UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

TRANSCRIPT

SUMMER 2015 BOARD MEETING

Wednesday

June 24, 2015

Denver Marriott West Hotel
Salons A - D
1717 Denver West Boulevard
Golden, Colorado

NWTRB BOARD MEMBERS PRESENT

Rodney C. Ewing, Ph.D., Chairman, NWTRB
Jean M. Bahr, Ph.D.
Steven M. Becker, Ph.D.
Susan L. Brantley, Ph.D.
Allen G. Croff, Nuclear Engineer, M.B.A.
Gerald S. Frankel, Sc.D.
Efi Foufoula-Georgiou, Ph.D.
Linda K. Nozick, Ph.D.
K. L. Peddicord, Ph.D., P.E.
Paul J. Turinsky, Ph.D.

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Nicolette L. Brannan, Stanford in Government Intern
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P R O C E E D I N G S

8:00 a.m.

EWING: So good morning. Welcome to the summer meeting of the Nuclear Waste Technical Review Board. I'm Rod Ewing, the Chairman of the Board; and it's a pleasure to be in the Denver area.

Before we get started I just want to mention that as an innovation for the Board, this meeting is being webcast live. Viewers of the webcast will receive live audio and video of the meeting, including copies of the slide presentations. You can find the Internet link for the webcast on our web page. The full webcast will remain available on our website for at least a year after this meeting; and I hope by doing this we make our activities more available to the interested and concerned public as well as scientists and engineers around the country who have an interest in our activities.

A few words about the Nuclear Waste Technical Review Board. The Board is an independent federal agency in the Executive. The Board is not part of the Department of Energy; the Board is not part of the Nuclear Regulatory Commission; in fact, we're not part of any other agency. We stand as an independent agency.

The Board was created by the 1987 amendments to the Nuclear Waste Policy Act, and we were given the charge of performing ongoing technical and scientific reviews of the validity of DOE activities related to the implementation of the Nuclear Waste Policy Act. Those activities include the packaging, transport, and disposal of spent nuclear fuel and high-level waste.

The eleven Board members are appointed by the President from a list of nominees submitted by the National Academy of Sciences. Today we have ten Board members present. One, Dr. Mary Lou Zoback, was not able to join us for this meeting. The Board members are sitting at the tables arranged in this V-shape, as well as I should point out Steve Becker, a Board member sitting in the corner, is there because he may have to take some phone calls; so he didn't want to disturb the proceedings.

I won't introduce each of the Board members separately, but just outside the room on the back table is a sheet, which states very clearly the mandate and charge of the Board, and on the back of this sheet are pictures and a few words about each of the Board members. I encourage members of the audience to take advantage of this opportunity to meet with and speak to the members of the Board during breaks and at the end of the meeting.

I also encourage you, the audience and the participants in this meeting, to take the opportunity to meet with and speak to members of our staff, who are seated at the table against the wall. Staff are critical to the Board's moving forward with its various activities.

Now a few words about the purpose and agenda and theme of today's meeting.

The U.S. Senate Appropriations Committee has submitted legislation that would authorize DOE to undertake a pilot program for developing one or more consolidated interim storage facilities for spent fuel. Later in July the Senate will also hold hearings on comprehensive legislation that would establish a new implementing organization outside of the Department of Energy for managing spent fuel and a program for siting and licensing spent nuclear fuel storage facilities as well as a permanent repository using a consent-based process.

Also in the news have been proposals by two private companies to apply for licenses to construct and operate interim storage facilities for spent nuclear fuel.

All of these proposals will require the transport of spent nuclear fuel that is being stored at commercial nuclear power plants at more than 70 sites around the country.

The federal government has established regulations for the transport of spent fuel. These regulations mandate formal procedures and planning, robust packaging, heavy shielding against radiation, and sturdy and reliable transportation equipment. Today we'll hear from representatives of the Department of Energy, national laboratories, stakeholder groups, and a speaker from the Swiss nuclear facility on the various aspects and challenges of transporting spent nuclear fuel.

Because the Department of Energy will be responsible for this significant transportation task, the Department of Energy and its national laboratories have been engaged in coordination and outreach as well as research and development to support this effort. Many of the key personnel working on these activities are here today.

So let me describe today's agenda. The first presentation this morning will be made by John Herczeg, who is the Deputy Assistant Secretary for Fuel Cycle Technology in the Department of Energy's Office of Nuclear Energy. John's office is responsible for many of the functions that were previously assigned to Office of Civilian Radioactive Waste Management, which is no longer. These responsibilities include planning the transportation, interim storage, and disposal of commercial spent nuclear fuel. John will describe activities underway at DOE relevant to the transportation of spent fuel and the focus of DOE's associated research and development efforts. He will highlight DOE's priorities for research and discuss actions that DOE can take relative to the transportation and storage of spent nuclear fuel which do not require prior approval from the U.S. Congress.

Following John’s presentation, Melissa Bates of DOE’s Office of Nuclear Energy will present details of DOE’s planning for nuclear fuel storage and transportation.

We’ll have a short break, and then Jim Williams of the Western Interstate Energy Board here in Denver will discuss concerns of his organization associated with the transportation of spent nuclear fuel. I should say the Board always tries to involve stakeholders from as wide a range of organizations as possible. So, Jim, we’re very pleased to have you here.

After Jim, Josh Jarrell of Oak Ridge National Laboratory will present details of DOE’s proposal for the development of a standardized canister for the transportation, storage, and disposal of spent fuel, the STAD canister. Although one can debate the pros and cons of such a standard canister, its implementation would simplify much of the infrastructure DOE must develop for transportation, interim storage, and final disposal of spent fuel.

After Josh’s presentation, we’ll have the first opportunity for public comment before the lunch break, which will be at 12:15.

I should say that we’re on a tight schedule. We’ll reconvene at 1:15. And in order to help people quickly have some lunch and some discussion, we have announced in flyers that there is a buffet that we have arranged that it be available to the participants. You have to pay, but it should be a little more efficient than using the restaurant if you want. So just call that to your attention.

After lunch, starting promptly at 1:15, we'll have a panel of government and industry experts who will discuss the potential for corrosion of dry-storage canisters used for spent nuclear fuel at utility sites across the country. Bob Einziger of the Board staff will chair the panel. The panel members include, in alphabetical order, Joe Carter of Savannah River National Laboratory, Shannon Chu of the Electric Power Research Institute, David Enos of Sandia National Laboratories, Steve Marschman of Idaho National Lab, and Meraj Rahimi of the Nuclear Regulatory Commission.

After the panel discussion, Meraj Rahimi will continue with a presentation of the Nuclear Regulatory Commission's perspective regarding dry storage of commercial spent fuel and some of the challenges the industry may face with the transportation of that fuel.

After a short break, we'll hear from our last speaker, Mark Whitwill of Switzerland's nuclear utility company, KK Gösgen. He will describe the Swiss experience in managing spent nuclear fuel, including wet and dry storage, repackaging in a dry-transfer facility, transportation, and operations at a consolidated interim storage facility. The Swiss experience is of great interest to the Board and can provide important lessons learned, as the Swiss activities are occurring before the same activities are planned here in the U.S.

At the end of the day we'll have our second public comment session; that'll be at 4:25. Hearing from the affected and concerned public is always welcome by the Board.

If you plan on making a public comment, please sign in at the desk just outside the door. If you would like a staff member to ask the question, write your question down on the card and give it to a staff member or a Board member, and we'll see that the issue is raised.

Written remarks and other materials can also be submitted, and they will be made part of the meeting record, which is posted on our website. We also post the meeting transcript and all the presentations on our website.

Because of the webcasting and because we provide a transcript of the meeting, when you speak, speak very directly and in close contact with the microphone so that we can record everything accurately.

After the formal meeting ends, we'll stay on for an hour or so in the Keystone and Telluride rooms for a poster session. This is meant to be an opportunity for all the participants to meet one another and discuss the issues that have been raised during the day, I think an excellent opportunity for the public to meet the scientists and engineers who are doing the research and development associated with the transportation of spent nuclear fuel. We have been doing this now for the last probably three or four meetings, and we've found this to be a very successful part of the day's activities.

As many of you know, the Board follows its public meetings with letters conveying the Board's observations and recommendations to the Department of Energy. Typically, the letter is directed to the appropriate Assistant Secretary, depending on the subject of the meeting; and these letters are also posted on our website.

So those are the announcements and descriptions. I'd ask you to mute or turn off your cell phones. I have to run over and do the same. And if you, as I said before, want to make a comment or when you raise a question, speak directly into the microphone. Always identify yourself and your affiliation so we have that as part of the record.

So, with all of that said, I'll turn the microphone over to John Herczeg, and we'll begin the day's presentations. Thank you.

HERCZEG: Thank you, Chairman Ewing. Good morning, Board members, staff, public, and participants.

My name is John Herczeg, and I manage the Office of

Fuel Cycle Technology, which has three offices in it, one of which is Used Fuel Disposition, and it also has a project office called Nuclear Fuel Storage and Transportation.

Before I get into addressing your specific questions, I’d like to ask the Board to take a minute and think or visualize in your mind a heavy-haul transport truck carrying spent fuel through a small town in the United States en route to an interim storage facility. Your role, as I envision it, is to challenge DOE with questions and require reports to make sure that the transport of that fuel through that town is safe and secure. But, equally important, that town should have the confidence that the U.S. government has applied the right checks and balances for that shipment to be safe and secure through that town. That’s equally important that the townspeople feel comfortable that we have done our job.

You have asked five questions of me; you have asked a number of questions from our staff and laboratory members; and I will address the five questions that were briefly outlined this morning by Chairman Ewing. But let me just go over them very quickly to set the scene, and I will address each one of those questions as part of the presentation.

You asked us to address the technical issues associated with the transportation of spent fuel to an interim storage facility followed by the transport to a repository, including the coordination with the Department of Energy's other offices like EM and NNSA; you asked us to give you the priorities of R&D in 2016 as we're going forward; you asked us to look at the transportation issues associated with moving fuel to a private interim storage facility; and you also asked us to address what can be done on transport activities to an interim storage facility and repository without additional guidance from Congress--legislation from Congress.

The approach that the Administration is taking as it moves forward is outlined in a January 2013 Strategy for the Management and Disposition of Used Nuclear Fuel and High-Level Waste. That document is actually embracing the findings of the Blue Ribbon Commission, for which I am sure you have a great deal of knowledge about. But, equally important, they indicated in that, their recommendation and in our strategy that we also achieve public acceptance at the local, state, and tribal levels.

Following the Administration's strategy document, two events took place this year on October 14th. One, President Obama gave authorization to the Department of Energy to establish a defense-only repository. He essentially gave the authority to the Secretary of Energy to move forward on that.

The second event was, Secretary Moniz made in opening remarks--or made remarks to the Bipartisan Center to identify the specific actions that the Department would take as it's moving forward. These actions are, one, planning for a defense-only repository; two, moving forward with planning an interim storage facility for commercial spent fuel; and, three, moving forward with consent-based siting for both types of facilities.

To achieve this requires a comprehensive workable solution. To help set the scene, I have tried to identify here the scope of the material and the categories of material that we look at. In the commercial arena we have commercial spent fuel and high-level waste that exists at 61 reactor sites and 13 shutdown sites at this time and at West Valley. That's the high-level waste.

DOE-managed spent fuel and high-level waste, which is mainly managed by EM and the Navy, is Naval spent fuel in Idaho, commercial and defense spent fuel at three primary sites, the Fort St. Vrain fuel, Idaho, and Savannah River. For high-level waste, which is primarily glass and in some cases calcine waste, is at Hanford, Savannah River, and Idaho National Laboratories.

Full implementation of the strategy will require new legislation; however, a great deal can be done within the current framework. I have listed here for you the high-level priorities of the request for the 2016 budget, which is in front of Congress today. In the area of Integrated Waste Management systems, which the project office that I referred to in the beginning called Nuclear Fuel Storage and Transportation, we've requested $30 million to conduct preliminary generic development and other non-R&D activities relative to the storage, transportation, and also consent-based siting.

Under the Used Fuel Disposition area we have two categories, $75 million for R&D in support of enabling the storage, transportation, and disposal of spent fuel and waste using the existing and future fuel cycles, and a separate $3 million for a defense-only repository, and that's to identify types of geologies and the material that would go in those facilities or that facility.

I should comment that the defense waste is significantly different than spent fuel, and I'll make comments on that later.

The Blue Ribbon Commission, it basically said we should go forward with an existing authority in three specific areas, mainly storage, transportation, and disposition. They asked us to lay the groundwork for implementation of a consolidated interim storage facility and improve the overall integration process. In transportation, they asked us to provide funding to work with the states and regional governments and train local and tribal officials on the transportation of fuel through their systems. And they also indicated that we should focus primarily on shutdown sites.

In the disposal area, they said that we should continue moving forward on various programs, non-site specific, of various geology, mediums, and barriers and that we should plan for the research, development, and a roadmap for taking forward borehole disposition to the point of licensing demonstration.

And I thank you for asking that your next meeting focus on boreholes. And that will be in D.C., and we look forward to that.

In 2015 the Department area is focusing primarily on identifying--for a mutual disposition identifying alternative sites for disposition of all types of material. But we're conducting a lot of R&D to enable the long-term storage, transportation, and disposal of both this fuel and the associated nuclear waste.

In the nuclear fuel storage and transportation area, we have $22 million, and that's to lay the groundwork for an implementation of an interim storage facility and lay the foundation for a new organization that would execute these programs.

Key elements of the Used Fuel Disposition Office are working on the retrievability and transport after extended storage of spent fuel, the transport of high-burnup fuel after it's been stored, and the disposal of that under various scenarios. We are looking at the feasibility of deep borehole concepts, and this is a scientific study. We are going to put no radioactive waste down that hole. We're doing the scientific work to understand the geology, and you'll hear more about that in a few months. But basically we are planning to drill down 5 kilometers a hole that's 17 inches in diameter.

We are looking at the technical feasibility of direct disposal of existing storage and transportation canisters, and you'll hear more about that today.

Extended storage and subsequent transportation; there have been a number of organizations who have given us recommendations. You have done that. You have asked us to evaluate the technical basis for extended dry-cask storage and transportation. The NRC has asked for a lot of R&D in helping to identify and prioritize the technical information needed to effectively regulate the extended storage.

The Used Fuel Disposition Campaign is going farther in identifying gaps to support this R&D, and an integral part of their work is what are called--under our university program it's called NEUP--and integrated research projects, which are working very diligently in this area. We are also working on the gaps associated with storage and transportation.

So how are we going to do this? Our approach is to take many components, put them together, mainly experimental, theoretical, computer modeling, and actually do a demonstration. We are engaged in a ten-year demonstration, which I'll talk about further in the next slide.

Extended storage and transportation, the key areas of interest by a lot of people is the degradation mechanisms and retrieval of long-term stored fuel and the subsequent transportation. The key number one factor, as I see it and as many others see it, is the hydration formation and reorientation of the material that's holding that spent fuel, mainly the cladding of high-burnup fuel. We are looking at the corrosion of stainless steel canisters, the thermal history of storage, the profile storage, and the mechanical loads associated under normal conditions of transport.

As I said earlier, we have entered into a ten-year program with industry. It's an 80-20 cost-shared program. The players in this program are EPRI, Dominion, AREVA, and many others that are listed on the bottom of this slide here. Basically, this program started about a year and a half ago and is focused primarily on looking at high-burnup fuel.

We are going to look at the degradation mechanisms over that extended period of time for four types of cladding from two reactor vendors. We plan to load a TN-32 cask with instrumentation sensors for temperature and also a port to monitor gas as a function of time. We will put fuel in that cask, we anticipate, in 2017. We will do a normal drying of the cask contents under the standard process. We will do the storage at the North Anna site. We will then--before that we will extract and ship sister rods so we have a baseline for the starting point of that test. We have actually done that already, and it's waiting for transport to a site to begin the PIE of the initial phase. That's 25 pins.

After ten years--we anticipate 2020--we will ship the cask to an appropriate site, open it, and examine the rods. We will do all this in coordination with the NRC.

You asked about transportation, storage, and re-transportation and the research going on in that area. It's broken into two parts. One, we are conducting R&D on closing the gaps germane to the initial transport of spent fuel and subsequent re-transport. We are looking at understanding the aging mechanisms during interim storage as part of that, and we are developing--under development right now is an aging management system to evaluate the degradation during storage. We are working on a generic pilot interim storage facility, and we are looking to move forward on a topical safety analysis report so we can identify the issues NRC would ask with regard to that facility.

The Nuclear Fuels Storage and Transportation Planning group, which reports directly to me, is charged with laying the groundwork for this interim storage facility. We have just completed a task order on a pre-conceptual design of a generic storage facility that can handle multiple types of casks, mainly to understand what is the type of facility that--what would we have to do for the shutdown sites in the way of storing that material at an interim storage site. And I’ve gone through a great deal of this, and I’m very impressed with the results for a pre-conceptual design.

The systems analysis that we’re doing on this area--and you’ll hear more about this from other speakers--is looking at compressing the time for overall construction of a consolidated interim storage facility and reducing the cost, and we are promoting integration across all areas. We’re trying to look at lessons learned relative to site processing and what are the benefits of standardization.

With regard to the large-scale transport, we do work with stakeholders and look at the policy for a transportation plan; and we are evaluating the inventory, transportation interfaces, and shipping status of used fuel initially from shutdown sites.

Activities to accomplish and support this are going to be talked about a great deal more by the next speaker, but I already said that the generic design of an interim storage facility has been put in place. It’s a very comprehensive document. And after going through 30 percent, 60 percent, and 90 percent design review, you will find, or I have found, that this is not just a concrete pad that you place spent fuel storage canisters on. It is much, much more complicated than that. We are evaluating the costs associated with that, receiving and storing that, and possibly handling and transferring the material on that site.

In transportation area, we are working with the revised 180(c) policy; we are putting together a transportation framework; and we're looking at routing options. It's called the START demonstration. And Melissa Bates will give you a few words on that at our next presentation.

We are planning on designing, testing, and acquisition of a rail car, which has to be done specifically for our fuel. As you may know, there is a rail car the Navy has designed for an M-290 cask. That car is much bigger than we need and actually would have to be modified. So we are designing a new rail car to transport current commercial spent fuel and the buffer car. We are working with the other parties, mainly the Navy, to look at the escort car. And we have commonalities there, so we will not have to duplicate our efforts on that. Our efforts right now are focused on removing fuel from shutdown sites.

You asked about the initiative of private interim storage facilities. I have to say at this time I'm somewhat limited in what I can say, because we have not really studied it in great detail. But the DOE is aware of two private companies who have expressed their intent to apply for a license for away-from-reactor interim storage. Both of these entities envision that the DOE would take title to the fuel at the reactor site boundary and be responsible for the transportation to the interim storage facility.

I mentioned comprehensive workable solution. You asked about working together. I can tell you with great assurance that the Office of Nuclear Energy is working closely with the Office of Environmental Management. We are doing so in regards to the borehole. We are doing that in regards to transportation. We are also working with NNSA, which is primarily the Navy, on their work.

We are preparing the framework for transportation. We are looking at the experiences that have taken place with EM and NNSA, mainly in the transport of a rail car. Yesterday we had the opportunity to visit a site down south of here called the Transportation Technology Center, Inc., which is a very interesting facility. That was a very valuable tour, and we were very pleased that some Board members were able to go on that visit.

We are looking at, to the extent possible, using common equipment. I spoke of that with regard to the escort car for transportation by rail.

In conclusion, I can tell you that the Department of Energy is committed to moving forward with the development of management strategies and technologies on transportation, storage, and used fuel disposition. The Used Fuel Management team, which consists of both the Used Fuel Disposition Office and the NFST, are laying the groundwork or the foundation for away-from-reactor interim storage.

We are providing the technical analysis to support the extended storage of high-burnup fuel. I talked about the ten-year demo. We are just beginning to look at a defense-only repository. We are moving forward with planning for the interim storage of commercial fuel, mainly from shutdown sites, and we are looking forward and are planning at this point in time--just planning--on consent-based process for siting both these types of facilities.

I will also indicate--and you did not ask for--but I thought it would be valuable for you to see the budget that we have requested in FY16 and what are the marks from the House and the Senate. As you can see, there is a significant difference between--there was a laser pointer here. This is used fuel disposition. The integrated waste management is the NFST office on interim storage and consent-based siting. Research is this line right here, and the defense-only repository is this line right here.

As you can see, the House has provided $175 million with no funding for the interim storage and the defense-only repository, but the Senate has provided funding in all of those areas.

That's the extent of my presentation, and I am open for questions.

EWING: Okay, John, thank you very much. And special thanks for addressing the questions that we posed, addressing them so directly.

So the paper is open for, first from the Board, questions.

Linda, identify yourself and speak into the mic.

NOZICK: Sure. Nozick, Board. I have two questions. I’m very intrigued by your comments about the consolidated interim storage site and the new things you’ve learned in the process of doing that analysis.

