the barge at Maine Yankee and I can keep us honest on time, these are a lot of the pictures that we have taken on the site inventory reports.

Off-site access, the Hoosac Tunnel, a challenge maybe for high-wide-and-heavy, high dimensional transportation of a spent fuel cask.

Low overhead clearances like I mentioned earlier when you take a look at the transport at the highway, the road conditions. What are the bridge conditions? What are the tunnel conditions? What are the road weight conditions? Are you going over any pipelines? Is there something that you should be concerned about? Do you have to lift overhead phone cables? Do you have to lift overhead power cables? You have to do all of the dimensional measurements to make sure you can clear a turn coming out of a facility. These facilities were built in the 70s and 80s. Communities have grown up around them. The roadways that were nice and open and wide when you built it in the late 70s are now congested and built up and developed. So, is that going to impact your calculus for transportation?

Pilgrim, Massachusetts. A rail, or a potential transload site where you're going to bring the cask from the nuclear power plant to a transload site. You're going to build the consist. One thing here I'll point out is one of the things we do is go and take a look at the track itself and chalk over the track and determine

the weight capabilities. In some cases, there's a date manufactured on some of these. They're over 100 years old in some cases which is interesting. But, again, the transload locations is something that we will look at for each one of the sites as a possible option for moving the material.

Rail Spur Fort Calhoun, Nebraska. You have a rail crossing. What does a rail crossing look like? What are the requirements for rail crossings? The bridge, the overhead bridge considerations?

So, we went to Crystal River yesterday and I know there was some request for more information about Crystal River. So, it was -- and I'm not going to read all the details, but operating nuclear power plant recently shut down. It has two decommissioned coal-fired sites which I believe are pretty much demolished. There's a gas fueled facility still on the premises. They have 1,244 PWR assemblies in dry storage... dry storage NUHOMS. You saw the horizontal storage casks. There are five or now, I think, six canisters of GTCC waste. And it's served by the Florida Northern Railroad. One of the things we look at is what railroad, again, who owns it? How often is it used? What other infrastructure is in the location? So as we go down, we drew down a little bit more on Crystal River.

So again, Google is your friend. It was interesting, we saw yesterday, we did the tour. So where am I?

We went and looked at the maritime transport possibility. Those are the two heavy lift cranes for offloading coal. This was the turnaround area that we looked at. We did the loop. We went to the storage. We walked around the storage. We didn't go in the protected area. We walked around the ISFSI and we just did a quick tour and drove around here. We looked at the rail spur as the rail spur came in. When we drove onto the property, there was a rail line on our left-hand side as we drove in. We saw what they're calling down here is part of the handling area. They have what they call the 'big top.' It's a great big tent and then they have a storage facility down here for some material.

A little deeper detail -- where are we? Alright, the gas plants are over here. The reactor and the ISFSI over here. This is a higher-level view. Here's the pier facility. There's the barge area, the rail loop. This is where the road came in, the rail loop. That's part of and that is a part of the rail loop you see there.

Good picture of the horizontal storage at the site. It's an elevated site. You can see some of the protective security requirements, or security facilities around the site. Part of what you have to consider is you're doing a de-inventory report is, how are you going bring the loaders in? Which way are they going to go? How are you going to take them out? What roadway looks like? What gates you're going to have to open? Again, what comp measures do you need to put place for security? Again, that doesn't go directly into these reports, but that's something we're always thinking about as we go forward.

The rail spur, again, we talked a little bit about that. When we drove in, you saw the rail spur and then the loop over here on the side as we – we drove literally right past where they would do some of the loading right here. Again Google Earth is your friend. Steve does a lot of great pictures of rail.

So, lessons learned. So Crystal River has shipped and received large components by rail. So you can see the rail line coming in with some of the heavy equipment that came in, the generator, moisture separators, 2009.

So again, lessons learned, how did they bring it in? What were the considerations? You see the size of that flat car, again what we call high, wide and heavy.

Again, more lessons learned, how they brought heavy equipment in, what kind of heavy lifting cranes did you have to do? I think I have a few minutes left. They also had the horizontal storage modules that were brought in by train. This was how they brought them in and then you saw them finally in place about top of the hill at the ISFSI. So they were brought in in heavy lift. You can see, again, the logistical considerations. This is something that we would look as heavy crane. What kind of platforms? What did you bring it on? How did you stage it? How did you use to bring it in? This type of information we see here helps inform us on our calculations of how we would go the other way with the spent nuclear fuel cask.

Again, more pictures of the horizontal facilities coming in, being stored prior to installation.

Great slide because we learned yesterday, we said, we talked to the folks up there. Our initial discussion with them was they receive coal by rail. So in talking to them yesterday, we found

that they don't get coal by rail. So once you do a site evaluation, it's not over. You have to go back. You have to continually look at that, reevaluate it. What's changed? I think in one case, I can talk about. We did a site evaluation and there was a building that was on the site and it came into our calculations and I can't remember exactly what and we went back and the owners of the site said, oh yes, we tore that building down. So you constantly have to go back to the site and understand what's going on, what's changed. Again, constantly understanding what's going on. So that's a great slide to say that it's not just a one-time snapshot. It's a constant evaluation.

Like I said, what type of rail do we have? So, coming out of the facility, how do you get to a Class 1 rail track? You have the spur. You have Florida Northern Railroad. This is where the FRA comes in. This is where the state regional groups come in to give you that information that you need as to how a shipment by rail may go to get to a Class 1 track. Each one of these is different. At every site, it's a constant evaluation. You have to go back and look again. Maybe the rail spur may have changed. Maybe it was developed. Maybe something happened. Maybe the tracks tore

up. Maybe they sold it. Again, all types of information that you have to constantly upgrade and take a look at.

One of the things we do with the rail is defect detectors. It's something that we always look at. You have what's in the news lately, and Erica mentioned, hot bearing detectors, dragging equipment detectors. Again, 115 pound rail, wheel detectors, number of axels determine speed. We always take a look at and understand what's on those tracks and what we can use to inform us of the condition of railroad shipments and their conditions.

Crystal River Barge. They brought in material for the low pressure rotors by barge. They also routinely receive a lot of coal by barge in that facility. So it's an ongoing facility. It's maintained. The Coast Guard has it on their list of Tier 3 facilities.

Again, another picture of the pier facility. Again, we toured. We drove past the cranes. We did a turnaround, I believe here. And then we went back up to the loop. These are the old conveyor belt for the coal. But this is the facility that we would be looking at.

Again, more information that we can use on bringing material off-site. Interesting, they did like a rail on rail off kind of configuration for the turbine components coming in. We would look at this as maybe we could do this in reverse for spent nuclear fuel going out in a cask. What would that look like?

Heavy haul truck, high-pressure turbines delivered. Again, if you look at the type of truck, what are the considerations for that type of truck? What road conditions are in place? What near site road conditions are in place. What would we have to think about for a spent nuclear fuel cask going in the other direction?

Public meeting in 2019, about 50 participants, two congressional staff, ten local government representatives... ten, at that time, Duke and 30 public. That information is available, by the NRC website. There’s a website ML number down at the bottom that you can look at that public meeting.

Every site has at least one possible mode of movement and what the folks at PNNL did I love this chart because it gives – it starts to give you a conception of the challenges that are going to be faced as we start to look at transporting spent nuclear material. All the different types of options for transporting

spent nuclear fuel in a quick snapshot, so it gives you some sense of the challenges that we'll be facing.

Lessons learned during site evaluations. Each site has at least one option for moving spent nuclear fuel. Connections and contacts, I mentioned quite often that we work with the federal rail. We work with our Coast Guard partners. We work with our SRG's and you're building those relationships and you're understanding who you need to talk to further communicate, coordinate, and collaborate as we go forward on the mission of our office to look at what we need to do to start transporting spent nuclear fuel or to get prepared to move it. And that dialogue has also brought information to us.

We are just not a transmitting mode. We're on a receiving mode as well. We get some great information and input from all of our partners, all of the stakeholders including at the community meetings. And then, once we get the information and we start to develop the report, we share it with our partners as we develop the report.

Future site. We have two coming. We're trying to get to TMI and I think Nine Mile Point. I think we're still working on those

dates. We haven’t got them established yet. But hopefully we’ll get two this year.

COVID put a bit of a hold on what we wanted to do and we’re trying to get back up to speed. So, we’ll see how we do in the next year or so.

And I did it with two minutes left. How did I do? Questions.

SIU: Thanks Gerry. I’ll start now with a “quicky.” Can you talk about some of the considerations in choosing sites for -- you prioritize, you obviously can’t look at everything all at once. So how do you decide which sites you look at first?

JACKSON: That’s a great question and full disclosure I have only been with the DOE for about five months so I’m going to phone a friend and I'll ask my colleague Steve Maheras to help me on that one.

MAHERAS: Steve Maheras. Let’s see. So, in the beginning, we started out doing the nine sites that were closed at the time, so like in 2012, 2015 timeframe and we continued to work on the closed sites in roughly the order that they closed. Not

exclusively, the order that they closed, but roughly the order that they closed, as we could get in. We have since moved over to doing operating sites. So, this year we did Morris, Dresden which are operating facilities. So, our goal is to transition to operating facilities in roughly the oldest fuel first order, but understanding that there's outages at facilities, there's maintenance at facilities, so that's more of a rough order, but probably will not be the order that occurs in practice.

BECKER: Stephen Becker, Board member. Thank you for a very informative presentation with a lot of great pictures that really show how the process works. In the second half of your presentation, where you talked about the examples of research, of results, rather, there were a number of really good graphics where you accumulated information across all the different sites that you have visited and those are very helpful in kind of getting the big picture.

I am wondering about the area of the meetings with community engagement and advisory panels. Has there been any effort to accumulate what has been learned from those meetings? Have you, for example, had the opportunity to think about any patterns or common issues across all the sites?

JACKSON: That's a great question and I am going to phone a friend again. So again, we had the one ML listing that the NRC listed as that engagement. But, great questions, have we synthesized that?

MAHERAS: So, this is the area of the evaluations that has probably changed the most over time. Right? In the beginning there was six of us in a van and we did three sites in a week. It has since changed into something that's larger with the three-day affair that was described. So, we learn, adapt, innovate, right? And really the innovation has occurred in the area of doing more community engagement. Now, we had a Waste Management conference paper two years ago that discussed external engagement that had occurred up through that time. So we kind have gone in phases, we did not do anything for the first couple of sites and have gradually increased over time to talk to community engagement panels, politicians, emergency responders, state police, tribes, etc.

JACKSON: I would also offer that as Erica described, how the office is being built, again ten or so new people in the last eight months. The social scientists coming on board are starting

to inform us. Again, I have been in this industry 15 years now as a security specialist. That’s my focus. But now I'm talking to other disciplines and I am learning, as well, how to communicate and engage with those communities.

BECKER: So, do you envision putting them to work in the future to accumulate what’s been learned across the different sites?

JACKSON: Again, we’re in the crosscutting team and I think that term, crosscutting, that’s part of what we’re going to do. We’re relying on those people to inform us on how to make these communications better.

BECKER: Thank you.

PEDDICORD: Lee Peddicord with the Board. A couple of quick questions, I think. Again, these photos are extremely helpful. Just comparing a couple of them, one with slide 13, you showed that range of the different transport containers and so on.

And then when you compare to a number of the others that you showed where they’re moving say, greater than class C waste off of site, you showed several of those. Roughly, how do those

transport containers for the GTCC components compare in terms of size dimensions and weight to say, what would be the transportation canisters for spent fuel. Are they comparable?

JACKSON: Each site, like I said, you've been to one site, you've been to one site. I think that greater than class C-type containers are a standard type of container, but I will phone a friend who has been doing this for a long time.

MAHERAS: This is Steve, again. So, in general, we have a fleet of transportation casks that are licensed to handle canisters of spent fuel and licensed to handle canisters of rad waste. And so that cask would be indistinguishable from the outside except for placards, right, that you would have, right? So, looks like a duck, quacks like a duck, it's a duck. It looks like the same from the outside.

PEDDICORD: So is the ducks, are they the same size and roughly the same weight as well, too?

MAHERAS: No, the canisters are in general similar in size, but not the same in weight.

PEDDICORD: Lighter?

MAHERAS: I would have to check that. I don't know the answer to that. But I would expect lighter because of the uranium that’s contained in the spent nuclear fuel.

PEDDICORD: Kind of where I was going with this is, you’re building up an experience base as you’re moving old core components and kind of pressure vessels and so on that hope, or I assume, would be valuable as you project forward in moving spent fuel.

MAHERAS: Oh, exactly correct. Exactly correct. So, Sara is going to talk about our reports that we do to analyze removing the fuel from the sites, right, the deeper dives. So, not to steal your thunder, but we are going to go to the Vermont Yankee site next, because they recently moved class C waste in an MP 197 HB that we heard about, we were down at Crystal River yesterday, because we want to capture that knowledge while the band is still together, right? We don’t what the people to disperse. This is a big problem in these evaluations, because a site will close and you will go from 800 people to 150 people in 18 months, right. When those people leave, knowledge leaves, too. So, there is a real

sweet spot to getting to sites after they close. All of that being said, COVID threw a big bash into that, right? It made it hard to get to sites. But, yes, we try to capture that knowledge and use that experience, because that could be the model for how the fuel moves.

PEDDICORD: Thank you.

TYLER: Thank you, Gerry. Scott Tyler from the Board. And thank you Steve, also. Great presentation and I recognize, I think a little better, particularly after your presentation how much work and effort has to go into this on the upfront side. So that is where my question comes from, this is a huge amount of work and you are staffing up and you made the point of the world changes out there on the sites.

Do you have at this point a sense of how often you'll be returning or revisiting these sites given the number that you still have to do? And just to begin your thinking of, what's the long term.

JACKSON: Again, phone a friend. There's conversation in exactly that and it's not just a planned cycle, but for example yesterday

having a conversation, “hey, how many coal cars do you get in?” “Oh, we don't get coal cars any anymore.” Okay, data point. So, formal and informal communication is key. Those relationships that you build.

I think one of the questions of the Board was, how do you communicate and coordinate with other agencies? It is a multi-agency, multidisciplined program. So federal rail, U.S. Coast Guard, state and local regional groups, tribal members making those relationships, keeping and building those relationships and as Steve just described, knowledge management. Erica touched on it a little bit. One of the big things we’re looking at is that knowledge management piece. People walk out the door and they take all that experience and those connections with them. So how do we keep that going.

MAHERAS: So, there is several types of sites, right? There’s the site where it’s an ISFSI pad, it’s a fence and it’s green grass. Nothing much changes at those sites. So, we do not anticipate having to go back to those sites as often.

There’s other sites like SONGS, for instance, that are dynamic in nature. There are buildings that when we went the first time, are

no longer there. There's train tracks that were not there the first time that is there now. We will have to go back to those types of sites frequently to get a baseline of conditions. So, it really depends on at what stage of the decommissioning process a site is at, how often we would decide to go back.

Now, one of the things that we are aware of, though, is abandonment of rail infrastructure in the U.S., right? And that is definitely a consideration. You know, we assumed the track would go all the way up to the facility and they would abandon the rail line and now we've got a 30-mile heavy haul truck route that I need to deal with. So, we do keep an eye on abandonments too just to make sure there is nothing that happened in the infrastructure that we need to account for.

BICKFORD: Just to clarify, when Steve says, we might have to go back to sites frequently, we're not talking about every year. We did the original San Onofre site visit in 2015. And, then, we had the opportunity last year, in conjunction with the Tribal Radioactive Materials Transportation Committee meeting to go do a sort of supplemental site visit and take some photos of the existing site infrastructure. Going to Crystal River yesterday, was also kind of a supplemental site visit. In addition, Steve

keeps in close contact with site staff and asks them sometimes to send him photos. Or we have state partners at Vermont Yankee when we did the site visit I believe in 2016, the rail spur into the site was overgrown and hadn’t been used in quite a while. And then, a year or two later it was fully refurbished and made operational. So we contacted Tony Leshinskie, who’s the state nuclear engineer for Vermont, and asked if he would take some pictures and sent them to us. And then those do get incorporated into the report. So we have multiple modes of collecting updated information on site conditions and incorporating those into our reports. We don't necessarily have to go do a three day excursion every couple of years to fully capture that data.

PEDDICORD: Lee Peddicord. So, what motivated that upgrade of the rail spur? Was that to ship off some class C, greater than class C waste? That’s quite a change.

BICKFORD: From Vermont Yankee?

PEDDIOCORD: That’s quite a change. - who invested in that?

BICKFORD: It was to support the decommissioning of the site. So, in the case of Vermont Yankee, this site was, I think,

contracted for decommissioning with NorthStar is the company and so as part of the decommissioning. And we've seen that in other plants. As Steve mentioned, the rail abandonments, kind of the little bit of likely sadness that we have in our hearts is when a plant shuts down and then they invest in maybe infrastructure upgrades, especially rail infrastructure to support the decommissioning, we're like, ooh it would be so great if we could capitalize on that recently upgraded infrastructure for the spent fuel shipments. But the scheduling is not necessarily in our control in that way. So, yes, a lot of plants, similarly at San Onofre, their rail infrastructure was not in current operation when we did the site visit in 2015 and subsequently, they've added probably like a quarter-mile of onsite track in terms of different configurations. So, that's routinely done. In the case of Vermont Yankee, it was maybe a quarter-mile, half-mile spur into the site so that was a very, very short distance that they had to do and made a lot of sense.

PEDDICORD: Thank you.

SIU: I understand that Paul Turinsky has a question. Paul?

TURINSKY: We have been talking a great deal about upgrades to rails, etc. You're very dependent on basically privately owned infrastructure and my question is, is the government doing anything to provide incentives for the owners of that infrastructure that you are dependent on to maintain it? Does it cost money to maintain it?

JACKSON: So, if I heard correctly, the question is, is the government doing anything to support rail infrastructure upgrades?

TURINSKY: No, just infrastructure in general whether onsite or off-site. Is there any incentive program such that the owners of this infrastructure maintain it for you which could be very beneficial in the long term? Having just done my taxes, I am thinking of tax benefits, you know for that. Or if you're not doing it, are you thinking of doing it?

BICKFORD: I will jump in, this is Erica Bickford, U.S. Department of Energy. In terms of the U.S. Department of Energy funding maintenance, ongoing maintenance of rail infrastructure that we don't own, we really have no mechanism to do that. There's also kind of cost-benefit considerations where it is

likely more cost-effective to just wait until you are actually going to use it and then pay for the infrastructure upgrades at that time. That said, we are anticipating having to find ways to make infrastructure improvements to support these eventual shipments. We've talked to our partners at the Federal Railroad Administration. They have grant programs geared towards short line railroads so Class 2, Class 3 railroads. And, so, partnering with them to maybe make some investments in those grant programs to support refurbishment of rail infrastructure.

I think we've also seen with some sites, Vermont Yankee being another example in support of the decommissioning of that site. The Northeast Central Railroad is the short -- the New England Central Railroad, I always get that acronym wrong, the New England Central Railroad is the short line that serves that site. And they were able to apply for a grant to the Department of Transportation to do some rail upgrades for their line in support of the decommissioning activities at the Vermont Yankee plant. So, there are some existing federal mechanisms through the Department of Transportation already and those are certainly things we are thinking about at the Department of Energy. We're also thinking about possible public-private partnerships that could be opportunities. For example, at some sites where you have

maybe a quarter-mile spur that you are looking at refurbishing, the cost-benefit analysis of that is likely going to lead to it being cost-effective to refurbish the spur to support movement of spent nuclear fuel out of the site. For sites where you may have five or 10 miles of rail infrastructure that you may need to upgrade, the cost-benefit analysis to solely support removal of the fuel from the site may be a little bit more difficult to justify. You're probably talking on the order of $1-2 million a mile for rail refurbishment, inflation notwithstanding. And so in those cases, there may be opportunities where there may be local industry who would similarly like to use the rail infrastructure, but also can't support the full upgrade costs, where we may be able to combine resources and similarly leave local industry and communities with some upgraded rail infrastructure at the end of it. So those are all the kind of things that we are considering. But in a direct response to your question, we are not considering the U.S. Department of Energy paying to maintain existing rail infrastructure. At this time, our focus is really on planning ahead for the upgrades needed.

This question does come up a lot and I think there's kind of a misperception that upgrading rail infrastructure is some you know decadal endeavor. But from our discussions with both sites and

rail carriers, it's really on the order of like months to a year to refurbish an existing -- assuming it's not in complete disrepair. We went to the Morris Dresden site in the spring and part of their spur appears to be sunken in a swamp which doesn't look great, but you talk to the rail guys and they are like yes, they can take dig this out and just regrade it and add some new track bedding and get this working again in a couple of months.

There are some lead times and reserve of specialized equipment need and things like that. There's a limited number of service providers who do that work, but compared to the whole transportation system, we're looking at maybe five-year timeframes to be ordering transportation casks for their fabrication, maybe two year time frames to be fabricating railcars for transports. Refurbishing the rail infrastructure falls within those time frames and so we're not anticipating that being a large area of difficulty.

TURNISKY: Thank you.

SIU: I know we're a couple minutes over, but I'll exercise Chair prerogative and just ask real quick questions. Regarding your evaluation reports and the data that you gather, do you (a) look

at accidents around the area or even near-misses if such are collected and (2), do you look at things that maybe susceptible to climate change and conditions that may change in your evaluation?

JACKSON: With respect to the near-misses, I don't know how we quantify that, but when we talk to the local community, the local law enforcement, the state highway administrators, we do get a snapshot of the road conditions. This is a very dangerous road. You may have to shut it down between 3 AM and 5 AM to move your material.

As far as the climate piece, I'm not sure if we dig into climate, exactly, but that's something that environmental justice that we do look at within the crosscutting and consent-based siting team. We do have that as part of our portfolio of things that we look at. Yeah.

SIU: Okay, with that, thank you very much, Gerry. And I appreciate you rushing through. Okay, next up, Sara.

HOGAN: Hi, I am Sara Hogan. I am a part of the new wave of hires, to the Office of Integrated Waste Management. Thank you

for having me here today, I'm going to be talking about the site-specific de-inventory reports as was alluded to by Steve.

Our disclaimer.

So, for the contents of this report, this presentation, I'm going to give you some of the motivation regarding these de-inventory reports that DOE has been funding.

Some of the history and the contents of the reports, I'm going to go delve deeply into the structure of these reports. So what exactly is within them and what information can we learn by reading them? I'm also going to show a few specific examples of some of the analyses completed for three of the reports. Hoping to give you some examples that include diversity in geography as well as mode of transportation and also some differences in levels of complexity of logistics involved. We'll also discuss some of the technical challenges to be addressed as identified by the contractors' perspectives. And some of the unique challenges that some of these sites present, as well.

So, I'm happy to be following Gerry. He laid a nice preview to this presentation. So, you now have an understanding about what

types of information that DOE gathers on our nuclear power plant site evaluations, the people involved, including the stakeholders and local departments of transportation and others that join us in order to gather information on the beginning stages of answering questions and presenting options as to how we will remove fuel from these nuclear power plant sites.

So as this work developed, gathered information at multiple sites, these de-inventory reports kind of came about to develop an understanding of the next steps on how to address and identify some of these impediments that may present themselves in future transportation efforts.

So, the de-inventory reports, to emphasize, these are a contractor's perspective on how they would recommend removing spent nuclear fuel and greater than class C waste from the nuclear power plants. Again, these represent what the contractors views and present options for the Department of Energy. They're not necessarily the routes or the next steps that the Department plans to implement.

So, they use a standard procedure, also in order to complete these analyses and some of the system analysis tools that Erica

mentioned in her work previously are used in these reports and can help to be integrated into the contractor's decision-making process.

So, these again, reports are a deeper dive into our nuclear power plant site evaluations. The contractor is ORANO, previously known as AREVA. And these – work on the initial set of six reports began in 2015 and these reports were released in 2017. Those reports that are now publicly available include Big Rock Point, Connecticut Yankee, Humboldt Bay, Kewaunee, Maine Yankee and Trojan. And, again, those reports are also available on OSTI.gov. We have five reports in development. They're being edited currently and should be released this year. And those include Crystal River, which has its release eminent. So very soon, that report will be available in addition to La Crosse, Rancho Seco, Yankee Rowe and Zion.

This is an overview of the contents of the reports. So, I'm going to break this down a bit further and describe each of these sections and what is contained within them. So, following an executive summary, an introduction, all of these sections are also listed. And the structure is the same for all of the individual site specific reports and it provides the opportunity

to have an apples-to-apples comparison for each site and compare routes and logistic process for each of these sites.

So, following the executive summary, introduction, it goes into pertinent site information. So, for each section – for this section of the report, it has a description on the site characteristics, so the layout of the power plant, the specific types of dry storage systems in place, the near site and onsite infrastructure. It also describes characteristics of the spent nuclear fuel and greater than class C waste onsite including specific types of assemblies, burn ups, discharge dates etc.

It also describes a... description of the canisters and overpacks to be shipped in order to understand if any modifications of the certificates of compliance will be needed as well as an understanding of what type of package will be needed – will be shipped in order to understand the cask weight dimensions which can be helpful in understanding and identifying a route to take.

The next section of the report includes a transportation route analysis. So, this describes the types of routes that will be used whether they be heavy haul, rail and/or barge legs of transportation. And for these analyses, considering that we do

not have a location yet where they will be shipped, the analyses used the geographic center of the United States for all of the route analyses.

The report also describes the participating entities involved. So in addition to DOE, federal agencies included, include describing the roles of each of these agencies, including the Department of Transportation, NRC, also how the utilities and their other personnel on site are included in the transportation campaigns in addition to contractors, cask suppliers, security personnel, emergency responders. In addition, other state officials including the Governor’s Designee for Advance Notification and other emergency response personnel in addition to coordination with other contacts for the transportation modes.

The reports then go into describing this Multi-Attribute Utility Analysis that is used to provide a standard structure for the analysis to compare routes. So, for every site, there’s often different routes and modes of transportation that can be presented as options for removing fuel from the site. And each of these routes is likely to have aspects of them that present advantages and disadvantages over the others. So, the first step in the MUA is identifying attributes that can help compare each

of the routes. So, for each of the routes -- once these attributes are identified, there's pairwise comparisons between them in order for comparative rankings between the attributes with these relative rankings. You can then apply them to the routes in order to make pairwise comparisons of the routes. And with weighting, the MUA then describes the most favorable route.

There are also sensitivity analyses that are included in these reports which help describe, if certain attributes are eliminated from the process, is the ranking of the route is similar in order to inform the contractor to identify if their weighting and pairwise comparisons are appropriate.

So, some of the attributes that are included in the MUA include different aspects regarding cost, environmental impact, safety and security, aspects related to timing, permitting. So, there is over 30 metrics that were identified in these analyses. Some of these are listed here including onsite rental equipment costs, infrastructure costs, transit durations, route characteristics, environmental uncertainties. So, a whole bunch of aspects that are listed here and well within the reports as well.

So, with the route preferred as chosen through the MUA by the contractor. They then describe a concept of operations which thoroughly goes into a sequence of operations from mobilization to demobilization. So, mobilization includes the procurement of the leases and equipment needs through operational readiness, which largely regards around transportation, training and operation training. Site operations that details mostly the loading of casks, coordination with the modes of transportation and their personnel and employees and transport operations all the way through demobilization and removing the equipment from these sites.

So, this section also includes information on resource requirements and staffing, as well.