So one question is: Could you elaborate on what are the things that you particularly learned that were surprising or that we’ll find very interesting? And the second follow-up question to that: Is there anything we should be thinking about doing now that would make the storage of spent fuel for new stuff coming out of reactors easier in the future?

HERCZEG: Well, I have to be careful in answering the second one, because I have a very strong personal opinion of the second one, and I don’t want to steal the thunder of

Melissa Bates, who is going to give you great detail on interim storage.

But in quick overview, by going through this process and working with the laboratories and independent contractors, we have been able to identify the critical path items that take us from where we are today at shutdown sites and take it all the way through and take it to the interim storage facility. There are many, many players and many, many pathways that you can do this.

There is a process of integration that actually uses risk-based analysis that helps compress the time scale at which we can get things done by doing many things in parallel that don’t require a critical path. I have had that explained to me twice, and I am very impressed. And I can see that it can save 30 percent of the time just by understanding all of the details of critical path items. And there’s a number of people here who can talk a great deal more about that from our laboratories, and Melissa will talk about that.

As to your second question of what we can do now, you will hear we’re talking about standardized casks that can be both for disposition and transport--I’m sorry--for transport and disposition. If we were to somehow come to the point where we could say, “Here is a particular type of canister that we would like you to put the fuel in,” then we would eliminate the need for a re-transfer of that--for those fuels which are in casks--which I cannot go into a direct repository--those cans, if we could provide some mechanism to provide those cans, to load them so that they are both transportable and also inspectable--or not--at the interim storage site, and then directly disposable in a repository, that would save a great deal of work.

This is more my personal opinion, but I think it is also the opinion of a lot of other people. How you get that done, I don't know, because right now utilities are free to do as they like and put fuel in any type of canister that's available out there. But I think common sense is going to come into play here, and hopefully we'll all work together and get this problem solved.

NOZICK: Thank you.

EWING: Yeah, thank you.

More questions, Board? Lee.

PEDDICORD: Lee Peddicord, Board member. On the shutdown sites you mentioned and the fact that you are giving early attention to them and so on, but you really have quite a spectrum of shutdown sites in terms of infrastructure capabilities ranging from, say, San Onofre, which recently shut down, maybe some more about to reach that point, all the way down to almost near greenfield sites with just the fuel remaining.

So within that spectrum, are you prioritizing which sites you will try to address first, maybe the low-hanging fruit where all that infrastructure is in place, or ones where a lot is going to have to be done probably to go to retrieve that fuel? So what is the thinking of the Department on the prioritization of the shutdown sites?

HERCZEG: We just released a report in October that lists the eleven sites we've looked at so far. At this point in time there is no prioritization; however, there is a clear understanding of the work that has to be done to get it from Point A to Point B.

I suspect, as time goes forward and we enter into this consent-based process and the potential for legislation, which I always keep in my mind here, that there might be a priority to get spent fuel out of the west coast of the United States. That might be something Congress might say.

We do not have at this point in time any prioritization; however, it is clear--and you'll see a slide in the next presentation--that there is fuel all over the United States, but they're concentrated primarily in the east coast and west coast. So that almost begs the issue, well, you know, where is the best bang for the buck? Where can we do the shortest transport and the quickest to get stuff moving and going forward? We have not made that priority list yet.

EWING: Okay. Efi?

FOUFOULA: Efi Foufoula, Board. So one of the recommended focus areas on disposal is to develop a certain development plan and the roadmap for taking the borehole disposal concept to the point of licensed demonstration. Are you prepared to give an estimate of the timetable? Do you see this licensed demonstration to take place in five, ten, or twenty years?

HERCZEG: I cannot speak specifically to your question of the licensing time, but I can give you an overview of the time frame the Secretary has personally told me that he wants to start drilling that borehole. And it’s October 2, 2016. So I am on the hook to get that done.

As far as licensing is, going forward we are to put together the roadmap for that and work with NRC. I would only have to venture a guess, and I don’t think I want to give a guess right now. But certainly the licensing process would require many, many steps here and probably the drilling of more than just one hole. We have planned to drill two holes, one a small pilot hole of 8 inches. And if we understand the geology there, close to that one we would drill the one that’s 17 inches in diameter. We would do all of the scientific measurements we can possibly do. We’ll align the canister; we’ll look at retrievability; and we’ll put all of this together.

So part of the reason why I can’t give you an answer is, we might find some showstoppers. We don’t know. I don’t think we will, but we might; right? And as part of this process going forward, the NRC may identify some certain things, the EPA gets involved with this, because the EPA regulates well holes, and so EPA may weigh in on this. So the licensing process could get quite complicated. My guess is, is that you’re looking at no less than five years and more likely ten years before you can go forward.

But I think it’s very important for us to point out that we are not looking at putting spent fuel into a borehole. What we’re looking at is primarily small quantities of defense waste like the cesium and strontium capsules. That looks quite viable. We don’t think that we would want to go much farther than that. It would mainly be defense waste, which is very benign or just radioactive and would decay away at a certain point in time. That type of license might be easier.

But it’s not spent fuel, as a few years ago everybody was talking, “You’re not going to put spent fuel down this hole, are you?” The answer is no.

EWING: Okay, thank you. Jean?

BAHR: Jean Bahr, Board. You mentioned that the two private companies that are looking into away-from-reactor interim storage facilities are assuming that DOE would take ownership of the--or responsibility of the waste. Is that an assumption that's acceptable to DOE? Problematic? Consistent with what you would have assumed? I'm just trying to understand if that's a potentially contentious assumption or if that's something that you don't see as a problem.

HERCZEG: I think it's a negotiating point. And the people who would negotiate that are not the technical people, but it would be our general counsel folks, and they would take on that discussion. So at this point in time we are not committing to anything on that front, because we're looking also for legislation. You know, legislation might say, "You must take possession." We don't know.

BAHR: Presumably that would determine who is responsible for the transportation?

HERCZEG: Transportation is not easy. Putting it on a concrete pad is very easy.

EWING: I'll take the prerogative as Chair and ask the last question. We're about out of time. And it has to do with the consent-based process where this is often mentioned in terms of siting nuclear facilities, interim storage, and repository. Does any of this concept of consent-based flow over into transportation?

HERCZEG: Yes.

EWING: And in what way would that--

HERCZEG: Well, I'm sure--

EWING: Do states get to say whether there would be transport across a state?

HERCZEG: Well, we are just--we are in the stage of planning for consent-based--I'm sorry--for holding meetings on consent-based siting. And we really haven't gotten very far down the road on this. And the reason for that is that we don't know our exact authority.

So the first step is going to go out and ask the pubic what is their opinion, what would they like to see. And I would expect that transportation will be high on their list. Is this going to go past a hospital? Is this going to go past my daycare? And we'll have to address those issues. So I'm sure it will come up in the planning process, but right now the overall process is looking at doing it in the most safest, secure, but yet have economics as part of that overall structure.

EWING: Okay, thank you. I know there are a few more questions, but we should move ahead. And thank you, John.

HERCZEG: Thank you.

EWING: The next presentation is by Melissa Bates from the Department of Energy's Office of Nuclear Energy.

BATES: Good morning. Can you guys hear me in the back of the room? Okay, good.

My name is Melissa Bates. I am the Acting Team Leader for the Nuclear Fuels Storage and Transportation team at the U.S. Department of Energy, and today I have the privilege of talking to you about the preparation for transportation of spent nuclear fuel for the commercial nuclear power plants.

Over the course of this presentation there have been eight questions that have been submitted by you, the NWTRB, for me to answer; and I'll be addressing those as they go throughout the presentation. However, before I go into that, I would like to talk about a very high-level overview of what we do in NFST or what our mission is. So the mission of NFST is to lay the groundwork for future consolidated interim storage and large-scale transportation of spent nuclear fuel.

This work mainly is comprised of two different areas. One is more technical; another one is more stakeholder engagement. In the technical area we do alternative designs of interim storage facilities. We do STAD, or standardized transportation aging and disposal, canister-type concepts. We're looking at designs for rail cars. We're also out there collecting spent nuclear fuel data in regards to what fuel is out in the inventory at reactor sites.

The other component is the engagement with key stakeholders, and we do this engagement through a number of different avenues. One is through the National

Transportation Stakeholders Forum. We have a Nuclear Fuel Storage and Transportation Core Group, in which we kind of bring in some of the key members of each of the different entities that are at the table. We have the Tribal Caucus, as well as we have a number of cooperative agreements with state regional groups, as well as the National Conference of State Legislatures. We use the National Conference of State Legislatures to have access to some of the tribal representatives that are at the table.

So let's dive into the questions. The questions were split into two different categories. The first set is more on the spent fuel stored at commercial nuclear power plant sites, holistically.

This is the first question: For the spent nuclear fuel inventory stored at operating and shutdown nuclear power plant sites, what operational or regulatory actions will be required prior to transportation of damaged or non-standard spent nuclear fuel from dry-storage systems at the sites?

Before I get into answering the question, I wanted to define a few components of the system. First, what is damaged fuel. Essentially what damaged fuel is, it's the spent fuel rod that has more than a pinhole leak or a hairline crack. Generally, or more specifically, it's defined by the NRC in ISG-1; and it's any fuel rod or fuel assembly that cannot fulfill its fuel-specific or system-related function. In general, on average, when you're talking about the shutdown reactor sites, it's about four percent of the inventory at the shutdown reactor sites that have damaged fuel--or I should say that differently--four percent of the inventory at the shutdown reactor sites is damaged on an assembly basis, I should clarify.

The next component in the system is the transportation cask. Transportation casks have been designed and certified by the NRC with provisions of including damaged fuel. If there is a Certificate of Compliance from the NRC on a transportation cask that has this provision, then no further regulatory actions will be required in order to ship the damaged or non-standard spent nuclear fuel that's been loaded into it.

The third component I wanted to define here is the damaged fuel can, also known as the failed fuel can. A damaged fuel can, as shown here, is a stainless steel container. Down at the bottom of the slide you can see the end cap. It's mostly closed, but yet it has some openings, some screened openings, such that it allows the fluid and gases to escape; however, it keeps the particulates contained within the container.

As I just mentioned, most NRC Certificates of Compliance for transportation casks allow for a limited number of damaged assemblies placed in damaged fuel cans in the cask. These damaged fuel cans or the placement of them is generally in the four corners of the cask, so here, here, here, and here. If it’s not there, then generally it’s in the periphery positions of the cask.

There is another component, a third called non-standard fuel. Generally what this is is assemblies that have a rod missing, or it can also be fuel debris from assemblies. And this material is required to be placed in damaged fuel cans.

When packaging damaged or non-standard fuel, there is other special packaging similar to damaged fuel cans that could also possibly be used. These can be used for the packaging of individual rods, group of rods, or fuel debris. A specific example of this is at Yankee Row. They have a reconfigured fuel assembly. You can see kind of an outline at the top of the slide. It has the shell with a basket assembly that supports 64 tubes in an 8 X 8 array, and it holds intact fuel rods, damaged fuel rods, and fuel debris.

So we’ve covered the scenario in which a transportation cask has a Certificate of Compliance that allows for damaged fuel. There is one scenario out there in which future regulatory action will be required, and that scenario is when the fuel status changes after a loading. One specific example is at Rancho Seco where the fuel was loaded. It was deemed to be intact fuel; but because of the definition change of intact fuel or damaged fuel, it has now been reclassified as damaged fuel. And so now you have the fuel already loaded into a canister with a CoC that doesn't have that provision, so there will be future regulatory action required for that.

So, in summary, in direct response to the question that was asked, for the most part, if damaged or non-standard fuel has been placed in a damaged fuel can and within a transportation cask that has been licensed by the NRC that has a provision for it, then no future regulatory action will be required. However, there are a few examples where future regulatory action will be required in a situation like that at Rancho Seco.

So let's move on to the second question: For the spent nuclear fuel inventory stored at operating and shutdown nuclear power plant sites, what types of dry dry-storage canisters and casks holding spent nuclear fuel are not currently licensed for transportation, and how much spent nuclear fuel do they contain? How much more spent nuclear fuel is planned to be loaded into canisters and casks not currently licensed for transportation?

When commercial nuclear power plant licensees select the system that they'll be using to go into storage, DOE has no involvement in that decision. We do try to stay abreast of the decisions that they're making through various publication articles and that kind of thing, but we do not know at this time as far as how much spent nuclear fuel is being planned for which kind of storage systems until they announce.

For the fuel that is across the complex that has already been loaded, the fuel fits into two main categories. One is casks and canisters that are in an NRC licensed--or that have an NRC license Certificate of Compliance for storage, so it does not have a CoC for transportation, so it’s a storage only CoC.

Another category would be casks and canisters that have been licensed--or sorry--that have been loaded into--I’m not saying this correctly--fuel that has been loaded into a cask or canister that has been designed for transportation but yet the CoC has not been fully awarded yet. So, specifically, in the first category the fuel that has been loaded into storage-only canisters, this comprises of 11,000 spent nuclear fuel assemblies stored in 427 storage-only canisters at 12 different sites. And I have a table depicting that here in just a little bit.

In the other category, as far as fuel that has been loaded into casks and canisters that have been designed for transportation but yet they do not have that CoC; that can be one of a number of different categories in that maybe the application has been submitted but not fully reviewed yet;

maybe it has yet to be submitted.

There is also a scenario where modifications may need to be made before the actual transport of the spent nuclear fuel, as well as there is a scenario where additional components will need--the CoC on additional components will need to be updated prior to the fabrication of those pieces of equipment. In this category there is a total of 325 canisters containing 11,895 fuel assemblies at 14 different sites.

And, more specifically, here is a table--it's this slide and the next--that depict the first category I just mentioned. This is one thing I will tell you, in the presentation, when we printed it, the numbers have been updated. And so there was a one-page handout that went with it and that has these tables here. Anyway, so look for that one-page handout. That is the accurate numbers.

Anyway, the first two slides are for the storage-only spent nuclear fuel canisters and casks. And then the third slide is the fuel that has been loaded into casks and canisters that have been designed for transportation but do not have an active CoC for the fuel that's in them.

All right, let's go on to the third question: For the spent nuclear fuel inventory stored at operating and shutdown nuclear power plant sites, what problems or challenges exist in designing and fabricating systems and components needed for transportation of spent nuclear fuel? How will the challenges be addressed? How are you incorporating consensus standards into the design of these components?

In looking at the systems and components that need to be designed and fabricated for the transport of spent nuclear fuel, no insurmountable technical challenges have identified. There is plenty of policy things to figure out, but technically there is nothing that has been identified as a showstopper. Given that, we have tried to identify the long-lead items, and we have tried to initiate as many of those as we can.

More specifically, with the transportation casks, most casks needed for de-inventory of the shutdown sites have already been certified. Some cask’s certificates need updating; however, we do not see any issues in this regard. There’s two specific examples here, the MAGNATRAN used at Zion and Kewaunee--that's under review by the NRC--and then the HI-STAR 190 that is used at San Onofre has yet to be submitted.

One thing that the team is keeping their eye on, although this is going to play a bigger role once we move into implementation, is acquiring the high-pedigree metals required for fabrication, as well as the availability of vendors that can actually fabricate. So with the Chinese nuclear renaissance, a lot of this is in high demand. And as we get closer to implementation, we are keeping an eye on this.

NFST has not yet evaluated the needs for transportation casks at operating reactor sites. However, we have done a task order with AREVA and EnergySolutions for them to provide us with a design concept for a reusable cask for bare fuel. At the conclusion of that work, it was determined that there were no showstoppers. It appeared to be a very feasible concept, and we are looking at the right time to implement our path forward as far as how that works into our overall plans.

In regards to railcars, there have been no identified issues. This is a long-lead item, but we are working on it. I have more that I will be talking to you about on railcars, but it’s directly in relation to the next question, so I’m going to defer that until then.

The question also asked about consensus standards. Specifically for railcars, the railcar that we are working on is to be designed to the Association of American Railroads Standard S-2043. And what this standard is for, is specifically for the transport of high-level radioactive material. They have a very rigorous program in which they give you various approval points, you know, like first you have to go through a conditional approval and then through final approval. There is a whole series of activities and analysis and design testing in order to get through this program. It’s very rigorous.

The consensus standards in relation to transportation systems, we are also focusing on these. You can see them here. And as each of these are being developed, we have NFST staff that are involved in that development, especially as it relates to transportation packages.

Move on to the fourth question: In the design of the new railcar for the transport of commercial spent nuclear fuel, what features of existing railcars are being changed and upgraded and why?

The Department is currently working on a procurement for the design and fabrication of a prototype cask and buffer car. Since we are right in the middle of the procurement, it is procurement sensitive. We were really hoping to have things in a different state before this meeting so we could talk more about it, but we are not there. So I can’t really talk too much about it. But the things I can say is that the initial contract will cover the design, analysis, and fabrication of the cask and buffer railcar; it’s anticipated that this award will happen sometime in the next few months; and that since the design work is included as part of the contract, we do not yet know what that design looks like.

We are also looking at--or we are also evaluating options on how to acquire a compliant escort car to make up part of the consist. The Navy is currently working on one. I think they are about 30 percent--their design--30 percent of their design is complete, and so we are in discussions with them to see if we can make some kind of arrangement between the two agencies, but that’s not official yet.

So we’re going to shift gears a little bit here. I’m going to address the second set of questions, and these questions are specifically related to the shutdown reactor sites. As you can see, here is a map of the shutdown reactor sites, and you can see that they are fairly geographically dispersed. You can see in blue the nine original shutdown sites. The ones in orange--let me rephrase that. The ones in blue and the ones in orange are the ones that the NFST team has visited. We have gone there and done site investigations to look at them. And I’ll discuss this in further detail later. And then the one in green is the one remaining of the initial--or of the thirteen sites that have been identified that we are planning to go visit.

So this is the first question under the second set: For shutdown nuclear power plant sites, have transportation issues or challenges been identified in the most recent site assessments that are different from the issues and challenges noted in earlier site assessments?

As we prepare for each of our site assessments to shutdown nuclear sites, we prepare for the site visit by reviewing the work that has previously been done. There is the FICAs, the NSTIs, SPDs, FIDS; they're all defined here, so I'm not going to read through that all. And I know that many of you guys have had key roles in that work. We look through that work; we try to identify the pieces that are applicable to the work that we are trying to complete; and we use that as a baseline point or a starting point as we move forward.

We also use this work as we develop each new chapter of the shutdown site's reactor--sorry--shutdown site's report. So as we go and try to detail the information in that report about each new site as we visit it, then we also try to use this as a starting point.

Currently, the NFST team has visited twelve different shutdown sites. They started in 2012, and our most recent site visit was in early June where we visited San Onofre. There have been some significant changes at some of the sites since the previous studies.

So at each of these shutdown site visits, we have gone there to confirm aspects of the inventories at the sites. We have been able to obtain detailed inventory data by canister, canister load maps, and the canning of the damaged and high-burnup fuel. We observed the transportation infrastructure both on the site and near the site. We are also taking detailed photos at and near the site, trying to get a good perspective of the infrastructure.

This information that has been provided by the sites, coupled with our opportunity to visit each site, has been really critical to DOE understanding the conditions at and near the shutdown sites. And recently, towards the end of May, we were able to issue on the DOE website our most recent version of the shutdown sites report. So if you guys have not seen that, I encourage you to race out there and go get it. I can send you a link if that would be helpful.

So, in our site visits, there are many--we are seeing that many of the transportation issues and challenges that were previously identified, they still remain. Yes, we still have issues with the weights and dimensions of railcars, needing to require clearance for every shipment. There are still conditions with the nearby rail and road and barge infrastructure, as well as there are still permitting and seasonal restriction issues to address.

However, there are also some differences. Rail is now the preferred mode of transportation, which historically we were looking a lot more towards heavy-haul. We also have additional route clearance issues from larger weights and dimensions. Several current casks have up to 12-foot-diameter impact limiters, where previous analyses were based on the 10-foot-8-inch diameter, as well as we also have some current casks that weight up to 156 tons for a gross railcar weight of up to 250 tons. Our earlier assessments were based on 100 to 125-ton rail transportation casks.

We are also seeing some local resistance to barging on the California coast as well as in the Great Lakes, as well as, as each of these shutdown sites are going through their decommissioning activities, the individuals are moving on to other opportunities. And so that institutional knowledge is leaving the sites.

There are also some additional differences that we are seeing. There is removal or disuse of onsite transportation infrastructure after decommissioning. There is the potential upgrades to near-site roads, bridges, and rail, as well as the rail industry is changing. There's more short lines, more carrier interchanges and right-of-way ownership issues that we're having to resolve, as well as in these site visits we have increased our consultative transportation planning process.

I believe historically, when the site visits occurred, there was a fairly small team that would go out. The site visits that we are doing now generally include our technical team as well as individuals from state governments, tribal governments, the individuals from the Federal Railroad Administration. And this has been really helpful in the sense that I think you get a fairly well-balanced response from the entities as we ask the questions, as well as, like, because the Federal Railroad Administration is on the team, he is able to give us access to areas that we would have not been able to access otherwise.

The next question: For shutdown nuclear power plant sites, what are DOE’s priorities related to removing spent nuclear fuel from the sites, and how do they correspond to the scope of the integrated waste management activities planned for fiscal year 2016?

DOE’s current priorities are long-lead time, destination-independent aspects of the transportation system. So we are working on the design fabrication of a prototype of a railcar, both the cask and buffer car that meet AAR Standard 2043. We are looking at ways of acquiring the remaining cars required for the train consist.

We are continuing our development of the transportation planning framework, which I’ll talk about a little bit more later, as well as we are performing activities to establish relationships with other federal agencies, state governments, and tribal governments.

All of this work that we’ve detailed here is part of our plans for fiscal year 2016.

All right, so let’s move on into the Transportation Planning Framework. So it says: How does the new

Transportation Planning Framework document differ from the National Transportation Plan that was issued in April of 2014 from a technical perspective?

And, essentially, the two documents are the same document. It was just purely a name change based on feedback that we had received from various stakeholders, so there was no major technical change with the change of the name. The full name as it currently stands right now is "Transportation Planning Framework for Removal of Commercial Spent Fuel for Shutdown Reactors." And the name was essentially just changed to more accurately reflect the scope of the document. There were some misconceptions previously with the prior title.

So in this document revisions are being made based on input from state and tribal representatives, as well as we are including data from the additional site visits to the shutdown reactor sites, as well as we are incorporating cask certificate information as it becomes available. The Transportation Planning Framework outlines DOE's plans and activities needed for large-scale spent nuclear fuel transportation campaigns and recognizes the role the stakeholders have in system development.

Let's move on to the next question: To support the planning for transportation of spent nuclear fuel from the shutdown sites, what progress and improvements have been made in the development of systems-oriented tools using advanced information technologies to aid with decision-making and stakeholder engagement?

So the NFST team is in the process of developing a number of different tools that relate to system analysis or to support the decision-making and stakeholder engagement. These include the Multi-Objective Evaluation Framework, Facilities and Infrastructure Analyses, the Execution Strategy Analysis, the Unified Database and UNF-ST&DARDS, and the Stakeholder Tool for Assessing Radioactive Transportation. Each of these I will be discussing more over the next few slides.

So one of the points I would like to make on this slide is that, as we are developing each of these systems, we are designing them to kind of look for the long-term, to kind of take the problem in holistically, as well as we are developing them such that they each talk to each other such that if you're making a change in one area, that you can kind of see how that change affects the other systems.

So let's talk about some of these tools. All right, so this one is the Facilities and Infrastructure Analysis Tool. And essentially what it does is it looks at the multiple potential different configurations that could be incorporated for the integrated waste management system. It is being developed such that it tries to maintain flexibility, the maximum flexibility for how the integrated waste management system is actually executed, as well as it evaluates the system impacts based on various alternative scenarios.

The next tool is the Multi-Objective Evaluation Framework. Recognizing that trying to solve this is getting to interim storage, doing the transportation, this is going to require a very complex system. We are trying to capture all the decisions and--yeah, I guess, decisions that need to be made in a decision analysis framework, given the multiple alternatives and the stakeholders that are involved. We are also, through this process, trying to develop consistent metrics by which to evaluate the different alternatives.

The next tool is the Next Generation System Analysis Model. This is an advanced integrated waste management system simulation tool that we are developing to replace the legacy tools.

The next tool is the Execution Strategy Analysis. This is a comprehensive tool such that, given all the alternatives that could be deployed, what does it actually take to deploy each alternative? I don’t know if I said that very clearly, but, okay, given a specific end state, what is it going to take to get from here to there? What activities are required? What timing is going to be required? What schedule, what decisions, what kind of risk is associated with that?

So it's a fairly complex system that we are developing based on subject matter expert input, as well as other variables. And this does not even do it justice. But to kind of give you a perspective of the complicated matter or outputs that are coming from it, here is a very brief snapshot of just one small area as far as how the decision trees can happen as far as the activities that--how it kind of lines it out.

One other tool or one other feature that this system provides us is getting a perspective of critical path, so what activities could be on the critical path and what are we doing in regards to address those.

Another tool that we're working on is the Unified, Comprehensive Spent Nuclear Fuel Database for Integrated Analysis Systems, or also called UNF-ST&DARDS. Essentially what we are doing is collecting data across the complex that will provide a tool that has credible, controlled data--or it will be a credible, controlled data source that we--all of these tools, we try to have them draw off of one source of information so that we're not getting conflicting outputs, as well as it can perform as-loaded safety calculations, for example, shielding and criticality. It can also provide foundational data and analysis capability.

And if you'd like to learn more specifically on this tool, there is a poster at the poster session tonight.

So the last tool that I would like to talk to you about today is the START. START stands for the Stakeholder Tool for Assessing Radioactive Transportation. And essentially what it is a Web-GIS spent fuel routing tool where you can--where the information can be used by DOE and key stakeholders to evaluate alternative routes for shipping spent nuclear fuel based on either rail, heavy-haul, barge. You can set up various intermodal points.

It also gives you a perspective as far as the emergency response infrastructure along each of those alternative routes. And this is supporting exercises that we’re doing to investigate the 180(c) policies that we’re--we’re doing an exercise 180(c) implementation--I’m not saying this very clearly. We are doing an exercise to dry run the Nuclear Waste Policy Act 180(c) policy, to see if there is any lessons learned out of it and how we would go forward with implementing it in the future. So we are also using this tool to help with that exercise.

We are also incorporating site-specific infrastructure information and photographs into it. So if you look at a site, you can actually pull up various details in regards to that site.

And so that is the end of my presentation. With that, I can take some questions.

EWING: All right, thank you very much, Melissa.

Questions from the Board? We'll start with Linda.

NOZICK: Nozick, Board. The local resistance you're seeing on the Great Lakes and the California coast, what is the Department doing to try to get ahead of those issues?

BATES: This is a question that I may pass on to a member of my staff. Her name is Erica Bickford. A high level of what we are doing is we are trying to develop those relationships, establish that trust relationship there, such that we can hear their concerns. Maybe there is a different solution, try to understand, okay, what is their concern with barging on the Great Lakes or the California coast? Is there a different solution that could resolve that? Try to understand their problems, that kind of thing.

Erica, do you have anything you'd like to add?

EWING: Please identify yourself.

BICKFORD: My name is Erica Bickford. I'm the Transportation Program Manager for the Nuclear Fuel Storage and Transportation Planning Project. And just to more directly address your question, we've been doing a number of things we're trying to get ahead of of this public opposition that we're aware of.

One of them is bringing the state stakeholders on our site visits, as Melissa mentioned. So last fall we went and did a site visit of the Kewaunee nuclear power plant in

Wisconsin. And by bringing the state stakeholders along, we were able to demonstrate what are the actual transportation options. And from that site, you’re looking at a 25-mile heavy-haul to get to the nearest railhead, and that infrastructure is not even very high-quality rail infrastructure. Versus, alternatively, you can do a nine-mile heavy-haul up to the Port of Kewaunee and put it on a barge, and that is actually a route that the site had used for shipping out components previously.

So just demonstrating the infrastructure and taking them along those roads and also seeing where they put in--in Wisconsin particularly they’ve put in lots of roundabouts, little roundabouts, too, that if you’re talking about a long heavy-haul truck, it’s going to be difficult for that truck to even negotiate those roundabouts. So just sort of bringing them along on our technical evaluation missions and presenting them with the technical obstacles and what the options are and trade-offs are has been helpful in that regard.

In addition, just providing more information, one of the things they’ve requested from us is, okay, so say you did--you know, following that visit to Kewaunee from the states we heard a little bit of softening on the barging issue and a request for more information on, okay, if we are going to transport by barge and say, you know, something capsized, how would you retrieve that package and what would be the obstacles there? So that’s something we’re actively developing right now, trying to get more information for them using various resources we have access to through other shipping campaigns in the Department of Nuclear Energy to provide that information.

So those are part of the two primary mechanisms, understanding that, you know, sometimes no amount of technical information is going to be able to overcome any kind of public objection; but we’re doing what we can to try and address that.

EWING: Just a follow-up question. Ewing, Board. An important stakeholder for the Great Lakes will be Canada, and so is there any--

BICKFORD: That is true, but it depends on which lake, actually. So Canada is a stakeholder for the lakes that border both Canada and the U.S. And so in the case of Kewaunee, Lake Michigan does not border Canada. But we are aware of those--we are aware of that.

EWING: All right, thank you.

Do you want to follow up?

NOZICK: One more. Do you have reports on three of these tools? It’s kind of hard to get a good grip on what they’re doing.

BATES: And I can refer to Mark Nutt. He’s our main individual that is coordinating these tools. My initial take of the question is that they are still under development. I don't believe we have actual reports that have been developed that go into them.

Mark, I don't know if you want to say more on the matter.

EWING: Identify yourself.

NUTT: Yes. Mark Nutt, Argonne National Laboratory. We do have reports. They are under development. As Melissa put together, the tools are still being put together. We are trying to integrate them, so--

SPEAKER: Yes.

NUTT: Thanks. We do have papers from various conferences where we have presented material that we could provide.

NOZICK: That would be wonderful.

EWING: I'd suggest, provide them to our Executive Director, Nigel Mote, and he'll distribute them to the Board.

Paul?

TURINSKY: Turinsky, Board. I have two questions. If I understood it correctly, you're saying that all casks and canisters, whether they're considered transportation or not in their design, can be qualified? They can meet the NRC requirements on criticality during transportation? They can meet the retrievability of individual fuel assemblies, and they can be qualified without opening them up and modifying them? Or did I misunderstand?

BATES: Okay. So let me make sure I understood your question. You're saying that your understanding from my presentation was that I was saying that all casks and canisters that are out there could one day be qualified for transportation? Did I capture that correctly?

TURINSKY: That's it, yeah.

BATES: Okay. I'm going to pass that one off just for fear of getting it wrong. I think I have a good idea, but let's go ahead and go to Steve Maheras.

MAHERAS: Hello. I'm Steve Maheras of Pacific Northwest National Labs. So for casks that were never designed to be shipped, those could prove to be very difficult to qualify for use as a transportation cask. The designs of those cans that go inside the casks aren't as structurally robust as the ones that can be shipped. So some action would have to take place if we were going to transport the casks that weren't specifically designed to be transported.

TURINSKY: Okay, which means either repackaging or--

MAHERAS: It means something would have to take place, a number of different options.

TURINSKY: How many are there--

MAHERAS: 427 cans or casks.

BATES: And those are the ones that are depicted on the two initial tables; correct, Steve?

MAHERAS: Yeah, those are the ones on the initial tables.

BATES: So on that handout the two--

TURINSKY: Yes, but all of them would not--your judgment now is all of those would need to be repackaged or somehow--

BATES: Not necessarily. They are currently in casks and canisters that have a Certificate of Compliance for storage; right? As far as what that future action that would be required in order to accommodate transportation, I think what Steve was saying is that it’s not yet been determined.

TURINSKY: So is DOE doing anything to evaluate exactly how many of those may have enough strength for transportation and those that don’t need to be repackaged or strengthened?

MAHERAS: What we’ve done is to look at the status of each one of those types of canister, look at the structural attributes to see what exactly the issue is with each different kind of canister. That’s ongoing work right now. There’s some that might be able to operate under an NRC exemption; there’s some that could operate through some other means to ship; but there’s some that will undoubtedly have to be repackaged. We just don’t know where we are with that quite yet. That’s ongoing work.

The other thing that’s interesting to note, though--

SPEAKER: If you could get closer to the microphone, please?

MAHERAS: Okay. The other thing that's interesting to note is that none of the cans at the closed-down sites fall into this category, so this is not an issue for the canisters that are the first priority in our efforts.

TURINSKY: And a yes and no sort of answer, you know, a lawyer-type question. Are there any requirements either in the standard contract or through NRC regs that require a utility to maintain some level of infrastructure to support transportation?

BATES: Do you want to give this one--my understanding is that there is not.

MAHERAS: You know what, I've been to all twelve sites; right? And there's some sites where, you know, it's green grass, a concrete pad, and a fence. And they've kept little infrastructure there at the site; right? Other sites, you know, they're still doing work at the site; there's still stuff ongoing. And so the transportation infrastructure goes right up to the ISFSI pad.

But there's no requirement that says you need to maintain the train line into this specific site until your casks are removed. But, to be honest, most of the utilities have been doing that, because they kind of regard that as in their own best interest.

EWING: Sue?

BRANTLEY: Sue Brantley, Board. You started off your presentation by talking about the damaged fuel, and you said there was four percent of the assemblies have damaged fuel--or, no, four percent of the inventory has damaged fuel on an assembly basis. Can you just tell me what that means and then tell me how you know that number and just talk about that a little bit?

BATES: Sorry, he is my subject matter expert. He knows this stuff cold.

MAHERAS: Okay, so when we go to individual sites, this is the thing that we ask about, because this is really, really important information to know when you're trying to ship. So we sit with the sites, and we say, "Okay, how many assemblies do you have that are damaged? How were they packaged?" So we actually talk to the sites and ask them how many. Now, four percent is an average. It ranges from almost half the assemblies at some sites to practically no assemblies at other sites. So it's quite a range also.

BRANTLEY: So just to follow up, you essentially ask the plant how many are damaged, so how do they know how many are damaged?

MAHERAS: Because they've done an evaluation of putting that assembly into storage that's going to require them to examine the assembly and determine if it's damaged.

BRANTLEY: So it’s a visual assessment?

MAHERAS: It’s not necessarily. Other means are used, too. They might sniff the assembly, which means to draw off the gas from the assembly. They might use other means, too. Visual, you know, has usually got to be augmented at this time.

BATES: And just to further clarify, when he’s talking about sniffing the assembly to collect the gas off of the assembly--and I don’t know if this is a concept you’re fully aware of--they look for the fission products, which would indicate that there’s damaged fuel.

MAHERAS: Or ultrasound.

BATES: Yes.

MAHERAS: Usually prescreen with ultrasound.

BRANTLEY: And then why would some sites have no damaged assemblies and others have--what did you say--almost all of them or half of them?

MAHERAS: Oh, age, age. We’re dealing with sites that, you know, came up in the ’50s; right? And that fuel does not perform as well as the fuel now. And also the type of clad. We’re dealing with clad that could be steel clad as opposed to zirconium.

EWING: Linda?

NOZICK: Nozick, Board. Given the way that you have to load, the sites that have large amounts of failed fuel, that’s going to make a big difference for the amount of shipping you have to do. Did I misunderstand that, because of where you can place it?

MAHERAS: It really depends on the specific site. At the La Crosse site, that’s the one that probably has the most damaged fuel; right? They used a specific cask that allows them to put 32 assemblies that are not intact in that cask. So they’re not stuck with using a cask that has the four corner positions like you saw in the graphic, because if they were, that would have added--

NOZICK: That would be awful.

MAHERAS: Yes, awful would be a good word for that, yes. So it really depends on getting the right canister and the right configuration for the amount of fuel that you have at the site that’s damaged.

NOZICK: Thank you.

EWING: And while you’re standing, just a follow-up question. So we’re talking about the role of cladding, failed and unfailed, in terms of transportation. But, of course, for geologic disposal, if one takes credit for the cladding, the state of the cladding, the percentage of failed fuel elements becomes quite important.

So as you do your assessment, pull this information together, is it readily available to be incorporated into, let’s say, the generic performance assessments that will go on for different rock types?

BATES: So for this question I'm going to pass it over to Rob Howard.

HOWARD: Rob Howard, Oak Ridge National Laboratory. It's a good question, and it's one that we've obviously been thinking about as we do post-closure performance assessments and whether or not you would take any performance credit for that material.

The answer is yes. Since it's being included in the UNF-ST&DARDS and Unified Database, that database and those tools are used for some of the analysis that the Used Fuel Disposition Campaign does like for the criticality analysis for direct disposal of DPCs. So that information is captured and is available, and the performance assessment analysts will have access to that if that's the route they choose to make their safety case.

EWING: Okay, thank you.

Other questions? Lee?

PEDDICORD: I wanted to go back--

EWING: Identify yourself.

PEDDICORD: Oh, I'm sorry. This is Lee Peddicord from the Board. Kind of following up on Dr. Turinsky's question, I think Dr. Nutt's response to that--I'm not sure who responded, but let's assume that--

BATES: Steve Maheras.

PEDDICORD: Oh, okay. So going to the tables you provided that were updated and looking at the sites that have the storage-only casks and then the ones that are for both storage and transportation, on the assumption--maybe not well based--that it might be in the utility’s best interest to expedite the movement of fuel off their site without having to repackage, for example, would be a motivation to select those casks that are qualified for both storage and transportation, the question I have is: As you look at these sites and as ones are making decisions to go to dry-cask storage, do you note any trends in that going one direction or another; or is it purely based on other criteria that would incorporate that, and you don’t see any patterns in the choices being made?

BATES: Yeah, I would say there are very few utilities that are making these decisions on storage or as far as the canister that they will be loading into. I believe that there is a trend that is leading towards canisters that have a storage and transportation component.

Steve, would you like to add anything to that?

MAHERAS: Yes, I would say that that’s correct. The other thing that we see is that sites stick with the technology that they started with. So if they started with a vertical concrete cask, then they tend to stick with that. NUHOMS, if they started with that, they tend to stick with that. They also tend to stick with those across their fleets, too. So they'll load NUHOMS at this site, this site, and this site, because they can have a crew of folks that actually go from site to site to site to accomplish that.

But the bigger picture is, is that we don't see as much fuel going into storage-only canisters. We see a shift from storage-only up to things that you can transport.

EWING: Other questions? Board? Staff questions? Bob?

EINZIGER: Bob Einziger, Staff.

EWING: Get closer to the microphone, please.

EINZIGER: They usually don't like to put a microphone in front of me.

EWING: We have a switch for that.

BATES: You know, Bob, I just have to say, I intentionally ended early just so you would have time to ask questions.

EINZIGER: Yeah, I have a number of questions. The first one is about your reevaluation of the damaged fuel at Rancho Seco. When the definition of damaged fuel became more liberal and allowed it to be based on a function as opposed to a physical defect, that should have made fuel that was previously classified as damaged as undamaged, yet you're going the other way.

Was there some event that happened, either there was a misloading, there was an event at the site where they reevaluated the records and found out things that were previously classified under the old definition as intact are now damaged? That’s question number one.

BATES: Okay, let’s handle these one at a time just so we don’t get them mixed up. I’m going to go ahead and pass it back off to Steve.

MAHERAS: So at SMUD what happened was--

BATES: Steve, identify yourself.

MAHERAS: Okay. This is Steve Maheras, and I’m at Pacific Northwest. At SMUD, what happened was, they loaded according to one tech spec when they did the initial loading. And that allowed them to classify as undamaged any fuel that had a cladding gap less than .34 inch across the clad or about the length of a pellet in length on the clad; okay?

So then the definition changed; right? And they had to go back and they had to look at all those tapes of the evaluations that they did, and they came up with fuel where it was greater than a pinhole leak or a hairline crack, but below the larger amount of damage that I said. And so that’s when they found the extra six assemblies that they put into the five cans that required them to go back to NRC and amend the storage license.

So I would say that the definition, for them anyway, and the way their tech spec was written did not become easier to meet; it became harder to meet. So they were kind of stuck in this gap for these six assemblies in the five cans.

EINZIGER: Okay, that was not exactly due to the change in the definitions we normally accept, but rather because of their particular definition. Thank you.

The second question: You mentioned that there were no challenges to the transportation. This was in your Question i.c. answer. I would think that challenges to transportation would be considered; how does the canister behave in transportation, especially if you have to take moderator exclusion?

And, secondly, if you've got to repackage fuel that's currently in systems that are not transportable, storage-only, and cannot be made transportable, are you going to have to repackage those, and that's going to have a technical challenge of how do you do that in a site where there's no pool or no facilities? So how do you respond to some of these challenges?

BATES: I will also defer this one to Steve. At least an initial response to that is I believe we are--sorry--as an initial response, we are trying to take an approach where we are not going to be repackaging the fuel. Before I make a wrong statement, I'm going to pass this over to Matt.

FELDMAN: Matt Feldman, Oak Ridge National Laboratory. Bob, could you repeat the beginning portion of the question?

EINZIGER: Both parts? One was with respect to the canister and the fact that if you have to take moderator exclusion and use the canister as your secondary barrier, there's some issues, as we're going to see later in the day, with respect to the integrity of those canisters. I would think that's a technical challenge to transportation.

FELDMAN: Right, right. So currently we are concentrating on the shutdown sites. And at those sites all the cans are in canisters that do have associated transportation overpacks that do have Certificates of Compliance or are in the process of getting Certificates of Compliance. To me, that indicates that the Nuclear Regulatory Commission is comfortable and feels that those assemblies and that transportation cask meet the requirements of transportation and therefore are transportable.