It also mentions a budget and spending plan. So, within these reports I think it may be easier to first discuss what's not included. So, not included in the cost estimate of these reports is the cost of the transportation casks, the impact limiters, cask ancillary equipment, in addition to the rail rolling stocks. So, the railcars are not included in the cost, as well.

Some of the larger items that are included in the estimate to the cost includes fees and permits, campaign operation management, in-transit security. Transportation cask shipping cost is also included but only on short line, where short line means Class 1 railroad.

In order to ensure the safety and security of the materials, the employees and also the public in the transportation of these activities, the analyses also discuss security plans and procedures that should be in place, as well regardless and including the different modes of transportation that may be involved including heavy haul, rail and barge.

And along with that, there’s also considerations for emergency response and preparedness included in these reports, as well.

Each report ends with the recommended next steps as identified by the contractor, as well. And these largely deal with the need for modifications to certificates of compliance and also infrastructure and equipment needs, identifying where refurbishment or installations need to take place, as well. And because, as Gerry alluded to, each of these sites is unique. The

complexity of logistics and some of these recommendations are often site-specific.

So, plans for new reports. Again, we have five reports which are to be released this year. Two additional reports will also be started in 2023 and those include San Onofre and Vermont Yankee. And, these reports will be – more reports will be funded as funding is available.

So, before we get into some specific examples and results of these analyses for three specific power plants, some of the limitations and considerations to be considered when considering these results are that AREVA, now ORANO, only use their site expertise. They did not discuss and talk with the power plant site personnel. They used the information that was provided that’s publicly available, as well as, the information that DOE provided and their expertise. They worked with MHF, experts in transportation logistics, for these large packages as well as NAC, a popular cask vendor, in order to determine some sequences of events, estimate for budgets and timing of operations, as well.

So, we saw this map before. It identifies locations of commercial spent nuclear fuel in the continental U.S. where the green represents operating commercial reactors and those red indicating the shutdown commercial reactors. And, we have listed here by region those sites that have completed -- that DOE has completed site evaluations reports for. The red sites are those which have released reports and the blue ones, forthcoming.

So, again we have three examples here for the results from three sites. The first of which I will describe is Connecticut Yankee. Again, we wanted to show you some diversity and complexity of logistics and location and mode of transportation. So, I will first give you an overview of some of the pertinent site information. So, for Connecticut Yankee, located 25 miles southeast of Hartford on the Connecticut River. It’s site inventory includes 43 casks, 40 of which contain spent nuclear fuel. And you can see the ISFSI on the image on the bottom left, as well.

So, for the operations, the contractor listed the likely transport package as a NAC-STC and the route that was selected by the contractor’s MUA analysis included a heavy haul, 13 miles to Portland, Connecticut where it would then be transloaded onto

local rail in Worcester,... sorry Portland,... transloaded to local rail in Portland and then transloaded to Class 1 railroad in Worchester, Massachusetts. So, because this total campaign would have 43 casks, it would require nine mini campaigns of four to five casks on each leg with a round trip taking six weeks. And incorporating some additional time for planning of the operations, the total campaign would take approximately 60 weeks at a cost of $17 million. I would also like to highlight here that the report cost estimates are reflective of when the reports were completed, so this report was released in 2017. So, we might want to consider about five years of inflation, probably added to these costs, as well.

The next example we are going to be looking at is for Humboldt Bay, located approximately 260 miles north of San Francisco. It has six casks onsite, five of which contain spent nuclear fuel. This is an image of the location right on the bay.

So, for this operation, the contractors' recommended route using the likely transport package of HI-STAR HB would be a heavy haul two miles to Fields Landing where it would then be transloaded onto barge, where it would be barged approximately 350 miles up to Concord, California and then transloaded onto BNSF rail. To

note, that location in Concord is the military ocean terminal at Concord which is a DOD military base.

So, having only six casks, it would take only one campaign and it would take approximately 20 to 24 days with additional planning time, the total operation is estimated to take five weeks at a cost of $2.7 million. I should also add that these dry storage canisters at Humboldt Bay are able to be transported, so only impact limiters would need to be purchased here, as well.

Last example we have here is our local example. So, Crystal River, located 70 miles north of Tampa, 80 miles northwest of here in Orlando. And, as described by Gerry already, the inventory includes 44 casks, 39 of which contain spent nuclear fuel and an estimated five containing greater than class C waste. And we can also see here the image here the horizontal storage, NUHOMS storage systems.

So, for the operations here, the likely transport package as identified by the contractor would be an MP197HB. And, the likely route for transportation would be to put these casks onto the local rail on site at Crystal River and then have them transloaded onto Class 1 railroad in Newberry, Florida.

Again, with the larger amount of casks, it would need to have nine mini campaigns was their identified best route with five casks each, approximately with a round trip of 24 days each for a total time estimate of about 39 weeks at a cost of $14.3 million.

So again, each of these reports ends with some technical issues to be addressed. And we wanted to also mention here that again these reports are limited by the experiences that ORANO has identified working with the cask vendors and the transportation logistics teams, as well as what data we have in our nuclear power plant site evaluations.

Something we discussed in discussion of Gerry’s report is also how we keep this information updated so Steve has also been working with some of the onsite personnel to hold virtual meetings which have been helpful and feeding information back from site evaluations and de-inventory reports back into our site evaluation reports, as well.

So, some of these next steps that have been identified that are applicable to multiple sites including modifications of the certificates of compliance. So these CoC's are on a five year

renewal period and one thing that is needed to be considered in the future, prior to shipment, is that these storage canister changes where they can be traded out for like-for-like canisters through the 10 CFR 72.48 process are propagated through transportation casks as well.

Another theme in recommended next steps includes detailing equipment needs and ensuring that there is appropriate equipment readily available at the sites.

Also, a large theme that we saw, also through our site evaluations reestablishing and preserving onsite infrastructure, the need to supply electricity in order for these operations to take place.

Also, considerations for route clearances. These routes selected aren’t necessarily cleared. So, if there are bridges or other impediments such as electrical wires or if dredging needs to take place for barge routes, that should also be identified going forward, as well.

Some unique challenges the sites for which de-inventory reports have been completed, I will identify a couple here. So at Big

Rock Point, one of the unique challenges is to modify that Certificate of Compliance. It needs to have an updated certificate from a -85 to a -96 in order for the fabrication of this one-off cask, for the TS125, to be fabricated. It also needs to be updated in order to include GTCC in the transport, as well. Also, considerations for other transportation casks to be used could be another method in moving this fuel as well.

Other unique challenges include those at Humboldt Bay. So, a modification to their Certificate of Compliance was needed and actually revised in order to provide for lower enrichment of uranium to be incorporated into the cask for transportation.

Other issues that have been identified and should be considered include, testing that needs to occur prior to the shipment of this fuel, as well as some issues associated with fuel channel thickness and lid bolts as well. And providing that there’s coordination with Diablo Canyon and sharing the crane for the cask transporter.

So, this information that is provided within the de-inventory reports is being used to identify some common challenges across sites as we discussed. And again, this data, and the results of

these analyses are being fed back into our reports for consideration in these living versions of our nuclear power plant site evaluations, which are meant to be updated and revised going forward prior to shipment of fuel.

The information can support future transportation planning. Some of these results have been shared with these sites, as well. And some of these utilities have made changes as we saw the revisions to the certificates of compliance at Humboldt Bay, for example.

Also, going forward, we have – we're working with this contractor with this structured method which can help in comparison to the logistics between these sites and future sites, as well as they're funded. And also, the data in these reports is being fed back into some of our system analysis, as well, likely routes, potential issues we can use to start our routing tool and see how we can improve upon that as well to aid in future planning.

Lessons learned, one of the large highlights from these reports include the importance of preserving onsite and near site infrastructure. As Erica mentioned, it's not always the end-all if there is not rail, but having it there would certainly help in the process.

Also, identifying and modifying the certificates of compliances and making sure that they are in place prior to transportation. And again, these virtual meetings, keeping up-to-date, keeping contacts with the site personnel has proven already to be valuable in helping to update and keep these connections between the Department and sites.

And, yes, these reports have been shared with sites and we plan to do so in the future. Again, we have six reports that are publicly available for you to dig into and see even more of the details than I've shared with you today.

So, to conclude the de-inventory reports. Again, build upon and help delve deeper into our nuclear power plant site evaluation reports. And they are helpful in identifying some of the next steps and challenges that are presented in transporting spent nuclear fuel and high-level waste. And although we have identified some impediments and some challenges, again we want to emphasize that there are options presented at each site for transportation and there are no showstopper technical issues in completing this work in the future. So, I'll take questions.

SIU: Thank you, Sara. Steve.

BECKER: Steven Becker, Board member. Thank you for a very interesting presentation. Just to clarify things, for yours truly, and perhaps for others, so these contractor reports are based solely on technical, logistical and economic considerations. Meanwhile, the DOE process that we heard about earlier seems to include an increasingly robust piece related to community input, stakeholder engagement and so on. How do those two pieces mesh and, for example, are these reports part of what's discussed when those community meetings are held?

HOGAN: Sure, I will try to take a stab at this and then also phone some friends for their perspectives as well. Yes, these contractor analyses largely rely upon just logistical and economic information. There is a certain public perception variable as an attribute in these analyses. However, it's mostly just population that the route is traveling to not necessarily perception. So, I would say that these reports present the options, and they're available to the communities for them to view. But the important part about the site evaluations is that we do get to converse with the locals and understand their perspectives and, again, use the information from just that

logistical standpoint and then combine it with the perspectives from the site evaluations where we get to discuss with the public and consider that in our full reports.

BECKER: Steve, you're going to chime in as well.

MAHARAS: So, it's also important to remember that the nuclear power plant site evaluation occurs first. And, so it might be a number of years before we get to doing the reports that Sara just discussed, so the time sequence is not – there's no way for us to give the de-inventory report to the public during the site evaluation.

BICKFORD: I will tack on one little addition. Erica Bickford, U.S. Department of Energy. I'll also say that these reports are titled as initial site-specific de-inventory reports. So really, it's kind of our first stab, focused on the more technical issues. In advance of actually removing spent nuclear fuel from a site, we would do, absolutely do a site-specific transportation plan and associated with that, we would do a lot of outreach and engagement. Section 180(c) that I discussed in my presentation is the mechanism through the Nuclear Waste Policy Act to provide technical assistance and training associated with

shipments. The draft policy for that sets about a five-year advanced timeline for doing that. And because we don't at this time know exactly when those transportation activities are going to occur, we do want to be a little bit mindful of the time and energy that we would expect local communities, state, tribal, government representatives to put into this and want to try and be strategic about that. That we don't go too soon and get everyone excited about shipments and then ended up waiting a long period of time before they actually happened. So that's kind of the thinking there, as well. It's not that we don't intend to share this information and do a lot of outreach. It's more about being strategic in how we plan for that closer to the actual shipping timeframes.

BECKER: Thanks all three of you for that answer. Just to follow up on one thing that you said, Sara, you mentioned that these consultant reports are available to communities to view, do you have any sense as to whether communities have actually viewed any of them or any way of knowing?

HOGAN: Through my minimal time at DOE, I can describe that they are available. Everyone involved in our -- my large role in the National Stakeholder Transportation Forum which is largely

our outreach and engagement with states and tribes, we always make them available and people do seem to be knowledgeable on the options that are presented to them and are able to discuss what they – their opinions on them. So, I think that is one metric in order to say yes that I do believe that they are getting viewed.

MAHERAS: So, the sites will often call me and say when are you doing my site? So, that's a part of the continuing engagement with the sites. We don't do one and done and then we don't come back for five years. I continue to talk to these people, right? And, so they'll come back and they'll say, when am I getting my report? And we'll have to say, well, I don't know. So, the other thing is that oftentimes community engagement panels are interested in the reports, too.

You heard that we are going to SONGS this year to prepare a report. The community engagement panel there is interested in having a chat about the production of this report.

BECKER: Thank you for that elaboration. And, thanks again to all three of you for fielding that question.

PEDDICORD: Again, Lee Peddicord from the Board. And, again, thank you very much, very nice. Continuing my fascination with greater than class C waste, because most of it's coming to Texas, so we are keenly interested. Also, for my edification, now some, you cited three locations where there are canisters with GTCC. But, we heard on other examples, I think, from the most popular person in the room, Steve Maheras, that some of these are actually moving now and making their way to Andrews County. So, my question is, does DOE have any role in that planning and execution or are you mainly receiving that information? And, of course when you do your multi-attribute utility analysis, you're going to the geographic center of the United States. They're going to Andrews County, Texas.

So, my question was, first of all that is part one. Are you part of that or only informed about these transports? And then secondly, can you use your multi-attribute utility analysis to go through your planning process of getting it from point A to Andrews County and see how that matches up with actually the routes, the ways it gets transported to have some verification or build confidence in your multi-attribute utility analysis. So that is a two-part question.

HOGAN: Sure, I think I'm going to hand this off over to -- Steve Maheras looks ready to answer.

MAHERAS: Okay, so in our reports we analyze greater than class C waste. That’s not moving. The class C waste is moving.

PEDDICORD: And some GTCC, as well or is none of that moving?

MAHERAS: There’s none greater than class C moving. Only the class C is moving. But you raise a great question, right. So, they just moved class C from VY down to Texas, right. And so that’s one of the reasons we’re going to the VY site for the next report that we’re doing is to capture that knowledge and to see, you know, okay, so they picked a route, but what would a MUA say about that choice of route, right?

PEDDICORD: May I ask a follow-up on that as well too? When you are finally loaded in spent fuel or the Class A and stuff like that. It’s on a transporter. It’s on a railcar and so on. What organization is the final arbiter of what route it goes? What I’m asking here is, is it the railroad that finally decides, because they’ve got to take into a lot of real-time considerations, maintenance on rails or derailments, let’s say? So, are they the

ones, when you finally launch, they're the ones who are going to decide how it gets from this point A to the ultimate destinations?

MAHERAS: So, the first thing is our casks are heavy enough and large enough so that every single cask is going to require a route clearance from the train company, the railroad, right? Because, the first rule is, if it doesn't fit, it doesn't ship, right? So, we'll have to get the clearance first, dimension and weight wise. The infrastructure has to be available for the load, right?

Okay, now part two, right? Part two is there is a rail routing rule, 49 CFR 172.820, right, that describes the process that the railroads use to choose routes for spent nuclear fuel and other commodities, right? But, first rule is, if it doesn't fit, it doesn't ship, right? So, two-pronged process, right?

TYLER: Steve, this is Scott Tyler from the Board. Can I keep you up just with a question for my edification? On the class C waste that is being shipped, it is not being shipped in the kind of containers that would be shipped using high-level waste or

greater than class C, is that correct? Is that what you were saying, just so I understand?

MAHERAS: No, the Vermont Yankee was shipped in the very same cask.

TYLER: Ah, okay. Okay. Thanks.

MAHERAS: But, that’s not always the case.

TYLER: But it is – it has been done. Okay, thank you.

SIU: I have a couple questions, Sara. So, the, that’s a lot of work doing these trade-offs on all of these attributes, and I understand this is the contractor who’s done the tradeoffs. Does DOE plan to get involved at some point in providing preferences?

MAHERAS: So, we discussed this issue, right, because you might have gathered I might have an opinion, right. Okay, so we made the conscious decision not to weigh in on the MUA analysis or the results as to not bias the contractor’s evaluation.

SIU: Okay, but at some point, when you are trying to choose between different routes, preferences, the ultimate decision-maker would be --

MAHERAS: Absolutely. Absolutely, it's the federal government. But with the proviso that the railroads have a role in the routing, also.

SIU: Yes, yes, yes. And the second question, sorry Brian, I'll get to you. Is it fair to say that these analyses similar to what we asked of Erica are best case analyses? They don't have things like equipment failures or rail lines being taken out by a storm or something like that.

HOGAN: Right, they are best case.

SIU: Okay, thank you.

WOODS: Brian Woods with the Board. Just to follow on with Nathan's questions a moment ago. I understand the DOE doesn't want to bias the contractor's report. I understand that but has there been any thinking about the actual weighting of these factors, because I think weighting is actually... is going to be

a really big impact with the outcome of the final result. So is any thought been going on about maybe not what the weights are, right now but how you're going to get that information to do the weighting correctly?

HOGAN: Sure. I see Erica would like to comment on that. But, the reports do go into detail. They have a panel of 12 people, I believe, that work on the reports. They, each individually weight the metrics themselves and they create this bias and average, which is not normalized, and they have an average weighting they use as well, and they compare those to see if the weighting are affected by each examiner. They also do a sensitivity analysis with removal of I think they do one with removal of environmental impacts, one with the removal of safety security impacts. So, I am sure there is different opinion in the weightings that would be used, but that is how they tried to add assurance to their weighting metrics by doing this sensitivity analysis and having these average metrics used.

BICKFORD: Yes, Erica Bickford from U.S. Department of Energy. I'll just step in because since Sara is new to our organization, she hasn't participated in the development of these reports yet, though she will soon. And I was involved in the

discussions for all of the reports that we've developed so far. So, the process that we've had for developing these reports and how it works in the past is the contractors assign the work and then they come back to us, at maybe about the 60 or 70% point and present to us the work that they've done and then we have a discussion. And, there's certainly been cases where in their MUA or other aspects where we disagree or we're like, nay our data points from going to the site evaluation or talking to people from that community or what have you is, there's a clear support or expectation for this to happen in terms of shipment. One just example, say like Connecticut Yankee, when you talk to representatives from the State of Connecticut, oh, well, they use barge to ship components out of the site. Barge seems like a great way to go, that way you are not going to anybody's community, you just put it on a waterway, take it to a port location where you can put onto Class 1 rail and away you go. And then in the initial site specific de-inventory report for Connecticut Yankee as Sara presented, the contractor considered that not to be the preferred option. And as I recall, one of the major factors that came into play was how the contractor was weighting the number of lifts that needed to occur and so more crane lifts added in their analysis, more risk. And so that ended up being a lower ranked option, which I think in our discussions,

DOE did not necessarily agree with, but as was discussed previously, we didn’t want to bias or influence their approach, because we very much wanted these to be contractor's recommendations to DOE and not contractor’s recommendations with some DOE influence, you know, in the mix.

That said, again, these are recommendations that DOE may or may not be what the actual transport looks like in the future. It provides us with just a first look. This is how a company with corporate experience, making these kinds of transports, proposes to conduct this work. And again, there is things that change over time, so depending on the passage of time between even 2017 versus 10 years from now or whenever the shipments may occur. There’s likely going to be new considerations that come in that may affect those weights and those preferences or there hasn’t necessarily been the exact same experts on the contractors’ team every time, and they’ve added, especially some new rail transportation expertise that I think may have shifted some of those weightings and rankings, as well.

SIU: Thank you, Sara. Thanks, Erica.

FRYBERGER: Teresa Fryberger, board member. So, okay, it's hard to look at her and speak in the mic. Okay. So, thank you for that. I think it was probably one of the problems that I think I'm seeing with these reports is simply that people, sort of, even though you tell us that are just informing you, we think they are going to be making, those are going to the decision. And I actually think that they would be quite useful as starting points for planning way in advance, not only planning possible routes, but also planning what it's going to cost even though the budget will not be anything close by the time you actually do this, it gives you a feel even if they're not very accurate which they probably aren't. But, so I applaud you for doing these and so are you going to do them for every single site or is that sort of TBD?

BICKFORD: Erica Bickford, U.S. Department of Energy. We'll certainly need to have site-specific transportation plans. Now, whether the time frame for these initial sites specific de-inventory ends up then converging because we start shipping and then instead of doing the initial site-specific, we just transition into doing site-specific. I think it's a question of timing. So, we will certainly need to do a site-specific transportation plan for every site that we move fuel from. That's

just operational requirements and in terms of whether it's sort of a draft or whether it's more of a final at the time that we do it will just depend on the [multiple people speaking].

FRYBERGER: But, you could also learn from your experience with these reports to do your own at some point. So, you don't have to [multiple people speaking].

BICKFORD: Absolutely and also when we get to the point of transportation, it's very likely that we would have an integrated transportation contractor or and M&O contractor doing these operations that would be having systemwide experience so it wouldn't necessarily be sort of one-off in terms of equipment. That's one of the reasons like the costs don't include the cost of the railcars, because that is not a site-specific cost. That's a systemwide cost. So, to be able to incorporate that experience, as well.

FRYBERGER: Okay thank you.

SIU: Bret?

LESLIE: Bret Leslie, Board staff. Thank you, Sara, nice job. This question is at the interface between the two presentations. How is DOE practically updating the infrastructure evaluations? And, how do you know what changes between the versions have occurred? So, for example, Crystal River, 2015, you went to there, 2019 initial site de-inventory report it's not public, but there's information in there that Gerry should know about and he shouldn't be surprised when he goes to the site and says oh, they don't have that infrastructure. So, kind of for me, how is that process between these contractor reports and the updated site evaluation reports being captured? Thank you.

HOGAN: Steve, would you like to take that?

MAHERAS: Yes, so one of the things that we did in producing these five new reports that we have going through the approval process is we conducted virtual meetings with the sites to say "hey, so, what has changed since we were at your site before, right?" And so, we were able to gather information on those changes that then got propagated into the reports that we're discussing now. So, that's the major way. But the other way is that sites will call and tell me things and we keep abreast of

what's going on at the sites too, and call them and ask questions.

So, it's not a static one and done thing. It's more like a dynamic occurring over time thing to know what's changing at the sites.

LESLIE: A quick follow-up. So, I know you update the site evaluation reports, but it's awfully hard to tell what changes between versions. So, it's -- in a way, kind of what I'm looking at is how is DOE, I mean, I know there are new photos in there, but the data which, you know, there's infrastructure that's not described in the update. So, anyway, it's so just for your consideration.

MAHERAS: Yes, thank you.

SIU: Okay, Sara, thank you for bringing us back on schedule. I think it's time for lunch now and we will reconvene at 12:50 PM.

[BREAK]

SIU: Okay, folks, it is 12:50 PM. Okay, next we will have a panel on tribal perspectives on transportation and consent-based siting

and that panel will be moderated by senior staff member Bret Leslie. And for those of you keeping score on your agenda, the Q&A will start at about 1:35 PM, so we will give about 15 minutes for the opening Q&A after the discussion. Okay, Bret?

LESLIE: Thank you, Nathan. The Board is particularly honored to have these distinguished panelists here joining us today. I will do a brief introduction, describe a little bit about the panel and then I'll turn it over to do some introductory comments by each of our panelists.

First, today we have Richard Arnold who is Southern Paiute and Chairman of the Pahrump Paiute Tribe in Nevada. He is a member, a founding member, and co-chair of TRMTC which you heard about earlier which is the Tribal Radioactive Materials Transportation Committee.

Next, we'll hear from Nelson Andrews. He’s the Emergency Management Director and a Tribal Councilman and Vice President of Community Development Corporation for the Mashpee Wampanoag Tribe. He is also the Chairman of the United South and Eastern Tribes Homeland Security and Emergency Services Committee.

And finally, we'll hear from Heather Westra, who is a consultant to the Prairie Island Indian Community. She has over 30 years of time working in Indian Country, focusing primarily on regulatory and legislative matters related to spent nuclear fuel storage, transportation and disposal. And through the Emergency Management Institute, she has trained hundreds of tribal representatives in the areas of emergency management, planning and hazard mitigation.

And as I indicated, we've asked the panelists to provide about 10 minutes or less of introductory comments; and then we are going to ask them to comment on what they heard or reemphasize what the key messages they heard from their other panelists; and then we have a series of questions and as Nathan indicated, the last 15 minutes then I will be turning to the Board members if they've got questions and if they don't, I have got more.

So, with that I'd like to introduce Richard Arnold.

ARNOLD: Okay, my timer has begun so I am determined to do this. Okay, first of all I want to thank everybody, especially TRB for the invitation to come here and share a few words from a tribal

point of view of some of the things that we see and I'd like to share some insight I think that would be useful for everybody.

By way of background, I wanted to provide some talking points just so people have a foundation about the tribes.

First of all, there's 574 federally recognized tribes throughout the U.S. With that, 229 are actually Alaskan native villages and so they are not… they are a part of the states, obviously, but they are not often times counted, because of the transportation issues that affect everybody in the lower 48 wouldn't affect them.

Secondly, the tribes are created typically in three different ways, either through treaties, and treaties are viewed as the law of the land. Secondly, there is executive orders and congressional actions, so sometimes tribes will say the Catawba band, sorry the Catawba tribe, they were recognized through being added through some legislation and then it got past, and they became a tribe overnight. And so, a lot of those are very important.

Next, and there is the importance of government to government relations, tribes are unique and have a special relationship unlike other groups oftentimes referred to as “stakeholders”, in one sense maybe in a broader sense the word stakeholder may fit, but stakeholders could also include the Boy Scouts, the Girl Scouts, people like that. Whereas tribes have a unique responsibility with the federal government and the federal government has a trust responsibility that helps build those relationships and interactions.

Next, there’s jurisdictional considerations that tribes have because not only with the tribal land. People will oftentimes look at the boundaries where the tribe is and say, ok that is all that they are concerned about and that is all that we need to deal with and consider.

However, what happens many times is tribes can either purchase land, and can have that land held in a trust by buying back some property to expand the reservations for example. Or they may have their traditional homelands and oftentimes there’s federal legislation that allows them to go and either do things through treaty rights, or what have you, to interact with other larger portions of the land. Or you can look at some of the tribes from

the East Coast that were removed by Andrew Jackson out to Oklahoma. And so, people that have ties back east, they have ties in Oklahoma and vice versa.

So, some of those things were beyond our control, but things to consider. And cultural affiliation is one thing again beyond… and I guess I am supposed to use this… hey, okay, I thought this was a phone… okay, so now that you know where we are at, or I know where I am at… so cultural affiliation is one of the important things that tribes often times may have and they can be not only be removed from their locations, but there's something that they have a unique relationship to the tribes and to the area where they have that maybe tied to maybe, traditional stories or traditional songs and ceremonial use, song-scapes, story-scapes if you will. So those are very, very important.

But lastly, on the last bullet on this page is that the tribes don't speak for the states and the states don't speak for the tribes. So, it's always, we have to remember that whenever we are working or interfacing with the different groups.

Next, as I go on and I'm trying to coordinate here, I think I am doing it. With tribal engagement, we've actually expanded that

and it has been a long row to hoe, I think is what the saying is, English is my second language, so those of you that understand that one you'll get it. But, one of the things is we've now expanded our presence and I think it is evident by a lot of the comments that are coming in where you'll see states and tribes and tribes and states and I went to Waste Management and I heard a lot of reference to tribes, tribal governments and states and so it's kind of encouraging and refreshing to see that kind of interaction.

Next, we have the Tribal Radioactive Transportation Committee which focuses on transportation routes and that goes really well with not only what we do but how we're integrated into the system. That is a collaboration with the Department of Energy through the Office of Nuclear Energy and the Office of Environmental Management where there is a cooperative agreement that help support our interactions along with state governments.

Next, there's the Nuclear Regulatory Commission where we interface with them a great deal. They have certain protocols that we interface with and address the tribes. We're a little bit different in how we participate in things in notification, for example. You hear a lot of times the Governors Designee, for a

contact where the tribes don't necessarily have that from the get-go. We have to opt-in to a processing, we want to engage in communication.