EINZIGER: So that's only with respect to the shutdown sites?

FELDMAN: Yes. And, honestly, that's where our focus has been.

EINZIGER: The second half of the question was, with respect to those systems where there isn't a canister and there's bare fuel in a storage-only cask that may or probably won't qualify for transportation unless there is an exemption, what are you doing to get that into a system where you can transport it?

FELDMAN: Okay. And you specifically mentioned at the shutdown sites--

EINZIGER: Yeah.

FELDMAN: --when you initially asked me that question. None of the fuel that fits into that category in the storage-only canisters are at shutdown sites. They are all at operating sites currently that have pools that are operating. So it would be up to the utility to provide us the transportable canisters. And if they have to repackage, there may be some other avenues to transport those; but if they did have to be repackaged, they do have operating pools where that repackaging could easily take place.

EINZIGER: Thank you. The next question is with respect to your railcar design. Right now I know that DOE is undergoing a significant program to determine what the vibration spectrum is on transportation and also how that'll affect the behavior of the fuel.

AREVA used to ship their BWR assemblies with the channels intact to the utilities. They stopped doing that when they found out that the fresh fuel assemblies were getting to the reactor site with damaged fuel, and they had trouble inspecting them. So now they ship them without the channels on so they can be inspected at the reactor.

Those transportations of fresh fuel are with the shock absorbers while, in fact, spent fuel has no shock absorbers on it. Have you spoken to AREVA about their experience, and have you factored that experience into your design of your railcars?

BATES: I am not specifically aware of that specific point in regards to the railcar.

Matt, do you have anything that you'd like to add on that?

FELDMAN: Matt Feldman, Oak Ridge National Laboratory. As Melissa stated in her talk, there has been no design work done on the railcar yet. We are in the process of placing a contract for that design work to take place, and we certainly expect that whoever does design that car will take into account any lessons learned that are available, including the ones you've referred to.

EWING: Thank you. Other questions from the staff? Back to the Board?

All right, Melissa, thank you very much. We appreciated your presentation.

And so now we'll take a break. And we have a few extra moments, which is good, during the break, but we'll start promptly at 10 after 10:00. Thank you.

(Whereupon, the meeting was adjourned for a brief recess.)

EWING: The next speaker is Jim Williams of the Western Interstate Energy Board.

WILLIAMS: Good morning. Thank you very much for the invitation. First, I will mention what I view as oversights or limitations of three key documents in this program. I'm hoping that these can be addressed at a fairly high level so that these limitations do not persist as the program moves forward.

Second, I'll discuss consultation and coordination in spent fuel transportation planning. A tribal work group is addressing this topic at the moment and focusing on definitions and processes. I'm going to mention some of the barriers that I see, and I'll relate these to what I see is interrelated levels of transportation planning.

Third, using Yucca as the case example, I'll consider what I consider a neglected constituency in a consent-based program for spent nuclear fuel storage and disposal, the transportation corridor community--that is, a county or community that is neither an origin for a shipment or a destination for a shipment--and what I see as the necessary basis for dealing with this constituency more directly, less coercively, and more effectively.

Fourth, I'll explore a spent fuel transport in a program whose first current purpose is offsite storage and the potential costs and benefits of such a program that tailors transportation impacts to convincing current transportation purposes.

I think my items 1, 3, and 4 are related and warrant a high-level inquiry by a group that includes expertise in system design, risk perception, siting, as well as spent fuel transport and modeling. And I think that the direction from such an inquiry would help sort out our problems on item number 2.

So here are my three documents, for which I will indicate some of what I view as limitations in good documents, the first of which is the Nuclear Waste Policy Act of 1982. And there are several things about this, for our current purposes this foundation document of the whole program includes no criteria for spent fuel transportation, no thought of transportation as a system or a subsystem that imposes its own constraints on the other components in an integrated waste management program.

The NWPA does include an intriguing section, 135(a3), regarding what we now call pilot storage facilities, in which it says that these should seek to minimize transportation of spent fuel and the associated public health and safety impacts and costs. But after 30 years this is mainly forgotten.

Second is the National Academy of Science 2006 report called “Going the Distance.” And there is, again, a number of things that we could say about that report; but for my current purposes, the key limitation is that the National Academy, in that 2006 report, took Yucca Mountain as a given; disposal at Yucca Mountain was a given, no offsite storage. And, as a result, I think that they did not examine the link between transport and program purpose.

Blue Ribbon Commission, another report that I admired, I'll point out both a limitation and what I think is an oversight. The BRC advocated WIPP as a longstanding and highly successful model for partnering with states to achieve shared success on issues related to transport. But its oversight, in my view, was that it looked at the current legacy of the WIPP effort, not the program context or the process by which the WIPP transport model was crafted.

And here are a few things that address the program context of WIPP and the process elements of WIPP. I won't go over all these, of course, but two of the program context things are that 84 percent of the WIPP shipments are from western states. It's a regional facility, in effect. And of those western states shipments, 94 percent are generated by corridor or destination sites, including New Mexico itself. So the corridor states in the WIPP program had a shared interest in removal.

A process element that is distinct from our current circumstance is that during the WIPP negotiation, Secretary

Admiral James Watkins directed DOE-EM to negotiate directly with western states, and they did that over ten years with state people who had the confidence of their governors and who were well-funded in the negotiating process. And DOE did their part. They had a couple of negotiators that had authority, skill, patience.

The limitation of the BRC report, in my view, is that it was directed not to serve as a siting body; therefore, the report reads as if geography doesn’t exist. It doesn’t consider the linkages between generation, storage, and disposal. And following the BRC recommendations, the DOE strategy also basically ignores geography. Geography does exist, and it affects the extent and nature of the physical linkages and who is affected for what transport purposes.

So I’ll be very interested in the last item on the agenda, the report from Switzerland. But I looked it up on the internet, and I’ll keep in mind that Switzerland is half the size of the state of South Carolina.

Now the second topic, consultation and coordination, the Blue Ribbon Commission strongly advocated what it called extensive involvement by state, tribal, and local officials in transportation planning. And that statement leaves several terms undefined, but we welcomed it at the time, and we have appreciated DOE’s efforts to follow through since 2012.

But after three years I have a slightly more sober view. One part of that is that I see barriers to this extensive involvement on both sides, perhaps more on our stakeholder's side than on the DOE's side. And also I think that the consultation and coordination, these barriers are entangled with what I see as multiple levels and interrelated levels of transportation planning.

The barriers--and these are ones on the DOE's side--are several and sort of mundane situations. But they include that DOE is not really responsible for transportation as a subsystem in an integrated spent fuel program. The NFST project is not responsible for that. Also, the general counsel--God bless them--its review has inhibited the exchange for policy discussion and development. All those model reports that Melissa discussed, never been shared, for example. And then the FACA, Federal Advisory Committee Act, is a more recent issue, and it constrains policy discussions with people--with outsiders.

Among the stakeholders--and I'm thinking mainly of the state regional groups--the barriers are maybe more difficult and more structural. Our committees include a single appointee from each state. That appointee cannot be the state government expert on all of the topics on this program. Cooperative agreements do not support members' time. The SRG's work is an additional commitment to their main duties, and some transportation issues are complex, that learning for effective consultation and coordination, not just reaction, takes time, energy, engagement, and opportunity; and that isn't always available.

Now to the levels of transportation planning. Some see it differently, but I view spent fuel transportation planning as a multi-level component of an integrated system, in which the limitation of transport and its impacts is a legitimate policy and program design objective. My list of the levels top down is an integrated program plan, major technical choices, some of which were discussed earlier: the destinations, the removal of sequence, the queue, the standard contract, the modal and hardware choices, the routing, and then, lastly, the operations, notification, emergency response planning, and so forth.

So how do these barriers relate to the levels? And I haven't solved this, but my observations are that focusing on consultation and cooperation at lower levels, like operations, routing, ignores and discounts the upper levels of spent fuel transportation planning at which the transportation impacts are mostly determined. On the other hand, focusing on all or most of the levels quickly exceeds the capacity of our stakeholder groups and even of DOE to effectively engage in that process.

Now move on to neglected constituency in spent fuel transportation planning. And I’m using Yucca as the case example, which it does pretty well, I think, in that in Yucca, transportation truly was an afterthought, a dependent variable in a national program. And the transportation program result of that was 77 sending counties, all eager to remove spent fuel; 9 affected units of government in Nevada and California, all eligible for consent agreements; and 891 counties in every region of the country facing 12.8 million shipment miles over 25 years.

What can you say about that 891 corridor counties? One thing is that they were never aware, most of them, that they were selected for this role in the national disposition program. Each one, however, is a political entity. They have staff; they have elected officials; they have meetings. They have very limited legal recourse due to the commerce clause and the supremacy clause, but they do have political resource. They can expect massive federal documentation that technically all is very safe, and there will be limited trust in that massive federal documentation.

And they will have local concerns that are not directly linked to transportation safety. They will have a deep concern about just the sheer radiological content of these shipments. They will reflect that they do not directly benefit from a spent fuel shipment. They will worry that their local economy or their property values might suffer, and they will question: Why is it necessary to ship this stuff through us for this purpose?

Furthermore, they will discover that there are opportunities for incidents and accidents in this system. Spent fuel transport is logistically complex and interdependent, and spent fuel transport is embedded in the U.S. rail freight system that's very big, very complex, very interdependent, involving very heavy stuff that doesn't stop quick and doesn't turn easy. And it is a complicated system.

I've tried to develop a few bullet items on that, but the main ones are that in this rail freight system an incident in one community will quickly become an incident for all 891 and that there is a risk that multiple incidents could shut down this program.

So I think there are two basic approaches here. One is sort of to neglect or discount these concerns in program design and hope that incidents will be minor, infrequent, hope that local concerns are attenuated rather than compounded, or hope that multiple incidents don't occur. And that could work. It could be contentious, messy, time-consuming, and with incidents it could be very time-consuming.

Another approach is to address corridor community concerns in program design. I have designed a program to address the question: Why us for this limited offsite storage program purpose? I make the case that offsite storage, not the HOSS proposal, is actually needed, then demonstrate that the impacts on communities that do not directly benefit have been minimized. My instinct is that this would enable the feds to deal with many fewer corridor communities more directly and effectively over a much shorter period of time. There will be concerns, of course, but the conversation is likely to be different if the program purpose for this transportation is clear and convincing.

So with the help of Fred Dilger, I’ve tried to explore what some of this might mean. And the first thing is that there really is no major technical limitation on sites for offsite storage. This map is from Oak Ridge. The green is 400-acre sites that exclude areas with high population density, protected lands, earthquake potential, seismic concerns, landslide hazard, flood plain, wetlands, open water, or security concerns.

So let’s assume that a five-site solution is a reasonable minimum for transportation impacts. It reasonably minimizes the transportation impacts of all site storage on corridor communities. Four sites increase those impacts by five to ten percent, it appears. All these numbers are preliminary, by the way, but five to ten percent, depending on whether you’re talking about the number of counties, the shipment distance, the population affected, but five to ten percent.

One, minimizing transportation distance, one storage facility increases those impacts by about 11 times for shipment, 50 percent for counties, 2-1/2 times for population affected. Moving next from the least transportation distance site to, for example, in southeast New Mexico site, we haven’t calculated yet, but those numbers are factors which substantially increase.

So what are the costs and benefits of such an approach? The costs include a patient, purposeful, principled spent fuel storage siting process. It also increases the construction and operation costs for multiple consolidated storage facilities, and it has some limits repackaging at consolidated storage facilities, because they can’t be multiplied easily.

But there are some potential benefits here that might be considered. One is that it makes for--lays the groundwork for a successful engagement with much fewer corridor communities over shorter periods of time. It involves much simpler transportation logistics and less Class 1 track, making the program less vulnerable to control by rail carriers. The shorter distances and easier logistics reduce vulnerability to incidents and contingencies, and the spent fuel storage site location does not prejudice repository siting. And it also could provide a contiguous state role in managing these consolidated storage facilities.

So, in summary, there are some key deficiencies in key documents in these programs, and these tend to persist if not addressed at a fairly high level. Consultation and coordination is needed, important, but there are barriers on both sides, and they are exacerbated, in my view, if spent fuel transport is a multi-level system of an integrated transport storage disposal program.

The corridor community is a neglected constituency. These communities have real concerns not addressed by appeals to safety; and to address these concerns requires program design and upper levels of transportation planning, not just the lower. And the minimizing of transportation impacts for offsite storage, the current key purpose, has costs; but it also has a range of benefits that have not yet been seriously addressed. So there you go.

EWING: Thank you very much.

Questions from the Board? Yes, Lee.

PEDDICORD: Lee Peddicord from the Board. So a couple of questions as you're looking at the transportation challenges and a lot of the issues that you identified there. And, as you noted, a lot of these things are kind of resource constrained just of the number of variables you can look at.

But two questions that come to mind: Have you had the opportunity to look at transportation of, say, spent fuel that is taking place in other countries and how they engage with some of the issues you've looked at here? And then the second is: For the western states where you do have transport of highly radioactive materials going through the region, that you've assessed how that's impacted the communities and so on and how it would relate then to the commercial spent fuel.

WILLIAMS: Well, if you're referring to the WIPP example--

PEDDICORD: No, I'm referring to the Navy.

WILLIAMS: Oh, the Navy. Right. I don't have all the answers to those questions. I think that if we had the right people in this room for, you know, a long series of discussions, we could kind of sort that out, what the dynamics of why it's okay to--have a short program for foreign research reactor fuel shipments that--why it's okay to ship the Three Mile Island residue fuel to Idaho, and why I nevertheless anticipate real problems in a large-scale, long-term campaign for Yucca even though Yucca has, in my view, a higher purpose for transport and legitimacy in that it's permanent disposal presumably of the whole 140,000 metric tons at Yucca.

Okay. Any shipment goes through your community once, they may keep going through for 25 dadgum years. You may not like it a bit, but you can sort of accept the purpose. On the other hand, if that purpose is interim storage with no repository close to licensing, then I think there's a different mindset in the community regarding the legitimacy of the transport to the purpose. And the difference in a federal shipment for defense purposes, I think, may be viewed differently than a purpose for clearing commercial sites in areas that have benefited from nuclear power over the past 25 or 50 years.

PEDDICORD: Well, I was wondering if, in terms of the community issues and so on and the corridor communities, that there might be some lessons learned out of these previous experiences. I mean, yours is a good example, the ones you cited; and, again, these transports are really going, if you will, to interim sites already. I mean, they're not going to stay for the longer term where they were transported now in terms of Three Mile Island.

WILLIAMS: Right. I mean, I--

PEDDICORD: So I'm wondering if you can--I mean, particularly, a lot of this happened in the western states under your purview. If you can go back and interact with those communities, see what those issues were, how they were approached both from the community level, their perspective, and the federal--

WILLIAMS: There are people that still remember the WIPP program, which you--there's those differences. But that is--

and I wanted to make a point of that in this presentation. There were some very specific differences in the program context in which the WIPP transportation program was designed and in the way that the interactions weren’t there than we’re dealing with today and so I think appeal to--if it worked at WIPP, it should work for Yucca or something else. To me--and I don’t say that it won’t work; I just say I’m not satisfied it will work. And I can see a lot of bumps along that road.

EWING: Other questions? Sue?

BRANTLEY: Sue Brantley of the Board. I enjoyed your talk, your presentation. It seems that the central conundrum of your presentation was this idea that no matter how much documentation that the federal government comes up with, it won’t be believed necessarily by the stakeholders. And then, on the other hand, the stakeholder engagement opportunities that you’ve been involved with, you saw great difficulty there in terms of getting appropriate engagement and people having the time or the expertise.

So if that’s the central conundrum, what’s the answer?

WILLIAMS: The one I’m proposing here is--it’s just Jim here, you know. What I’m proposing is to make damn sure that the purpose for this transportation is--that the transportation purpose is clear and convincing to our communities. Okay. What we’re doing is we’re going, What are you going to do here? Where are you going to store this thing on an interim basis? Well, then what's going to happen? Well, we're going to ship it to some disposal site. Well, where is that? You're going to ship it back through us? You know, that kind of thing.

I think the program needs to think about this stuff, and it involves geography, and it involves some choices. And my proposal that I've presented at the bottom end was arrived at by way of thinking--or trying as best as I can with my limited resources to think in the way I expect a corridor community to think. Others can develop that. Lee was talking about this.

But I think it needs to--you know, it needs to happen, and it needs to happen seriously. And it needs to be combined with the things that I mentioned in the first place, systems analysis, how do these components really relate to each other in space and in program terms, you know. And the proposal that I came up with has some substantial benefits other than its ability to deal more directly and straight-forwardly with corridor communities. There's a bunch of good things in that final list there.

So I'm pleading for or suggesting, you know, (A) a good high-level study that does come to some--or that brings in the appropriate types of people with expertise in systems design, expertise in siting, expertise in transportation and modeling and risk perception, and then thinks about that together for a while before letting the program wander off into some other purpose.

EWING: Jim, I have a follow-up question. This is Ewing, Board. So Melissa presented in the second half of her talk or previewed a whole series of sophisticated system analysis tools.

WILLIAMS: Right.

EWING: So they'll be developed, and from the use of those tools there will be recommendations about where the corridors should be and what the routes should be and what the risk is. How will the 891 corridor counties deal with the results of these analyses?

WILLIAMS: Your first meeting and the reconvening of this Board in October of 2012, if you remember, was in Richland, Washington, and Mark gave what was then discussed as a system architecture effort. I've been interested in that stuff ever since. I've been wanting to get into it, dig into it, and not just--I mean, the way you phrased the question, due respect, is we'll take the answers from the models.

I think the models are very useful, but they need to be used as a tool in a program design that I'm trying to advocate here. And, you know, they are complicated models; they are interesting models. I think they can be very informative. But they are not going to present the right answer for this program. They need to be used as tools in searching for a right answer or a better answer.

EWING: Related to that, are there ways as these tools are developed to increase the possibility of public confidence in their final use application and--

WILLIAMS: I think the tools--let's see, how should I answer? I mean, I think that there needs to be--transportation needs to be incorporated in program design, not a transportation program, but the whole damn program, storage and disposal. And I think the tools can be used. But I think--I've been putting myself into the position of the poor DOE guy that gets sent out there, you know, two years before shipment starts and tell a community, "Hey, we're going to start a shipment campaign. It's going to maybe go on for 25 years, and you're on the route." What happens then? You know, how do you deal with those people?

And my preliminary answer, the best I can do, is that the program needs to provide that person with a convincing case, why, for this purpose, are you shipping it through us? If you can provide that case, then I think you can prevail on them to work with you. If you cannot or you sort of avoid it, you know, and say, "Well, our models tell all this," you know, or something like that, I think there's deep trouble out there.

So that's why I said at the outset that I think that these kinds of things need to be addressed with the right set of talents and expertise at a pretty high level. And you don't have to take my word for it, but I'm putting the notion out in front for consideration.

EWING: Okay, thank you.

Other questions from the Board? Efi?

FOUFOULA: Efi Foufoula, Board. So, you know, we have been talking, and you have been stressing the systems approach. System is a whole nation.

WILLIAMS: It's what?

FOUFOULA: It's a whole nation here, you know, it's a whole map of the U.S.

WILLIAMS: Yeah.

FOUFOULA: So how do think at the county level--what would be the best way to convince the county level, which is a very local level, that what might not be best for them in their own mind is good for the whole system, for the whole nation?

WILLIAMS: Can I go back to my slide?

(Pause.)

Okay. In this slide, let's say I'm a community right here; okay? And this is coming from Kansas, I think the Wolf Creek plant. And there's a certain amount of fuel there. You go to this community and say, "Well, what we're doing now, we need to ship this stuff offsite because of its drain on the federal treasury and because we have for good reasons decided that leaving it onsite hardened is not the best thing for the nation." And so we have worked with these communities and said, "And we've come up with this site that minimizes the effects on communities like yourself who don't benefit from this shipment directly but have benefited from the nuclear power that has supported the electric grid in this region. And we will clear this site in a matter of, you know, a minimum amount of time that involves a standard contract and other things. But once we clear it, it's cleared. We'll all work together in this six-month period to clear that line, and then you've made your purposes, you've done--you know, we are finished with you all for the purpose of interim storage."

Now, then you ask--you have to ship for disposal. But we're a long way from having this site for disposal. We haven't decided whether it's one or two or where or what media, so it's hard to tell, you know, if you ship to here, you know, what my friend John Heden wants is the whole wad of spent fuel down there. And why? Because he wants a permanent economic base to southeast New Mexico. And it's perfectly reasonable from his point of view, but it's not necessarily good for the program, and it compromises the State of Nevada's ability to consent freely for disposal in salt if that’s what emerges.

So this does not prejudice disposal siting. See what I’m saying? Whereas, if you go--all right, take this one. I mean, here you take--oops, sorry, sorry, sorry.