So, a federally recognized tribe, they have to then go through safeguarders training. They have to confirm their boundaries. They have to designate an individual who is going to be in charge of, be the point of contact for the information. So, those are some of the steps that we have to go to. A little bit different than what states do and here it was that we have treaty rights and certain responsibilities and trust responsibility. But sometimes that, it just kind of goes a little bit differently.

The other thing is with the Federal Railroad Administration. We also are engaged with them. They have, it’s, I can’t remember, the acronym is the SCCOP I think it is, the Safety Compliance, it used to be the Safety Compliance, I think, Operational Plan.

LESLIE: Oversight.

ARNOLD: Oversight Plan. That is what it was. Okay, I am trying to read all of the lips, but I appreciate all of the get-goes. And where is Steve when I need him? That could have been a question.

You could have come up and corrected that. But they added another "C". But anyway, so, we want to see that get completed. It's been in revision for quite a while. The tribes actually wrote a letter to the FRA. Because sometimes other people can't because of the unique relationship we have, we wrote a letter and saying, "so, what's the status on this?" And we're again still trying to see some movement. We're still waiting.

So, again those are some of the things that we see. And then moreover, when we're looking at activities and things going on, we oftentimes wonder even with -- when it comes to siting that, that is one of the things that we need to look at and how we will be engaged.

So, looking at the initiatives that were involved. TRMTC, the Tribal Radioactive Materials Transportation Committee, we wrote the … a paper on consent-based siting, and provided some of the comments that we felt were important and those were acknowledged and integrated into things that DOE was looking at for some of their comments. Tribal authority, again, is something that we have to bring into what we do, who we are, how we engage. Jurisdictional issues that would be a part of that, and quite honestly for a lot of the things that we're involved in, the

tribal people would say who better knows the land and people who have been here for thousands of years? So, we can oftentimes provide insight that many people do not know about. So, for example, a treaty right could have something for collection areas where people needed to go collect foods and medicines, waterways is another thing. We hear about barge shipments. And so how are tribes going to be involved in that? And that's one of the discussion points that we have. You know, Nuclear Waste Policy Act ...tribes were a part of that, and getting the ability to have effective status for repository on-siting. And Yucca Mountain, that didn't work out like a lot of people had hoped, and so, but there was one tribe, the Timbisha Shoshone tribe, who was designated and received effective status under the Nuclear Waste Policy Act.

And again, the trust response and you also heard about the environmental justice. But environmental justice has a calculus that is used to determine whether or not there is an environmental justice. So, conceivably a tribe could say sorry, there is not an environmental justice but there is still the trust responsibility that's first and foremost and still, still proceeds forward.

The challenge that we have oftentimes, though, is with changes of administration. So, we have to deal with changes of administration and congressional actions, things like that help drive kind of where we are. I'm trying to look at my timer and it just went away, but okay, I’m good. I’m getting down. This is going to work.

Okay, so, anyway, we’re looking at some of the things that we need and we need early and consistent notification for route selection., As I mentioned barge shipments, that’s something that we need to be engaged in. Siting selection, we’ve shared all of this with the Department of Energy. They’ve received that information. And the communication is a lot more robust now then what it was several years ago, and I have been doing this for many decades.

The other thing is, sometimes we look at the limits to tribal resources to support emergency management, because tribes don't have the capacity oftentimes or may have funding and you will hear more about that from some of the other presenters. There’s a disparity in knowledge, preparation and participation. So, we want to know what we can do, and I think everybody agrees that waste, it’s a problem, we need to deal with it, but nobody wants

to agree on what we're going to do with it and how we are going to and when we are going to do it. So, so again, we keep on hearing the same messages from everybody else and we are trying to make and plan accordingly for the future.

So, um, in conclusion, one, I think it's important to remember the audience. Remember who you are talking to, in my language, I was brought up with my language to speak fluently, we have no word for radiation. And so, you try to explain the concept of radiation to the people and there's a whole other story there and I promise not to go into the story. So, but there's things that I think you have to consider.

Engage early and ongoing involvement in communication. Try, again, don't speak for the states and states don't speak for the tribes. Remember the trust responsibility to tribes, the government-to- government consultation, that is important. And collaboration builds communication. Boom, I'm done. Thanks. Appreciate it. Did it. Okay, did I do it? Let me just check,54. Not too bad, okay. Okay. Thank you.

LESLIE: Nelson? There, okay. Your slides are up Now.

ANDREWS: Alright. [Native Language] Nelson Andrews Jr., Red Turtle, Mashpee Wampanoag, Cape Cod, Massachusetts. [Native Language] for your time.

So, I said in my language, greetings, my name is Nelson Andrews Junior. I'm from the Mashpee Wampanoag tribe located in Cape Cod, Massachusetts. And thank you for your time.

So, I'd first like to acknowledge the ancestral homelands of the Seminole tribe of Florida and also the Miccosukee tribe that we are standing on here today. So, alright. Let's get started.

So, I am the tribal councilman and also a Director of Emergency Management for my tribe, but I also sit as the Chairmen of the Homeland Security & Emergency Services Committee for the United South and Eastern Tribes. We also collaborate with the National Congress for American Indians, these are tribal organizations that serve and support tribes in various capacities around the country. As Richard had mentioned, we also have the Tribal Radioactive Materials Transportation Committee. And I'm on the executive committee for that and also the Nuclear Energy Tribal Working Group that I sit on, as well.

Previously, I worked for FEMA. I was on the National Incident Management Assistance Team, as the support branch director and I was the fourth tribal graduate of the National Emergency Management Advanced Academy at the Emergency Management Institute.

So, my presentations going to be primarily on emergency management focus for tribes and the disparities between states, and as a result of the lack of funding.

So, we are known as "People of the First Light" and what you'll see, so, here, this is where the Pilgrim Nuclear Power Plant is. And our home reservation lands are here. And up here this is where we have additional trust lands. Richard mentioned a bit about how tribes have, you know, various lands that they get put into trust. Well, don't have to. Some are federally recognized, some are not from the federal government. There are two federally recognized tribes in the State of Massachusetts and we are the Mashpee tribe and over here, we have our sister tribe, the Aquinnah tribe of Gayhead. So, we collaborate and support them in various capacities, as well.

And so, we are known as the "People of the First Light" and have inhabited present-day Massachusetts and Eastern Rhode Island for more than 12,000 years, and after a long process we were federally recognized in, um, 2007.

All right, so Tribal Emergency Management Department capacity issues.

The large majority of tribes do not have an emergency management department, our state counterparts… Also maybe Richard, you keeping an eye on my time, because I am not… give me a heads up, at least. Thanks. Alright.

So, the majority of tribes do not have an emergency management agency or department, but the majority of all states do, right? Even if it's a state Fire Chief or Police Chief, they have somebody in that capacity. And I'll get into the reasons for that, but the majority of this is due to funding.

So, tribal emergency management departments must be based on the foundations, the same foundations that states are required to, the National Incident Management system, NIMS, and the incident command system, ICS. There's four key roles that emergency

management departments play. You have your planning, your logistics, your operations, and your finance and admin. So, somebody like myself with a limited full-time staff of two, has to do all these roles, right? And our state counterparts, they basically will more than likely have somebody in that position.

So, this is all of a result of the Stafford Act, primarily. So, the Stafford Act outlines basically the funding and resources that states are going to receive. Tribes primarily do not receive anything as far as funding as a result of the Stafford Act. Not until 2013, when President Obama enacted the Sandy Recovery Improvement Act, SRIA.

So, as a result of SRIA, the tribes were able to go to directly to the President and request disaster assistance and emergency assistance Prior to that, that wasn't an option.

There haven't been, really any other amendments to the Stafford Act. Some of the new adjustments and amendments had been to FEMA's tribal policies, tribal consultation policies. And one thing I've been working on with a focus group out of headquarters with FEMA, the declaration pilot guidance that hadn't been

touched, sat stagnant since 2017, until we just approached this and started working on it again.

So, this results in the need for direct funding. So, as I mentioned earlier, tribes get direct funding on a daily basis and I am sorry, states get funding on a daily basis, tribes do not get this direct funding. So, a lack of direct funding for tribal nations towards emergency services and programs, that's the leading cause of major financial difficulties and deficiencies toward the road to self-sufficiency.

So, states within the U.S. receive direct funding and grants each year through the federal government that enable them to be self-sufficient.

This leads to various disparities that could also lead to and do lead to national security gaps. As you know that -- over the years there has been additional man-made disasters and natural disasters. Homegrown terrorism is on the rise, as well. There's a need for direct funding for tribes to be able to combat these issues and to protect their homelands, as well.

I'll give a really quick comparison. So nearly 1.8 billion in FY 2020 grant to assist states and tribal territories as well and non-profit agencies in the private sector for their preparedness efforts. Of this 1.8 billion, roughly 30 million went to tribal nations or 1.6 percent of the allocation.

So, this next slide will show what that looks like. So, as you see up here, we have a set of coins, right? So, think about this annually, 1.6 billion roughly annually is going to states for their emergency management homeland security funding capacities. And that comparison with the tribes results in about 14 million. But get this, the tribes are competing with each other over limited grant funding. So, when it comes to having to protect their nations in result of say a hazardous materials spill or preparedness actions for being close to a nuclear power plant or future shipments, there's not the capacity. We're limited in capacity due to the lack of funding and resources, but yet we are held to the same standards under the National Incident Management System.

So, in conclusion until true parity is achieved, tribal communities will be unable to fully participate in the national homeland security and emergency preparedness strategies and will

continue to unnecessarily and unfairly be a weak link in protecting vital infrastructure from domestic and international terrorist attacks, natural disasters, hazardous materials shipments, and related threats. These funding shortfalls for tribal nations place all Americans at risk.

So, I just wanted to provide an overview so you could all see the disparities that we deal with on a daily basis but still fight to protect our tribal homelands in addition to our neighboring partners, state and county colleagues and jurisdictions.

So, there's my contact information and [Native Language] thank you for your time. It has been a pleasure.

LESLIE: Thank you, Nelson. Alright, next we will hear from Heather Westra. And --

WESTRA: Thank you, Bret and thank you members of the Nuclear Waste Technical Review Board. And thank you for putting together this tribal panel. I think it's really important to hear from the tribes themselves and I'm glad to be a part of it, today. I'm glad to talk to you about the work that I have been doing for the Prairie Island Indian Community.

I have been working for the Prairie Island Indian Community since 1994, first as a full-time staff person and now as kind of a contract staff /consultant.

Where Prairie Island is a part of TRMTC as has been mentioned and the National Transportation Stakeholders Forum and we also sit on the ad hoc working groups and also a part of the Nuclear Energy Tribal Working Group that Nelson mentioned. And through the network, we've been able to travel out and we have visited Nelson's homeland, we have visited the Shoshone Bannock tribes to see what they're dealing with respect to nuclear issues.

I'd also like to shout out to my colleague back here, Ron Johnson, former tribal council president, now retired I guess here in Florida. So, okay.

So, just to orient ourselves to where we are at, the Prairie Island Indian Community is a federally recognized tribe. The tribe's homeland is on Prairie Island, which is about 35 miles southeast of the Twin Cities of St. Paul and Minneapolis, along the Mississippi River.

In the last couple of decades, the tribe's landholdings have grown from about 500 acres to over 4,000 acres, 4,500.

So, when I first started working for the tribe, this was their land, about 500 acres right there. And then because of gaming the tribe has the resources to buy back some of its own land, historic lands.

Up here this is the Upper Island and kind of outside of the picture to help meet the housing needs of the community members and also to meet the needs of community members who don't want to raise their families so close to the nuclear power plant.

So, why we are here. So, this is as I mentioned that lower Island of the Prairie Island reservation. So, right here, immediately adjacent to the reservation is the Prairie Island nuclear generating plant which has been online since 1973 and will probably go through a second or subsequent license renewal which will bring the operating life of the plant up to 2053, which to me is a very astounding milestone, if you will.

The the ISFSI and the spent fu… is right here. Right now there's 50 casks. It's the Trans Nuclear 40. So, each cask holds about 40

assemblies. And right next to, so about 700 yards, from the nearest tribal resident. Here is the Treasure Island Resort and Casino, the enterprise of the tribe, the government building, community center, etc. Another feature I'd like to point out are the rail lines which we hope someday will be transporting spent fuel to an appropriate site. And also, but in the meantime transports hazardous materials every day.

Because, right now the Department of Energy really isn't involved in this facility, it is regulated by the Nuclear Regulatory Commission. And we work pretty closely with the NRC. We were a cooperating agency for the relicensing of the power plant and of the ISFSI, cooperating agency for purposes of drafting the environmental impact statement.

But, our main concern remains, probably the number one priority for the tribe, tribal members and the Council is the spent fuel on Prairie Island. It's just there for the foreseeable future. The tribe did not consent to be a de facto long term storage site. When the plant was first licensed, the material was supposed to be reprocessed. That's what it said in the licensing document, it's going to be sent to a facility to be reprocessed.

No, we're not going to do that, now we are going to send it to a national repository at Yucca Mountain, fine. We'll follow that process. No, we're not going to do that anymore, we're going to assemble a Blue Ribbon Commission. We are going to release a number of recommendations. And then the Department of Energy implemented it's own … developed its own implemented strategy. So, I was glad to hear Erica talk about the Department will take a second look at that implementation strategy, because I think some of the dates that are in that are optimistic. 2025 for an interim site and then 2048 for a repository.

So, another thing that the tribe is actively doing is educating members of Congress on their responsibilities. And I was glad for your question this morning, Bret, about the DOE's authorities with specific regard to the Nuclear Waste Policy Act. But, we're not very optimistic that anything is going to happen anytime soon. And it's not because of the people involved with the Department of Energy. People that are assembled now are very good at what they do. And they're very earnest and very conscientious about what they are doing. But, we all know that there's going be a change in administration at some point…. Something's going to change. So, the tribe itself is not optimistic that the waste is going to move anytime soon.

Last summer we were happy to have Dr. Katy Huff visit us and see for herself how close the facility is. Dr. Steve Maheras has been to Prairie Island. And so, when we can, we invite people in to see what the situation is and how close this is and really what an untenable situation it is.

And with that, I am done, so looking forward to answering questions on the panel, thank you.

LESLIE: Thank you, Heather and thank you, Richard and Nelson. So, first off, Rich, do you want to expand upon anything you heard from either Nelson or Heather, something, a key message that you want to expand upon?

ARNOLD: Yes, one thing that I'd like to build upon real quickly is one of the challenges that we have had in this is not just what Heather and Nelson echoed, was about some of the things that we have seen over the course of time.

And at one point back into 2005, we had Skull Valley Goshutes in Utah, were going to have an interim storage site there. Everything looked good. It was working, private fuel storage, and

we thought it was going to be a go and Yucca Mountain was always on the table, as well. And it didn't happen. And it was interesting, because here you had a tribe, a federally recognized tribe, that made a decision to support this, but then yet the state came in and said afterwards, no, we are going to prevent any transportation coming to and from.

And so, then the question will surface about who, who gets to make the decision, does the tribe, or does the state? Or a tribe might say what is the use of doing it because the state may intervene. So it creates a lot of challenges.

But overall, all the points were spot on. And I've been to both places and one of the things that we have done with the site visits is really trying to encourage the local tribes to be involved in those that are culturally affiliated, and secondly making sure that there are relationships going on, because oftentimes they don't exist. End of comment.

LESLIE: Thank you, Richard. Nelson, anything you want to expand upon or highlight?

ANDREWS: I'd just add that I guess for the Prairie Island presentation, the pictures don't even do it justice as far as how close this tribe is next to this nuclear power plant. And it ties in with what other tribes have to deal with, as well. So, take us, you know, the Mashpee Wampanoag tribe, being within close proximity to the Pilgrim Nuclear Power Plant that is decommissioning through HOLTEC. We are nowhere near as close to the closest tribe to a nuclear power plant and it has gotten so, to the point where their tribal members have had to relocate, you know, due to this.

And real quick, I'll also say that during the life of the Pilgrim Nuclear Power plant for our tribe, the Massachusetts Emergency Management Agency did receive direct funding for their community. But the Mashpee Wampanoag tribe, in general, did not receive a dime, right, to protect our community members in the same respect as the state. And I understand the state has a role to share these funds, but in reality, that doesn't happen and I am not speaking just for my tribe, that is literally what goes on across-the-board.

LESLIE: Thank you, Nelson. Heather?

WESTRA: I'd like to wholeheartedly agree with what Nelson just said. For years, decades, the Prairie Island Indian community, received zero funding for radiological emergency preparedness. City and county and state did, but the tribe did not. So, used its own resources and fortunately because of gaming, the tribe did have its own resources to establish somewhat of an emergency management plan. But the other jurisdictions didn't have to use their own resources, they received funding from the plant.

And just one other little side note that the tribe does not even get electricity from the plant. You know, it's right next door, they did not even… I mean it is kind of sad, but when they were building the plant, they had to bring in off-site electricity and that is when the tribe got electricity, the homes, in the late 60s.

LESLIE: Okay, so one question I'd like for each of you to -- and you all have different experiences. Richard you participated in the site evaluations. Nelson you are well into the emergency management and Heather, the Prairie Island Indian community has participated for instance in the nuclear energy tabletop exercise. And so what I'm asking is kind of what are some of the lessons learned that you think can be applied and do you see DOE

volunteering or are the tribes the ones kind of you know saying, well, can you do a dose assessment for our buffalo herd on … in our community? So, in any order.

ARNOLD: Okay, well let me start out by first there is the need in what I have seen is for consistency within communication. Promises are nice, but this is a problem that we've all been dealing with for decades and we're not seeing any resolution. And as Heather noted, it's not necessarily the people at the Department of Energy, because they are following their marching orders. But, whatever happened with Congress with revising if we're going to revise the Nuclear Waste Policy Act and that may be a driver in what we're going to do, but if we leave it as it stands. Then things are laid out. And so there is a disparity there that I think needs to be addressed. The other issue of concern that comes up, and part of it is from the lessons learned, and seeing a lot of the community engagement going on and participating on those on-site surveys was that oftentimes listening to the local folks, some of them will become distressed because now a site is closing down. It provided them support for the community. So now what do we do? The next thing was that people are passionate about what do we do with wanting to get things out of respect of both locations and understandingly so.

And the problem that surfaces with Yucca Mountain is that trying to put a repository in a location where, one, people felt like we did not have any nuclear power in the state. Secondly, what are we going to do, with these tribal people saying why are we getting the back end of this stuff that nobody wants? So, it's a very complex situation, but it's all something that dialogue needs to happen but action needs to be … to happen at some point.

ANDREWS: Great points, Richard. And I will just echo and jump in on some of that. You mentioned some disparities a little bit. So one thing that we had to… I'll go back to my tribe, one thing that we had to deal with within the past year through HOLTEC, and this'll result in a lesson learned. So they had mentioned they were going to dump millions of gallons of wastewater into the Cape Cod Bay. A lot of senators and state representatives got on board in front of the Cape Cod Times, etc. because that is where we found out about it, the Cape Cod Times. And they basically said 'hey, we cannot stand for this, this cannot happen in our backyard, right?' And then so tribal community members are reaching out to me like what are we going to do about it? But as a result of these working groups that are funded through DOE, the Tribal Radioactive Transportation Committee and Nuclear Energy Tribal Working Group were able to reach out to the Nuclear

Regulatory Commission and set meetings up with HOLTEC and the NRC which halted that, you know, for a moment. So, I guess a lesson learned I guess for these companies and … that are regulated from NRC that go ahead and decommission these power plants, maybe be that liaison between the tribes. We shouldn't have to go out and literally reach out to DC to have the NRC or DOE come and be that conduit. It's a scary thing that, you know, these large companies -- not taking anything away from HOLTEC, but a large company could come in and just, you know, they control the show, right? But, we need to have the conduit there so that we can have a voice still, so.

LESLIE: Thank you, Nelson.

WESTRA: You know, Nelson, you hit on something when you said, "we found out afterwards". And that is so common throughout Indian country that you find out about something after the decision has been made, after something has already happened. And that goes to the heart of what Richard said earlier in his presentation is that tribes are governments. And we expect a government-to-government relationship with the DOE, with the NRC. We expect to be consulted before a decision is made. We shouldn't -- don't want to find out about something in the newspaper after the fact.

And I think another important thing is relationship building. We were a part of the NEI tabletop because we've a fairly decent relationship with Xcel Energy. And that is why it was at Prairie Island, because it was at the Prairie Island plant. You know, and we were invited to participate in the planning of that, as well because of our relationship with them. So, I think that is a key element, is the relationship with the utility, with the federal government.

LESLIE: Thank you, Heather. So, now I'm going to ask you a question that I did not give you any preparation for which is so… Richard, and you are familiar with it and you touched upon it, in the Nuclear Waste Policy Act there's affected tribes. Have you all thought about the implications of the framework that is already in existence in the Nuclear Waste Policy Act as it relates to consent-based siting of an interim storage facility, which could also be being pursued under the Nuclear Waste Policy Act. I know that is a tough one, but whoever wants to think about it, because, again, it's a government-to-government relationship and how do you envision that that might play out?

WESTRA: I will jump in if you don't mind. You know, when Yucca Mountain was an option, you know I think the Prairie Island

Indian community was really cognizant of the fact that the material was going someplace else, away. And away was to a place that perhaps other people didn't want. But, Prairie Island did not consent to be a waste storage facility, either. You know, it's an untenable situation that is not of the tribe's making. But I think with regard to other tribes, there may be also, might be impacted in consent-based facilities once, you know, we're down that road or is the host… you know we cannot rule that out, that the tribe may want to host such a facility and it's certainly within their right to do so. That they need to be consulted with a government-to-government basis.

ARNOLD: I'd like to weigh in, also, because I think it is really a thought-provoking question. Because definitely the way that the Nuclear Waste Policy Act stands currently, I mean, there's language in there and everybody has read it and knows it and there is certain expectations and then all of a sudden it's like okay, it's there, but we're only going to kind of follow it, when we want to. And it is almost like a policy of convenience and I think there needs to be things adapted and modified. It's been a number of years since that was developed and like all good things, maybe you want to revisit that and think, does it fit the bill? Secondly, I think under section 180(c), for example with

the consent-based siting proposed in Texas and New Mexico, one of the challenges there is that things can change from leadership to leadership and so maybe it's popular this time. Maybe next time it is not. And those can become challenges and secondly because they are private initiatives, 180(c) does not kick in. So, tribes are then going to be left out and one of the critical components of any transportation is the routing and the routing will be going through tribal lands in most cases one way or another. And so how are tribes going to be involved and how are they going to prepare for emergency management needs and response and training? The funding won't be there. And so, if it were and once it becomes a DOE initiative and when the Nuclear Waste Policy Act is finally agreed upon that, okay this is what we are using, then I think we have a roadmap to figure out how we're going to get things moving forward. The last thing that I wanted to mention, too is that with everything that's going on I think we have to look at and, just Steven, you had brought up some points asking a lot of questions about some of the risks involved. And you have to look at – I mean there's calculated risks that are out there that. Everybody looks at and granted you can do equations to figure out what the process may be. But the perceived risk is also the other challenge. No matter what we all say, and you can show numbers and graphs. The public perception are the people

4559 that we need to convince, whatever the process is, is the
4560 challenge. And sometimes I think we all fall short in trying to
4561 figure out a better way, you know, how to make it work.
4562
4563 LESLIE: Thank you, and Nelson?
4564
4565 ANDREWS: I will just add a bit. So, Richard and Heather brought
4566 up some really good points as far as government-to-government
4567 relationships and the tribal consultation. It comes down to
4568 trust. If – a tribe, each tribe is different, right? So, each
4569 tribe is going to have their own ceremonies and their own ways of
4570 doing things. But they are people just like everybody else,
4571 right? And so, with any relationship if you don't trust the other
4572 party, then how are you going to move forward or do any business?
4573 So, for the federal government to even approach some of these
4574 tribes, to come on the reservation, without even ever reaching
4575 out prior to that, just from say a "Dear Tribal Leader" letter,
4576 like why would they want to entertain whatever they're offering.
4577 So, these government-to-government relationships are critical.
4578 But on-site visits and getting to know the tribe, doing
4579 community, taking part in community events even, right? Showing
4580 good faith by offering resources, something that is going to
4581 start that conversation. And I understand the federal government

has ways of dealing with the states on a daily basis, but they are always still trying to figure out how you work with the tribes and get these relationships going? It’s, you know, basically just going to take actual visits and building that relationship and you are going to realize with tribes it might take a little bit longer than what you're used to seeing, because administrations change and it is the next vision, right?

LESLIE: Thank you, Nelson. And now I think we’ll turn to Board members if you’ve got questions, please raise your hand.

PEDDICORD: Excuse me, Lee Peddicord from the Board. First of all, thank you. These are tremendously valuable insights and perspectives that we don't get the benefit of hardly ever in any context whether we are talking nuclear waste or anything else. So, it’s really quite a learning experience. I have two questions, probably best Ms. Westra because of where you are geographically. On the picture you showed with the proximities, you identified the spent fuel storage as kind of your primary issue in terms of interest to the tribe. And then you also show the orientation of the Canadian Pacific Railroad which actually passes and is actually adjacent to your land. So, the questions I had related to that is, do you have an opportunity to then to

have input being informed in terms of what is going on with the spent fuel, the ISFS, and the transportation along the Canadian Pacific Railroad when they are shipping things off?

WESTRA: Well, no. We do not have any control or oversight over how much material is put onto the pad, the concrete pad.

PEDDICORD: Are you informed at all, though what's --?

WESTRA: They will let us know, ok we have three more casks, we are going to fill them this year. And also because of our relationship with the Nuclear Regulatory Commission, they treat the Prairie Island Indian community like an agreement state so that --. And it has mainly been council members. President Johnson has participated. And they have invited the tribe to watch their inspections. So, council members have watched Exel load a cask. But, yeah, so they'll keep in communication with us as far as we have another one, or we have a loading campaign for the next year. With regard to the rail lines, we fully expect to be involved with the shipments of spent fuel when they commence.

PEDDICORD: How about the other stuff going out, you pointed to that?

WESTRA: That’s the emergency --. We do have an emergency manager and she does work with CP Rail. But I think -- because the rail is a little bit of a different animal, I guess. They don’t find out until after material has already been shipped through.

PEDDICORD: So, I have another completely global question to you, as well. That we the Board are becoming familiar with some of the things going on in other countries and so on. And one that seems to have a parallel to the U.S. is now the activities in Canada and how the Nuclear Waste Management Organization in Canada is engaging with First Nations in Canada on I think exactly the same questions. So, my question to you all, are you tracking that at all, particularly being in Minnesota. And are there some lessons learned or parallels and things that can be drawn from how Canada and the First Nations are working together that may be of interest or useful here in the U.S.?

WESTRA: Yes, in fact, at our annual TRMTC meeting, we had an update from Canada's waste management organization. So periodically they come in and update us on their activities. And, I believe that the Department of Energy is also using that model to inform what they’re doing, as well. And just kind of as a side

note, a few years ago, I had the good fortune to go to France with the tribal Council to see how spent fuel is transported and we went to La Hague to see the reprocessing facility. And in France, it's no big deal. It seems like it's just another activity that's done on a routine basis. And that was interesting, as well.

PEDDICORD: Thank you, very much.