(Pause.)

Here’s a comparable community. We didn’t say that to them, you know. They are facing in this program shipments, not just--they’re facing shipments from all of these other origin sites over all this long period of time, and they are not--and they have not participated in the electric power generated in these communities. The community of interest is much attenuated in this kind of system.

And I think that nobody wants this stuff going through their communities. But if they have a decent reason why the transport is linked to a current program purpose, then they will work with us. And I didn’t say that they would like it or applaud. I said that they would work, you know, and that factor could save massive time, massive mess, avoid all the benefits, I think, arguably apply; and it’s worth the consideration.

EWING: Thank you.

Questions from the Board staff? Bob?

EINZIGER: Thank you for your--

EWING: Identify yourself.

EINZIGER: Bob Einziger, the staff. Thank you for your presentation. It’s one of the few I’ve heard that at least try to offer some solutions as opposed to just problems.

Last week in Vienna there was an international meeting looking at integration at the back end of the fuel cycle. And if anything came out of that meeting, it was the fact that until there is a decision made on the final disposition of the fuel, there’s going to be large uncertainties in any analysis that occur.

So my question to you is--

WILLIAMS: Analyses of what, Bob?

EINZIGER: Any analysis with respect to how you’re going to handle the back end, because you’re dealing with only part of the system. And my question to you is: You’ve done an analysis of transportation to various sites and the number of conditions. Have you taken these a step further and said, okay, there’s certain locations where you could have a repository, and looked at those and done some analysis on if you carry it a step further into those directions, how much uncertainty would be on the conclusions you’ve made? Because if it’s very little uncertainty, well, then you probably have a case. If it’s large uncertainty, maybe the analysis of the transportation and the effect on the community from the beginning isn’t valid.

WILLIAMS: Uncertainty in whether you would be able to site?

EINZIGER: Uncertainty whether you would minimize the effect on the corridor states.

WILLIAMS: Uncertainty of their facts. Well, I’m not sure--I don’t think you can--I don’t think the models--let’s put it this way--are going to predict responses in corridor communities, you know.

EINZIGER: Thank you.

EWING: Jean, you had a question?

BAHR: Jean Bahr, Board. These kind of optimization models that come up with five sites and minimizing transportation distances, I’m having trouble reconciling that kind of an approach to siting with what DOE is pursuing in terms of consent-based siting for a storage facility. So what if those aren’t the communities where people would consent--

WILLIAMS: You might misunderstand. I’m not saying that we should impose on storage communities and not impose as much on corridor communities. I’m saying that the key condition here is a purposeful, patient siting process. We haven’t done it.

I think that there are people at DOE and elsewhere that have the right ideas. I don’t claim to have all those right ideas. But that needs a set of people somewhere in government that are, you know, real experts on this, you know, thoughtful experts on this issue. They can talk to people, and it can--and they'd need to have authority. They'd need to be principled. If they say, "We're going to do something," then they need to do it. If they said, "You have a chance to back out at this point," they need to have the authority within the federal government to back out, you know.

And so that kind of team has not, as far as I understand, been created or even been--maybe DOE is thinking about it now, but it's not in place. And it needs to carry over to the new organization. It's a real thing. But there are, in all that green, you know, and probably more, is technically okay. It's all politics and people and communities and sort of how things are--what's the rationale from point of view, and I'm raising the rationale of the corridor community point.

EWING: So on that note, Jim, we'll have to move to the next speaker. But, again, thank you very much.

So the next speaker is Josh Jarrell from Oak Ridge National Laboratory.

JARRELL: Hello. Thank you for inviting me back to the Board to talk about standardized transportation, aging, and disposal canister design and some of the work that DOE has been doing related to this area. I'm Josh Jarrell. I am in the Used Fuel System group at Oak Ridge National Lab, and I also am the Strategic Crosscuts Control Account Manager in

NFST.

So, first, a disclaimer. It should be noted this is a technical presentation. It does not take into account the contractual limitations under the Standard Contract. Under the provisions of the Standard Contract, DOE does not consider spent fuel in canisters to be an acceptable waste form, absent a mutually-agreed-to contract modification.

Secondly, this presentation reflects research and development efforts to explore technical concepts which could support future decision making by DOE. No inferences should be drawn from this presentation regarding future action by DOE.

All right, so what I'm going to talk about today is standardized canister systems, the potential, where we are with that, the motivation for looking at these systems, and then I will respond specifically to a number of Board comments related to what the current canister concepts are, how do they differ from past concepts. I will answer questions about the timelines for these systems, specific questions about the operational impacts of loading these standardized systems, which are potentially smaller than the current systems at reactors. And then I will give an overview of the repackaging impacts as well. And then I'll conclude with a few remarks.

So first I want to kind of describe the spent fuel inventory in this country. We have on the order of about 75,000 metric tons of spent fuel currently. About a third of that, almost 25,000 metric tons, are in dry storage systems, and this is how they kind of break out. We have on the order of about just over 1,800 systems that are welded metal canisters in storage overpacks. There’s three main vendors of these overpacks, and they can be loaded either horizontally--this is the Transnuclear systems--or vertically stored; that’s Holtec and NAC systems.

And then there’s also 12 welded metal canisters that are already in transportation overpacks. And then there’s 189 bare fuel casks out there.

And what I want to take away from this slide is, there is a--it’s a very diverse dry storage inventory. There’s over 30 different NRC certified packages and many different vendors providing those different packages.

And the other thing I’ll note is, as we’ve moved forward, there has been a trend at the operating sites to larger and larger capacity systems. And so one of the big reasons for this movement to these larger capacity, more assemblies per canister system has to do with minimizing the operational impact at operating reactors. It’s more efficient for the reactors to load as many assemblies at a time into these large canisters; it minimizes dose; it minimizes the impact operationally; and it is more efficient from a cost perspective.

And the reason they have done this is because they are optimizing on their storage needs, and there is no integration between storage, transportation, and final disposal in this country right now.

And one of the by-products of these larger canisters is it's not clear that these canisters will be directly disposable. They may or may not be, depending on what the repository concepts are. It is an active area of research. Indeed, we are looking at direct disposal of these large canisters. But if large canisters are determined not to be disposable, they would have to be repackaged. And repackaging is a specific question that the Board asked, and I will address it in detail later on.

But there is the potential to increase cost, to increase the worker dose, as well as you're going to increase the number of handling operations of the spent fuel.

And so one of the reasons that we look at a standardized, triple-purpose canister system--and so, just to be clear, when I say standardized, I really mean triple-purpose, something that would be designed for storage, transportation, and eventual disposal without having to be opened back up--is to minimize the amount of bare fuel handling and to minimize the potential of repackaging.

And I want to clearly say here, I say minimize repackaging and not reduce. Right now there is--you saw on the previous slide--on the order of 2,000 dry storage systems loaded in this country, and every year we load on the order of 200 or so more. And until a change occurs to the system, those canisters will be loaded; and if they are determined not to be directly disposed of, they will have to be repackaged, and there will be some amount of repackaging required if direct disposal of DPCs is determined not to be feasible.

And the last point is, like I said, utilities are moving to larger and larger canister systems. Initially, they started out with a 24 pressurized water system, pressurized water reactor assemblies per canister. They've moved to a 32, and now they're looking at a 37 PWR, 89 or 87 BWR, boiling water reactor system. Again, that was to optimize on their storage needs. But the standardized systems will probably be smaller than these 37 P-size systems.

And so realizing the potential benefits that a standardized canister might have, NFST and DOE has initiated a number of standardization related activities, the first of which is the system assessment that I actually briefed the Board on back in fall of 2013. That is an ongoing assessment to look at the system-wide impacts of integrating standardized canister systems into the waste management system. We are looking at when, how, what, and whether to implement standardized canister systems into the system. And we expected to inform future policy decisions related to incorporation of a standardized canister system.

Our initial evaluation was submitted to DOE in August of ’14. We hope to have a more fully developed assessment at the end of Fiscal Year 15 here in September, and we expect completion in FY16. And, really, this assessment is driving all of our standardization activities. We are really trying to maintain flexibility related to the standardized canisters and keep our options open. And so this assessment, we are still trying to understand what the impacts are of implementation at different locations and at different times.

And, specifically, the Board recommended that we engage with industry to get their feedback on how standardized canister systems might impact the industries. And so we’ve moved out with a couple industry studies--we call them task orders--with IDIQ contractors, both of which have just been recently completed in June. And the first, which was Task Order 18, was awarded to EnergySolutions, and it looked at more generic designs of a small--and I say small--4 PWR/9 BWR size system--and tried to more fully flesh out what that system would look like.

And then we also initiated Task Order 21, which is actually a specific question that the Board asked related to what would the operational impacts be at reactors of loading these smaller canisters and are there mitigation techniques, optimizations that could be performed to minimize those impacts. And so I will talk specifically about this later on.

The other thing we've developed is a STAD Specification Requirements and Rationale. The laboratory draft was completed in May of '15. And this is specifically developing specifications for a STAD system for multiple-capacity systems, which was another question that the Board asked. And, again, we are in this purpose where right now we don't have all of the information. We're still collecting data; we're still running analysis. And so we're trying to maintain flexibility and keep our options open. I'm sure I'll say "keep our options open" a few more times.

But here I wanted to go into and address--or to review the questions that the Board asked, you know, what are the system concepts and what are their requirements? What's the timeline? What are the at-reactor impacts of loading these systems? And then what are the impacts of repackaging.

And as I go through each question, I just want to keep in mind that we are very aware that moving forward with a standardized canister system would be a significant change to the system, and we would have to have a firm technical basis. And that's why we're doing these things in kind of this assessment or a stepwise manner to get a firm technical basis to inform these future policy decisions.

So the first question: How does the STAD canister differ from earlier concepts and why are they different? The STAD canister concept would be different than past concepts, specifically related to the TAD concept for the volcanic tuff repository. Physically, it would have different characteristics. It would have different capacities. And we'll talk about that we're looking at multiple capacities, because we are looking at generic repository concepts.

It would have different handling assumptions. We don't have, again, site-specific information. We do not have--we have an uncertain regulatory framework, because the Yucca Mountain project was designed for 10 CFR Part 63, and the lifetimes of these systems may be different. So, really, again, these differences are driven by not having a known repository and not having a known design of that repository.

So specific differences. We are looking at three different capacities. We've set a small, a medium, and a large. The small is a 4P/9BWR system; the medium size is a 12P/32BWR; and what we call the large is a 21P/44BWR; whereas, the TAD system was a 21PWR system.

As far as enrichment and burnup, the STAD canister system, the requirements are 5% U-235 burnup up to 62.5 GWd;

whereas, the TAD went a little bit higher, looking at 80 and 75. This is based on the current regulations.

As far as inventory, we go back to keeping our options open. We're trying to design these systems to be flexible to accommodate any of the inventory; whereas, the TAD canister requirements had a limit of 212 inches, which would have excluded the South Texas Project fuel. So, again, the length isn't specified right now, but we would hope that it would accommodate the bulk of the spent fuel inventory.

And as far as diameter, we focused on three sizes. Nominally, those diameters are 29, 52, and 66 inches; whereas, the TAD canister was 66-1/2 inches in diameter.

So as far as some of the other functional requirements differences, structurally the status is really focused on Part 71 and Part 72 space; whereas, the TAD had additional requirements related to Yucca Mountain in addition to 71 and 72 space. And because we do not have a known repository, we really focused on 71 and 72 space.

They both have maintaining cladding temperature below 400 degrees C during loading, storage, and transportation.

And then the thermal during disposal, we have based our 400-degree limit on the cladding on coupled disposal-related boundary conditions, because, again, we are looking at generic repository concepts; whereas, the TAD was designed for 350 degrees C cladding temperature.

For radiation protection and shielding, again, we’re focused on 71 and 72 space. The TAD had additional requirements related to site specific.

We are using the same criticality controls, which was a borated stainless steel 11 mm thick, and this was based on a corrosion rate of 25 nm/yr in order to maintain criticality control.

Criticality burnup credit, we are requesting that burnup credit is used, and we are requesting that moderator exclusion would be used for the transportation hypothetical accident conditions. And these really are based on the fact that we’re trying to maintain flexibility, and we want these canister systems to be able to accommodate all of the fuel in the inventory.

From a confinement perspective, we are led by 10 CFR Part 72, which is a dual-welded closure; whereas, the TAD was kind of limited by the risk-informed performance-based requirement in 10 CFR Part 63.

And then transportation, both of them were governed by Part 71.

So that’s kind of a high-level overview of what the system might look like and what are the differences. And obviously we are looking at multiple sizes. This was a specific question from the Board. And we are evaluating multiple different options. We picked the small and the medium size based on EnergySolutions recommendations and the large from an AREVA recommendation, and these were what we call Task Order 12 2013 feasibility reports that EnergySolutions and AREVA provided to us. And these are the generic concept images that you're seeing here.

Next question: What is DOE's plan to advance the STAD through licensing before a repository is ready? So DOE is still evaluating implications. We're still doing the Standardization Assessment. And so we will use the assessment, which, again, completed in FY16 to inform future decisions. And I mentioned earlier we had an initial evaluation at the end of FY14; we'll have one at the end of 15; and we'll hope to wrap it up in FY16.

The other thing I'll note is, DOE could elect to do a detailed development of a STAD canister concept as part of a demonstration project. The 2013 AREVA report suggested this option; but, again, this decision would not be tied to a development of a repository.

So what is the timeline for a schedule, and how would it impact the pilot interim storage, is the next question that the Board asked. No decision on the use of a STAD system has been made; therefore, we do not have a schedule. Again, this is a stepwise process; we haven't completed the assessment yet; and that assessment will inform future decisions. So any decisions would be dependent on the future decisions that were made. If the demonstration project were to be initiated, the schedule would be based on that demonstration project and the scope of that demonstration.

And, specifically, a STAD canister is not needed to support DOE's strategy for a pilot interim storage facility. As we heard this morning, the DOE's strategy for the pilot storage facility is really focused on the shutdown sites, which are in canisters and cask systems that were designed to be transportable; and so the STAD canister system would not be required.

The next question was: What are the operational impacts of loading these smaller systems at reactor sites? I mentioned it earlier; these reactors, the utilities have moved to these larger systems. And the reason is, is they are trying to minimize their cost, and they're minimizing their operational impacts.

And so we understand that loading smaller systems would increase the loading times and would incur more cost, and we wanted to understand both the implications of loading small canisters in the current manner that the utilities load dual-purpose canisters, as well as what operational improvements could be made to minimize those impacts.

And so we looked at the optimizations. We awarded this contract to EnergySolutions' team, which included NAC, Exelon, and others, to look at, again, what the loading of these canisters using the current procedures would look like; look at potential optimizations; and then provide DOE with some estimated costs and loading time comparisons. And they also identified some site-specific concerns for these small systems.

So in the details, the high-level point in smaller canister systems will be more expensive. Both from a capital cost perspective and from a loading perspective, they would be more expensive than dual-purpose canisters; and they would take longer amounts of time to load. However, the current baseline of loading small canisters in the same fashion as loading the current large-capacity dual-purpose canisters, we had them look at this, and it shows there are significant improvements that could be made by doing some steps in parallel, buying additional equipment such that you could stage how these canisters were loaded.

And so I've shown here the loading time per assembly for a PWR canister system. The dual-purpose canister system--these, by the way, are based on the Zion 37P system, so this is where they kind of took their baseline number from--it's about three and a half hours per assembly to load a dual-purpose canister, is what the estimates come back as.

If you do a baseline and so you don't look at optimization, you're looking at a little over five hours for the large system, a little over eight hours for the small system, and around eight hours for the small system. And I'll just note that our reference was looking at small systems in basically a four-pack, so four 4P-size systems. And so we assume that basically you can get 16 assemblies in this system.

Now, once you go to optimization, you can see a dramatic decrease from eight hours to just under five hours per assembly; and the large system you get some decrease. And so if you look at the percentages above the DPC, you're about 25 percent slower in these large systems. But if you were able to go to an optimized small system, you would only be about 40 percent slower.

Just as a point of reference, for our FY14 assessment, we assume that they would be on the order of 900 percent slower. So these are very different numbers than our initial assessment assumed, and we are very interested to see how that changes some of the conclusions from our FY14 work.

As far as loading cost, same kind of thing here. It's about $3,500 per assembly for a dual-purpose canister; and an optimized case on these large systems, you're on the order of just under $5,000 and about $7,600 for these small system cases. So you see an increase of about 100 percent, a little over 100 percent, in these systems from a loading perspective cost.

Now, the loading cost and the loading time is one thing, but there is a significant capital cost of these smaller systems. The dual-purpose canister is on the order of just under $40,000 per assembly on these large 37P systems; whereas, if you went to a small system, you’re looking at on the order of $76,000. So you’re thinking of, really, a factor of two increase in capital cost.

And there’s two points here I want to make is, first off, the loading costs are on the order of about ten percent of the capital cost, so to just give you a reference on what we’re talking about from a cost perspective. The loading time is very important to utilities. The loading cost, though, is really about ten percent of the capital cost. You see 3,500 versus 37,000 for a DPC, and you see a very similar ratio here.

The other piece here is, the costs are more expensive, but there is a potential to avoid having to repackage these systems. And, again, the Board’s next question is related to repackaging. And so, you know, if you could move forward with a standardized canister system, you could minimized the repackaging, not reduce, but minimize the amount of repackaging. And so it may make sense to invest the capital cost up front.

So repackaging questions: What are the implications of repackaging? What facilities would be needed, and where would they be located? I'll just point out that this was discussed pretty thoroughly in the 2013 workshop right before the Board meeting in D.C. And so I'm just going to rehash a number of these, and then I'll just say check out the notes, I guess, from that workshop.

But repackaging would be complicated. There would be increased fuel-handling operations. If done at an operating site, you would impact the operations of the pool and potentially increase the worker dose and impact the operations of the actual utility.

If done at a shutdown site where no pool was available, a new system for repackaging would have to be developed; or if wet repackaging, you'd have to build a new pool and do wet repackaging. Very complicated, challenging questions to think about.

And, no matter what, there would be additional low-level waste that would be generated from these dry-storage canisters, so these dual-purpose canister shells would have a significant amount of--I mean, they would probably have to be disposed of as low-level waste, and there would be a lot of them, and it would be expensive to do. And I'll provide a reference number for, on a per-assembly basis, what that looks like. But it is fairly substantial if you look at it.

And I'll go back to this repackaging potential for reduction or elimination. If direct disposal of every single canister system that has been loaded is determined to be feasible, you could eliminate the need to repackage. However, if only a subset are determined to be directly disposable, some repackaging would be required. And if you move to the standardized system, which had disposal in mind, you could avoid future repackaging requirements; but it would not eliminate the need to repackage the current dual-purpose canisters.

If neither of these options come to pass, if the status quo continues, there is on the order of almost 500,000 assemblies. Assuming a 60-year life for our reactors, it would have to be cut out of one canister and placed into another waste package canister. And there is on the order of almost 11,000 canisters, is the prediction of how many canisters would have to be opened. So there is a substantial amount of repackaging that may occur down the road.

And so I wanted to bring up this specific question about: How does location of repackaging impact the total system? Repackaging at reactors will be challenging. I mentioned there would be operational impacts at operating sites, pool impacts, potentially impacts to ability to produce power. And then at shutdown sites you have to build a new facility or a pool, again very challenging process.

If you did repackaging at an interim storage facility or repository, it would allow flexibility to the system. You could have a purpose-built facility, built for repackaging. That's allowing the potential to minimize dose and maximize the throughput to the system. And if you do repackaging any time before the repository, it will impact transportation. If the canisters are smaller--and the current thing is they would be--you would have more canisters to transport and theoretically more consists and more casks that would have to be transported.

And then I wanted to go back to the low-level waste issue. There's a lot of canisters and waste that would be produced. Using our current assumptions, you would have on the order of about $9,500 per assembly in low-level waste generated for repackaging. That's on the same order as the loading cost for these things. It's on the order of ten percent of the capital cost, and that adds up to a lot of potential cost if repackaging is required. And so repackaging is challenging and could be costly.

So those were the questions that the Board asked. I wanted to just kind of recap what I had talked about so far, which was: We are looking at different options for STAD canister concepts. We are trying to keep our options open. We think that we've gotten good information from industry and task orders over the last year, and we hope to incorporate this information into this next round of assessments.

And repackaging would be expensive and challenging unless DPCs are disposable. Some repackaging will occur.

And I want to go back to this point again. I stressed this on 13, which, when I pitched the Standardization Assessment, is we realize that moving to a standardized canister system would impact every piece of the system; and any change would be a significant change. And we must have a firm, consistent basis to recommend implementation of those changes.

So at this time DOE has not made a decision about whether to or how to proceed with a standardized canister system.

And with that, I will take questions.

EWING: All right, Josh, thank you very much.

Linda.