ARNOLD: And if I may, I just want to respond quickly and I had also been tracking and TRMTC has been doing the same with the NWMO and what's going on in Canada. They were… a gentleman from NWMO presented at Waste Management conferences here. It was nice to see and hear his perceptions. Interestingly enough, in the states and so often times what we will hear from our partners, brothers and sisters up there in Canada is that Canada will say "well, gee we are watching what you guys do down there because you guys look like you are pretty progressive." And then down here they'll say "gee, you guys look pretty progressive up there." But they've really been … they've really blended and integrated First Nations people in their process. And I think that is one of the attractive things that is important to see what's going on up to and including having a Council of Elders

and different kinds of things where youth are involved and understanding, kind of building some capacity for everybody. And I think that is one of the things that we're all collectively looking at, not only the tribes, DOE is looking at that. We've had many different discussions on this along with TRMTC and the Nuclear Energy Tribal Working Group. We have all come together and I think there is some agreement that we all understand the importance once again of doing some good robust communications and educating people and integrating them into a robust process for showing something's going to happen. And again it's almost sometimes based upon the perception of what's going on or the message that is being conveyed.

LESLIE: Steve Becker?

BECKER: Steven Becker, Board member. Thank you for these excellent presentations. So, I have two quick questions. The first question is for Nelson, and then the second one will be for Richard and Nelson. So, the first question for Nelson, as somebody who works in emergency preparedness and response, I was stunned to hear that there are tribal nations that don't have the resources to be able to have enough trained people to even cover the four components of incident command. If you had to guess,

what proportion of the tribal nations in the lower 48 are in that situation?

ANDREWS: So, good question, Steven, thank you. So, a quick example, so you must be familiar with the hazard mitigation plan being one of the most critical plans any state, territory or tribal nation can have. So a little under 50% of tribal nations have a FEMA-approved hazard mitigation plan in place, yet all states and territories have one in place.

And it's not just the hazard mitigation plan. I don't want to take it off subject, but we just went through COVID-19, right? And one of the key plans for that was a FEMA public assistance administrative plan. And there wasn't one the place for tribes yet all states had practiced these annually. And so we had to go ahead and I actually worked with headquarters to create the PA admin plan and that was adopted and utilized for tribes. So it's a lot of nonstop behind the scenes work just to get any sort of parity working alongside our national organizations with. Thanks.

BECKER: I'll just say that those are stunning numbers; very useful for us to hear that. And the second question for Richard

and Nelson is, I believe in your comments that you referred to speaking or being fluent in your tribal nations' languages --

ARNOLD: Just my language. We're all different, we don't all do not speak the same language.

BECKER: But you each speak a language of a tribal nation?

ANDREWS: I'll, just so, like, I'm not going to speak for Richard, but I know he was raised, it sounds like, speaking his language around the home. So, and for us; where the Pilgrims landed, where the first settlers landed was Cape Cod, right? So that's -- my ancestors, the Wampanoags were the first to literally get the brunt of it, right? Just in, from the year 1613 until the year 1620 before the Pilgrims arrived, you know, over 45,000 of my ancestors had deceased from disease. So, with that, the women and the children were taken. So our language was pretty much wiped out and the boarding schools following that; Carlisle Indian school, all that. We were taught not to speak our language. Right now we have a language revitalization program, WLRP. We are teaching our tribal kids in our school the language and they actually speak the language fluently. A lot of us older folks, now, you know, we're relearning it.

BECKER: So, it sounds as though there is a bit of a Renaissance, a revitalization, so with those efforts and with individuals who currently speak those languages, would it be a useful thing as part of consent-based siting processes to have informational materials and communications in those languages available?

ARNOLD: Well, and, my language is not a written language. It's only orally spoken and so it makes it challenging and so you have to spell it out phonetically and everybody will spell it out differently. And I even see linguists try to write it down and often times you see some weird marks or whatever else and it doesn't read or flow right or the accents may not be right and so it would be challenging, I think often times with that. And so, there is a lot of wisdom and a lot of things in our language like one word may mean really a lot of things and so depending on how it's used will determine how you are interpreting what is being said.

BECKER: Thank you.

ANDREWS: Real quick on that, too. If you get a chance to look at what are the different languages, where are the base of them. The

Algonquin language is primarily in the Northeast region all the way down through the belt to the Carolinas. So that type, maybe that type of base for different regions may work, but good question.

LESLIE: Scott?

TYLER: Thank you. Scott Tyler, member of the Board. First off, thanks to all of you for outstanding presentations and informative presentations. I want to follow-up on a question that Steve asked, just to drill down a little further into the nuclear waste side. The three of you are all quite well-connected or at least participating in various nuclear waste advisory committees on transportation and other things. But, from a standpoint of the federally recognized tribes, what percentage of those tribes would be in the same situation as the three of you are? And you said 50% don’t have an emergency management. But if we go down to talk about things nuclear, does that number change? Does it go up or down?

WESTRA: It kind of depends on what part of the fuel cycle are you looking at. You know, we have tribes that are impacted by uranium mining, tribes impacted by fixed facilities, WIPP, if we are

4788 talking just nuclear, generally, materials, tribes that are
4789 impacted by the WIPP facility itself, WIPP transportation. We're
4790 trying to grow our committee but as far as like, it's hard to get
4791 tribes engaged on transportation since we don't know where the
4792 material is going to end up. So, it is hard to stay "well, we
4793 want you to get involved in this, but we're not really sure
4794 whether or not you are going to be impacted."
4795
4796 So, when, we have a good cadre of tribes that are involved in
4797 these matters, but back in the day, so to speak, when Yucca
4798 Mountain was the destination there were a lot more tribes
4799 involved, because they knew for sure they were on a
4800 transportation route. So it's hard as Nelson mentioned that
4801 tribes don't have the resources that states have. So it's hard to
4802 get tribes engaged and expend those critical resources on
4803 something that may or may not happen in the – you know. I would
4804 imagine once, if once there's a facility we'll engage more with
4805 other tribes.
4806
4807 ARNOLD: Yes, and I would just add that while there are some
4808 shipments, some WIPP shipments going on so that's low level, I'm
4809 sorry, transuranic waste going down to WIPP, that there are
4810 tribes that do interface with DOE on those shipments. And so

there are some collaborative approaches, I guess that they are using, not that it's – it's kind of a tough thing. Sometimes when just looking at our mix and sometimes when you're talking about nuclear issues. I mean nuclear -- sometimes there's a stigma that goes along with nuclear and whatever else and either it's good or bad, you know and the stuff on the backend, well, that's always the problem child, you know. So how are we going to deal with this kind of issue. So those things are elements that we have to oftentimes struggle with. And so some people will say, gee, you're pro nuclear or not nuc or whatever else. And the fact of the matter is that we see it as an impact to the community, and an impact to the tribes that needs to be addressed. And oftentimes it's not being addressed adequately, and tribes are -- . It's being addressed by other people are sharing their thoughts and oftentimes not the tribes. Our whole purpose oftentimes is just trying to be a tribal voice into a process and shape maybe some national policy that will impact positively tribes and making sure that we're, our voices are being heard.

LESLIE: Thank you, Richard and thank you, Nelson and thank you, Heather. It's been a fantastic discussion and I will turn it back over to Nathan. And if you could exit off that way, we've got to move the table and we will start with the next presentation. So,

thank you, again, the Board really appreciates your participation and keen insights.

SIU: And I will also add my thanks. It’s one thing to read some graphs and another thing to hear people talk so, thank you again. And thank you, Bret, for organizing.

Okay, we will take a few minutes just to rearrange the hardware here and then get started on the next presentation by Kaushik.

Okay, I think we are all set. So, our next speaker is Kaushik Banerjee from PNNL. Please.

BANERJEE: Good afternoon. So, thank you for having me here today. My name is Kaushik Banerjee. I’m from the Pacific Northwest National Lab. So, this talk will be slightly different from the previous one. I am going to show you a lot of data and talk about some results and so previous talks, they’re more about the programmatic level, and this will be more on the technical level.

So, as you can read the title of the slide is too long, I’m not going to read that to you. But, mainly I'm going to talk about the data, spent nuclear data analysis tools that we call UNF-

ST&DARS, at this point. That tool has many applications, and I'm mainly going to talk about one application today. That application is to find out the transportability of the loaded canisters.

So, we have loaded canisters currently at storage and we can use the tool to find out when those canisters will be transportable, or if we need to do something to make those canisters transportable. So, we have a team working on this project developing a UNF-ST&DARDS. So the team mainly from Pacific Northwest National Lab, also like we are working with Oak Ridge National Lab and Idaho National Lab.

I think you have seen this before a few times, I'm going skip. But it's just to let you know so my job is purely technical and my talk does not take into consideration any contractual obligations or limitations under standard contract.

So, this is a one slide for describing UNF-ST&DARDS. So, in this slide I'm going to talk about three things. One is, what is UNF-ST&DARDS. Then I'll talk about what are the objectives of developing the UNF-ST&DARDS. Then I will talk about what are the applications for UNF-ST&DARDS.

So, what is UNF-ST&DARDS? UNF-ST&DARDS stands for used nuclear fuel storage transportation and disposal analysis resource and data system; a mouthful and just let you know we are actually trying to rebrand or rename the UNF-ST&DARDS so you probably can see the same tool, different name in the future. So, basically the tools provide us with a spent fuel database, a comprehensive database analysis platform and you can actually take the data and find out different characteristics of spent nuclear fuel.

So, what are the objectives for developing this tool? So, the main objective of developing this tool, we are trying to track the spent nuclear fuel when it is discharged from the reactor, that time, to the time when it will be disposed in a repository. We tried to see or tried to calculate or find out how the characteristics will change as a function of time. And we can use that information for informed decision-making.

And what are the potential applications? So, definitely we can use the tool, we have data. We can use the tool to find out if there are any issues, and if there is any issues, if we need to prioritize any resources or doing any R&D. And I’m going talk

about some of those issues today and there will be examples in that area.

The second thing we can do using the tool we can also inform decision-making for example like, we can find out when a loaded canister will be transportable and I'm definitely show you some examples of that.

We can also use the tool to support fuel cycle analysis and also safeguard and security. I'm not going to talk about that today. And also, the tool can be used for licensing application and also licensing reviews. And the Nuclear Regulatory Commission is currently using the tool for some of the licensing reviews, especially for shielding and criticality reviews.

So, this cartoon here kind of shows you what we are doing in UNF-ST&DARDS. So we get data from the nuclear plant, not just from the nuclear plant, it's not shown on the cartoon, we get data from other sources, as well. We store that in UNF-ST&DARDS. There's a database. We take the data, we do different analysis, we get our results and get the base data and results and we can use that data for supporting long-term storage and aging management. We can use the data to support large-scale

transportation planning and also we can use the data to support future disposal.

So, now I'll go into more details. First I'll try to give you a background and try to draw a picture here. So, in the U.S., we have a large amount of spent nuclear fuel. So, this plot is kind of showing commercial spent nuclear fuel in 33 states. This does not include State of Idaho and State of Colorado, where we have commercial spent nuclear fuel currently managed by the Department of Energy. This hexagon is kind of showing how much spent nuclear fuel we have in each of those states, the number showing the spent nuclear fuel in terms of metric ton of uranium. You can tell we have a large amount of spent nuclear fuel in State of Illinois and State of Pennsylvania.

Not only that, this is the present nuclear fuel we have as of December, 2017. But we have been continuously discharging spent fuel at a rate of approximately 2,000 metric ton, MTU, or metric ton of uranium per year. So, for our system planning we also need to understand the projected inventory to the future.

So, if you project our inventory into the future, assuming that all of the reactors will run for 60 years, except the reactors,

the six reactors that already received their licensing extension for 80 years. So, we'll end up with approximately 140,000 MTU, metric tons of uranium of spent fuel in the U.S., which is a large quantity.

Not just a large quantity in the U.S., we use diverse systems for storing spent nuclear fuel especially for dry storage. This bubble chart is showing you the different vendors. So, in the U.S., we have three main dry storage vendors, HOLTEC international, NAC international or SNC International and ORANO/TN. So, the red is for NAC. The red bubble is showing all of the NAC system. The orange bubble is showing all of the HOLTEC system. The teal blue is showing the ORANO/TN system. And just by saying that you can see all of these vendors do not have one or two different systems, they have many different systems.

And this is also going into not that much detail so for example HOLTEC, I am just showing MPC-32, which is 32 [indiscernible] canister for HOLTEC. But there are different varieties of 32. They have 32, 32M, 32F and things like that. The point of this bubble plot is showing that we use like diverse system of storing spent nuclear fuel in U.S.

And not just we're using the diverse system for storing spent nuclear fuel in the U.S., also like our spent nuclear fuel itself is pretty diverse. We have BWR and PWR fuel. Our BWR fuel goes all the way from 6 x 6 to 11 x 11. And PWR fuel goes all the way from 14 x 14 to 17 x 17. And when I'm saying 6 x 6, so, like they have the 6 x 6 array in each of those areas like the fuel pins, right? And we have some weird fuel types as well-like 13 x 14, 15 x 16 and things like that. So, this bubble chart is showing like -- the point of this bubble chart, I don't expect anyone to read this thing, just to show the diversity of the spent nuclear fuel type we have in U.S.

So, what the point I'm trying to make, the point I'm trying to make is that we have a large volume of spent nuclear fuel throughout the country. The spent nuclear fuel itself is diverse and also they are stored in a diverse system. So, all of these large-volume and diversity make any kind of planning for transportation and disposal a complex activity in U.S.

So, now to do anything with the spent nuclear fuels, we need to understand the characteristics of the spent nuclear fuel. So, if you know the characteristics of the spent nuclear fuel, you know like what you can do with that. So, that's the basic thing we

need to know. And when I think about characteristics of spent nuclear fuel, I think characteristics should be like two types of characteristics. One is base and one is derived. So, base characteristics would be anything about the fuel that you see here. So, for example the length of the rods, the cladding materials, what kind of pellet you have, what is the thickness of the cladding. All of those things are the base informations, the design information is the base information.

Now we need to use the base information to find out, we use the base information to do calculations using different kind of code and find out derived or calculated information like decay heat, radiation sources, isotopics, criticality of the canisters. What is the temperature when you are storing the canisters and what will be the dose to the public, and all of those things are derived information.

And so, anything in this cartoon, anything about this fuel assembly you can think about as base informations. And we used that base information to find the decay heat and radiation sources and all those things are the derived informations. Now, we can use the base information and derived information for decision-making, for informing the decisions. So we can use this

information to find out when you can move the fuel from the pool to a dry cask and also the same information we can use to find out when the canister is transportable. So, that's how we can use this information to make different decisions about spent nuclear fuel.

And that's exactly what we do in UNF-ST&DARDS. In UNF-ST&DARS we get the base information, we use the base information to find out the derived information like the decay heat, isotopics, criticality dose and all those things. And the application would be, at some point, when we actually start doing large-scale transportation planning, disposal, etc. so we can use this information to inform that planning process.

So, UNF-ST&DARDS has, as I mentioned before, we have a database, a spent nuclear fuel database and we have some analysis tool. So, this cartoon is showing all of the components of UNF-ST&DARDS. I'm not go into the details of that. So, as you can tell there is a big database and we have some analysis tools like SCALE and COBA-SFS. So SCALE is the code we use to find out the decay heat calculations and to find out the isotopics and then we can transfer the isotopics to a canister, find out the criticality, dose and all of those things. And COBRA-SFS we use for doing

thermal calculations figuring out what would be the peak cladding temperature. What should be the canister surface temperature and things, things, things, like that.

And so, what we do is stored the base information feed that through our tool, our code and do the calculation, and get the results, that is the derived, and put it back into the database. So then you get both the combination of base and derived information in the database that we can use to inform decision-making in the future.

So, one of, one of, one of the unique features of UNF-ST&DARDS, we do all of these calculations in an automated fashion. So, we do different kinds of calculations that you can see from the other slide. We do depletion calculation. We do thermal calculation, criticality and dose calculation, all those things. And for all those calculations, as you know, like, you need different kinds of models for doing the calculation.

So, the model has two different things. One is that data and one is the structure. So, depending what code you are using the structure is always fixed. So, when we made our model, we made the structure and we do not do the data. So, it is just like a

skeleton, right? And then, like, when you're doing the calculation based on what nuclear power plant, what system, what spent nuclear fuel you're using, based on that decision, the tool can figure out what data we need to complete the model and then we can get the data like the discharge data, assembly data, reactor data, cask data and we can give that to the skeleton, complete the model, run the calculations in the automatic fashion, get the results and put it back to the database. That's exactly what we do in UNF-ST&DARDS.

And we follow this process. That's why everything is automated. We make one model, no data, and based on the nuclear power plant, based on the fuel and all those things we can actually fill that model and create an automated analysis.

So, I'll go more deep, more into the datas, but this is just an example datas we have here just to show what kind of data we have. So, for example we can just take a look at this one. This is kind of showing the decay vs burnup, here. So, you can see there are two main bands going on and the upper band is for your PWR and the lower band is BWR. So, BWR has lower decay heat than the PWR, because BWR also has lower uranium mass. So, you have a lower decay heat.

So, now let's talk more about the type of data we have in UNF-ST&DARDS. So, let's first talk about the base data and then I'll slowly move to the derived data and the results we calculated.

So, this is the main data that we have here. So we have right now about 275,000 spent nuclear fuel assemblies discharged from U.S. commercial reactors in our database. This data is coming from a process called GC859 process, so in the GC859 process there is a GC859 form and this is a part of the standard contract and we are collecting data every five years from utilities right now. So, this data is up to 2017 and this year again we are supposed to start collecting data from 2018 - 2022.

So, what I've done, I have taken those 275,000 assemblies and then I kind of bin them so that you can see the Y axis is the burn up and X axis is the enrichment. So, I bin them by burn up and bin them by enrichment and then each of the boxes is showing the number of assemblies we have within that particular bin. And the color is showing, like a heat map, is showing the gray color means you have more assemblies, and then the blue color is less number of assemblies. So, by seeing the color you can tell, like, most of the assemblies, there are a large number of assemblies,

and they are more like 40 gigawatt MTU burnup and they are more than 4% enrichment in that range.

So, that’s the base data. So using the base data we also find out like what will be the projected inventory in the future. So, these three plots are showing that. The first one here, right here, right here, that’s actually the base data. So your Y axis is all the nuclear sites, all the nuclear power plant sites we have in the U.S. and the X axis is the number of assemblies. So, plot number one is basically the base data shown after 2017 and number two, the middle one is our projection, and that projection we assume all of the reactors are around for 60 years except for the six that have already received license extension to 80 years. This also assuming that Diablo Canyon will shut down in 2024 and 2025. The third one the last one is assuming there will be two new reactors Vogtle 3 and 4.

So, if you do that you will get this projection in the future and with that projection, you will end up with something like I'm showing on the previous plot about 140,000 MTU spent nuclear fuel assembly.

This is the same plot. In the previous plot you saw your Y axis which was the site name, the nuclear site name and the X axis was the number of assemblies. This, I just changed the X axis to the MTU and we can calculate the number of discharges in the future from the reactors and also find out like what would be the MTU or the metric ton of uranium discharged from each of the reactor sites.

So, we also track the canister loaded at each site, so this plot is showing the canister loaded at each site. And also, the plot is colored by the number of assemblies loaded. So, you see some places loaded by like some of them are loaded up to 146 or 156, I can't read … 156 canisters, canisters, I think. But, if you see the color, that is not quite red. Red means you have more assemblies. That's like the PWR site. Another one, like the red one there is 121 and that is BWR site. BWR site. They load more assemblies in the system, that is why even though they have a lower number of canisters, they load more assemblies. That's the difference in this plot.

So, the point of all of this is to show you what kind of data we keep and what kind of data we track in UNF-ST&DARDS.

So, some other information we are also keep in UNF-ST&DARDS that we need for doing calculations like finding out decay heat and criticality and all those things is the fuel geometry. We need to know the fuel dimensions. We need to know the reactor irradiation history, like how long these assemblies were in the reactors, how many cycles they were in the reactors and what is the power in the reactor and things like this. So those are things that we need to find out with all of the derived information.

We also keep information about the cask system. That is something that we need to know to do a dose calculation and shielding calculations to find out like what would be the peak cladding temperature or canister surface temperature and all those things. We also keep other information like economic attributes, transportation infrastructure, and some other information that actually feed to our system analysis tool we call NGSAM.

So, the database that we have in UNF-ST&DARDS, NGSAM is using the data from the UNF-ST&DARDS database for doing the system analysis calculations. Some of that we are seeing here economic attributes, transportation and all of these things, they are actually supporting NGSAM systems analysis calculation.

And so, the plot here is another example, kind of showing how we can use the base data here. So, you see the purple side here is showing all kinds of canisters, not all the canisters, at least a majority of the canisters in the U.S. and they are broken, so the half circle is broken by the vendors.

So, the first one going all the way, that's the Orano. Then the next one that is going, that's the NAC. Then the next one is the HOLTEC like that. And the other side, the bluish color, that's actually the corresponding of the designated transportation cask. So, because of this diverse system, you also need to know like which canister goes to what transportation cask to find out the transportability, right?

So, using the database, we can easily find out like okay, this is the HOLTEC international MPC-24 and if you just pick that canister, so the database will tell you that designated transportation cask for that particular canister is HI Star 100. So that's another example of the way you can use the UNF-ST&DARDS data.

So, we talked about a lot of the base informations we have. Now, as I said, we take the base information and we do calculations.

We run codes to find out decay heat, isotopic compositions, and dose and criticality and all those things and I will quickly show you some of the derived information we have in our database.

So, this is the example of decay heat, so this is my supernova plot. The Y axis to show the burn up any X axis is showing the decay heat and you see that these two things in the density plot. The first one here is most of the BWR assembly will be there. And the second one is going that most of the PWR assembly will be in that particular band.

So, as I said, like, we also find out like what would be the isotopics and how that is changing with time which is really important for us to do criticality and dose calculations and also to support fuel cycle analysis and some safeguard type calculations.

So, this is just an example to show that we do have all, not all, at least the majority of the isotopics in UNF-ST&DARDS. So this is kind of showing the selected actinides and each bubble is representing an individual actinide and they’re showing the total of that actinide in one nuclear reactor site.

So, this was actually a movie but it is a PDF so the movie's not going to work, so sorry for that. So this is showing the temperature inside the canisters and the way it works if the movie would work you would see how the temperature is changing inside the canister. So, you go from the middle of the canisters actually below to the bottom of the canisters and then we would show you how the temperature is changing and then you can go up to see how the temperature is changing and also you can go forward through the time to see how the temperature is changing inside the canister.

The temperature of the fuel is important. As you know, the peak cladding temperature we talk a lot about this 400 C and hydride reorientation and things like that. So, we kind of tried to keep track of the entire history of the fuel to find out if there will be an issue with the fuel integrity after long-term storage and during transportation.

Okay, so now I will change gears. So we talked about UNF-ST&DARDS and the kind of data we have, and the analysis that we do. And now I'll just change gears and talk about some applications of the data and analysis we do in UNF-ST&DARDS. And the application I picked today is basically to show like how we can use the UNF-

ST&DARDS to find the transportability; how to find out when a canister will be transportable or we need to do something to make it transportable.

And so, before going to that, we need to understand the UNF-ST&DARDS analysis approach is slightly different than the analysis approach being used by the fuel, by the cask vendor. So, cask vendors, they use what is called bounding or a design basis calculation approach. So, in the bounding approach, what they do is they use a bounding burnup, bounding enrichment, everything is bounding. They try to bound their analysis.

And there is a reason for doing that, when they are doing the safety analysis for these particular system, they do not quite know what the utility is going to use or what the utility is going load in the future to the system, so they do not know and that is why they want to bound everything. That is why they have a good reason for doing a bounding calculation when they are doing the safety analysis for the system.

But for our case, we actually know what is loaded inside the system so we can take advantage of that. So, this plot is trying to show like if we take advantage of that knowledge we already

have, we know this is the content actually loaded so we can gain some margin and use the margin to support some of the future transportation and disposal activities.

So, this is the one, on your left, that’s the one that is an example of a bounding calculation. So, this is just showing what the vendor has done and I'm showing this example in terms of criticality. So they do the same thing for everything else.

So, in terms of criticality what they have done for this bounding calculation is they assume all of the assemblies will be in that canister and they will be enrichment 3.7%. So, this is a 24 assembly canister and they will all be 3.7%. And they did not assume any burnup and so they assume the burnup would be zero and they assume there would be no cooling temperature, as well.

But, that’s not the case, right? So, we call them spent nuclear fuel, we burn the fuel and they should have some burnup. They cannot have zero burnup. And so, in reality if you see the plot here, this is showing the burnup versus enrichment. If you can just imagine vertical line in the 3.7% wise and then you see a lot of assemblies on the other side of 3.7 line. I don't have the line, you have to just imagine the line. So, you can actually

load all of the assemblies in this particular canister, but they all have some burnup and some enrichment, right? So, in reality you end up with something like that on your right. So you'll have some enrichment like the top one 3.2% enrichment with some burnup, 34,000 burnup and some cooling time which is like 30 years for that cooling.

PEDDICORD: Are these bundle average or peak rod burn-ups?

BANERJEE: Sorry?

PEDDICORD: Bundle average or peak rod burn-ups?

BANERJEE: These are bundle average.

PEDDICORD: Okay, thank you.

BANERJEE: So, now if you take this one, this bounding approach and if you do a criticality calculation, so the criticality is measured by what we call K effective the neutron multiplication factor. So, the K effective is the one, when the system is critical and so just think about reactor, we have K effective one, and if it is more than one it goes supercritical and if it

is less than one we call it subcritical and that is where we like to be, that is the safest one and that is where we like to be.

And if you do this calculation, you end up with 0.9 with a bounding approach. Now, as for our case, we know the actual content inside. If we take advantage of that and model the actual content after that which you look at as loaded, then you end up with something like 0.66. So you get a margin, right?

And the margin you already have in the system - oh, sorry - so, we can use the margin for doing our … supporting several different things and I will quickly show some examples of some transportability determination.

So, for storage, we use a Part 72 for doing our storage, to meet our storage requirement. But for transportability we use a Part 71 for meeting our transportability requirement. Due to these two approaches, the canisters may not be immediately transportable. So you need to find out when they will be transportable. So, how do you know when a canister is transportable? So we know the loaded content and we compare with that with the content approved for transportation the transportation Certificate of Compliance. So, by

comparing that we can find out when the canister will be transportable.

So, there can be two scenarios here, one, for some canisters you just need some additional cooling time to make them transportable. Some canisters, they will not be transportable and you need to go through the licensing amendment to make them transportable and I will show you two examples here.

So, first of all, first example I will show you from the decay perspective. So, I will first show you the decayed perspective and then the dose perspective and then the criticality perspective and that is the last one I have.

So, from the decayed heat perspective you have two different scenarios. For some canisters you have a really simple one. Like for an example, like number one we have MPC-68 which is 68 canisters and you need to meet to 272 W, so if you are at 272 W or less then that canister is transportable. But, you can also have like a really complicated like the one at the bottom which is MPC-37. It has a three zone, the inner zone, the intermediate zone, and outer zone; zone one, two and three. And they each have a different heat decay requirement. And, not only that, if you

can see this side, they are actually proposing six different loading pattern. So you need to figure out what loading pattern is most appropriate loading pattern for your sites and based on that you need to show that you are meeting those zone requirements for that.