NOZICK: Nozick, Board. The analysis of the cost associated with going to different flavors of STADs is very interesting. What is the process for talking to industry, or what part of the idea of adopting this is in negotiation with industry? How do you envision that unfolding?

JARRELL: Honestly, the work that we did is really a technical, and I think you’re asking, really, a policy question. And I would defer to the Standard Contract and the

DOE's perspective that these canister systems would not be--or that canister systems currently are not an acceptable way to accept the fuel. And so there would have to be negotiations that would have to go both from DOE and the utilities, and the Standard Contracts would have to be looked at. But it's really a policy question. We are just trying to get input from the industry to help better provide a technical basis.

NOZICK: Did industry, in the process of doing this, provide insight as to their thinking on this matter?

JARRELL: Not to me personally.

Okay, Rob Howard has a point to add here.

HOWARD: Yeah, just a clarification. So--

EWING: Identify yourself.

HOWARD: Rob Howard, Oak Ridge National Laboratory. As a clarification, the team that Josh mentioned that did some of these studies included NAC, included Exelon, so we had spent fuel project managers from the utilities provide input to the analyses that Josh is referring to. So when we looked at operations and optimizations, we went to the experts, the guys who load these things every day, and asked them, "Think about how you would do this differently for this kind of system."

NOZICK: And they validated that what came out in these tables is their current belief--that they had been able to do with you?

HOWARD: Those numbers came from them.

NOZICK: Okay.

EWING: Thank you. Jean?

BAHR: Jean Bahr, Board. You've compared the loading costs and the capital costs; did you compare the transportation costs of the STADs compared to the dual-purpose canisters, and how would that add to the total cost?

JARRELL: We are including the transportation costs in that Standardization Assessment that is ongoing. I don't have the numbers offhand. We are in the process of getting the initial evaluation through internal review, and I can provide that to you as soon as possible, but as soon as it makes it through review.

EWING: Okay thank you. Lee?

PEDDICORD: Lee Peddicord with the Board. A question for the STAD canister and on your burnup limit of 62,500 MWd, which was less than the TAD canister. Do you know how many assemblies that might exclude then that could go into STAD canisters and why that number was chosen?

JARRELL: My understanding is, the regulatory limits are 5% 62.5 GWd. I think that would include almost all the inventory in the country right now with the exception of a few four-cycle assemblies, and I don't remember where they're at. I'm trying to think if I have any phone-up-friends that could give me additional information.

Rob, do you have any comments there?

HOWARD: Yeah, there are some lead test assemblies--

EWING: Again, Rob.

HOWARD: Again, sorry. Rob Howard, Oak Ridge National Lab. There are some lead test assemblies that went through, like, the four-cycle things. But where they're actually at, I know that there was some higher-burnup fuel like at H.B. Robinson that we're actually testing in the Used Fuel Disposition Program. But, in general, those would be handled on a case-by-case basis. It's not much.

EWING: Okay, thank you. Jerry.

FRANKEL: Frankel, Board. You know, we went through this two years ago already; but just to be clear on the issue of repackaging, you know, you talk about how repackaging could be avoided if direct disposal of the existing storage canisters would be approved, be allowable.

But in that case, we wouldn't need STADs at all; right? So if we could just dispose of the canisters that are being used, these big assemblies, if we could somehow transport them and dispose of them, then we wouldn't need STADs at all; is that what you're saying? We wouldn't need to repackage. We wouldn't need this whole--

JARRELL: I think it would be dependent on, first off, you know, what the repository concept turned out to be if there was a tonnage limit like there was with the past repository, as well as concerns with if there was desires to immediately move some of the fuel off of the site. For example, dual-purpose canisters are thermally hot, and there may be some waiting periods before they're transportable. So you still could implement a standardized canister system with that in mind.

So I wouldn't say that they're completely off the table, but I do think, for the most part, if you were able to directly dispose of dual-purpose canisters in a repository concept, I mean, that would be one way to, like I said, eliminate repackaging.

FRANKEL: But almost then eliminate the need for standard canisters. The standard canisters make the system--some aspects of the system easier, but--

JARRELL: So right now, I mean, the dual-purpose canisters, there's lots of different, diverse sets. I mean, like I said, there's 30 different NRC license designs. So if you had a standardized concept, then that would simplify many other pieces of the system.

And so, you know, if it turned out that a repository could accommodate large-capacity systems, I think you would still move out with a standardized, and one option would be a standardized large-capacity system such that the handling and the procedures could be standardized throughout the system. So I wouldn't say that it would completely avoid. I think you would just have to take in mind the fact that there are other benefits from a standardized canister system to the entire system operations.

EWING: Question. Ewing, Board. So one of the challenges of designing the STAD, particularly for the disposal purpose, is that we don't have a disposal site, and so you don't know what the requirements might be. But we do have around the world countries disposing of waste packages or canisters in granite, salt, and clay.

So in your thoughts or in the design of the STAD, have you looked at the requirements for disposal for other waste packages around the world in an array of environments? Are there any common themes that might emerge?

JARRELL: So in our repository concepts, we are looking at multiple different repository concepts. I see Peter Swift in the audience, so I may tag him to give details. But we are--in the development of the specifications, we did look at how a STAD canister might interact with a clay, crystal, and a salt in an open-mode concept.

As far as how those designs came about, I assume that we did look at concepts from around the world, but I can't promise that. Peter is the Sandian expert. If you want to add anything, Peter?

SWIFT: You're doing fine.

EWING: I guess my point goes a little further than--you know, we can design our STAD for three conceptual repositories, but I'd simply point out that there are other countries that are doing it. And they have a certain purpose in mind, and it varies from geology to geology for each of the canister designs. And so one thought is, looking at those different approaches, one might see some similar characteristics that have a technical basis and that would warrant consideration for the U.S. design.

JARRELL: Let me just--are you talking more like material compatibility? I mean, our assumption is that we would design our overpacks to be compatible with repository concepts. Is that what you're implying or--

EWING: Well, the different repository concepts, if you look at the three that I mentioned, you'll find the canisters are rather small compared to U.S. concepts

JARRELL: Right. I'm going to my phone-up friend, Rob Howard.

HOWARD: Rob Howard, Oak Ridge National Laboratory. You're absolutely right, Rod. And we did look at the other international programs when, first of all, trying to ferret out what the appropriate size of these things was. So you have a range of sizes, you know, the 4 PWR course would go after the granite and some of the clay systems that we've seen internationally. And so that was the technical basis for focusing in on smaller ones is because that's what we see internationally.

And then, of course, the material compatibility things, we've looked at the concepts. We always would assume that these would come in a different overpack, so if there was like an SKB-type system, you could put it in a copper overpack.

EWING: Right, okay. Thank you very much.

Other questions from the Board? From the staff? Bob?

EINZIGER: Bob Einziger, staff. On your view graph Number 16 where you look at the small canisters, the difference between loading a DPC with 37 assemblies and loading 9 small STADs is about 250 hours. Now, that's going to break down into probably three areas. One is moving the canisters in and out of the pool; the other is welding them shut; and the third part is drying them.

Most of the vendors will tell you that the majority of the dose that you get is in the drying part of the work. And since you don't have any dose estimates comparing the various concepts, that is important to some people. Approximately of that time, the difference to load an equivalent amount of fuel, how much of it is in drying time, and how much of it is in other time?

JARRELL: You know, I don't have the numbers offhand. I can tell you that the bulk of the time, from what I remember on a per-assembly basis, is actually from the movement and setup of the canisters, all of the steps to take to move the cask, the canisters, getting everything set up. That's where the bulk of the time is. The assumptions for drying these small canisters versus large canisters, I'd have to go back and look what the assumptions that EnergySolutions and NAC and Exelon made on that point.

Rob Howard may have some additional details.

HOWARD: Rob Howard, Oak Ridge National Lab. On the drying, Josh, I would remind you that for the smaller canisters the optimized condition was that they could kind of gang-dry these things. They would be in a basket, if you will, and you could dry four at the same time in parallel, because you could get the equipment to do that.

Yeah, you're frowning, but the concept is there. I mean, it's just a matter of getting more equipment.

EINZIGER: A follow-up question. When you were talking about repackaging, there is--obviously in operating plants or plants that are being decommissioned, there is a pool there that you could repackage with the stuff in. But, you know, utilities don't exactly want their pool to be full-time repackaging facilities. They have other activities that have to be done also there. Have you taken into account the amount of time that would be available in the pool to do actual repackaging? Because it's not going to be a hundred percent of the time.

JARRELL: As we mentioned, I mean, we understand there's significant impacts. Generally, for what I would consider loading operations for operating sites, we did look at the, kind of, windows that we assume based on how many reactors shared that pool on that site. We talked with NAC and others in industry about what those windows would be.

They're telling us in dry storage you're on the order of maybe three months, twelve to sixteen weeks, of availability for dry-storage loading. The rest of the time the pool was occupied by other--the crane was occupied by other activities. So somehow the repackaging would have to fit into either that time frame or the other operations.

EINZIGER: You might want to talk to the people who are doing the high-burnup gas demonstration, because they have specific windows for being able to load that cask in the pool. And I was under the impression that those windows were not--they were pretty far apart. So you might want to talk to them and get a data point.

JARRELL: Mark Nutt.

NUTT: Mark Nutt from Argonne National Lab. Just a point of clarification on the repackaging in regard to the standardization is, the scenarios and what we're looking at for this effort does not involve doing the repackaging of anything at the reactor sites. It's loading standard canisters from fuel in the pools at the reactor sites. So the idea of taking things off the pads and repackaging them at the reactors is not one we're looking at.

EINZIGER: Follow-up on that one. Unfortunately, there's an awful lot of large canisters and systems out on the pad, and they're being loaded every day, the MAGNATRANs getting loaded and all. And if you find out that you can't put the big canisters in the repository and that that's one of the reasons you're going to the STAD, what are you going to do with all the ones that are on the pad?

NUTT: Second bullet. Repackaging at the ISF or the repository.

EINZIGER: Thank you.

EWING: Other questions from staff? Board? Nigel?

MOTE: Nigel Mote, staff. On your Slide 16 you have the cost information that we've discussed before, and that is the cost differential for packaging at the reactor sites. Did you look at the avoided costs downstream if you didn't have to repackage? So you've talked about the possibility with an unknown probability that there will need to be repackaging of some or many of the 11,000 canisters you're projecting. If you don't have to repackage, there's an avoided downstream cost. How does that compare with these figures?

JARRELL: We are actively doing that as part of the

Standardization Assessment, looking at from a system perspective what are the potential cost implications of not having to repackage 11,000 canisters, maybe a few thousand instead of 11,000, whatever it is. I don’t have the numbers in front of me. We’ve been working through some of those questions. But I’d be happy to provide the Board those reports as I am able to.

MOTE: Rod?

EWING: Yes.

MOTE: Just a quick follow-up. Can I ask you your gut feel? And I don’t mean to put you out on a limb, but if that is the packaging cost, presumably the repackaging costs would include that plus an unpackaging cost, in which case there may be some ready gut feel that says the offset would more than save this. I understand that this cost would be--well, the cost may not be incurred at the utility sites, or it would be incurred in the packaging there. Who pays it? I’m not discussing--but if this cost is going to be more than offset by costs saved downstream, that should be something that would be readily apparent on a fairly broad-brush cost analysis, wouldn’t it?

JARRELL: So, again, we’re trying to get our hands around that in this assessment this year. The only thing I will say is, one of the things we talked about, repackaging facilities, is if you do them at an ISF or a repository, you have the--they're really--they're built to do that job. And, really, some of these costs--you might be able to reduce some costs if you do it at a purpose-built facility, for example. That's the only thing I will add in that context.

EWING: All right, thank you, Josh.

We'll move on to the Public Comment now. We have two people who have signed up to take advantage of the public comment section.

First is Paul Plante. I'd ask you to keep your comments brief, five, ten minutes.

PLANTE: I should be able to do that.

EWING: And identify yourself and affiliation.

PLANTE: My name is Paul Plante. I'm from the Three Yankees. I'm the project manager. This is three decommissioned sites up in New England. One of the things that we like to bring to light at these sorts of proceedings is that our ultimate goal is obviously to remove the radioactive material from these sites so they can be decommissioned.

Most of these sites have what is called GTCC waste. At our site we have packaged that in transportable storage canisters as well. They are identical to a spent fuel storage canister. GTCC waste is typically activated metal from the reactor that'll be gone and segmented and packaged in these kind of canisters. It's also probably inherently less dangerous, relatively speaking, to spent fuel.

And so I would urge you to consider the idea of transporting GTCC waste as a way of proving out your system, as it were, before you graduate to transporting spent fuel.

And that's just the nature of that comment that I'd like to make. Thank you.

EWING: Thank you very much.

The second person is Rich Andrews.

ANDREWS: I'd like to defer my comments to the end comment period if I could at the end of the day.

EWING: Okay, no problem.

Is there anyone who would like to make a comment who is not on the sheet? Judy?

TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force. I would like to thank the Board very much for having this session, because I think it so clearly points out the horse-and-cart scenario of the whole DOE program.

For more than 20 years I have been standing at microphones like this, and I know that other people have from Nevada and other places, saying, "Hey, have you thought of--hey, what about if--" and about all parts of the repository system, whether it's on site or transportation or TSPA or anything that's been talked about. We've consistently been bringing up, "Have you thought of this or have you thought of that?" and we're seeing now so clearly that these questions are finally being asked 20-some years later.

And the second thing I wanted to ask was: When is it too late to be talking about standardization? We've already got the 70,000 or more MTUs sitting at the reactors, and it gets--I just don't know when there's a time you draw the line and you realize you can't do, really, standardization.

And the third one is, I think it's going to be really difficult to make the case for moving waste. If you're talking strictly about public safety and the health and safety of people, you can completely eliminate transportation, which is one of the riskiest parts of this thing, by leaving waste at the sites unless you're at a site right on the Great Lakes or right on the ocean beach where waste does need to be moved, but probably not across the country. And until you know where final disposal is, it's very difficult to know if you're going to cross those same roads more than once. Thank you.

EWING: Thank you, Judy.

Any additional comments from the audience? Yes.

PLANTE: Paul Plante back again, Three Yankees. Didn't want to hog the microphone time, but I'm interested in the aspects of barging spent fuel away from the site. I've seen the concept floated on several occasions, but not a whole lot of the practical aspects of it.

Obviously at one of our sites we--or, actually, two of our sites--we've barged the reactor vessels away from New England to South Carolina, fairly uneventful process. Until you, of course, know where the interim storage site might be, that may or may not be the most desirable method for moving spent fuel away. But certainly at some sites where barging has happened in the past with highly-radioactive components, it would be easy to move it to railheads at other states and minimize the amount of rail transportation that would need to go on.

So certainly it seems to be a concept to me that would bear careful examination and some sort of a trade-off as to which would be the best approach to take. Thank you.

EWING: Okay, thank you.

This will be the last speaker before lunch.

LACY: Thank you. Darrell Lacy with Nye County, Nevada. A lot of the discussions here are talking about the uncertainties involved with not knowing what the final repository is, the extra cost, the exposures from repackaging. I sure hope that maybe this group would be the one that could help pull all of this information together and provide it to our policymakers. I don't think it's well understood by people who are making decisions that Yucca Mountain is not workable, that they understand what the extra costs, the time, and potential exposure to individuals is going to be from making that decision. Thank you.

EWING: Okay, thank you.

So I'll call an end to the public comments for now, but I'll remind everyone that we would welcome the comments at the end of the day.

So we'll break for lunch, and we'll reconvene at 1:15 with the panel discussion.

Thanks to the speakers and to the audience.

(Whereupon, a lunch recess was taken.)

AFTERNOON SESSION

EWING: So let me open by welcoming you to the afternoon session of today's open Board meeting.

The first item on the agenda, the first event, is a panel discussion, which will be led by a member of our professional staff, that is, Bob Einziger. And so I'll simply turn it over to Bob.

EINZIGER: As announced, my name is Bob Einziger. I'm your mild-mannered moderator.

We're going to have a panel today to discuss dry-storage canister degradation, in particular chloride-induced stress corrosion cracking. The way we're going to work it is, after I give a short introduction, we're going to have each panel member give a talk up to five minutes, telling what, essentially, they're doing on this subject. And then we have a number of questions that the panel has been given previously to discuss and try to get their opinions from different points of view, because we have representatives from the industry, from DOE, and from NRC.

So why are we interested in this subject when most dry-storage systems in use and being built in the U.S. are canisterized as opposed to Europe where most of them are directly loaded? In the United States the canisters, the primary containment boundary in dry storage, and the secondary containment boundary in transportation if moderator exclusion is required. So, with that use, we'd like to keep it intact.

Preliminary work by the Japanese, who have done a lot of work in this area, indicates that the chloride-induced stress corrosion cracking can initiate any time in the short period between 10 years and 400 years. Hopefully we can narrow that down a little bit. If it's 10 years, we have problems now; if it's 400 years, we don't have problems.

As far as we can tell, based on some basic research I'll explain in a minute, the storage conditions appear to be suitable for this particular mechanism to occur. To date, successful inspection of the canisters for either stress corrosion cracking precursors or cracks in the welds has not been demonstrated. So it's an issue that's being worked on.

Now, you need a number of things for stress corrosion to occur. You have to have a susceptible material, and the austenitic stainless steels that are used for canisters is a susceptible material to this mechanism. In fact, at one ACRS meeting they couldn't understand why anybody in their right mind would use this material for a canister.

Besides that, you have to have a tensile stress to drive the mechanism, and you have to have a corrosive atmosphere. And a corrosive atmosphere is the salt deposited on the surface, and it's still in the liquid form. That means the temperature can’t be too high; there has to be sufficient humidity; and the temperature can’t be too low.

That’s the basic background on this mechanism. With that, I’m going to turn it over to Shannon Chu of the Electric Power Research Institute that’s going to tell us what they’re doing.

CHU: Thank you, Rob.

So Rob gave you some of the background. Here it is up in words. The three conditions that you need are a susceptible material, which some stainless steels in some applications have shown to be susceptible to CISCC; and then the environment, there’s two aspects of that, the chloride and the humidity aspects of the environment; and, finally, the elevated stress--are the drivers required in chloride-induced stress corrosion cracking.

EPRI has--we have done an initial surface inspection of dry-storage canisters, but the technique that we used, as Bob described, was not qualified to detect cracking, and it wasn’t a standard--like an ASME standard--visual technique to take credit for even detecting precursors of cracking. What they did see was no evidence of gross degradation, and they took chloride samples and found low amounts of chloride, but not non-existing chloride.

So at EPRI, in addition to that piece of the work, we have a multi-year project involving modeling and aging management guidance development. So we’re evaluating what factors make a canister susceptible to CISCC, what are the differences between all of the canisters that we have in the fleet, in order to identify lead candidates for aging management actions and then to develop an aging management guideline.

EPRI’s project is very specific to extended storage. It doesn’t include transportation loads or other transportation issues. It’s just dealing with the immediate issue that utilities are facing, which is extended storage on their site.

In addition to this aging management work, we have development work in order to prove that the techniques that we have applied in operating plants to inspect for chloride-induced stress corrosion cracking can also be applied to canisters and address the challenge of trying to apply those techniques in situ without taking the canister out of the overpack.

So, as I said, my presentation today mostly just covers our modeling project. I work closely with the folks in the NDE center who are doing the work to develop examination capability, but that’s not my area of expertise or my lead in the project. So I’m focusing today on the modeling work that we’ve done.

The first modeling effort was in 2013 with the

Failure Modes and Effects Analysis, and this was sort of starting from the big picture of, you know, yes, the industry has been informed that CISCC is a particular point of concern. But, you know, what are other corrosion mechanisms that we need to consider for this canister, and do we--you know, looking at the factors for those mechanisms and the operating experience and the literature on those and looking at the finite element analysis of the weld conditions, do we agree that CISCC is the biggest concern? And the answer was yes, we do. So that effort sort of confirmed our focus on CISCC for this aging management effort.

The next piece was Canister Flaw Growth and Tolerance. So, again, using available experimental data and operating experience, EPRI developed a flaw growth model for determining, first, conditions have been established and then a crack after--sometime after conditions are established a crack is initiated. From that point in time, how long would it take for the crack to grow, you know, to 75 percent through-wall or to a through-wall crack? That would be of concern to the industry.

And then the flaw tolerance piece looked at, if you do have a through-wall crack, how long could it grow before you would have a structural concern? I'll talk a little bit more about that model in another slide.

The current effort that we're working on the draft of and under review is the Susceptibility Assessment Criteria, and this document identifies the critical parameters and attempts to weight those parameters in terms of relative importance for CISCC susceptibility. And, again, that's based on the results that we've built in the FMEA and in a literature summary and in the Flaw Growth and Flaw Tolerance Assessment.

The final piece of our modeling work, which we haven't started in earnest yet, is a Canister Confinement Integrity Assessment. And this piece uses probabilistic techniques to evaluate different assumptions about your inspection regimes, how many canisters do you inspect, what is your probability of detection, what is your inspection frequency, and looking at essentially optimizing an inspection plan based on a probabilistic assessment.

So I talked about the Failure Modes and Effects Analysis already. I might not need to spend a lot of time on the details. Essentially, the conclusion was that chlorides are the most credible species to cause degradation of concern. The consequence of concern is a through-wall flaw; and if that consequence were to occur first, the helium would be released, fission gases may also be released, and eventually air would enter the canister. And, as I said in the flaw tolerance piece, which is coming up next, we had the same conclusion that canister rupture is not a concern for extended storage.

So, because we have very limited crack growth study data available, our model relied only on relevant data, atmospheric data, not data collected for cracking in submerged specimens, but specimens in a humid air atmosphere with chloride salts as a contaminant. And there is very little data available, so our model uses a very conservative statistical approach. And with the limited number of data points available, there was not a relationship between crack growth rate and the amount of salt or the stress intensity factor. Those items are of importance for the likelihood and the timing of initiation.

But with what little data we have on crack growth rate research, we don't model a dependence on those factors for crack growth rate. And, again, conditions are already established; you're assuming crack initiation has occurred; and then from that assumed point, how long does it take for the crack to go through-wall.

So then the next step after the crack growth rate model was modeling the performance of a cracked canister. And the results showed that you could have a relatively long flaw or a relatively--like, over 80-percent-deep full circumferential flaw without having a structural issue for the normal handling loads in storage.

So, finally, the piece that we're actively working on right now is the Susceptibility Assessment Criteria. So there is a ranking factor for the ISFSI, basically the whole pad and the factors that are common to the pad, including distance to a chloride source and absolute humidity of the atmosphere that pad is in. And then there is additional ranking for specific canisters based on the power load of the canister, the canister geometry, what particular alloy the material is made of, and how long it's been in storage.

So I have listed the EPRI product numbers for the work that's already published, and then the last two items are coming out this year.

EINZIGER: Thank you, Shannon.

The next speaker is going to be Dave Enos from Sandia, who is going to give the DOE's perspective.

ENOS: Okay, so my name is Dave Enos, Sandia National Labs. The work that I'm going to be talking to you about is done by myself and Charles Bryan, who isn't here today. Essentially, what I'm going to be talking about are the programs that we have going on, trying to address some gaps that exist in our current state of understanding of the process.

So you've seen this type of figure many times about things that you need for stress corrosion cracking to go. The three questions that we're really focusing on are: What is the environment on the surface of the container and how does that evolve with time, or does that evolve with time? Is there sufficient stress to support through-wall stress corrosion cracks and, if so, what's the magnitude? That's pretty important in terms of understanding, once a crack is initiated, how quickly is it going to go, is it going to stop, and so on. And then, generically, what are the crack growth kinetics given the known physical and environmental condition of dry-storage casks?

So this is some work that we did with EPRI. This is analyzing samples taken from containers that were in the field. EPRI was able to get three sites to volunteer to allow the cask vendors to develop tooling to take samples from the surface that we then analyzed for the chemistry; and the analysis was done at Sandia. We had two near-marine sites, so on brackish water. What was interesting here is that we saw almost no chloride. And one of these, you know, had been in the field approaching 20 years. So it was a little surprising to us who would have thought that it would have been more significant.

We did look at a marine site, and there was significant sea-salt aerosols, so significant chloride on the surface in that case. And certainly when you walked around the site, pretty much everything that was, say, carbon steel was rusting away and so on. So that was typical. But this was surprising to us who would have expected to see a little more chloride present.

So the next project is looking at salt and brine stability, and this is aimed at trying to understand why it is that in some cases we don't see significant chloride where maybe we expect to. Well, there's an awful lot of things that can happen. Once these salts get deposited on the surface, they can change the chemistry as a function of time. You can have gas-to-particle conversion reactions, acid degassing, and decomposition of ammonium minerals.

On the hot canister, prior to when you're at a temperature where you can get deliquescence, things like sodium chloride and magnesium chloride are going to obviously stick around, as well as ammonium sulfate, but things like ammonium nitrate and ammonium chloride are going to rapidly degas; they're going to go away.

Once you've deliquesced, it gets to be a little different. And you can have interactions again with things like your ammonium materials with chlorides that will then result in the degassing of the chloride, so removal of chloride from the liquid brine. And that could be what's leading to the lower chloride concentrations that you see in some of these brackish water sites.

We've been doing experiments in the lab where we're putting down low loadings of different types of salt chemistries on the surface and looking at how those evolve with time, and we do indeed see degassing. And that'll be work that we'll be talking about as time goes on.

The next thing that you obviously need is stress, and we've--stress for the crack to propagate. What we're trying to understand in this case is, what does the stress state look like at a circumferential or a longitudinal weld in one of these canisters, both in sort of the pristine state as well as where there has been a weld repair done.

So we have a full-scale NUHOMS 24P container that's been built. We're in the process of getting residual stress measurements made through thickness for the longitudinal and circumferential weld in the well-formed weld as well as at a repaired region. This is being done by a company actually in the U.K. using some techniques that the NRC demonstrated where sort of, I guess, your ground truth; that being, deep hole drilling.

We're also doing contour measurements combined with x-ray defraction to get the three-dimensional view of the stress state. And we'll also be characterizing the electrochemical properties, looking for the degree of sensitization associated with the different welds and with the weld repaired regions and how that changes. In addition, this sample provides a resource that we'll be using both for the UFD as well as the NEUP programs for providing samples from a representative cask to do stress corrosion cracking work on.

So the final piece of work that I'll talk about is a probabilistic model of stress corrosion cracking that Charles and others are putting together. The goal is not to be perfectly predictive in terms of the stress corrosion cracking growth rates, but to really understand what parameters are most important and where do we maybe not have a sufficient level of understanding or sufficiently high fidelity data to be predictive.

The model is modular. It has a pitting initiation part, a pitting growth part, a pit-to-crack transition part, and then a crack growth part. Certainly Jerry appreciates this, but there is probably a lot of uncertainty in some of these here. What we're doing is taking information on thermal loads or thermal--temperature distributions from PNNL and other folks that have put those together, as well as environmental conditions that have been collected at different ISFSIs or weather stations near different ISFSIs around the country to populate this model and then try to predict what the crack growth rates are for the risk of chloride-induced stress corrosion cracking as a function of location.

And so that's my presentation.

EINZIGER: Thank you, David.

The next speaker is my former long-time colleague at the NRC, Meraj Rahimi.

RAHIMI: Good afternoon. Can you hear me? I don't have a presentation given this is a five-minute talk.

Actually, the NRC that identified these phenomena of stress corrosion cracking a few years ago through the tests that were done at the coupon test at the Center for Nuclear Waste Regulatory Analysis, and it demonstrated that these could be a potential issue, especially in a marine environment.

And that was really pretty much NRC's role, and that's what our role is in terms of, you know, identifying those issues. And in the meantime, what NRC is doing in general on the aging management guidance that we are developing, this is a NUREG that is under development, first revision, which, as part of that development, the staff is putting together an aging management table.

And the stress corrosion cracking is one of the potential issues, but it's looking at all the possible material degradation issues in terms that the applicant has to demonstrate the canister still maintains the safety function during storage, because this aging management table, the NUREG, it is for storage only. It is being developed in the context of storage. And I will talk this afternoon with regard to the canister role for transportation.

So that's the really main effort that is happening right now at the NRC, developing the NUREG, developing the aging management tables, developing MAPS report. It's similar to the reactor renewals, what the reactors went through. This is as part of their renewals activity that we're doing.

Another major activity that the NRC is involved is with the ASME Code Committees, developing criteria for inspection for mitigation. And we believe that, because the NRC decommission requires that the staff, to the extent possible, use the industry consensus, so the staff at the NRC is working with the ASME Code Committees in terms of developing criteria for inspection and mitigation. And those will be referenced in the NUREG report.

So we have issued--actually, since the whole new phenomena about the whole renewal activity, we issued the renewal on Calvert Cliffs recently, a couple months ago. And so in there is the whole aging management program, which, actually, is outlining what the applicant needs to do in order to maintain the canister integrity in order to provide the confinement to confine spent fuel during storage.

EINZIGER: Thank you, Meraj.

As you can tell from the first two speakers we had, there may be a considerable amount of work to get a fundamental understanding of this mechanism and whether it's going to be operative. So an alternative approach is looking at inspection of the canisters to determine what the progress is of any initiation and cracking.

So Steve Marschman of Idaho National Laboratory is going to update us on what's being done in that area.

MARSCHMAN: Steve Marschman from Idaho. And I'm going to talk a little bit about what we've done and where we think we might be able to go.

Strategies for inspecting canisters, of course, include both in situ without removing the canisters from their overpack and the ex situ ones where you might want to pull the canister from the overpack. Both are highly complex, and they're both complicated. Just because this stuff is sitting on a pad doesn't mean that the work is easy.

Pulling a canister out, though, allows you to look at about one hundred percent of the surface, and that's being investigated by the storage system vendors. I know of at least one vendor that is looking at how to utilize their loading system and how they could put an inspection system on that in that evaluation, and they're keeping it fairly quiet.

The in situ stuff we're more familiar with, because that's what we've gone and done. David mentioned that we've gone to three sites and taken a look, and all of those were done in situ. It's a little less complicated if you're doing it in place, but there's still a lot of human interaction and things that require you to proceed very cautiously when you do this kind of work. It may not let you look at a hundred percent of the surface, and we'll have to determine if that's adequate or not. Both DOE and the industry is doing it.

The pictures I've put up here aren't just for the prettiness of them at all. Notice that this is an AREVA TN horizontal storage module, and so is this one. And if you'll notice, the lower vent on this one is in the center of the module, and they have a different exhaust vent here. The newer systems have vents that kind of go between the two different modules. So if you were to develop a system to go do an inspection on this system, it will vary depending on the generation of the system you're working with. So your tools can be complicated by the generation of what you're doing and what a particular utility might want to purchase.

Here is a HOLTEC Hi-Storm 100 that's at Hope Creek. Its inlet vent--there's four of them--are narrow and long. And then I don't remember which site this one is from, but we saw similar kinds of vents at Diablo Canyon where they use a square-type inlet vent. So if you were to make an entry into the bottom vent, it would be a little bit different system than what you might use here. And, of course, going through the top has its own sets of challenges, and I'll talk about that in a minute.

So up to now, everything we've done has just been, you know, manual entry. There's no robotics available for getting into these systems. The environment itself, we've got a high-radiation field to deal with. And if you notice the inspection--this is a picture I took at Diablo. Notice that the workers are actually working below the level of the vent, because there's a radiation dose here even though you're about almost two feet away from the annulus and the top of the canister. You still want to be concerned about that from a worker dose perspective, so most of the tools were designed to keep the workers protected.

Here at Calvert Cliffs for the HSM system, when we needed to get into the annulus to take some temperature measurements and surface samples with the tools they've developed, they needed to put a water shield in front to help cut the gamma and help cut the neutron dose coming out the front face of the HSM series. You can actually see the fuel canister or the bottom of it there where it's inserted. And there is quite a concern for dose rate in this area, so it was all very carefully orchestrated to get at that.

One of the things you learn in dealing with these systems, they weren't designed to be inspected. And so, you know, they're put together to protect the fuel and to let it cool. And we've learned that they don't always have to sit straight; they don't always have to be centered. The tolerances from the design plans and those sorts of things can be quite variable, and that's just the nature of manufacturing something that large.

So I put this title on this one called, “Challenging Spaces,” and I’ve got some--and I haven’t focused on the NAC system simply from the standpoint of not getting too many pictures on here. But just since we’ve looked at these two, I have included them; and that’s the only reason why I’m not being discriminatory towards my friends at NAC.

But this model that the AREVA folks have for this system, you can see that if you come through the bottom vent, which is the inlet, trying to get at this space up in here, you’ve got to have something that goes in and then reaches up to get to where the canister will sit. If you try to get through the front face, you’ve got a very narrow annulus you can work from. And, as we found at Calvert, those things are a little bit out of round. You have some challenges getting in around the entire side. So, you know, that was one of the things we learned there.

From the HOLTEC system, this particular picture shows the transfer cask with a MPC that’s not welded shut or loaded, and here is the shielding overpack here. There is a series of channels that are welded on that help keep this canister centered. And it’s through these--you go through the vent and then try to go down inside these channels. That can be a bit of a challenge to do manually, even getting a tool that you can go over the edge and into the system, hit the channel, because the orientation is random. It presents some challenges as you’re working on it.

And just by way of kind of showing you the space, this is a SaltSmart sampler that we use on the surface of the canister. It uses a small bit of water to pass across a membrane so that it sucks up any of the salt that’s on the surface. And it’s only about a quarter--well, three-eighths of an inch wide, so you can see you’re not working in a tremendously large space. And that’s kind of what goes along with trying to be able to sample these canisters.

So one of the things we did in late 2013 was we wrote--for an integrated research project we wrote a proposal, and we were out looking to attract folks that could begin to look at helping us develop a system for being able to inspect these canisterized fuels.

One of the reasons we went out and searched out universities in this process was, one, we wanted to get some fresh ideas. If we stay within our world, often we begin to develop prejudices in our brain from working in this. And it was really attractive to start to bring in some professors who have gotten some nuclear background for bringing in the young kids and the students that can bring fresh ideas to, like, robotics and think about things in a different manner.

So we’ve given them a three-year $3 million project. It’s led by Penn State, Cliff Lissenden, and you may have run into him at the last ESCAPE meeting in May in Florida, because he was presenting on the functional requirements of this project that have been developed. But they were tasked with performing R&D for a robotic device and new sensing systems to monitor for conditions conducive to stress corrosion cracking and inspect the surfaces for dry-storage canisters.

So, you know, they’re supposed to come up with a way to perform visual inspections. We had a lot of discussion whether that needs to be a formal visual or just a regular visual, or does it have to pass QA, be able to perform chemical analyses in situ. When we brought these salt specimens out, we would rush them to a cooler, and we would have to try to preserve them and get them shipped quickly to the laboratory. And there was chain of custody and radiological surveys. Wouldn’t it be nice if you could do that in place? We want to be able to inspect for cracking, measure temperature, radiation dose we see.

And then this one down here at the bottom--and we’re really working on this one--if we see something we think is of interest, how do we get back there in five years? So that’s really key.

Now, we defined their success as being able to be deployed on a single-vendor system. We felt if we asked them to look at too many or three systems that their efforts would be diluted. So we were going to focus on the HOLTEC Hi-Storm system simply because HOLTEC was part of their proposal team.

So what are some of the challenges we've had? Well, when you go build yourself a robot--and this down here is just simply one of their test beds--but you've got these challenges. You've got to harden the components to the high radiation and a high temperature. Doing things off the shelf doesn't necessarily work in these environments, and they're having to develop some of their own equipment.

One of the things that Penn State has, they have a research laboratory there that supports the Navy with taking products from laboratory to essentially, like, commercialization; and those folks are involved in their project. So we felt they had a fairly high chance of success getting from concept to deployment.

One of the other things we have to be careful of is, we can do no harm. We don't want to leave scratches; we don't want to leave organics behind; we don't want to bring iron in and scratch stainless steel surfaces and those sorts of things.

In the functional design of the equipment itself, this is going to be first of a kind. It's not off the shelf. We've got to be able to attain accurate temperature measurements in moving hot air; not as easy as you think on a grit-blasted surface of stainless steel. Getting good contact between a thermocouple and the surface is a challenge to get accurate measurements. Accurate chemical composition of the deposits: you heard David talk about degassing and reactions that can change the acid.

So we want to be able to try to do that in situ, and we've got specifications for that; ability to find potential cracks; logging our locations to get back; flexibility to deal with the variable geometry of the space. And then the big one, going up and down in a vertical system, of course, is--and this one is more complicated--is getting traction in there.

So, you know, they've got a team of about 20 people with all their students working on these things. The big thing, it just started in October, but we've got a good advisory board with industry folks, laboratory folks, and everybody is engaged and enthusiastic, and Cliff's led the development of a functional requirement document. It's out there published and available.

Last one, Bob, the current efforts are focused on developing these tools. Let's see the functional requirements have led them to--you know, they've selected the measurement methods; they chose a laser-induced breakdown spectroscopy for the chemical assay. They're going to use a guided wave, you know, EMATS essentially, and they think they can use a two-robot system to get underneath the channels and try to get as much of the surface as they possibly can, Geiger-Muller tube, temperature laser thermocoupler and RTD. And we’re not expending any effort right now on any of the ex situ stuff.

That was it in a quick summary.

EINZIGER: I want to thank all the enthusiastic researchers for giving us a very brief description of the work they’re doing in this area, and they encourage you after the meeting is over, if you want further details, to speak to them personally.

Before the meeting started, each of the panelists got a list of questions that we’re going to discuss, and I have to admit these questions are the ones that I had. And so other people may have other questions, and I’m sure we’re not going to get through them all. But the object is for the various participants to weigh in, not just one participant, and not yes and no answers, but a description of why you made that particular position.

First one: What are the important issues for transportation and subsequent storage if a canister develops partial wall cracks, a through-wall crack, or many through-wall cracks? What are you doing to assess the magnitude of these issues as a function of crack initiation, rate of crack propagation, and time after storage when transportation occurs? Anyone can take that question. Shannon?

CHU: So we are not doing anything to address transportation. We are very much limited to extended storage. We have, as I mentioned, done some flaw tolerance work to understand at design pressure or even at elevated accident pressure and normal handling loads, just based on loading information available publicly and, as I say, ours for some of the designs to understand the flaw tolerance of the canister designs. But in terms of what to do about that potential for transportation, that's not been part of EPRI's scope.

And, Rod McCullum, I don't know if you had a comment on this question.

McCULLUM: This is Rod McCullum from the Nuclear Energy Institute. And, actually, Bob, you alluded to it a couple times earlier that in licensing these dual-purpose systems for transportation, no credit is taken for the function of the stainless steel canister unless moderator exclusion is involved. The couple of thousand systems we have that are sitting out there right now that may be subject to these mechanisms, none of them take credit for moderator exclusion.

Now, we have recently licensed some systems that will, so this is a very good forward-looking discussion. But EPRI's focus has been on the current regulatory issue that's before us, and that is strictly a Part 72 or a storage issue.

EINZIGER: Thank you.

Let me just bring to the panelists--remind them that the question--What are the important issues for transportation and subsequent storage? And there the canister then plays a role again.

Dave?

ENOS: I think for all of the cracking, one of the things that, I think, you pointed out early on is, you know, we assume we--we know we have a material that’s susceptible to this sort of cracking. We know that this material has cracked in other situations. We haven’t actually seen a crack on one of these systems.

So, you know, before we can assess how a system is going to behave if it has a crack in it, we need to have a good understanding of what types of cracks are likely to be present. I think, you know, certainly some of the stress models that have been done have suggested that the cracks would tend to be short and perpendicular to the weld, so, from a structural point of view, maybe don’t play too big a role. They aren’t such--you’re not at risk of if you were to drop a canister that it’s going to break, as an example.

So what we’re hoping to gain through this mock-up and the experiments that we do on the mock-up afterwards is a good understanding of the types of cracks that you’re likely to see in this. I mean, we might not--well, we will be able to make the material crack; that’s not a problem. But just trying to see what sort of crack geometries and everything can be supported by--and I’m talking a macroscopic sort of crack geometries--can be supported by the stress state that exists in a well-formed weld as well as at a repaired region.

But I think before you can get to the point where you say, well, how is the system going to do if it’s cracked, you have to make sure that the cracks that you’re assessing are relevant to what’s going to be in your structure. So that’s where--

EINZIGER: Any other panel comments?

CHU: Well, I would just add that the capability to detect and size the cracks accurately would be essential, you know, understanding what you expect and then understanding what you can detect in terms of what’s important to understand and then also understanding the transportation loads. That’s how you would answer the puzzle. I just want to be clear that it’s currently not part of EPRI’s scope.

EINZIGER: So I suspect when you talk about detecting cracks, you’re also detecting on sizing them so that the fellow that’s doing the structural analysis of the canister under an accident condition can take that crack into account.

CHU: Yes, if that was a decision that had been made that one--you know, as Rod pointed out, whether or not the canister is serving a safety function in the trip, if that’s been established. You know, given all of those things, absolutely yes, you want to be able to accurately size it and then model it, based as much as possible on accurate loads.

EINZIGER: Okay, thank you.

Let's move on to another question, and that's: In some instances, it's been stated that inspections will be done at locations on the canister surface that are accessible. Is this sufficient and acceptable, or does some guidance have to be where on the canister you're going to examine it? For instance, if you don't have accessibility to the area where a weld meets a rail and has a crevice, is it acceptable just to say you can't inspect that? What's your feeling on that?