So, for the simple example here, so remember the simple example is MPC-68 and you just need to be below 272 W. And then you are transportable. So, what I've done, I just have taken an actual loaded MPC 62 canisters, I plotted the decay heat as it changes with time and the redline is showing the 272 line, so you have to be below that redline to be transportable. The first particle line is the one the canister has been loaded in as we can tell like many of those assemblies when the canister is loaded above the redline that means the canister was not transportable and the canister is loaded in 2008 and around 2014, all of the lines or all the assemblies are below 272 W, so the canister is now transportable. So, it required 6 years additional cooling time on the pad to become transportable. And we can find out this kind of information using UNF-ST&DARDS.

This is a complicated example with like six loading patterns and three zones here. So, this one, what I've done, so I plotted all

of these patterns so each of the rows are showing one of the patterns. So they have six rows here and each row is showing one pattern and the columns are showing the zones like region one, region two and region three. The redline is the one you need to meet. That is the limit for that particular pattern. And what I did is just plot the decay heat from particular sites, like six sites like Palisades and SONGS and all of these things on these things to show like how the decayed heat changes over time.

So, if you have this kind of data than you can find out for these six sites, the most applicable pattern would be pattern five and six. Using pattern five and six to show the transportability in 2025, but if you use another pattern, that probably would have been used for other sites, but not these sites and they are not transportable. Like pattern one, they are not transportable in 2025, so you can use the UNF-ST&DARDS for using this type of information.

Okay, so I will quickly move and talk about dose calculations here and, so dose like you also need to make sure you meet the transportation CoC limit to make sure transportation Certificate of Compliance limit and to show like you are actually meeting the dose requirements here. And we just compare the cooling time,

5406 burnup and enrichment to find out if we're meeting the
5407 transportation limits here.
5408
5409 So, for example if we take the row number one. So it has to be
5410 more than 12 years cooling time and the burnup has to be less
5411 than 24,500 and the enrichment has to be more than 2.13, right?
5412 So, you need to compare with this requirements to get your loaded
5413 content to find out if you are transportable or not.
5414
5415 So, just take like one of the yellow lines here. So according to
5416 the yellow line that you see the burnup is 36.53 and that means
5417 we need to either use 39,500 line or the 40,000 line to see if
5418 they are transportable or not. But, for both of those two lines,
5419 your enrichment has to be more than 2.9% or more than 3.2%, but
5420 our enrichment is 2.62%. So, we do not meet the transportability
5421 CoC requirement and that means with this particular canister we
5422 need a certificate amendment to make them transportable and even
5423 if you wait longer, you cannot make this transportable.
5424
5425 Same example, but this is by the burnup here. You can see that
5426 they loaded some high burn up fuel after like 50,000 or more than
5427 50,000 and you are only allowed to load up to 45,000. The last
5428 row here showing that you cannot go more than 45,000. So, these

canisters are also not transportable because you need to amend the certificate to make them transportable.

But, if you do the dose calculation like we do in the UNF-ST&DARDS using the actual loaded content, you can show the canisters are transportable. You can justify the transportability or use this approach to support future licensing amendment. That is what we are showing on this particular plot, and this is showing the dose and we have seen those two canisters and you see the redline here is the limit for transportation. That's the most limiting transportation dose limit. And you can see in 2020, both of those canisters, they are not meeting the CoC limits, but they were actually less than Part 71 limit meaning they are transportable in 2020 although they're not meeting the CoC limit. So, you can use the as-loaded approach using UNF-ST&DARDS to show some of these things can be justified for transportability of the canister and use them for licensing amendment.

Okay, my last one is the criticality, and I will quickly talk about that as we are already overtime here. So, for criticality we have like something called criticality loading curve. And you need to make sure that you are actually following the loading curve to see if you are transportable or not and I'm just showing

a couple examples here. One, this is for the NAC system, NAC MAGNATRAN system. So you and there are two curves there for 15 x 15 assembly types and 17 x 17 assembly types and just think about those lines, I draw those lines based on the information from the CoC. The CoC information I'm showing on this side right here.

And if you are above the curve, you are not acceptable and if you are below the curve, you are acceptable for transportation. And then I plotted some assemblies from actual loaded assemblies from Zion and some of the sites on those plot and kind of like checked that and according to that analysis you can see those canisters at that those sites are transportable from the criticality prospectives because they are below that curve.

So, the last example I have is the, the, this HOLTEC MPC-32 for the HI-STAR 100 system and the same thing here. We have a transportability curve. And for this one, you have to be above the curve to be transportable and if you are below the curve, you are not transportable, right. And we have separate curves for different 15 x 15 assembly types in 17 x 17 assembly types. And then what I have done I have taken some real loaded canisters and got those assemblies plotted and many of those are already loaded, but they are below the curve meaning that those canisters

are not transportable and for this scenario, waiting of additional cooling times do not help so you need to amend the certificate to make them transportable.

So, we can figure out this kind of information to support transportability using UNF-ST&DARDS. And as I said before, so we have seen, in the previous plot, we have seen many of these canisters are not transportable according to current or current Certificate of Compliance for transportation. But if you do the actual as-loaded criticality calculation which I'm showing you right here, the K effective is your Y axis and this is the date or the time on the X axis. Normally for your transportability if your K effective is less than 0.95 and as you can see the loaded calculation, all of them are below 0.92 meaning like even though they are not transportable according to the transportation certificate compliance, you can use this as-loaded criticality analysis approach to justify the transportability or use this approach to amend Certificate of Compliance in the future.

Okay, so for criticality we are, we analyzed 1,100 loaded canisters as a function of time we have the three main focus areas here. And one is like we -- utilities are loading canisters and loading that and we analyze this as a function of time.

That’s one thing. And also, we are collecting more detailed information from the utilities by signing NDAs with them to kind of validate some of the assumptions we make for the criticality calculations. And the third focus is also like we are developing an approach for code evaluations for as-loaded criticality analysis.

So, here are some of the recent publications that we have. I will quickly go through this, this is my last slide here.

So, we talked about UNF-ST&DARDS providing database and analysis platform. So, this is the database of electronics, and you can store data for generations which provides knowledge management and also as we have seen you can use the UNF-ST&DARDS information for informed decision-making supporting large-scale transportation and eventual disposal. Also, currently we are working with EPRI and Oak Ridge National Lab for commercialization of UNF-ST&DARDS. So, with that, thank you, that is all I have and sorry I am 10 minutes over, I guess.

SIU: Thanks, Kaushik. Okay, let's take some questions.

WOODS: Brian Woods, Board member. Thanks, Kaushik for that really great presentation. I did see for the criticality you had some validation exercises called out as something you're working on right now, so have you done something also for other things like the decay heat portion of it, and the heating, the peak clad temperature, like how you done verification and validation exercises for that, as well?

BANERJEE: Yes, for decay heat, yes, for decay heat, we definitely do validation work using a lot of these decay heat measurements done by SKB in the CLAB facility, and also like using some of radiochemical assay which basically we compare with our isotopic calculations and we do that.

For thermal calculation, we have done some validation using the high burnup remote cask and there is just not that much data to do that kind of validation work. So high burnup demo is one of the systems that gives us a lot of data for doing the thermal validation work.

WOODS: Okay, and one other quick question, as well. So you talked about having the margin between the design or the as loaded and the calculated. Oftentimes I know we use that margin to deal with

uncertainty. So have you also done the uncertainty calculations on your code to understand how accurate UNF-ST&DARDS is when you're calculating the criticality piece and the decay, decayed power piece?

BANERJEE: So that's like …. Yes, so definitely we're trying to quantify. You're right. We're trying to quantify that margins to support any kind of uncertainty, especially the uncertainty coming because of the extended storage and the then transportation. There are uncertainties coming from that. To offset those uncertainties using that margin. We are trying to quantify the uncertainties. There are a lot of different uncertainties because we get a lot of the information through the GC859 process. For example, the utilities are providing us the discharge burnup, initial enrichment and all of these things and we have uncertainty in that. And then we put the uncertainties through the code through the results. So we do not even know like what uncertainties are in the actual input data part at this point.

So we have a process also like we collect the data using the GC859 process from all the utilities. We also collect data using NDAs from the utilities and they have more details and they are

actually QA'ed from -- and we can compare that to the GC859 to see how they are comparing and if there are any uncertainties in those information provided by the utility. And so, we are trying to quantify the uncertainties and put it in that way.

WOODS: Okay, great. Thank you.

SIU: Do you have a sense when you will be done with the uncertainty quantification?

BANERJEE: So, we are doing that by fuel type. So this year we are trying to do that for GE BWR. So BWR has a lot of varieties, especially they have their fuel design is quite complicated. So, they have actual radiations. They have radial radiations and things like that. So this year we are working with the GE fuel type. Next year we want to use to commercial engineering. So, the last year or the year before, we worked with the Areva fuel type. And we also need to do for Westinghouse fuel. We cannot do it for all of the sites, but we can do that by fuel type.

PEDDICORD: Lee Peddicord, with the Board. So, building this analysis capability is really impressive. Are you getting a chance to kind of look forward, maybe like fairly far forward as

we're now getting into the small modular reactors, but the new fuel types, coated particles, pebble bed, HALEU and so on, to make some projections of what might be the bounds, if you will, on transportability. And you think with the HALEU, you're either going to get a really high burnups or have maybe residual enrichments that are nontrivial compared to LWR fuel. So are you getting a chance able to wrap your arms around this to see what challenges we may be facing as these new technologies come into play?

BANERJEE: We are at least planning for that for sure. Last year we have done some work for, not for HALEU, yes, actually for HALEU but using the ATF accident tolerant fuel, not using TRISO or anything else. So, we implemented ATF analysis pipeline UNF-ST&DARDS. This year we started looking into TRISO and yes, there is definitely a plan, so ATF part is kind of done, but we are moving to other fuel cycles now, right now.

SIU: I think we have one from Paul, is that right?

TURINSKY: Correct. I have --. Can you hear me?

SIU: Loud and clear, Paul, thank you.

TURINSKY: Okay, I have three questions. One is, I remember that basically the defective, failed fuel containers basically caused a great deal of conservatism in your calculations. And it's because you were lacking data to really know what is in those containers. Have you made any progress on that?

BANERJEE: So, you're asking about the failed nuclear fuel in the loaded canisters, right?

TURINSKY: I am not muted.

BANERJEE: (CHUCKLE) Yes, so, yeah, so one of the issues as you know, Paul, one of the issues is that we do not have… we know that they marked assemblies as damaged or failed. But we do not know the extent of the damage or the extent of the failure. So we normally take a bounding approach to model that in and if you do a bounding approach to model that you definitely lose a lot of the margins, right? So, we are actually looking into at least taking partial credit for the burnup, that is the one that we are looking into.

TURISNKY: Okay, and on this idea, people are talking about uncertainties. You.ve built a lot of, because of proprietary data and because the data you need is so voluminous, that you really need, which is detailed isotopic data as a function of spatial distribution. You make assumptions. You make assumptions about the axial burnup distribution. You probably make assumptions for BWR pool history control, blade history. Do you have any idea of what, how big…how much conservatism that introduces?

BANERJEE: Yes, that's a great question. So, we do not know as we talked about the as-loaded calculation and as Paul is kind of pointing out, we do not know a lot of these reactor side of the information. For example, like when they are burning assemblies for BWR reactor, if they are exposed to control rods and we do not know their axial void distributions, the axial burnup distributions and things like that. So, when you do calculations, you make assumptions for those things. The margin I showed you, so they already have those assumptions.

So, what are you doing and what we're doing right now we are also at the same time as we do not know. We are collecting detailed information, signing the NDA's from some of the selected sites. So this detailed information gives us the reactor cycle

histories. For example, like the rod insertion histories and their void fractions, at least the average void fractions per cycle. And we are using that to quantify what kind of margins we have or what kind of uncertainties we have when you make thee assumptions.

Yes, so, Paul, we are doing that and we are collecting detailed information and comparing that to quantify that and we have like a couple of journal articles on that as well and if you want I can point that to you.

TURINSKY: That would be great. And my last question is that you mentioned validation. I mean validation is experimental data, usually mocking up pretty much what you're considering. In this case, it would be basically the configuration of the canister. I don't see how you are going to do that. I mean you're concerned about the poisons, the spacing, the non-fuel materials in there. So, what are your plans, and I am thinking obviously K effective … give me a little bit more insight on how you plan to do validation.

BANERJEE: So, we use the validation using the critical experiments and you are right, so none of the critical

experiments are using any kind of spent nuclear fuel canister for doing the critical experiments, right?

And a lot of the experiments, are they also using the fresh fuel they are not using burned fuel. And only have like a few experiments that are done in the 80s in France where they use some burned fuels and some of them they used MOX fuels so they have something. So we are doing like an uncertainty analysis using the Tsunami, scaled Tsunami and trying to find out if this experiments are applicable to our system. So we find out the applicability of the systems and based on that we actually find out, okay, so we have 1,600 criticality experiments and we do that applicability analysis using the Tsunami code and find like 200 of them will be applicable to our systems. And we take that 200 to find out the biases and uncertainties for our validation calculation.

TURINSKY: But you're believing in covariance matrices, are you not?

BANERJEE: Sorry, Paul?

TURISNKY: You're believing covariance matrices when you do that.

BANERJEE: No, I believe the Tsunami takes into account the covariance matrices when they do this … when they find out the correlation between experiments and correlation between the actual system.

TURISNKY: Yes, my point is there is a great deal of uncertainty in the covariance matrices.

BANERJEE: Yes.

TURISNKY: I mean we know that, because we can use them to predict uncertainties in power reactors. And the uncertainties they predict are so different than experimental measurements.

BANERJEE: Yes, you are right.

TURISNKY: Okay, thank you.

TYLER: Scott Tyler, with the Board. Thank you, Kaushik. I appreciate the excellent presentation. A question on the transportability, do you have a sense of, and maybe you can just remind us, how many canisters you have analyzed so far and how

many of those are -- we will need CoC amendments going forward, and do you have a sense of when we will have a sense of how many we have overall in current inventory?

BANERJEE: Not really, actually. We are, as we are speaking we are doing a more comprehensive analysis to find out that fraction right now. So, the things that I've done are more like spot checking, not a comprehensive analysis. But we're actually working on a comprehensive analysis where we check each site and finding out the ship by date and if they are not transportable if they need an amendment and what we need to do to make that happen. So, we'll probably have a report ready next year on that.

TYLER: Okay, so, a year or so from now, thank you.

SIU: Any other Board questions? Board staff? Okay, I think we have earned ourselves a full break. Thank you very much. So, let's pick up again at 2:55 PM.

Thank you, Kaushik.

[BREAK]

SIU: Okay, we are into the home stretch here. And Erica is going to talk next about the railcar projects.

BICKFORD: Alright, thank you, glad to be back here. And also to preface my presentation, I also want to give credit to Dr. Pat Schwab, who's in my group, who provided all the content on the Atlas railcar project. He's been leading that project for close to ten years, now. So, I just want to give credit to him.

Familiar sight again with our legal disclaimer. Moving on. And we kind of covered some of the ground previously in this presentation, but since I know we do have a number of Board members, I hope you don't mind a little bit of a repeat of some of the things, because I think it probably helps some of the retention. We'll talk about why we are using rail, the railcar standard S-2043 that we are developing, some of the Atlas railcar design process, because the project's been ongoing longer and is farther along, the Fortis railcar design process. And then I'll talk about the integrated security and safety monitoring system, which is a part of the railcar operations.

So, why rail? Because we get this question a lot and as I mentioned in my talking points this morning, there is sometimes a

public perception that transportation by rail is less safe than other modes. We've actually received public comments to the tune of 'why on earth are you planning to transport this material by rail, surely it is much safer to transport on the highway.' However, if you are familiar with transportation statistics, the accident rates for highway transport are much much higher than they are for rail transport. Again, it just comes down to people drive on the highway next to big heavy trucks all the time and there is a certain comfort level with familiarity and many people only engage with rail/freight transportation when they see some kind of the derailment or other accident highlighted on the news. And that affects their perception of the relevant safety.

However, we have to look at what the best mode of transportation is based on the packages that we are planning to transport. And at this day in age we've seen a number of presentations about the canisters of spent nuclear fuel and the corresponding casks from Kaushik's presentation. And what those casks will look like in a transportation configuration is they'll weigh on the order of up to 80 - 210 tons. And legal weight truck limit for a highway transport the U.S. is 40 tons. So, clearly we are much higher than a legal weight truck. You can think of a legal weight truck may be like a Walmart truck or an Amazon truck, a standard

freight truck. If you look at shipments where you're moving a package this large and heavy by highway, which we have seen in the presentation that Gerry gave. We look at some of the past heavy haul experiences of the sites that we visit and we are looking at things like 20-axle trailers, which we will absolutely use because as we mentioned we don't have rail access at every origin site. But we do not necessarily want to be using 22-axle trailers for every shipment over very long distances, because that becomes challenging for a number of factors. Partly that you can only transport one cask per conveyance, whereas on rail you have multiple casks make up in a train. As well as for things like navigating roadway weight limit, any clearance issues, turning radius issues and things of that nature having to transport the shipments at lower than marked speed which affects congestion on roadways and a whole number of factors.

So, because primarily of the size and weight of these packages of spent nuclear fuel, we find rail to be the most appropriate mode to transport this material.

Additionally, the U.S. Department of Energy and the Department of Defense has entered into settlement agreements with three of the

Class I rail carriers. Does everybody know what I mean when I say Class I rail carriers? Alright. Great teachable moment.

So, in the U.S., we have basically three classes of rail carriers, Class I, Class II and Class III. They are classified by, I believe, the Surface Transportation Board based on the revenue. So, that is a bit kind of minutia, but you can think about the major cross country rail carriers are going to be your Class I's, so your BNSF, your UP, your CSX, your Kansas City Southern, Canadian Pacific, Canadian National and also Amtrak is considered a Class I railroad, but they are not a freight railroad, so we don't look at them.

And then you have Class II and III railroads which is short line railroads or regional railroads. And those are often the serving railroads at a nuclear power plant site. Sometimes they are served directly by Class I, but a lot of times it is a short line or regional railroad that's serving and then you will be looking to find connection points to the Class I railroad. Because once you are on the Class I rail network, you can get across the country or wherever you need to go.

And so, the Department of Energy and DOD have settlement agreements in place with three of the Class I rail carriers, BNSF, UP and Norfolk Southern. And part of those agreements is a commitment that the government will use Association of American Railroads S-2043 compliant railcars for those shipments. That was negotiated in the agreement. The sort of background to these agreements goes back to the 1980s when the Interstate Commerce Commission was still active and there was a rate case brought basically alleging that the rail carriers were overcharging for government shipments. It went through various iterations and the Interstate Commerce Commission ceased to exist. The Surface Transportation Board was stood up in its place in the 1990s. They found that it was likely that the government had been overcharged and directed that the rail carriers enter into an agreement with the federal government for reasonable rates of service.

And so, the government has been moving one by one, because there are antitrust elements of negotiating in mass with the rail carriers. We have three in place between 2004 and 2017 and we're working on additional agreements presently.

And again, those agreements require that the government will use S-2043 compliant railcars. So that's a part of our motivation for

pursuing these and just lastly that we find that rail is the most suitable mode for large scale transport of spent nuclear fuel in the U.S.

As an example, the U.S. Navy has been transporting the Navy defense-related spent nuclear fuel from their nuclear submarines and aircraft carrier fleets by rail since the 1950s. So, we also have a long history of rail transport of spent nuclear fuel in this country, as well.

Just to provide some visuals on what we're looking at with the packages of spent nuclear fuel we are planning to transport. At the time we set out to design the Atlas railcar, we found about 17 different packages that were certified by the Nuclear Regulatory Commission for transportation. And so, here's the first half. And this just shows you the dimensionality and the loaded weight that you're looking at. And I mentioned before that we have some of these rail size casks, these four in the middle designed with 144 impact limiters, which is pretty large or most of our rail clearances, so that's something we may have to navigate in the future.

And then moving onto the next set, here you have on the higher end you get up on the right-hand side, the heaviest cask that's currently sort of certified for transport in the U.S. is 420,769 pounds loaded, which is getting pretty heavy. And we are certainly hopeful that we do not get any heavier than that.

Having this variety of casks presents some challenges in designing railcars. You have to qualify these railcars and you have to put weights on them. And so we worked with the Association of American Railroads to come up with bounding conditions.

I mentioned this morning that the U.S. Navy was the first to qualify an S-2043 railcar. Well, they only had one package that they were carrying. And we had 17. So that presented some unique challenges, but not insurmountable.

So, we mentioned the standard S-2043 again. The Association of American Railroads is the standard-setting organization for freight railroad transport in North America. It goes back to the 1800s. The Association of American Railroads existed prior to the Federal Railroad Administration.

And so, they established standards for railcar design, principally to ensure safety as well as interoperability across the North American freight rail system. The S-2043 is the performance specification for trains used to carry high-level radioactive material. This is a unique term that AAR came up with, but we interpret it, high-level radioactive material, to encompass spent nuclear fuel and high-level radioactive waste.

The intent of the design is to apply all the latest and greatest technology that we have available to reduce the risk of a derailment during transport. And I'll focus momentarily on what that includes.

Here is our Atlas railcar design and the attachment system on the surface. So, going back, you saw the 17 different cask models. And one of the things that the Atlas team had to develop was what they call cradle families. So, you have 17 different types of casks. How are they going to attach to a railcar?

They group them based on different certification parameters into different cradle families that would have different attachment mechanisms. And they developed the attachment mechanisms for the Atlas railcar to be compatible with all of them. We also, we have

some documentation to that effect that I will mention at the end, as well. But here is just the schematic. You'll also notice that this is a 12-axle railcar. We ended up going with 12 axles in order to accommodate that heaviest cask. At lower axle levels, your per axle loading begins to exceed what is the limits are for current rail infrastructure in many geographies.

Here's another schematic of the Atlas railcar with the heaviest load. I'll note here, do I have a clicker … no … okay -

SIU: I think Bret is going to bring a laser up -

BICKFORD: There was a laser up here. Oh, is this is? Sorry. Thanks Bret. Alright. So, you notice here, for this design, there are something called end stops. A lot of our graphics include these, because this is a part of the heaviest cask model, but not all casks will use end stops to be affixed to the railcars. So, to set your expectations. So there is a cradle here with an attachment mechanism overtop and end stops at either end in this particular model.

Again, this is the HI-STAR-star 190 XL which is the heaviest cask that's currently certified for use. These end stop, end cradle

attachment mechanisms also add additional weight. So for this a loaded cask with the attachment mechanisms would be 480,000 pounds loaded that you'd be transporting.

And here’s a graphic of the actual Atlas railcar, in the flesh. This is with the test weight. One of the challenges we had was working with the Association of American Railroads to come up with bounding weights that we would use for testing. We have a light load and we have a heaviest load. And then we had to develop test weights that could be segmented to account for either of those conditions. And so here is a picture of the test load in its lightest weight configuration. You can see in this configuration there are no end stops and the reason it has a center beam had to do with the crane load limitations at the testing facility. They couldn’t accommodate test loads that were the maximum size. So they had to create something that was modular and had a center beam and then you can add sort of different weights with slots on them to make up the largest and lightest loads. So that’s why it looks the way it does.

And then here is the test load configuration in the heaviest load. And so, you will see with this attachment, this one does have the end stops on it. Again, it’s the same foundation, center

beam model, but you just have the extra weight segments added on in this case.

Some more close-up pictures of the railcar. You can see here's the cask cradle in the pin block. It is a little bit difficult to tell from the photos sort of what the scale of these are, but we do have some photos with people.

And so here in this photo, this is Pat Schwab, the man himself. And then here we have a familiar suspect of Steve Maheras. So, just to give you a sense, here are those pin blocks and the holes in those pin blocks, I have not seen in person, but it has been described that you can fit your whole forearm through it. So these are very heavy-duty railcars with very heavy-duty attachment mechanisms to keep these heavy spent nuclear fuel casks attached to them.

In concert with the development of the Atlas railcar, we also developed a buffer railcar. And this is intended to separate the radioactive material carrying railcars in the train from the people-carrying. So, at a minimum you would have one in the front separating the locomotives from the cask cars. And you would have one toward the back end separating the rail escort vehicle with

the security escorts from the railcars. There may be circumstances where you would additionally have buffer railcars in between each of the cask railcars depending on load considerations and if you are moving over, say, a long bridge and you need to do some kind of weight distribution to meet the train dynamics.

Steve Maheras mentioned in the Q&A earlier that we'll need to do route clearances so that would be one of the things that we learn in the route clearance process if we need to have additional buffer railcars separating the cask cars.

Something you may see if you look up close is this is just a flat deck railcar and it actually has steel plates welded to the surface of it. And that was to weigh it down. The requirements of the S-2043 standard tend to lean towards better performance for higher axle loading. So, this railcar with the added steel plates welded on the top is actually at the maximum axle load. This railcar cannot carry anything else on top of it. It is just for show but it meets those S-2043 requirements. You also notice that it is only a 4-axle buffer railcar and part of that has to do with the train dynamics. When you have the cask carrying railcars that have 500,000 pounds on them, you can't have very light

railcars or light loaded railcars on either end because then you risk when you go around corners the railcar coming up off of the rail and considerations like that.

And here is a photo of our rail escort vehicle, or REV. As I mentioned this morning, we ended up being able to collaborate with the U.S. Navy who is in process of designing a new rail escort vehicle for their use. And we had the same exact needs as they had and so we were able to use the same design they came up with and contribute some funds to the effort and coordinate with them.

They had put in an order, I think they were planning on ordering five rail escort vehicles for fabrication. We were able to add a sixth one and they were even gracious enough to give us the second one that was fabricated off the line.

So, the Navy delivered the first one and theirs is a classic navy blue and ours is the second one fabricated, and ours is gray. And these are fabricated by Vigor Ironworks in the Portland, Oregon area. Whereas the Atlas and buffer car were fabricated by Kasgro Rail that’s north of Pittsburgh, in Pennsylvania.

And so in terms of the Atlas railcar project, here are the accomplishments we have had to date. In the S-2043 standard requirements, there's multiple phases you move through. First is the design phase where you have to do a lot of computer modeling and testing of design. You then submit your design and all this computer modeling analysis to the Association of the American Railroads. They have an Engineering Equipment Committee that is the authority for reviewing these designs. They review it and then come back and may have additional questions or need more information. At the end of that exchange, hopefully, they give you approval to move forward with the next phase. And the next phase after the design phase is single car testing. So, you check the performance of the individual railcars and then after you complete single car testing, you again gather the data and provide that to the Association of the American Railroads EEC. And then get the go ahead to proceed with the multiple car testing. So this is a multi-phase process and, again, that's why it is the most rigorous of any of the AAR standards and that is why it takes quite a few years to qualify a railcar.

So, our Atlas and buffer railcars have completed the single car testing and were approved to move forward with multiple car testing. The rail escort vehicle, the DOE's rail escort vehicle,

was fabricated and delivered to the testing facility about a year ago. The AAR had already approved the railcar escort vehicle for multiple car testing because the Navy led the single car testing for that phase. And then, because the scheduling coincided with our move to multiple car testing for the Atlas railcar, we're taking over the multiple car testing for the rail escort vehicle. So, that was a nice cooperation between us and the Navy in the development of our railcars.

Right now, multiple car testing is underway for Atlas, the rail escort vehicle and the buffer railcar.

In terms of completing the Atlas railcar project, what's left, there is an off-site service test in April/May of this year. What that is, is a lot of the testing is done on a rail testing site, the Transportation Technology Center that's owned by the U.S. Department of Transportation, out in Pueblo, Colorado. And then after you have completed those testing rounds, you next move into what is called revenue service testing. And you take it off of a test site and put it onto actual live rail track and see how it performs. And then the next test after that, that's kind of like the final test in this series is called a demonstration run,

which is intended to be a route that you run that would be comparable to routes that you would use for actual shipments.

We do not currently have a destination for a shipment, so we've just negotiated with the Association of American Railroads to use an alternate route which is going to be from Colorado, near the testing facility, up to Idaho near the Idaho National Lab and then back down. And that is again, just for the demonstration run purposes, it's not indicative of any future destinations for spent nuclear fuel.

Following completion of these tests, there is a lot of testing documentation and results to submit. You have to compare the actual measured performance, the experimental performance of the railcar against the modeled performance that was predicted at the design phase in order to qualify the railcar.

We're expected to get that approval from the Association of American Railroads either late this year or early next year depending on how long it takes to compile those reports and how much back-and-forth or additional questions they come back with. So, the Atlas railcar is very close to nearing its completion and being qualified for use in commercial freight transport.

If you're interested in more details on the Atlas railcar project, there's a lot of public reports available, documenting each phase. A phase from the conceptual design to the preliminary design and then to the as-built design. There will also be a single car testing report that will be due out soon. It's currently in my inbox to review and some of these are quite lengthy, on the order of 800 pages, so if you need some bedtime reading, have at it.

This last one here, I mentioned that we had to look at developing sort of cradle families in order to figure out the attachment mechanisms for the railcar that would be compatible with the 17 different casks. That information is in this Atlas railcar interface control document geared towards an audience of the vendors for the cask to make sure that when they get to the point of sort of finalizing their designs to make sure that whatever they come up with is compatible with our railcars.

All right, and moving on to our Fortis railcar. So our Atlas railcar is a 12-axle railcar that was designed to carry the heaviest casks that we have. However, in the rail system there are other considerations, one is that you pay by weight.

So, in general you don't necessarily want to use the heavier railcar than you need for lighter casks. In addition, some of the sites, based on our site evaluation work are a bit snug, even if they have refurbished on-site rail, there could be space considerations that would be advantageous to have a shorter railcar which the Fortis is because it is an 8-axle railcar. There's also considerations for fabrication cost and maintenance costs between 12-axle versus 8-axle railcars. So, we frequently get the question of, well, you already had a 12-axle, why did you go develop an 8-axle railcar? And the reason is to give us flexibility in the system, to operate the system as efficiently as we can based on the loads that we're carrying.

And our Fortis 8-axle railcar was designed by Sharma and Associates. It's a Chicago-based company. It is an 8-axle railcar and was designed to use the same payload attachment mechanism that Atlas has. So, Atlas kind of did all of the legwork for Fortis on and that, and there was no reason to do anything different. So we would expect that interface control guidance document to be just as applicable to the Fortis railcar.

It's also designed to be compatible with the buffer railcar and the rail escort vehicle in terms of, sort of, meeting up in a train configuration. The design for the Fortis railcar was approved by the AAR Engineering Equipment Committee in February 2021, which gave the Department of Energy the go ahead to begin the fabrication and testing process. And we follow that up with a Request for Information to solicit information from potential bidders. Because the difference between the two projects as Atlas went out and did a contract for design and fabrication and then did a separate contract for testing, with Fortis, because there were some questions on whether an 8-axle railcar could even be designed and meet the qualifications, the Fortis railcar project was done first as a design contract. And then once the design was approved, we then went out with a fabrication and testing contract. So a little bit of a different contracting mechanism were used between the two projects. And so we first went out with a RFI to get some industry information on how to design the contract and then followed that with a request for proposals that we placed the contract for last summer.

So, we are now in the fabrication and testing phase for the Fortis railcar. And here you can see a graphic of the Fortis railcar. Again, the same attachment mechanisms you saw in the

Atlas with eight axles underneath. You can clearly see the railcar is shorter.

I should have focused, but one of the things the Atlas railcar has is the articulated ends, and that was to get those extra wheel sets called trucks underneath, but without affecting the turning radius of the railcar. So, they both have I believe the same or similar turning radii.

The contractor for the fabrication and testing of the Fortis railcar is ENSCO with Kasgro Rail as a partner. Kasgro Rail also built the Atlas railcar and the buffer railcar. This contract kicked off last December. One of the first things that we did, which is not uncommon when you have a different designer and a different fabricator, was to go through the design and see if there were, maybe, any adjustments that needed to be made. One of the adjustments we did make to the design was to increase the deck plate thickness from 3/4 inch to 1 and a half inch. This was at the preference of the fabricator. They had concerns about making some of the heavy-duty welds on a thinner deck plate, also just based on their corporate experience, fabricating heavy-duty railcars, they just had a strong preference to use an inch and ½. They had some concerns about warping that could occur during the

fabrication process with a three-quarter inch deck plate. And so, we agreed to that change. There were also some related and unrelated weld changes made again, just based on differences between how the designers had fabricated railcars before versus how the fabricator preferred to do certain welds.

A lot of it has to do with order of operations so that you can do full inspections of welds before you add additional components on and lose visibility on them.

Here’s another blown out view of the Fortis railcar. Here’s your car body and deck. You have something called a span bolster, which attaches the deck to what is called the trucks. The Fortis railcar users swing motion trucks. A different type of wheel than the Atlas railcar uses, which ended up being one of the possibly challenging components to acquire. There’s only one fabricator in the U.S. of these trucks, Amsted Rail and they’re not as commonly used. And so, when we entered the contract with ENSCO and Kasgro sort of the first thing was to reach out to the fabricator of those trucks to make sure that we can put in an order for them which we were able to do last fall.

The path forward for the completion of the Fortis project is to complete the fabrication. Right now, the contractor is procuring long lead time components. Steel and other things as you can imagine has been affected by supply-chain issues which may put us a little bit behind the schedule that we would like to have. But we are still able to get those components. In parallel with that, there are instrument and wheel sets that are needed for testing. And, so these are wheel sets that go on the railcar that collect all the data for the performance.

We've been told that there can be long lead times not just because you need to get the wheel sets, but also there is a lot of instrumentation that goes on them and calibration that takes quite a long time. That was something that we wanted to make sure the contractor started early so that did not become something that delayed testing from proceeding later on.

The testing for the Fortis railcar will also be conducted at the Transportation Technology Center in Pueblo, Colorado.

It'll be using the same test weights as the Atlas railcar. So the Atlas railcar is supposed to finish its testing later this year. The Fortis railcar should begin testing sometime in 2024, so that

will hopefully align pretty nicely. When the Fortis railcar gets to the multiple railcar testing phase, we will be able to use the buffer railcar and the rail escort vehicle for those tests, as well. We're currently expecting the Fortis railcar to be ready for use by 2026, but that could be subject to any delays in fabrication or in the testing phases.

Lastly, I wanted to talk a little bit about our Integrated Security and Safety Monitoring system or ISSMS. So, this is both to meet DOE security requirements for shipments as well as to meet security requirements that are a part of S-2043. I mentioned earlier in the presentation that the S-2043 standard is designed to have all the kind of state of the science and state of the engineering components to reduce risk of derailment. And how that works is there are 11 different real-time parameters of the railcar that are monitored. So things like lateral, vertical, horizontal acceleration, truck hunting, roller bearing temperatures, GPS location, among others.

And so you have to have instrumentation on the railcar in order to collect that data. And what the S-2043 standard requires is there are performance boundaries for each of those 11 parameters and if the railcar starts to exceed those performance parameters,

there will be a light box in the rail escort vehicle that'll flag yellow if something is not seriously amiss, but slightly concerning, as a flag to stop the railcar at the next safe point and do an inspection. If something is seriously outside of those parameters, there will be a red light, stop the railcar as soon as possible, do an inspection, something is amiss.

And so that is the mechanism and that's the component of the design that is intended to reduce the risk of a derailment that you have.

All this monitoring that you have on the railcar performance so that there should not be or there should be a very low risk of derailment due to any kind of something component going amiss with the railcar, itself.

With the Atlas railcar project, we started with a different security and safety monitoring system provided by a different company. That company was then bought out and that division was not continued with the new company. And some individuals from the original company kind of spun off on their own. But it was a little bit of a three people in a garage type of operation, so we had some concerns of continued availability of that system. And

so separately in 2020, DOE embarked on an effort to develop our own, our own system that we could have confidence in both its ability to operate and its continued availability when we get to fleet fabrication of the railcars.

We have a prototype design in progress that's going to be used in testing last year and this year with the Atlas railcar. And is also being designed to be compatible with the Fortis railcar.

We are also intending for the ISSMS to integrate with DOE's existing TRANSCOM system for real-time telemetric tracking of those shipments. That's a system that DOE uses for other shipments including WIPP shipments that provides the capability of states and tribes along transportation routes to have visibility on the shipments when they are traversing their jurisdictions. And that's a system that our state and tribal government partners are familiar with using and comfortable with using.

Just a brief description of the system: it has three subsystems; it has an on-car subsystem; on the cask carrying railcar; there is a rail escort vehicle system that transmits real-time data on

either cellular or satellite networks depending on network availability. And then there is a cloud subsystem, as well.

The S-2043 standard I think requires data upload every hour, or some not very detailed amount. But that standard was based in the 1990s. Now with modern computing capabilities, I think we are probably looking for more of a frequency on the average of once a minute, potentially depending on data, data access limitations. And that brings me to the end and I'm happy to take any questions.

SIU: Thank you very much, Erica, that was very nice. Steve, of course?

BECKER: Steven Becker, Board. Thank you for a very nice presentation, it is always good to see progress being made.

So, when both of these are fully operational, how long do we expect it will take to produce each one? How many do we anticipate could be needed? And you mentioned, in the case I think of the Fortis, that there is a single manufacturer of the truck. Is that correct? So, what potential issues might there be in terms of production capacity?

BICKFORD: Yes, great question. And it also nicely also ties many components of today's work together. So, we've had one example in the Fortis project with the designer we had them provide us some estimates of fabrication timelines and things like that. And as I recall, if you were ordering on the order of 50 - 100 railcars, the timeframe is on the order of a couple of years.

That does not account for limitations in availability of certain components which is of course a concern that we have. However, in the process of designing the Fortis railcar, we did have some Amsted representatives who participated in that and seemed very interested in making sure those trucks remained available. So those are all positive signs for now. Also, in rail, it is a little bit of a volume business where the more things you're making, the more interest there is in making them. That's kind of been our experience with at least prototype fabrication. There sort of a limited number of companies out there that build highly specialized freight railcars and even then a limited number of companies who are interested in building one prototype versus 200 whatevers. And so, when we get to the point of having an as-built railcar design that's fully qualified by the AAR and then putting

out RFPs for fabrication, I think the numbers, at least, that we are looking to likely fabricate will probably help our case.

To that point, we can use our NGSAM, systems analysis tools, to help inform how many railcars we expect to need for the system based on the number of facilities that will be receiving spent nuclear fuel, the expected receipt rate that the facility may have. Both sort of in the early years that it may ramp-up until we get to a steady state operation. And then considering if we add additional facilities whether additional storage facilities or additional disposal facilities. So how much spent nuclear fuel is the system processing. What's the estimated turnaround time of the fleet in terms of empty cars go out and loaded cars come back. And so, we can use those systems analysis tools to provide us with that information.

I think in our preliminary analysis that we've done so far, based on a 3,000 metric ton per year receipt rate at a facility, I think on the order of 100 railcars is kind of what we're ballparking for the fleet at this time.

BECKER: Thank you.

BICKFORD: Sure.

PEDDICORD: Lee Peddicord with the Board. Of the AAR member railroads, are there -- do they transport anything heavier than 420,000?

BICKFORD: Absolutely, absolutely.

PEDDICORD: So, this is no, never mind in terms of a --

BICKFORD: I wouldn't say it is like a no, never mind. I don't know if it's an every day Tuesday shipment. But one of the examples that we are frequently provided, is the example of transformers. Like rail carriers transport transformers or they use some specialty railcars called Schnabel railcars. Actually, a really cool shipment that happened with a nuclear power plant a couple of years ago from San Onofre was the unit one reactor vessel pressure head?

MAHERAS: No, the reactor vessel.

BICKFORD: The reactor vessel. It was 700 tons as I recall was the shipment out of San Onofre. It used a Schnabel car, which if you

don't know what a Schanbel car is, it is a railcar that is in two parts and then integrates the package that it is moving and attaches it so it’s a part of the conveyance as a way to distribute the weight across it.

That particular railcar was a Kasgro Schnabel railcar that had been in operation for 40 years and this was its last shipment. They shipped it from San Onofre, Southern California to the Las Vegas area, and then they trans-loaded into heavy haul truck and then transported it up to Clive, Utah. I did talk to some folks involved in the shipment about why they couldn’t use rail the whole way. It turned out there were some of the turning radius on the rail that were between the Las Vegas area and the Clive Utah area were too tight for that Schnabel car to make so that’s why they did rail and then trans-loaded to trucks .

PEDDICORD: Is that the only Schnabel car available if we want to go get one?

BICKFORD: No, it has a twin. [CHUCKLE] But we will not be using a Schnabel cars. When they transport transformers, those are sometimes on the order of 400,000 or 500,000 pounds and sometimes

Schnabel cars are used for those, as well. But, certainly these are not the heaviest things that move on the rail.

PEDDICORD: And what's the capacity of the Fortis car?

BICKFORD: The weight load capacity? It is… especially because we went from the three-quarter inch deck plate to the 1 and a half inch deck plate, that's going to increase the axle loadings on the railcar, so we are unlikely to be able to transport the HI-STAR 190 XL and possibly the HI-STAR 190 itself. But the other 15 or 16 casks that you saw, the Fortis railcar should be capable of transporting.

PEDDICORD: So, I mean, one gets the impression that will become your mainstay in the transportation fleet if you can go to Atlas --

BICKFORD: It is possible. We are definitely seeing a trend to the move to larger and larger casks, especially since the HI-STAR 190, the vendor is HOLTEC and HOLTEC is purchasing sites for decommissioning. We've also been hearing proposals out there for the standardization among the individual vendors, which in HOLTEC's case might lead them to using their HI-STAR 190 as their

universal cask which is a large cask. So it’s, it really just depends on the lay of the land looks like at the time we transport.

PEDDICORD: Thank you.

FRYBERGER: Another great presentation, thank you. Teresa Fryberger, Board. So, I have a question, it’s not what you are focusing on right now. But in this possible new era of advanced reactors, we also would face a great deal of complexity in terms the number and types of fuel and canisters. And so, is the department thinking of ways that they can sort of avoid having as much complexity?

BICKFORD: Absolutely. My entry point to this program was on the transportation and it just hurts my heart to no degree that it’s like, why didn't we just go with the standard… especially when you look at it in France or other countries which have more government corporation run, so different considerations in their system that full standardization or have close to full standardization. And you’re just like, why didn’t we do it. I was told that there was an effort made in the 1980s, but something went awry, and it did not pan out.

But, certainly in the Department, actually this kind of goes, coming full circle goes back to the standard contract. Our office of standard contract program in the Department of Energy came to us and asked us. Because something I did not mention is in order for reactor vendors to get a license from a Nuclear Regulatory Commission to construct their reactors, they need the standard contract with the Department of Energy to agree to accept their spent nuclear fuel. And with these various reactors designs and small modular reactors, and microreactors and various things, we did start to have some internal discussions. Oh, some of these could look pretty different than what's currently out there. We may want to take a look at this. So our office of standard contract came to us and asked us to provide them with some advice on possible changes to the standard contract that could be made to improve sort of the back-end handling. So, we set up last fall an integrated project team of federal and national laboratory expert staff. It's called BEMAR, backend management for advanced reactors, because we just love acronyms. And so they are going vendor by vendor and collecting detailed data on what their fuel looks like. They've been through maybe five or six at this point. There are sort of proprietary considerations and kind of NDAs and other things that need to be signed that make the process move

maybe a little bit slower. But the plan is to use that reactor and fuel specific data that we can get, to then analyze it and then look at, where can we introduce maybe some efficiencies or standardization or ease the process on the backend of storage, transportation and disposal of this material. Very much a learning from lessons, lessons past in trying to do better as we move forward.

FRYBERGER: That's great, thank you.

SIU: Any other questions? I have a nuts and bolts question, Nathan Siu, the Board. For the integrated safety security system, it sounded like this system provides a signal that it has to be acted on manually to actually change the train motion. Is that correct?

BICKFORD: Yes, yes.

SIU: So, you are not thinking of automatic --

BICKFORD: No. I think because there are safety and security considerations with automatically stopping the train. The way it was, it's laid out in standard S-2043 is the signal box is

supposed to be in the locomotive and so the train engineer will see that and get the signal. The practical realities of that, as we've learned from the Navy's experience and talking with different rail carriers is installing those boxes and training the crews on how to use them and keeping in mind you swap out train crews along the way made that a little bit more cumbersome and difficult. And so, what our understanding is how the Navy has made that work is the signal box is in the rail escort vehicle with the shipment couriers. They monitor it. If a light goes off, they have radios and redundant communication mechanisms with the engineers in the locomotive to tell them that the signal box has gone off. And so that's the rationale for that.

I think it would be very challenging in a rail environment to have sort of automated signal box signals and that train just automatically stops, because it may not be -- it could be across a road crossing or some other location that's not a safe location to get out and do an inspection or something of that type. Also, I just can't imagine that the rail couriers would allow a non-rail courier entity to exert that kind of control over their operations because it's private property, private locomotives and they provide those services.

That said, there are things like positive train control that's been implemented in the system following some passenger and freight crashes in the last couple decades that do have capabilities to remotely stop the train if train is exceeding posted speed limits or on a collision course, kind of thing. So, it's not, it's not infeasible that that kind of system could be applied to the railcar, but that would be the PTC system is separate from the ISSMS.

SIU: Yes, in other realms, the so-called error of commission has been a player in reactor accidents and overrides safety systems.

BICKFORD: And I'd not rule that out ever being put into place. Automation seems to be the way things are heading in a lot of spaces. There may be some advantages to some rail automation. I don't think we are likely to get there right now, but there is certainly potential in the future to implement some of those capabilities.

SIU: Okay, thank you.

BALLINGER: This is Ron Ballinger from the Board. How much margin do you have in the trucks? In other words, you have 12-axles on one, can you operate with 11?

BICKFORD: No.

BALLINGER: So, your margin is slim?

BICKFORD: Yes, but it’s not like a road vehicle where you get a flat tire. The trucks are pretty robust and typically for standard freight vehicles operated for decades with daily use. Our railcars will experience a little bit more than light use than that. And also be subject to heavy inspection requirements including looking at the trucks and the wheel profiles and looking for things like wheel flats. The S-2043 requires a specific inspection approach. And the railcar safety inspection protocol that we implemented includes an approach where you inspect the railcar before it’s sent to the nuclear power plant. you inspect it when it is at the nuclear power plant, after it is loaded and before it disembarks. So, with those procedures in place, we expect that we would in all likelihood detect any component issue before the railcar is in transit.

BALLINGER: I was thinking of the hot bearing issue.

BICKFORD: Oh, the hot bearing issue. Those inspection requirements and the maintenance requirements require replacement of components I believe at a higher frequency than other standard railcars, as well. But, not, that’s a good question.

SIU: Any other questions? Bret?

LESLIE: Bret Leslie, Board staff. Nice presentation. I have a question that goes back to several of presentations and also touches upon consent-based siting. So, kind of in the communication for why an interim storage facility is needed or should be used, is that we would, we being DOE, would be removing all of the waste from nuclear power plants. So what’s the path forward for greater than class C waste? So, even if you were able to take all of the spent fuel you are not necessarily releasing, going to be able release as site if there is greater than class C. And my understanding is not necessarily your office, but someplace in DOE is responsible for greater than class C.

BICKFORD: Yes. So that is a unique and nuanced question. We’ve had some internal discussion to that effect. So, just for kind of

situational awareness in the absence of a commercial disposal facility for greater than class C waste, the U.S. Department of Energy Office of Environmental Management is generally responsible for the disposal of greater than class C waste. With a caveat that past court cases had determined that the greater than class C waste at commercial nuclear power plants with a contract, with the standard contracts with the Department, the standard contract included the GTCC. Again, there is some questions if a commercial facility were to come online is there grandfathering, I don't know the answers to those questions, but I can tell you that our current plan … because one of the benefits of pursuing interim storage prior to disposal is being able to clear some of these sites, especially ones that have been shut down and been decommissioned just have spent nuclear fuel and GTCC on site. If you can remove that, then the site be released or put to other economic or industrial uses that the communities hosting those sites can benefit from.

So, our current plan is that a design for a federal consolidated interim storage facility would be capable, conceivably, of storing the greater than class C waste at that site. However, whether or not it does will depend on a number of factors including whether there are commercial GTCC disposal facilities

available at that time or not, as well as, any preferences that the host community may have.

If there are, you know, again, I gave the example of this, this morning. We can conceive that there may be communities that want facilities with more narrow missions and there may be communities with more broader missions. And those will be a part of the discussions along with any host community and likely to be included as part of a consent-based agreement that's established with a community hosting.

So, we are certainly mindful of that. It would certainly be advantageous if a commercial GTCC disposal facility became available between now and then because then that's one piece of the puzzle that would addressed. But we are also thinking that if that does not happen, the greater than class C waste is currently stored at 10 CFR Part 52 licensed interim storage facilities. There will certainly be a technical capability of moving the GTCC along with spent nuclear fuel to a federal interim storage facility whether or not that happens again depends on a number of factors and the situation at the time.

SIU: Great, I think we are still perfectly on schedule. Thank you. You guys are great. Okay, David Pstrak from the NRC will talk to us about preparations for large-scale commercial shipments of spent nuclear fuel. Thank you, Dave.

PSTRAK: Good afternoon. Yes I am David Pstrak. I work for the U.S. Nuclear Regulatory Commission and I'm the last presentation of the day. I think all of the presentations have gone extremely well and I that hope mine does also.

So, my presentation is titled the NRC preparations for potential large-scale commercial shipments of spent nuclear fuel. The key here is that these are commercial shipments. These would be NRC licensees offering the spent fuel for transportation in NRC approved packages going to a licensed, an NRC licensed facility, possibly a consolidated interim storage facility. So in what I just described, the Department of Energy would have no role at all. These would be NRC licensees making these shipments.

So, what I am going to be describing here is a summary of our report. We did a transportation regulatory assessment report and the goal of that report, or that project, was to assess the NRC readiness to fulfill its regulatory safety and security

responsibilities in the event that there is large-scale transportation of NRC licensed spent nuclear fuel to a facility.

So, we did an internal review of our regulations, of our guidance documents, one more time here. And what I will be presenting this afternoon is a summary of the readiness review. I'll talk a little bit about the current storage situation and where that puts us for what our licensees are doing. And then I'll describe a little bit about our regulatory roadmap that was developed as a part of this overall project.

So, in the big picture, the review scope looked at our regulations and looked at our guidance documents. And the regulations that were assessed in this overall project were specific to 10 CFR Part 71, which is transportation of radioactive material, 10 CFR Part 72 which is storage at independent spent fuel storage installation, or an ISFSI, as the acronym is. And additionally, we looked at the security requirements associated with 10 CFR Part 73, which is physical protection of the material, specifically during transport. So, within those three overall areas, the project was initiated in May of 2020. And we issued our report publicly in December of 2021.

This is my sixth presentation on this out in the public domain. And we initiated, or did our first report of our report at the Tribal Radioactive Materials Transportation Committee Meeting in January of 2022. And that was followed by a public meeting in February 2022 where we had, it was a virtual meeting, but we had over 150 participants. We had a large number of congressional offices represented in the audience. We did get some questions and fielded those questions. But we also benefited during the public meeting in February by having representatives from the U.S. Department of Transportation, our colleagues from the Department of Homeland Security, as well, made their own portion of their roles and responsibilities and described what those are in their overall requirements and responsibilities for packaging and transportation spent nuclear fuel.

Oops, let me go back one. I'd be remiss if I did not point out, we looked at 19 different areas and you can see the bullets there associated with what the assessment was. A key area, the third to the last bullet is the information needs. Things that don't, have not come into the NRC yet, and that is okay, because we do not have an immediate need for the information at that time. And I will cover that in just a moment in a little bit more detail.

Additionally, we do have, in this modern age, we do have the QR code that you can scan that code either on your sheet or on the slide on the screen and it will take you directly to the 40 page report that we issued in December of 2021.

Overall, the key results are very, very positive. The NRC has a very well-established and strong regulatory framework that will support packaging and transportation of spent nuclear fuel.

That framework meshes extremely well with other frameworks, with other federal agencies, and again the Department of Transportation. I'll describe a little bit more detail there. Those agencies associated under DOT, as well as with our colleagues at the Department of Homeland Security.

We've had successful shipments, safety based, security based shipments of spent nuclear fuel in the United States for way many years. We've seen a great record that the U.S. Navy has done. The Department of Energy has shipped spent nuclear fuel, as well. We have had fuel back in, I don't recall the exact timeframe, but all the shipments that went to the GE Morris wet storage site in Illinois, all those were transported by our NRC licensees. So, we

have a very strong success story here and very strong experience. Certainly we'd be able to put those experiences and the regulations of safety and security regulations into play in the future to have, again, equally safe and secure shipments of spent fuel.

The working group that was developed also documented a couple of enhancements, things that would help the NRC do work more efficiently and effectively. So, during that internal review, there was also the benefit for where we could improve some areas.

The recommended enhancements were really focused on already established programs that we have. We have an inspection program both for safety and security that we go to our licensees facilities and we ensure that their transportation related operations are done safely and securely, again in compliance with our transportation and security regulations out of title 10. But, we found that in many of our inspection manual chapters or in our inspection procedures, that the specific language associated with the spent fuel was not there.

That's not the end of the world. When spent fuel is transported, it is transported under the DOT regulations, Department of

Transportation regulations as a type B quantity of material. I will explain that a little bit later on as a closeout. We've heard a lot of discussions and I will take advantage of Erica's comment and have a learning moment to share some additional things with you toward the end.

We also identified that we should be doing additional outreach. Again, I mentioned that this is the sixth presentation that I have done on this topic. It doesn't mean I am done and there will not be a seventh one. We are just looking for those opportunities. But, timing comes into play, as well. We do not have a facility for this fuel to be going, so we don't need to be out there yesterday saying here is how things will be done, but it is certainly something that we are looking at and determining the resources and the timing and really who we need to be going out and talking with.

We have a great relationship with the DOE at the National Transportation Stakeholders Forum. We have an equally great relationship with each of the four state regional groups as well as the Tribal Radioactive Materials Transportation Committee. So, we've done many things already in a very positive way. Again we

are looking for additional opportunities to go out and do additional outreach.

Some of the other outcomes that came from this internal review was we identify the information needs. And again, without a facility for our licensees to be making shipments to immediately, this list of the needs is somewhat growing, but we don't have the need to know these things yesterday. Sara mentioned and Kaushik mentioned in both of their respective presentations about Certificates of Compliance amendments. The NRC has an established program to react to amendments that come in from a licensee or from a vendor to change something associated with a Certificate of Compliance. That would be potentially under Part 72, something that has to be done in storage. It could be potentially something done in Part 71 for transportation.

But, those things are not rolling in and we are not having to react to them because our licensees have not provided those to us, yet. We would expect that to increase as other things happen like a facility get licensed and constructed and authorized to operate.

So, nothing is a critical path at the moment, no pun intended. But at the same time, we recognize that we would benefit by knowing those things when the time comes. And our licensees are aware of that, as well.

But, that should not be viewed as being a challenge that is insurmountable. It's a matter of when the timing is right. When our licensees know those things. All of the information that Kaushik provided, that is huge for our licensees to be assessing things moving forward. And I think he hit the nail on the head when he said something may not be transported in accordance with a certificate, but the certificate could be at least assessed for an amendment to make it suitable for transport out in the public domain at some time in the future. That's the value of having time in our favor and having that type of science that certainly exists out there.

The second item is potential areas where we would have to go out to our commission. You're, much like you, you are appointed by the president and we have a commission that is appointed by the president. Three areas that the working group determined could go to the commission for additional guidance, I'm not go through these in great detail, but I will certainly mention them here.

The first is additional outreach and communication with the tribes, coordination with the tribes. What would help the tribes to have a better comfort level for shipments of spent fuel in the future?

The second item has to do with fuel that is being stored and the potential for, over time, the what is called the self-protection and how it has to be protected, physically protected under Part 73 as I described earlier, during transport. And there is a belief, an understanding, a potential, that a small amount of the fuel would not be self-protecting during transport and therefore it would have to have additional security requirements in place during transport.

NRC is looking at that,. To my understanding, DOE is looking at that, as well. Way, way, way early in the process, very pre-decisional on what I can share other than that is one item that was identified.

The third item that was identified for the commission consideration is a 1984 transportation policy statement. Certainly since 1984 to today, things have changed in the overall

structure of the federal agencies there are out there. We had an unfortunate event, known as 9/11, where an entire new agency came into being, the Department of Homeland Security. That was completely not even around in 1984. So, the interest of updating that transportation policy statement was also identified by the working group.

And then thirdly, part of the working group we identified and developed a roadmap that describes the roles and responsibilities not only of the NRC, but of the other federal agencies and again I will cover that roadmap in just a moment in a separate slide.

The current storage situation is, nearly all the fuel that has been produced by a commercial nuclear power plant is being stored at an operating or a former nuclear power plant. It is being stored in much like you saw at Crystal River yesterday, either in a vertical configuration like you see here, or in the horizontal storage module, the HSM. We've seen some great pictures here in the previous presentations of those modules being delivered. It's basically a concrete bunker that a storage cask slides into and there are no moving parts with either one of those sciences, either one of those technologies. There are no cooling fans. Any cooling that is done is done by natural convection. There are

ports at the bottom of this particular system that allow heat to circulate obviously as the heat rises, it draws more air in from the bottom.

Storage is being done safely. If you look at the next bullet. At 84 different sites in 36 different countries, upwards of 3,930 casks in place as of January. That's the number that I had. You may have seen some slightly different numbers here from other presentations, but that's what I had as of January.

Again, a very safe and secure system. Our licensees also have to implement aging management programs to make sure that as the waste, as the fuel is sitting there in either an HSM or vertical pad that there's no degradation of the storage system. They take actions to monitor that. That is under their aging management program that is a part of our requirements under 10 CFR Part 72. And I like the photos we've seen in at least two of the presentations of the 17 different designs. I have here that we have 19 different approved storage designs. Recognizing again that storage is done under Part 72. That's a completely different Certificate of Compliance and completely different set of requirements to transportation under Part 71.

So, as collectively, all of us get our hands around what is being transported, my world is transportation, getting it from point A to point B. We have a great running history of that all along; no reason why we cannot repeat that in the future.

I don't know if they showed, shared with you yesterday, but a typical storage pad is about 3 feet thick of concrete. I've heard one licensees say we have over 200 miles of rebar in the storage pad. So it is extremely robust, extremely well-established to hold all of the weight that will be sitting on it for some period of time.

The next slide shows the proposed consolidated interim storage. So, the NRC is currently continuing a review of a license application to construct and operate a consolidated interim storage facility in New Mexico.

The second bullet shows that in September of 2021, we issued a license for a consolidated interim storage facility in Andrews County, Texas.

So, neither one of those facilities, well, the one that has been licensed, they have not turned the first shovel to start

6931 developing anything there. So, that plays into the overall
6932 equation of, our licensees aren't getting ready to ship spent
6933 fuel, because there's nowhere to ship it to. So, as time goes on,
6934 hopefully that changes. We may eventually have two licensed
6935 facilities. Obviously, that would be a decision the NRC is still
6936 making, the decision for the facility in New Mexico is likely to
6937 be made later this year.
6938
6939 Either licensing and construction, licensing and construction of
6940 either one of these facilities would open the door for our
6941 licensees to start making shipments. And again, with the 80+
6942 sites that are currently storing, the floodgates could open and
6943 there could be a lot of transportation.
6944
6945 Our licensees don't have to use the S-2043 Railcar. That's a DOE
6946 project, okay? These two facilities are both looking at rail
6947 shipments as being the primary mode of transport into their site.
6948
6949 It does not mean that spent fuel could not be transported by
6950 highway, it does not mean that spent fuel could not be
6951 transported by barge. Those three different scenarios have worked
6952 successfully in the past and there is no reason they cannot work
6953 again in the future.

So, what we really have here is a scenario of storage being done currently under 10 CFR Part 72. The potential for it to be on the road, the rail, the barge under 10 CFR Part 71. Security would come into play under 10 CFR Part 73. And they would go back to a licensed facility back under 10 CFR Part 72 under storage at one of these proposed sites.

So, I mentioned about the oversight roadmap. The working group developed this roadmap. It is in section number seven of the report. And the roadmap has a very nice set of bullets associated with each of the federal agencies that are part of the overall federal plan. But it also includes some information about the states and the tribes and local governments, what their roles would be during a transportation campaign.

So, the next, about two more slides from now Ill talk about, more specific about the roles. But the NRC would step in and do point-of-origin inspections. What have our licensees done as far as loading the transportation packages. What have they done, as far as Sara mentioned, some of the packages are both storage and transport capable. They are authorized for both. We call those dual-purpose packages. So, they are authorized under Part 72 for

storage and then equally authorized for transportation under Part 71.

So, the potential for making that type of shipment is much easier than a facility that might have to repackage their fuel for whatever reason,. Again coming out of storage and going into transportation.

Additionally, the NRC would be doing inspections at the receiving site at one of the proposed facilities. Other agencies have roles during the actual transport. And, I'll describe that here in just a little bit.

In the big picture in the United States, it is the U.S. Department of Transportation and the U.S. Nuclear Regulatory Commission that co-regulate the packaging and transportation of radioactive material.

The DOT has the responsibility for defining and determining the hazard class for nine different hazard classes of material. Radioactive material is in hazard class VII, that doesn't mean it is the seventh most dangerous or the seventh least dangerous. It's just in hazard class VII.

And that hazard class is a universal number. So, I will ping some of the comments we have heard about France, a couple different times during the day. But, the class VII requirements in France and Germany and the United Kingdom are the same as what they are here in the United States. Very much the same. We harmonize with the international regulations.

Additionally, the NRC, the DOT have a long-standing memorandum of understanding between the two agencies, that delineates the roles and responsibilities of each of the agencies. And our regulations are in 10 CFR Part 71. The Department of Transportation has class VII radioactive material transportation regulations in 49 CFR. Two completely different agencies, but I have a direct line to the folks at the Department of Transportation. They have a huge staff of two people. And we work extremely closely together. I've known the gentleman there for over 25 years and we have a very solid program. Anything from a smoke detector all the way up to spent nuclear fuel can fit into one of the designated categories for transportation and is offered for transport safely in accordance with safety regulations.

We identified that there were no changes needed to our Part 71 regulations. The guidance documents and the inspection procedures that I spoke of are not part of the regulations. They are a part of staff development or staff requirements of going out and doing various activities, inspections being the primary one. So, we did not identify any changes that were needed to our regulations.

The -- I mentioned about the oversight, going out and doing inspections and point-of-origin inspections point-of-receipt inspections already.

We also reviewed the security plans that our licensees are required to implement. Part of those security plans are providing notification of the shipment as it goes from point A to point B along a transportation route.

And, additionally, there could be coordination with other federal agencies that come into play.

So, again, in the big picture four major areas come into play. What is happening at the shipping site; that would still be under NRC responsibility. What is happening during transport and in transit from point A to point B? What is going on at the

receiving site? I'll assume for a moment that that is one of our NRC licensed consolidated interim storage facilities. And what happens if something goes awry? Who has what role and what responsibility from an event happening?

Firstly, the NRC's role. We do inspections at the point of origin, so we would be at the shipping site. I didn't cover it, you probably understand already that NRC issues a Certificate of Compliance for the type B packages. And the Certificate of Compliance is a requirement that our licensees must follow in order to, even offer, the spent fuel for shipment.

So, part of the regulations is under 10 CFR 71.17 that our licensees must have a current copy of the Certificate of Compliance and they must follow that Certificate of Compliance.

Additionally, the NRC requires that they have a quality assurance program. And we do inspections against that quality insurance program to make sure that they are meeting the requirements of the QAP; again to ensure safety and security during transport.

So, point of origin. We would step in and maybe even watch as they load fuel, maybe watch as they transition it from storage

into the transport mechanism. We would also do inspections at the receiving site. Making sure if anything has changed during transport that the receiving site is aware of that. We would not anticipate anything happening, it is just a transport from point A to point B. But again, there would be requirements to do inspections at the receiving site.

During transport, in the in-transit mechanism, it is the Department of Transportation that has the primary responsibilities. And you see some acronyms here, these are defined for you, the Federal Railroad Administration, you've heard that several times. It is the Pipeline and Hazardous Materials Safety Administration or PHMSA that they are my main contact at the Department of Transportation. And they are the ones that uphold what is in 49 CFR for the hazard class VII, radioactive material. And then there would be for highway transport, the Federal Motor Carrier Safety Administration, FMCSA. Each of them would have a specific role in transit, for either in transit inspections, or answering any questions, or doing assessments for the shipments. Our good colleague, Steve Maheras, mentioned the word 'placards' a couple hours ago. Boy that resonated with me. Maybe it would resonate with you. But it is the Department of Transportation that dictates what

radioactive loads during transport are required to be placarded. Everybody says, ‘are the placards in place?’ They might mean the labels in place. DOT also requires that labels be on packages, I don't have all of those graphics, but a label is 3.9 inches on each side. It is for radioactive material, it is in three different categories, radioactive white one, radioactive yellow two, or radioactive yellow three; nothing more than the licensee living up to the DOT requirements to ensure that they have put the proper label on the package.

Any yellow three labeled package requires that the vehicle be placarded. I can tell you the actual regulation if you need to know that, but I won’t. But all those things are in the regulations and basically when regulations are followed when the Certificate of Compliance is followed, safety is insured. Safety is insured.

Moving forward, the Department of Homeland Security, if there is some event, something goes awry, some action that needs to be taken, it is the DHS and/or the Federal Emergency Management Administration under DHS that steps in. They have that role, it is not the NRC or the DOT at that time.

Once again, any communications for this overall scenario would be coming from our licensee to the NRC. So, we have a pretty big hook. We have a pretty good requirement that our licensees communicate with us for really any aspect of transport, but from the overall federal structure for any event response, it would be the DHS. And, obviously, you know who FEMA is.

There are local roles, as well. Whether it's the states or it's the tribes, we do not anticipate that there would be any failure ever of a type B package involving spent nuclear fuel or greater than class C waste in transit. A derailment doesn't mean that the package has failed. A flat tire doesn't mean the package has failed. Neither of these scenarios means anything has come out of the package.

These type B packages are extremely robust, extremely well engineered, they have proven themselves over and over again, not only here in the U.S., but in other countries, as well.

Erica made the comment, and I will pull the string again, because it is, it doesn't get any better than this. Zero injuries, zero death ever, ever, around the world due to the hazard class VII radioactive material contents of a package.

If it's an 18 wheeler hits a Volkswagen, that is physics. But, if the front bumper on the truck is hit, it does not mean there is any damage to the load in the back. Certainly, that would be looked at and our licensees in the scenario would have to give their own assessment and feed information to us to say, here's why we think this shipment can continue going from point A to point B.

We would not expect the states and tribes to ever be doing a cleanup of a spent fuel shipment, because, again, the robustness the engineering, the qualifications, the approval, all of the safety built into that type B package would not fail during an accident.

Erica talked about the Package Performance Study. Again, the regulator, we are the regulator. We approve the package design. Why was it approved? Because we have confidence in the design that it is going to do its job to protect the public health and safety, to protect the environment.

Running it into a train will give, hopefully, everybody a level of additional confidence, but one impact might not fit every

single scenario. So please be gentle as they evolve their program, because one size might not fit all; but it should. We have safe transport around the world, from day one of radioactive material.

It should give everybody involved comfort that we have that impeccable record. These are not mobile Chernobyl's, they are not Fukushima freeways, these are well engineered structured systems that can get from point A to point B safely and successfully.

And lastly, we have heard excellent presentations all day about the DOE's role, particularly in the area of radioactive material and spent fuel transports. We certainly like and value the input that DOE has put out as far as research and development, and the outreach that they do. We're all in this together as far as being able to successfully navigate all the hurdles. We can certainly rely on our impeccable safety and security record and say why, can't we do this again in the future?

So, the key messages. We have a well-established and strong regulatory framework for the safe and secure transportation of spent fuel. That framework meshes well with the other federal agencies that are out there. And again during our public meeting,

we had input from each of those agencies where they spoke about their own respective roles and responsibilities. And our regulations provide adequate protection of the public health and safety and protection of the environment; protection of the common defense and security. Those are company lines, but our mission is a safety and security mission. And transportation, a lot of logistics, and when the regulars are followed, when the CoCs are followed, safety is insured.

We have already had safe transportation in the past. There's no reason we cannot have it again in the future and before I go to the – I'll go to the last slide and get back to a couple points.

There is within the report, there is a long list of studies that the NRC has done or has conducted or has hired contractors to do. Our first report coming out in 1977. And each of these various reports not only are they listed, but each of them gives what we call our Agency Document Access and Management System. The acronym is ADAMS, and it gives the ADAMS ML number. You go to the NRC.gov website and at the very top it will say ADAMS. You can select ADAMS and drop that ML number in there with the ML the reports all pop up.

Those reports each demonstrate where NRC has looked at real-world accidents. We've looked at real-world fires. We've looked at transportation scenarios to assess how do our Part 71 regulations ensure safety? How do those regulations bound what we would see in real-world transportation? And again, this most recent assessment that we did, issued the report in December of 2021, we have no reason to change anything in our regulations. The regulations as they exist, they provide adequate protection to the public.

So, there is the report again. You can take advantage of the technology and look at the QR code that was back on slide number 3. We have the summary of the review that was sent to our commission. We have the ML number for that if you have an interest read through those details. And then lastly, the most recent risk analysis is our NUREG-2125, commonly known as the spent fuel transportation risk assessment or SFTRA as the acronym has come to be. And if nothing more, if you read through the executive summary of that, it gives a very short synopsis of each of the studies that the NRC has done over the years.

So, collectively, not only is there this for further reading, but if you went into appendix C you would see all of the reports that

were assessed as a part of this overall working group's effort to go through and do the internal review of our regulatory program.

So, I'll stop there with my formal presentation. But before I open up the questions and answers, let me just throw out a couple lesson learned or learning moments.

Waste class A, waste class B, waste class C and greater than class C. Those are not transportation terms. Those are disposal terms and those are all defined in 10 CFR Part 61. And those terms all include some degree of control that a disposal site has to implement because of how long lived the radioactive nuclides are going to be in that specific waste class. Waste class A, a facility has to be authorized for a waste class A. A facility has to be authorized for a waste class B and likewise for waste class C. Nobody is authorized for greater than class C waste. But my point here is that those are disposal terms. A waste class eventually will have to be packaged and transported. If you read my very short bio, I am chairman of the IAEA, International Atomic Energy Agency’s Transport Safety Standards Committee and I routinely in every meeting say, “all roads lead to transportation.” That’s a mouthful. Our licensees have to ensure whatever they are dealing with, whatever they are intending to

package and transport, that they can do it in accordance with the existing regulations.

So, a waste class, some facility generates a type C, excuse me, I mean a waste class C material, they need to be able to transport it. It either goes into a type A or type B package. Those are DOT transportation terms, those are defined both in NRC and DOT regulations, that is the transportation aspect of it.

Generally, there's a correlation that higher activity, higher long-lived radioactive nuclides class C or greater than class C would go into arguably the best transportation package that exists. That's a type B package.

We've had zero release from type B packages ever, why would we not want to put that into the best package and sleep well at night knowing that it's going from point A to point B in a very robust and well-built package.

Whoever, JoJo, can we go to Sara's slide number 5 for just a moment? Oh, you're good, look how quick. Thank you. I'm going to take advantage of this photo, and this photo, and just share with you. The DOT transportation radiation dose rate limit on that

package on contact with, let's assume there is spent fuel in there is 200 millirem per hour, or 2 milliSievert per hour for those that speak international. 200 millirem per hour on contact. The vertical plane projected by that vehicle, there's also a dose rate limit of 200 millirem per hour, okay? The most likely dose that a member of the public would see is 2 meters away from that, in this case, this railcar, 2 meters away the dose rate limit is 10 millirem per hour. So, a member of the public conceivably standing at the rail line, and there goes the train, and don't blink because it is moving at what 40 miles an hour or 50 miles an hour and if, if there is 10 millirem per hour, 2 meters away from that vehicle; you can do your own math and your own health physics, what actual exposure that individual might get.

I would offer it's very insignificant, if not zero. Let's say there is a rail crossing and there is a van full of soccer players sitting there and there goes that same train and it stops. They would have to be in that field for one hour to receive arguably some portion 10 millirem. Not every shipment has that number of 10 millirem at that distance. Generally it's zero at 2 meters away.

This is not the photo that I'm looking for and that is okay, I did not bring in my slide, either. But there is a shipment that was a DOE shipment from the West Valley project up in New York. It was spent fuel in a DOE spent fuel package, very much the same configuration sitting on the flatbed railcar. There are guys out there taking surveys and that is great. It is the same DOT limit, 200 millirem per hour on contact is the limit. 200 millirem per hour on the vertical plane and then 10 millirem, 2 meters away. And the actual dose rate during transit of that shipment was 8 millirem per hour on contact.

Okay? Everybody knows, radiation drops off over a distance, therefore, to have something greater than 8 millirem, 2 meters away, is nearly impossible. My point is, these packages are extremely, not only robust and accident tested, but they have a lot of shielding in them. And the shielding is designed to help ensure the safety of the public. The regulations indicate the 200 millirem per hour and again the regulations are there to ensure safety, not to challenge safety. They are there to ensure safety.

So, that was the quick…and for any one of these, whether it is highway or rail or barge, it is those same dose rates. We heard good examples of the success going on in France and the

routineness with which they are able to transport their spent nuclear fuel. Both in the United States and in every other country around the world, they use what is called the Safety Standard Number Six, the regulations for the transport of radioactive material that is issued by the International Atomic Energy Agency.

In the United States, we are currently, both the NRC and the DOT, are at the very tail end of a harmonization rulemaking since our inception, the NRC coming into being, this is our seventh time of harmonizing with the international regulations. So, those who commented about the French connection and how successful those spent fuel shipments have been, it’s the same regulations. We would use the same regulations here. Essentially the same. Again, we harmonize, ours do not read word for word with the IAEA. France's does not go word for word with the IAEA, but the overall safety is there. The regulations are there to ensure safety during transport. So, with that, I will end and I'm happy to take any questions. Thank you.

SIU: Thank you, David. Okay, do we have any questions?

WOODS: Brian Woods with the Board. David, thank you for your presentation. I was just curious, we heard the presentation a couple hours ago for UNF-ST&DARDS. Does the NRC use that tool for their certification activities and if not, do you have your own set of suite of tools?

PSTRAK: We do and in fact, Kaushik has left; Kaushik has left the building. Just last week, both Kaushik and a colleague of mine from the NRC, Drew Barto did a… generally before each National Transportation Stakeholder Forum meeting, the NTSF organizes webinars. So Kaushik did essentially the same presentation we saw this afternoon and my colleague from the NRC spoke about what NRC uses from that as part of the certification for storage. Not in the transportation, it's all storage area, but yes, it's information and that information is also cited in our report, as well, that UNF-ST&DARDS info.

WOODS: Great, thank you.

BECKER: Steven Becker, Board. Thanks for a very interesting presentation. A lot of today has been devoted to discussions of public input, consent, concepts along those lines. I'm wondering

how those concepts fit into the scheme that you just presented, if at all?

PSTRAK: So, again, part of the enhancements that the working group recommended was to do additional, and I would offer focused outreach, not only -- I mean I often get like how long have you worked at the DOE? I don't work at the DOE, great place to work, but I think in general there’s a misconception of who is doing what. So, to be able to take this show on the road, if you will, and let anybody with an interest know who the NRC is, how we are not the Department of Energy, what other agencies have roles and responsibilities. I think we can do that many, many times and still not be done. I think that we have already issued, we have a spent fuel safety pamphlet, NUREG-2192, off the top of my head. That is a very accessible pamphlet that says here are all of the safety things. Here are the security things that are built into a spent fuel shipment.

We can’t have a better record than we have for safety and security. Yet, it seems like no matter how good that record is, we still get characterized as this is so unsafe, we shouldn’t transport any of the stuff. I don't know what more we can do than share what we know. Yes, it is a lot of numbers and unfortunately

it is a lot of science, but it works around the world routinely. Our regulations, coupled with the Certificate of Compliance. It works extremely well for any type of radioactive material. So, I think from NRC's perspective to continue to, I'll say, consider, because I don't write the check for who does what for resources, but to consider not taking the foot off the gas pedal for going out and doing outreach at many levels. To get questions answered, to put a face with the name, to put contacts out there, to put documents that are available for anybody to read on their own, and hopefully form a potentially different and more acceptable understanding of how safe transportation actually is.

BECKER: Thank you.

PEDDICORD: Lee Peddicord, from the Board. First of all, personally I have to say, I found your presentation very compelling. And both on the technical science spaces and on the message you are conveying it with. So I think that is great. You said this is number six in terms of you're going out and talking about it. So, I guess question one on that, is how has your presentation been received? And perhaps more importantly, have you gotten yet in front of those constituencies, groups of

stakeholders that would have the attitude that, my God this is bad, bad stuff and be able to convey what you have just told us?

PSTRAK: And, so, between me and one of my good colleagues, actually my boss going out on doing presentations, the overall outcome has been extremely well accepted. The challenges still exist. Just people; how you manage the understanding of the risk we just shared with you, that is on the individual. We have an impeccable safety record. We've looked at and obviously I am a little bit old-school, but we have looked at doing YouTube videos, we have looked at doing TikTok, and whatever else is out there. All of those foreign languages that exist for all of us old-timers. But we really want to capture the moment, if you will, of getting that message out and coming here and speaking in a coat and tie. I'm very comfortable doing that. I am just as comfortable sitting down in a pair of shorts and having a conversation, because I think that is what it will take to really get to the very fundamental concerns, what are the concerns, what are the concerns.

PEDDICORD: I also have to say that you're bringing in and referring to the international experience of transportation where countries are doing it routinely, as well, to. And that is very

compelling, my suggestion would be to incorporate some of those photos into your report and presentation, as well too. One other question as well, too. We talked about greater than class C and so on. Has any facility or organization made an approach to the NRC or an application for a facility to accept greater than class C waste?

PSTRAK: So, that’s not my particular area, I want to say the answer is yes. I know that some of our folks from NRC are working with the Department of Energy on, and it might just be the DOE is looking at that. I don't know if anybody from DOE wants to step into the conversation here, but the current low level waste facilities are not authorized for it.

And obviously it exists. But from a transportation perspective it would get into the proper packaging that the licensee determines. And it would meet whatever the applicable transportation requirements would be. Our licensees must, as a requirement under 10 CFR 71.5, follow the DOT regulations. And Steve mentioned 172.820, boy, that resonated with me, the other one, and boy that was the highlight of my day and that is a requirement for the rail companies to have a security plan in place. That’s a

security requirement. But again, that's a requirement, Steve mentioned it. It's a hoop that has to be met by the right people.

If you are doing Highway transport, not everything has a security requirement. There are lists there in that 172 800 portion of the DOT regulations indicating what requires security.

PEDDICORD: And I have to say the barge transport all the way to Andrews, Texas is going to get a lot of attention.

PSTRAK: That would take some doing. In general, it would be probably a couple different...And in fact Sara mentioned intermodal transport so maybe a barge to a port and then highway or make a canal, right? Other questions?

SIU: Dan Ogg?

OGG: Yes, Dan Ogg, Board, Executive Director. Dave, thank you very much, you obviously have very deep and detailed knowledge of all the regulations. And so my question falls in the areas of Part 71 and Part 72. It has to do with the storage of spent fuel, where the fuel had to meet all of the requirements for storage under Part 72 and in its first move to storage, you were able to

see the fuel, inspect it and ensure that the cladding was good, it had cladding integrity. But now with proposed transportation, the utility or whoever's moving it can move a whole canister at a time rather than individual assemblies. But, then they go back to another storage facility, so you have this so-called 72, 71, 72 issue where the question becomes how do you ensure the integrity of the cladding when you put it back in storage? Can you comment on that?

PSTRAK: So, in some regard, not to basically be curt, but it doesn't really matter. If it is a welded system, you have a welded canister. And unless the goal is to take out each individual assembly at some time in the future, and I think that may still be something the DOE is considering. But, as far as the, what has to be met during transportation is the Certificate of Compliance along with the radiation dose rates. And contamination is in there, too. We have a regulation 71.87 that says all right, for every shipment, licensees have to ensure many things, but those are two things, radiation level and proper contamination. The welded canister, I remember having discussions with staff years ago, what if all the fuel completely slumps to the bottom of the package. It's still is a canister that is

welded shut or bolted shut and that’s what’s being offered for transport. I don't know if I am --

OGG: So, no. The question is when you get to the next storage site and you have to meet 72, Part 72 again where there are requirements for validating or ensuring the integrity of the cladding.

PSTRAK: Okay, so I got you. So, that would be part of our inspection, and part of what our licensees are assessing. I truly don’t know what is being anticipated, do they expect cladding degradation from point A to point B. I would offer that some of the studies that recently been done by Sandia National Lab would seem to indicate that there are extremely few actual loads, the gravity loads on the fuel. So I don't know that, me personally I have not looked into and seen what NRC is doing. I don't have a phone-a-friend here. So, I probably would have to get back to you on what specifically would be done at the receiving end on that.

OGG: Okay, thank you. I know that in the past we’ve heard from some other NRC spokespersons that they had been thinking about that particular issue but I hadn’t heard a final answer on that.

PSTRAK: Again, from my perspective it would also be ‘what is the next step?’ because interim storage is not final geologic disposal. We have a fairly new consent-based citing process that is in its infancy that can result in something else being developed for operations. But ultimately that would probably be more of a DOE issue and they go in, I’m assuming assembly by assembly to do something with it in the future. But, again, I don't have anything solid to tell you, because I'm not sure exactly where we stand on that. But, that’s a good point.

OGG: Alright. Thank you.

TYLER: Thanks, Scott Tyler from the Board. Thank you, David, I really enjoyed your presentation, as well. And maybe this is just more of a comment, but getting to Steve's comment and thoughts about consent based decision-making. I kind of get the sense that there’s a little bit of, and I’m a new board member, so excuse my ignorance, but there’s a little bit of parallel paths going down here for interim storage. One driven by regulation or authorization, another driven by the private commercial sector. And I think that seems to be leading to maybe some confusion to the public, or at least to me, as to what is happening next and

what are the critical areas, because the facilities will look the same and be doing the same thing.

So, maybe my question, which is poorly formed, is how do you see helping to reconcile to the public the two different paths and the requirements of those two paths. Are they similar? Where are the differences? And why are there differences?

PSTRAK: That is the million-dollar question of what is the final… I mean DOE can go with their path forward and that is, they get funding to do that and NRC as a licensing process for approving a request that comes in. Clarifying that to a member of the public and clarifying that, I am comfortable doing it, but not everybody is comfortable hearing from a federal person, perhaps. So, I think that my personal view is that there should be a multifaceted, how do we get the word out, how do we explain over and over, how do we make this distinction. Again, NRC is routinely invited to the National Transportation Stakeholder Forum. But in some regard that is kind of an established group that already understands the secret handshake, if you will. Engaging with others as I commented here, that’s not an impossible challenge, but it is something that will only help to go out and explain our role if it’s an opportunity for DOE to be

there as well, and explain their role. But certainly, that is a huge crux of... we don't want confusion. That is why I stood up here and said let's talk about waste class A, B and C. I don't want anybody walking out of here saying I do not understand that. And if there is something else, I am here and happy to answer. But, collectively that is a huge challenge, how do we get out in front of everything that has everything gone on with the federal government, we don't deal with weapons. I can say, none of our stuff is weapons associated. Ours is moving what we routinely call licensed material. Our licensees are authorized to have it. They're authorized to use it, we know what it is. But, again not to end on a confusing point, but all of this, I've mentioned at the very beginning, NRC licensees making shipments of spent fuel is not being done or would not be done under the Nuclear Waste Policy Act. It's our licensees transporting their material in accordance with our and DOT regulations. It is offered in commerce. That is a big stickler, 171.1 paragraph D subparagraph five from DOT says there is an out. These hazardous materials regulations do not have to be followed. That doesn't apply to our licensees. It might apply to DOE. That's for them to figure out and pull that string if necessary, but all of that is confusing, I agree, I have talked to many, many, many, many people to try to not let them be confused. And it's still confusing.

All we can do is say, well, that worked up to a point, let's try something different. That is where I said the ideas of the YouTube, the TikTok, the everything else that is out there. Let a younger generation pave the way for success on that.

SIU: Well, if there are no other questions, thank you, again, David. And thanks to all of the presenters for keeping us on schedule and for still providing wonderful answers to our questions.

At this point, I think we are open to public comment. I think, Bret that we have one commenter, Kevin Kamps of Beyond Nuclear. Kevin, please. Since we just have one, you have time to make a comment.

LESLIE: Nathan, I'll point out that we have 50 other -

SIU: Right, I do understand.

LESLIE: Kevin's asked me to remind him 5 minutes is up.

SIU: Okay, please.

KAMPS: Thank you so much for this opportunity to provide public comment. My name is Kevin Kamps and I serve as a Radioactive Waste Specialist at Beyond Nuclear in Takoma Park, Maryland. And I am also on the Board of Directors of Don't Waste Michigan. And one of themes of my public comment today is irony. It's ironic that this meeting was held on the 44th annual commemoration of the 3 Mile Island meltdown in 1979. And I had the honor of writing an article back on the 25th anniversary, anniversary is too positive of a word for it, with my board president emerita, now, Kate Dry in St. Louis. She is the institutional memory for the anti-nuclear movement in her part of the country, and nationally.

And our article was entitled "Mobile Meltdown, 3-Mile Island Train Troubles." So, it was written on March 12 of 2004. And it was about the two dozen or less shipments of 3-Mile Island of meltdown fuel that traveled from Pennsylvania to Idaho for so-called interim storage. And the shipments took place I believe between 1986 and 1990. And just in St. Louis, that's the heart of the article, there were numerous incidents during these small number of shipments. So, one placarding came up today. There were placards on buffer cars between melted down fuel containers on

this train that were confusing to put it mildly. They were calcium carbide placards. And inspectors from Missouri went over to Illinois, to East St. Louis, to see what was going on with the shipment they saw these calcium carbide placards. And so a flammable material that cannot be in contact with water or moisture on a train hauling high-level radioactive waste and it is still dubious to this day, was there actual calcium carbide in those buffer cars? One report, was that it was crushed limestone, so it was mislabeled. Another report was that some were empty. The point is if there had been a fire and there was not, thankfully, involving this training, but when the firefighters showed up and saw those placards, they could not have fought the fire with water, it would have made the situation worse. So, that was one of many incidents that took place. Another one was in one of these train shipments in St. Louis actually decoupled, there was a transfer from one locomotive to another. And the high-level radioactive waste on the buffer cars rolled away and a locomotive engineer had to chase it down, jump on to the rolling train and manually apply the brakes. So, um, yes. I guess one of the lessons that we have learned over all these decades of watchdogging the subject matter is that we need to stop making this material.

And yet today, visions of what Dr. Huff said was a doubling or tripling or quadrupling of the annual dose rate and I think that her estimate is actually lowball bigtime. Because if you look at a recent study by Dr. McFarland and Dr. Ewing, who I think is a former Chair of this panel, they are estimating that small modular nuclear reactors by their design, are going to generate to two to 32 times the quantity of high-level radioactive waste per unit of electricity generated as compared to current nuclear reactors. So, that's problematic.

I mean just think about it, we are, if you go back to Enrico Fermi in 1942, I believe we are 81 years into this dilemma of what to do with high-level radioactive waste. And as my board president has put it, we don't know what to do with the first cupful. That was generated on December 2nd of 1942, but now we have approaching 100,000 metric tons of just commercial waste in this country.

So, I just have a short time left. I want to point out the nonstarter status of consolidated interim storage. I think the driving factor is transfer of liability. From the companies that have generated this waste and profited from it, onto the public, onto the Department of Energy, onto taxpayers. The preferred

alternative of the environmental movement in this country for the waste that exists, is hardened on-site storage, and where that's not safe, as near as possible to the point of origin.

But, to ship waste, the current proposals are in New Mexico and Texas. When 90% of the waste is in the eastern half of this country, is a violation of regional equity and what's so ironic about it is that we do not know where the final repository's going to be.

So, if you look at Maine Yankee, I believe it is 60 containers, at Maine Yankee. A one-way trip to the Permian Basin, 2,500 miles. In the past the Department of Energy has looked at Maine, has looked at Vermont, has looked at New Hampshire as possible repository sites. So a round-trip of 5,000 miles with 60 containers for no good reason if the repository is located in the northeast and we don't know where it's going to be.

Skull Valley Goshutes was mentioned. I just wanted to point out that the George W. Bush administration, Bureau of Indian Affairs, the reason it gave for not approving the lease agreement between the tribal council and private fuel storage was that there was no guarantee that the waste would ever leave.

And as the trustee for the tribe, it could not in good conscious approve that lease agreement. And the George W. Bush Bureau of Land Management also disallowed the intermodal transfer facility. So, in the next minute, because I know there is 50 people online, the best interim alternative is hardened on-site storage. We need to stop making it. We need to transition to renewables and efficiency and storage.

The first technical study to my knowledge was Arjun Makshiani's "Carbon-Free and Nuclear-Free" published in 2007 which saw that in 30 years the United States could transition to a renewable energy economy that was carbon-free and nuclear-free. And since that time, a country like Germany, the fourth largest national economy in the world, is doing just that. It will be nuclear free by some months from now and is transitioning to dramatic greenhouse gas emission reductions.

So, the final thing I'll say is that the fuel should be shipped once to a safe, sound and socially accepted permanent geologic disposal repository. But you can't really dispose of this stuff and even at Yucca Mountain there would be tremendous releases.

And thankfully that site on Western Shoshone land is off the table.

So, some of the stringent criteria for a highly radioactive waste, permanent geologic repository would include things such as legality, consent-based siting, scientific suitability, environmental justice, regional equity, mitigation of transport risks, intergenerational equity, nonproliferation, which means do not reprocess. And other things like indigenous lands and sacred sites are off-limits to any such considerations.

And that will be the final thing I say as this attempt by the Office of Nuclear Energy to spin what they call consent-based siting for federal consolidated interim storage facilities as an environmental justice initiative is Orwellian. And I'll point out that New Mexico, just last week, passed a state law saying, no. Essentially, we do not consent. We will not allow this facility in our state. Texas did the same in 2021. There is no consent in New Mexico and Texas. Thank you for your time.

SIU: Okay, Thank you Mr. Kamps. Bret now has 50 public comments to read and they will all go onto the record for this meeting.

LESLIE: That’s correct, and Nathan, because we have new Board numbers, the way I am reading them is pretty much the order in which they came in and I will say for example for Erica's presentation, here are the following comments and that allows our presenters to better understand some of the comments and concerns and questions that get raised. So, it’s not exactly chronological in terms of when they came in, but I’ve tried to group them according to the topic. So, I will state who submitted the comment, and any affiliation, and then I will read into the record exactly their comment.

So, our first comment is from Karen Bonime from Southwest Alliance for a Safe Future, or SAFE. SAFE's position is that spent nuclear fuel should be stored as near as safely possible to the facility that utilized it. This would minimize the risk entailed in transport. No matter how sturdy the containers and railcars are, the weak link in the chain is the deteriorating condition of the nation's railways and their vulnerabilities to sabotage. The cost of inspecting miles and miles of tracks for damage or IEDs prior to each transport would be prohibitive. The spent fuel should be placed in Hardened On-Site Storage (HOSS) or Hardened Extended Life Storage (HELMS) at least until such time as a safe alternative is available. Any consent-based siting

process must be carried out in a way that respects the principles of Environmental Justice and ensures that information on possible impacts is provided in language(s) accessible to the layperson and is provided to the broadest possible socioeconomic spectrum of people within the area of potential impact.

The subsequent comments I’m going to talk about came in during Erica's presentation.

The first comment is from Carolyne Green from UCX, LLC. Very interesting, informative and comprehensive presentation. All this groundwork demonstrates the need for an independent agency to manage this program so a future administration does not take another hiatus.

The next comment Rich Janati. Good morning Erica, will DOE consider lessons learned from siting low-level radioactive waste disposal in the United States? Specifically, some states implemented a “volunteer siting process” and could share information that would be useful for DOE for implementing the consent-based siting for a storage or disposal facility.

Our next commenter, Barbara Warren, RN, MS. The weakening of the transport regulations for trains by the Trump administration had significant impact. There needs to be a serious review of these changes in relation to any movements of spent nuclear fuel.

Our next commenter, Michael Ford, HealthPhysics.com. Regarding DOE Bickford presentation on the IWM overview. Given DOE's missions “to implement federal interim storage for commercial spent nuclear fuel following a consent-based siting process,” one, is the DOE committing to the Nuclear Waste Policy Act and observing state and tribal authorities to not only participate but consent to or reject the proposed siting of MRS/CIS facility? Two, slide 6, will the DOE continue to acknowledge that the CISF is in fact the Monitored Retrievable Storage facility fully enshrined in the NWPA and will not attempt to redesignate the CISF an Away-From-Reactor ISFSI to abrogate the rights of the states and tribes in the Nuclear Waste Policy Act? Three, on slide 23, regarding helium leak testing, will that be testing considered a whole-body leak test or only a test of accessible surfaces, as is currently done? Also, how will Failed Fuel (FF) canisters be leak tested when their leak rates 1E-5 standard cc per second, are generally well above the acceptable leak rates last specified by the NRC (1E-7 standard cc per second). Four,

slide 23, will the site design include a hot cell for the transfer of UNF assemblies from a damaged or leaking canister into a new dry stored canister?

Regarding Dr. Huff’s comments.

Tony Leshinskie, Vermont Public Service Department and I apologize to Tony if I mispronounced his name. FYI, Dr. Huff's audio feed is not being broadcast to the session webcast. We can sort of hear what is obviously the in room audio of Dr. Huff's presentation, but it is quite muffled on the live broadcast.

Barbara Warren, RN/MS. I cannot hear the presenter at all. Needs to be louder.

Judy Treichel, Nevada Nuclear Waste Taskforce. Hey Bret, is Katie Huff’s presentation happening? We can hear that there is a faraway voice but it doesn’t sound like her and we really can’t make out the words.

Now, I will stop here, because we have been assured that when we post the webcast, everything will be available to be heard, so there will be some other comments similarly like when the audio

comes out, but I just wanted to let the audience and the Board members know that when we post the webcast everything will have been heard. And the transcript will reflect everything that was said.

Tony Leshinskie, Vermont Public Service Department. Much better, thank you.

Judy Trichel, Nevada. Thanks.

Tony Leshinskie, Vermont Public Service Department. Regarding using spent nuclear fuel as a fuel source for advanced reactors, for example, TRISO, does DOE anticipate a significant reduction in spent nuclear fuel volume/inventory from these efforts? If yes, is there a volume or mass reduction estimate available?

The next comment, Sven Bader, Orano Federal Services. Kathryn, one potential hurdle towards an advanced reactor receiving an operating license from the NRC is signing a standard contract between the operator and the DOE for DOE taking receipt of UNF/SNF from these reactors. Does DOE plan on creating a “new” standard contract for advanced reactors? If so, when, or if not, will the current amended standard contract for “new reactors”

apply? Also, in the current amended standard contract for “new reactors” which is applied to Vogtle 3 & 4, there is an item related to an “Approved List of Canisters” which DOE will pay or compensate for, does DOE plan to publish anytime soon this list of approved canisters for LWR UNF/SNF and/or in the future for advanced reactor UNF/SNF?

Moving on to Gerry Jackson’s presentation.

John Wheaton Nez Perce Tribe. Participating as a TRMTC member and Stakeholder Tribe of the Hanford site in Richland, Washington. There are no current routes through the Tribe’s reservations, but we recognize usual and accustomed routes.

Phyllis Dixon, Orano TN/ADP CR3. There are 39 DSCs containing fuel and two (2) RWCs containing greater than class C waste stored in the Crystal River ISFSI facility.

Carlene Green, UXC, LLC. By the time the spent fuel will be removed from any of these sites, the on-site and transportation infrastructure most certainly will have changed. How often will these reports be updated?

Tony Leshinskie, Vermont Public Service Department. More info on Vermont Yankee. NorthStar Nuclear Decommissioning Company completed its purchase of Vermont Yankee in 2019. The onsite rail spur was refurbished and expanded at that time to support shipping the bulk of radwaste from the site via rail. The spur now splits into three loading areas. Previously the spur only ran to the south end of the Turbine Building (i.e. one loading area).

Phyllis Dixon, Orano TN/ADP CR3. One clarification for Gerry Jackson’s presentation. While Duke Energy does not bring in as many rail shipments of coal into the Crystal River complex as they did previously, they still do maintain the option and will utilize rail coming into the complex when needed. They evaluate on a case by case whether to bring in coal by rail or barge for the remaining two coal plants located on the complex.

Tony Leshinskie, Vermont Public Service Department. Regarding the additional VT Yankee photos, these were actually taken by Solange DeSantis of Entergy (former site owners), but I went out with her to direct what photos would be taken. These have been supplemented by addition photos I’ve provided either personally or by forwarding presentations given to the Vermont Yankee’s

Community Engagement Panel (a.k.a. VT-NDCAP, which was actually created by the Vermont state law).

Regarding Sara Hogan's presentation.

Donna Gilmore, SanOnofreSafety.org. DOE technology gap report, SAND2019-15479, 12/23/2019 made stress corrosion cracking of canisters a priority one problem among other critical problems with current dry storage of thin-wall canisters. The DOE stating the current dry storage is good, ignores their own evidence in this and other reports. A link to the gap report is https://wwww.osti.gov/servlets/purl/159862. More information with a full technical reference at SanOnofreSafety.org.

Another comment by Donna Gilmore, again from SanOnofreSafety.org. The DOE claim transport casks cannot fail ignores the condition of the fuel rods inside the transport cask and canister during rail shipment, with or without a transport accident. It also ignores how long a canister can stay sealed inside a transport cask before it will overheat the contents. It also ignores the problem of not having a method in place to deal with a problem canister leaking whether in storage or transport or when delivered to a new site.

Diane D'Arrigo, NIRS. Has DOE done or When will DOE do a report on the capability to move the high level waste in canisters at West Valley, New York? -- the only commercial reprocessing waste in the country.

Diane D'Arrigo, NIRS. There appears to be no opportunity for public challenge to certification and amendments to certification of transport (and storage) containers. Does DOE care about that?

Donna Gilmore, SanOnofreSafety.org. What will DOE do with a transport cask that arrives at a storage site with a canister that is leaking? What is the status of these high priority technology gaps identified in in DOE Technology Gap Report SAND2019-15479, 12/23/2019, such as priority one stress corrosion cracking problems? https://www.osti.gov/servlets/purl/1592862

Sven Bader, Orano Federal Services. With respect to the Multi-Attribute Utility Analysis (MUA) performed in a site specific de-inventory report was performed only with contractors and cask vendors input for route ranking. The MUA should also be performed with other stakeholders to get their views on ranking of routes

as the contractors and cask vendors may have undervalued a route metric or had data oversight.

Donna Gilmore, SanOnfreSafety.org. Please provide technical reference for evidence that the high burnup fuel rods will not be too brittle to transport by rail. The zirconium cladding degrades during dry storage, yet there are no plans to inspect the fuel rods that have been in storage. Where is the thermal analysis of how long a canister can remain in the transport cask before the fuel waste would overheat the system?

Diane D'Arrigo, NIRS. Please remind what MUA stands for.

Donna Gilmore, is DOE and NWTRB aware that HOLTEC canister downloading system into overpack results in scraping, scratching and gouging of canister walls? References at this link. https://sanonofresafety.org/blog/ Is the DOE aware that the HOLTEC canister downloading system embeds carbon particles in canister walls, accelerating stress corrosion, cracking in canister walls?

Now, moving on to the tribal panel and comments that came in then.

Lisa Windsor, Mashpee Wampanoag tribal member. Just lost audio.

Karen Bonime, Southwest Alliance for a Safe Future. I am extremely glad to see native voices included. I hope that in response to their testimony, NWTRB will make a strong recommendation for significantly increased funding to the tribes for Emergency Management planning, preparation and capacity building. Tribes should not have to compete against each other for funding.

Donna Gilmore, SanOnofreSafety.org. The Swiss have an on-site hot cell facility for retrieving fuel assemblies and they use the best available dry storage spent nuclear fuel storage technology that exceeds NRC and ASME-N3 requirements. In contrast, the NRC gives exemptions to regulations and ASME-N3 requirements for nuclear pressure vessels for storage and/or transport of spent nuclear fuel and other high-level nuclear waste. Why isn't the DOE and NRC requiring the best available technology? See details on the Swiss system at https://sanonofresafety.org/swiss/

Moving on to Kaushik's presentation.

Chris Bajwa, U.S. NRC. Can you speak about the validation or benchmarking that has been done to support the UNF-STANDARDS code?

Diane D'Arrigo, NIRS. So, spent fuel is not transportable, the routine next step is to amend the CoC??

Sven Bader, Orano Federal Services. Kaushik, will UNF-ST&DARDS be used to perform similar calculations for advanced reactor and accident tolerance fuels and if so, is the GC 859 process being planned to be updated for getting more or different data for these advanced reactor and accident tolerant fuels?

Erica's presentation on the railcars.

Donna Gilmore, SanOnofreSafety.org. The Navy spent nuclear transport is very different than the commercial spent nuclear transport, so Navy transport is not evidence that commercial spent nuclear fuel can be safely transported. What kind of damage and wear will these heavy transport systems do to the fragile U.S. rail system? Who is evaluating this for safety, cost estimates and funding?

Rich J. On average, how many shipments of SNF are expected to be received at the Interim Storage Facility?

Chris Bajwa, U.S. NRC. Would the ATLAS or FORTIS railcars be used for shipments to a Consolidated Interim Storage Facility?

Donna Gilmore, SanOnofreSafety.org. Has a DOE or NWTRB made Congress aware that there is no current even temporary storage solution for radioactive molten salt waste? It would be prudent and sane to not consider let alone approve molten salt reactors until this issue is resolved. This is both a cost and safety issue. TVA experimental reactors should be a reality check that these reactors are not ready for prime time.

Sven Bader, Orano Federal Services. Does DOE understand that many of the advanced reactors have already designed portions of the backend fuel cycle that is integral to their Part 50/52/53 applications (e.g., dry canister storage facilities instead of spent fuel pools) and it sounds like some of them may be at risk if DOE GC creates a Standard Contract that differs from the existing Standard Contract and potentially requires redesign, or worse, repackaging of SNF to meet the revised contract. Seems

like the Standard Contract for advanced reactors should be a priority for DOE GC, is there a schedule for this?

Now, moving on to our last presentation by Dave Pstrak, NRC.

Donna Gilmore, SanOnofreSafety.org. The NRC has refused to address how a leaking canister can be replaced at existing ISFSI sites or after transport to another site. The proposed CISF sites in New Mexico and Texas plan to return leaking canisters to the sender. Outrageously the NRC is okay with this non-plan.

Sven Bader, Orano Federal Services. For a consent-based sited consolidated federal interim storage facility (CSF), an obvious requirement (amongst others) would be a viable disposal facility to avoid the CSF becoming a de facto disposal site, especially when Senators from more than 25 states with SNF/UNF potentially drops to Senators from one state associated with the CSF. This critical and obvious link was not discussed in today's presentations and questions. I believe this link exists in the analyses tools that DOE has put together and should have been highlighted in the discussion as it is critical path for consent-based siting in a need of Congressional action.

Kalene Walker, concerned human. The many tribes and people involved in this complex transportation discussion are likely unaware of the implications in the Legal Disclaimer presented at the beginning of each DOE presentation. The Nuclear Waste Policy Act Standard Contract requires Monitored Retrievable Storage of the spent fuel.

But the NRC has approved nuclear waste canisters that do not and cannot meet the Nuclear Waste Policy Requirements and Federal Code of Regulation 10 CFR 72.122(l) that the fuel be retrievable. NRC also exempts canisters from meeting basic ASME N3 storage and transport requirements for these nuclear pressure vessels.

Almost 4,000 welded canisters have been loaded, yet no dry fuel handling facility (hot cell) exists in the entire U.S. for retrieving fuel from a failing canister.

The Board is well aware of canister cracking issues (Chloride Stress Induced Cracking) and has had numerous presentations that discuss problems with fuel, particularly High Burnup Fuel, in storage. The Argonne data that discussed the buildup of zirconium hydrides and zirconium oxides and the thinning and embrittlement of the fuel rod cladding was particularly concerning. With no

actual data from stored fuel, the computer modeling assumptions leave a great deal of concern regarding the conditions of canister fuel.

With each canister containing about a Chernobyl disaster worth of radiation, this could not be more serious.

As Erica Bickford stated, regulations require the fuel remain intact during transportation.

Question, in light of the lack of ability to inspect the fuel, how will DOE verify the condition of the fuel before transport?

Donna Gilmore, SanOnofreSafety.org. The NRC is misleading the public. They have no method to find or characterize cracks in canisters, repair cracks or otherwise mitigate these problems. They have no ability to monitor the condition of the fuel rods or other contents of the canister. The NRC has demonstrated that they cannot be trusted to protect our safety. Evidence at SanOnofreSafety.org.

Diane D’Arrigo, NIS. Regarding Erica's presentations--she said there were buffer cars intended to go between the irradiated fuel

car and passenger cars--so, irradiated/spent fuel cars would be on the same train as the public?

For Dave Pstrak, how will fuel stored in 10 CFR 72 certified storage containers be transported? Will they be transferred to 10 CFR 72 transport certified containers and if so, how?, especially at a site with no fuel pool to transfer the fuel.

Also for Pstrak--he said amendments to CoC's are not rolling in. But, there are 40 year renewals being requested for cask system with no opportunity for public interventions or adjudicatory review.

Michael Ford, HealthPhysics.com. Regarding NRC/Pstrak presentation on NRC Preparations for Potential Large-Scale Commercial Shipments of Spent Nuclear Fuel.

One, given the scope of review of the NWTRB's March 2022 meeting, what is the process for advising the NRC of the numerous activities undertaken to assess the risks of CI-SCC and the ability of licensees to detect a breach in a DSC or the worst-case-magnitude canister breach due to CI-SCC.

Two, acknowledging extensive research undertaken by the Board regarding the legitimate concerns of CI-SCC, has the Board expressed any concerns regarding the siting of the New Mexico facility in an area of the Salado formation “literally surrounded by” (NRC language) four salt playas.

Three, it is noted that while the NRC only refers to the Texas national-level SNF storage facility as an " AFR-ISFSI " in the 5th Circuit Court case, allowing it to license to the CISFs under the AEA and not the NWPA, abrogating the rights of state and local government units to collect between $400 million and $1 billion under Section 171 of the NWPA--the NRC refers to the Texas facility as a CISF in the Board's presentation. Does the Board agree with the NRC’s approach in licensing the Texas and New Mexico facilities, ignoring the rights of both states to accept or reject the facilities, and in turn, having state laws enacted in barring the facilities and destroying consent in these states?

Karen Bonime, Southwest Alliance for a Safe Future. If a derailment were to occur, I’m concerned that even if the container remained intact, the internal instrumentation including sensors could be damaged. I have heard that when HOLTEC’s casks

were tested at Sandia Labss by being dropped from a height of 30 feet, the container remained intact, but the instrumentation was destroyed. Once the sensors are destroyed there is no way to determine the internal temperature, radioactivity or pressure may be. I don't know if this information is documented in a way that you have access to, but please, please ask to see it! I’m very concerned that this is never discussed. I am at least as concerned about damage to those instruments as I am about a breach of the container and resulting release of radiation. Why? Because, without functioning sensors, NRC inspectors would have zero information about the factors that affect cladding integrity, for example. How could the inspectors at the receiving site make a determination that the canisters and its contents pose no damage?

Kaylene Walker. The NRC is currently considering approving the proposed HOLTEC New Mexico Consolidated Interim Storage facility where - if they have a leaking canister arriving at the site, they will "return canister to sender." Repeat, the NRC is considering approving the HOLTEC CIS facility where - if a radiation leaking canister arrives at the site they will "return canister to sender.”

As they say, fail to plan, plan to fail.

Simply making exemptions to certificates of compliance will not solve non-transportable problems.

When will the NWTRB acknowledge and alert Congress of the need for dry fuel handling storage facilities (hot cells), to provide a viable method to repackage fuel BEFORE canister failure?

In Europe, thick-walled bolted casks are used, they are designed to be inspected inside and out, repaired and monitored to prevent radiologic leaks or hydrogen gas explosions. Please consider the Swiss nuclear waste storage system,

https://sanonofresafety.org/swiss/

I need to check to see if we have gotten any more comments and we have not. That is the totality and to remind folks that these comments will be part of the record and posted online with a transcript as we move forward. With that I turn back to you, Nathan.

SIU: Thank you, Bret for a yeoman job. That was a lot to read. And I'm glad we have those comments in the record. So, I believe

that is it for the meeting. Thank you again for attendance and I know that the DOE folks had to leave to catch their flight before they heard all of the comments, but they are on the record. Okay, with that, thank you again and we are adjourned.