ENOS: I would say that it's important that you get an idea of what the overall surface looks like. I mean, one of the things in the initial inspections that we've done is we've established exactly how difficult it is to get into one of these systems and do any sort of data acquisition. You know, on the first system that we went to, which was a horizontal system, Steve showed you pictures of the front.

The whole tooling with the design was to go in through the front and to be able to access the areas where we can see significant deposits of stuff on the surface. When we went and put that shield plug in there, the gap was too small at the top for them to deploy their tooling, so we couldn’t even access the areas that we wanted to.

So I think significant work has to go into developing tooling such that you can make--you can accurately assess what the overall surface looks like. You know, if your weld is in an area that you know from your environmental sampling is very, very unlikely to have significant deposits on it in terms of chlorides and so on, then maybe you don’t need to look there. But you need to look at the areas where the environment is going to be most severe and maybe not look so much at areas where the environment is insufficiently aggressive to assess or to result in the formation of stress corrosion cracking.

EINZIGER: Thank you.

Steve, do you want to comment on that further?

MARSCHMAN: Well, I’ll echo kind of what Dave says. You know, we went in and we saw how difficult some of the things are, and that kind of question sort of went into the beginning of the thinking for this IRP. And we’ve challenged them to figure out how to be able to--like in this HOLTEC system, essentially be able to get a 360-degree view around the entire vertical walls of the canister.

So I am hopeful that, for that one particular system and the set of tools we’re developing, we’ll be able to see the welds of interest. But, you know, there is always a possibility that our methods might fail. And the way we’ve defined the program, if that were to fail, that's still okay because we're learning from that exploratory process.

EINZIGER: In your talk you mentioned a number of different systems with different accesses to them. Any inspection technique that's going to be able to be used probably for licensing purposes is going to have to both be qualified and shown to work. That might be done on mock-ups. Is one mock-up going to work, or are they going to have to make mock-ups of every type of system?

MARSCHMAN: I think for the methodology development you'll be able to qualify a lot of that on the bench. The deployment part of it, for example, when we were looking at the HOLTEC system, we put some salt on some stainless plates that could be taped to the side of a clean canister; and then as they deployed the system, we could do that in a mocked-up mode on that particular MPC.

I think--you know, to me, it's the access requirement. Once you've got the basic geometry down, it's a matter of getting a system that will get into the geometry and approach the surface. So I don't know that--my opinion would be you wouldn't need mock-ups for every single thing. You just have to be very careful about developing a suite of tools that can work with these different geometries.

EINZIGER: Okay, we have time for one more question before we open it up to the Board.

A “considerable”--and put that in quotes--amount of research has been conducted in the U.S. and Japan to determine the conditions under which CISCC occurs and thus possibly allow an exemption from inspection for those sites that don’t exhibit those conditions. However, there are significant differences in the results obtained by the Japanese and the U.S. studies. Are these differences significant? If so, why? And how do you suggest reconciling them?

CHU: Well, Bob, I think in the more recent research, the differences aren’t necessarily that significant. The more recent--and maybe Meraj could comment as well--the more recent NUREG was more aligned with the CRIEPI results, but the number of samples is quite small.

So the way to address any remaining uncertainty would be additional experiments, especially at low salt loadings, running experiments for a longer period in order to get a better idea of the crack behavior over time. I think that is one area where we would agree that more data is certainly needed. I don’t know that we can--that I would necessarily characterize the limited data we have as significant discrepancies.

EINZIGER: Now, previously the work that was done down in the center had studied, I think it was, $10mg/m^2$ and still found the stress corrosion and cracking occurring, while the

Japanese said that you needed above 800mg/m^2, so that’s a pretty big difference. As of the meeting in Vienna last week, the Japanese were still holding to the 800mg.

So what you’re saying is that the U.S. numbers are coming up?

CHU: Some of the CRIEPI data that we have summarized in the EPRI report goes down to 300mg, and so it’s getting closer for sure. And I think it also depends--you know, you’re looking at specific temperature and humidity conditions. So I think we agree that more testing is needed to resolve any differences, because we’re talking about, you know, a handful of data points being compared here, really.

EINZIGER: Anyone else wants to weigh in?

ENOS: I think one of the other issues with maybe some of the laboratory studies is you look at what they’re using to initiate the attack; right? So they’re depositing straight salts on the surface and seeing what happens. And if you look at the environmental dataset that we have so far from the three sites we’ve taken data, you know, it’s not a huge dataset; but it’s pretty radically different from what the folks have been doing in the lab.

So that causes some concern in that the growth rates, you know, they’re looking at much higher effective chloride concentrations or different mixtures of materials on the surface. The type of behavior that they might see could be very different than what you might see on a container surface. I'd expect the container surface to be less aggressive given what we've seen so far from the dust samples we've taken.

EINZIGER: Okay, with that, we're going to end the panel portion of this, and I'm going to turn the session back over to the Chairman for additional Board questions.

EWING: Right. We continue, though, with the panel answering questions; right?

EINZIGER: Yes.

EWING: Okay. So thanks very much, Bob.

First question? Jerry?

FRANKEL: Jerry Frankel, Board. So there's no doubt that this material is susceptible to stress corrosion cracking. I'm a little concerned at the focus of this work. It might be a little misguided.

So we know this Venn diagram that we need the material, we need the environment, and we need stress for cracking to occur. But more than needing stress, we need a critical stress intensity. And, you know, this material typically--and Dave alluded to this--the material cracks from pits; the pits form the necessary stress intensity to drive the cracks. And so this stainless steel will form nice pits, certainly particularly under emergent conditions. That's where our understanding of the mechanism really derives.

Atmospheric corrosion of this material and cracking is different than--you know, we have the same issue in aerospace with aluminum alloys, really. So, in my experience, stainless steel in these kinds of environments--so thin concentrated layers of solution--forms shallow, dish-like pits that aren't necessarily very good stress concentrators.

Bob mentioned this wide range of times to initiate the cracks, so is crack growth rate the critical thing here? Certainly, you know, when a growing crack is--maybe it's already sort of a lost cause in the way that the--the key parameter might be the initiation and the formation of pits that are going to initiate cracks that, I think, are difficult to do. In fact, depassivation may be a bigger problem under these conditions than deep pit formation.

So, I don't know, do you have any experience of the formation of deep pits under the kinds of environments that, you know, as you say, exposed to some aerosol near--

ENOS: So, you know, for the boldly exposed areas, the areas away from the weld, I'm not anticipating much of anything happening. I mean, you do see--in experiments that we've done where if you put 304 and you decorate it with salt and put it into--we've done some crevice corrosion initiation tests. You see very little happening away from the crevice and getting far enough away that you're not protecting yourself with your active area under the crevice. 303 is a little bit different animal; it will go at the manganese sulfide inclusions.

What we’re worried about more in terms of localized attack or in the--you know, these are 304. They’re welded. There is no mitigation done, either thermal or other techniques, to address sensitization at the weld. So from a localized attack, what we’d be concerned about is something that would happen in the sensitized area where it could maybe get to something more significant than, you know, a nice hemispherical pit that maybe doesn’t create a huge concern from a crack initiation point of view.

You’re absolutely right in going from aqueous to atmospheric. In constructing the models, I’ve been somewhat involved in that, but that’s a big--I guess, a barrier to get over is, how do you take what we know from looking at potential mapping and stuff like that and apply that to a bold surface. They’re coming to me and saying like, “What’s the open circuit potential?” It’s like, well, it’s complicated, you know, it’s not a straightforward thing to do, and you can’t use those models to predict.

So what we’re trying to do is see what do we need to know, how does the material behave. And so we will be looking at localized corrosion from heavily sensitized materials. We’ll be starting with the material that we have from the mock-up and then generating replicate--or generating sort of--I don't know if you call them bulk samples of sensitized areas using Gleeble to -- it's a weld simulator -- to capture the thermal profile that you see in different areas so we can more effectively assess the initiation and propagation of pits, what sort of distribution do we expect to see under not just any condition, but under the conditions that are relevant to the packages, so the relative moisture content and chloride loadings that are present.

But that's an area that we recognize there is a very limited understanding of what's there and so being able to make that leap from, yeah, we're going to get localized corrosion, and they're going to go to stress corrosion cracks. There's a lot of information that we still need to gather there.

FRANKEL: Go ahead. I have a clarification question for you, David, but go ahead, please.

RAHIMI: The tests that the NRC started doing a few years ago, I mean, these were the u-bend plate samples, and I think the report is out. And so they simulated sort of the stresses that the canister--these canisters that are fabricated from plates, and there is no stress relief. And under those conditions and under the adequate salt, you know, they created deliquescent condition, and it showed very aggressive stress corrosion cracking. And those were the start of, you know, looking at that phenomena and simulating the canister conditions.

Of course, that's not my field. Al Csontos, our material person, would be more than happy to provide the details.

FRANKEL: Just one more, Dave. You've talked about crevices. So do you think that crevice corrosion is an issue here, or where would the crevice--

ENOS: So I guess I was using that as an analogy for some other work that--what I was talking about that for was for the surface that we were putting the salt on and looking at. The crevice corrosion work was a carryover from sort of a prior repository program where we were trying to see if you could get stifling in limited reactant. So that's what we were doing there. We definitely wanted to have a crevice present.

FRANKEL: I'm sorry, but that's in Yucca Mountain, causing a crevice; is that--

ENOS: Well, not just dust. It could be, you know, a container resting on the--

FRANKEL: The support--

ENOS: --support structure, rock coming in contact with the surface. There can be any number of things that could give you a crevice, maybe not as tight as what we're generating, but--

FRANKEL: These canisters are resting on something also, clearly?

ENOS: Yeah, but, you know, when you--

FRANKEL: Not at the weld--

ENOS: --think of this canister--I mean, so it's sitting on--well, so if it's a vertical system, it's sitting on a pedestal. Your baseplate is, I don't know, six inches or so thick. So you could worry about, I guess, attack of that weld there. But, I mean, yeah, I'm not thinking that crevice corrosion is a significant concern for these.

FRANKEL: Thank you.

EWING: Other questions from the Board? Sue?

BRANTLEY: Sue Brantley, Board. I'm just curious. Can you talk a little bit more about the example where you only saw calcium and sulfate? That seems kind of mysterious to me.

ENOS: Oh, so in the--I mean, so we took--these are the samples that were taken from the brackish water sites, so there were wet samples and dry samples. The wet samples were the SaltSmart device that Steve showed you. The dry samples were taken--well, there are two different ways in which it was done. On one of the sites you had the abrasive pad, and then you had a filter paper behind that, and you were pulling air through that. So as you abraded the surface, you'd knock loose stuff and collect it in the filter paper, and then we analyzed what was present there. In the second set you were just using an abrasive pad and hoping for static attraction to hold the particulate present there.

For none of these do we really have a good idea about extraction efficiency, how effective they are removing everything from the surface. But the analysis was on the particulate that were present on the dry pads as well as the materials that were evaluated in the wet samples.

So I don't--I mean, the analysis--that's what was present. There was also pollen and other sort of stuff that you might expect to find--

BRANTLEY: And you thought the sodium chloride vaporized somehow or something? Is that what you're saying?

ENOS: Well, so we don't--there are a lot of different interactions that can happen if you have ammonium species that are present where you can degas and lose the chloride with time. We aren't saying that "and the reason we see this is because we saw these degassing." That's just one possibility for, if you had significant chloride deposited, you could lose that chloride if they were, you know, from, I don't know, a nearby fertilizer-type stuff, I mean, from--if you look at Diablo, there were cow pastures and stuff all around. There could be all kinds of things that would give you ammonium minerals that might be deposited on the surface as well.

We’re in the process of doing tests where we deposit 100 micrograms per square centimeter of mixed salt loads containing these ammonium materials as well as chlorides, expose it to relevant temperatures and humidity levels for periods of time, and look at how much material is present on the surface. In the case of, like, ammonium chloride or ammonium nitrate, you put that at 70°C, and it’s gone--you know, 100 micrograms is gone in hours.

So this process is very real, but we need to do some more work to demonstrate the effectiveness of it in terms of removing chloride materials.

BRANTLEY: But wouldn’t you still have the sodium there? Aren’t you expecting there to be sodium?

ENOS: There could be sodium present, yes.

BRANTLEY: But you said you only saw calcium and sulfate.

ENOS: Those were the dominant materials.

BRANTLEY: Oh, there was still sodium?

ENOS: Yeah, there is--I should--I can provide the SAND report numbers. The reports are all publicly available that give you the full rundown of all the different species that were present. It wasn’t just we saw calcium. There was a whole slew of things that were there. I was just trying to briefen (phonetic)the slide.

EWING: Other questions from the Board? From the staff?

Bob, this is another chance for you.

EINZIGER: I have no questions.

EWING: Okay, caught him off guard. All right.

So I have one very, I guess, naïve question. Are there alternative materials that could be considered?

ENOS: For the canisters?

EWING: Just to avoid this problem.

ENOS: Well, I mean, surely there are other materials, I mean, you can just go to more significant or, I guess, higher alloys like 316L, something like that. But the thing is, we have a field of these that are out there, and we can't change them; right? So the systems that we're worried about are what they are.

There is certainly some work--I think AREVA TN recently put out some ads where they're offering a duplex stainless steel as a material. So there are certainly materials that you could use. They do come at a cost. You could use 304 even. If you were worried about stress corrosion cracking, you do something to mitigate stress. You could do low-plasticity burnishing or peening at the welds to give you a compressive stress state at the welds, maybe address this.

But I think what we're trying to do, certainly in the work that we're doing, is to address these fielded systems. We just don't have that option. The systems are fielded; they are what they are.

EWING: But we have a lot of casks ahead in the future, so it might be wise to consider--

ENOS: Yeah. And if you go into the--you look at the CoCs for, say, the HOLTEC system, they aren’t just 304. It could be 304, 304L, 316, 316L. There’s a whole bunch of alloys. Now, I’m sure, you know, if as a vendor you go--or as a utility you go to them and say, “You know, I want my system out of 316,” they’d be more than happy to supply that. But they’re going to--it’s--

EWING: Cost.

ENOS: --cost, yeah.

EWING: Yes, Jerry?

FRANKEL: Frankel, Board. So I have one more for Shannon if we have the time.

EWING: Yes.

FRANKEL: So you said that the data don’t support evidence of crack growth rate dependence on chloride loading, for instance, or stress intensity. So in stage II cracking, you would expect an environmental influence on the crack growth rate. So--

CHU: There is a difference between crack initiation and crack growth rate. And, as I said, we’re working with just a handful of data points, and there was not enough data to include in our crack growth rate equation a relationship between the crack stress intensity or the chloride loading.

But the report acknowledges, and in our susceptibility criteria when we're looking at evaluating the sites that are of more interest, obviously more chloride, more likely to initiate CISCC sooner.

FRANKEL: So these were pre-crack samples that were loaded with salt, and then crack growth rate was measured in that humid environment?

CHU: So the data points that were used, they were from CRIEPI, and they used a salt droplet method to initiate cracking at a particular point. And then they measured the--they were able to measure the onset of cracking and the continued growth rate. So we relied on a very small dataset for our crack growth rate equation where they were measuring--not a lot of the data that's out there is the total time for initiation plus growth. And there are very few experiments available with just crack growth rate, and it's those few experiments that we used to get a crack growth rate--

FRANKEL: So maybe the local environment was independent of the exterior loading.

ENOS: Sure. I mean, these are--you know, the CRIEPI work is done on a four-point bend test, so it's not done on, like, a nice fracture mechanics type specimen. So you have a dynamically changing stress intensity.

And so there's a lot of features to the test that need to be de-convoluted. There's a change in slope of the crack growth rate, and current understanding or interpretation is that that change is from sort of an initiation process to a steady-state growth rate. But you don't--there isn't a ton of data out there, and there is certainly work to be done to refine our understanding of the crack growth rate as a function of time.

But certainly CRIEPI has a dataset that's fairly consistent within itself, but it is a non-standard sort of test to generate that information.

EWING: Thank you. Efi?

FOUFOULA: Efi Foufoula, Board. So this is a naive question, but is there any research and development in self-sealing materials or--I mean, you are aware of the science news that came, like, a few months ago on self-sealing concrete. You imbed bacteria which are dormant for decades, and they've become alive only when they sense water in their environment and not only they produce whatever materials to seal the cracks.

So is there on the horizon any ideas along those lines?

ENOS: I am not aware of anything for metals. Certainly for coatings and composites and stuff like that, there is a wide variety of maybe microencapsulated additions--sometimes it's inhibitors; sometimes it's film-forming materials--where you can address damage in an organic material. But I'm not aware of anything for, you know, like a 304 or a canister or something like that.

EWING: Go ahead.

FRANKEL: Frankel, Board. So I think, just to follow the line of thinking, rather than just monitoring for cracking, there is obviously the idea of changing the local environment. So rinsing or applying an inhibitor, you could rinse with an inhibited solution periodically if you could get in there and try and improve the--so we know we can inhibit things with chromate, for instance. We're not worried about the effects of chromate in that environment.

ENOS: Yeah, I think certainly we've, at least, you know, maybe jokingly, talked about the idea of washing the canisters down and stuff like that. But then, you know, you get to worry about like, well, what happens if it collects in some area, it wicks underneath the canister and makes it worse under there or something there? Now you've got a crevice that you've introduced water.

So it adds a lot of questions. But, yeah, why couldn't you just clean the canisters? I mean, I--

EWING: Other--Dan.

OGG: Yes. Dan Ogg of the Board staff. I believe Steve mentioned in his short slide presentation that there is some work going on at Penn State regarding detector technology.

Can someone from the lab possibly speak for DOE and talk a little bit about other research programs funded through the Nuclear Energy University Program, the NEUP program, that are focused on this issue of dry storage of canisters?

MARSCHMAN: Ken, could you mention the one that’s probably just been funded? We have another IRP, I thought, that got funded this year that Sandia wrote?

SORENSON: We didn’t write it.

MARSCHMAN: Well, I thought you guys did.

SORENSON: No.

MARSCHMAN: Sorry, didn’t mean to put you on the spot. I just remember during the call there was another looking at stress cracking detection.

SORENSON: Right. So--

EWING: Identify yourself.

SORENSON: Yeah, Ken Sorenson from Sandia National Laboratories. Yeah, I recused myself from that review, because I’m from Sandia. So I can’t remember the actual university that was the lead on that, but there is a fair amount of work going on right now under NEUP in terms of looking at the deployment of these systems, which Steve is looking at, but also the NDE technologies--different type of technologies that can be deployed to actually look at corrosion, surface condition, and then crack depth as well, and in really looking at a wide range of different types of technologies that could potentially be used.

And so the challenge, I think, is to take potential NDE technologies that can be used and then tie that to the deployment technology that Steve talked about at Penn State and have actually a working system that can be used at the site.

MARSCHMAN: Yeah, if I could add, so in the fast IRP that Sean McDeavitt led out of Texas A&M, Darryl Butt at Boise State has been working on an instrumentation package that could potentially be placed in the environment. And I called it the “guitar string” method, but they have a method for helping identify when one might want to sample the surface of a canister by looking at a surrogate that’s placed in the same environment; and when that surrogate fails, that might be an indication of a time to begin looking at a canister for the possibility of an unsuitable environment being developed.

That’s the big one that I know about. That IRP is just coming to completion this year, and we’re looking at how to maybe integrate some of that kind of stuff into what Penn State is doing.

EWING: Okay, thank you.

I’m afraid we’re out of time for this part of the program. So I want to thank all of the panel participants. This was very interesting.

And we'll move on to the next presentation, which is by Meraj Rahimi.

You can go to the podium if you like.

RAHIMI: Hello again. My name is Meraj Rahimi. I'm the Chief of Criticality, Shielding, and Risk Assessment Branch in the Division of Spent Fuel Management at the Office of Nuclear Material Safety and Safeguards at the NRC.

So, actually, when I got the invitation to speak and the questions that--or three questions the Board was interested in, rather than really trying to put together very detailed slides and go down into the weeds, I mean, I tried to take, really, a ten-thousand-foot approach. And those questions should be answered through this presentation, and hopefully it will generate more questions. I'm sure Bob will have more questions.

So the title of my talk is the "Regulatory Perspectives on Transportability of Spent Fuel Dry Storage Systems." So let's look at the Part 72. Is there anything in Part 72 with regard to transportability of these systems? The regulation, Part 72, was developed in the late '80s, in the '90s. And, as you can see, that part very directly speaks to the transportability. But, as you can see, it's not a very hard and fast requirement. It says, "To the extent practicable in the design of spent fuel storage casks, consideration should be given"--no hard requirement--"to compatibility with removal of the stored spent fuel from a reactor site, for transportation, and ultimate disposition by the Department of Energy." So that is the one requirement you will find in Part 72. But it is not a very enforceable requirement; let's put it that way.

And, of course, you've got to remember the atmosphere of the era that this regulation was put together. The reactors were running out of storage. They wanted something, a dry-storage system, additional storage; and they did not want to be imposed with an additional requirement for transportation or for disposal, because at that time it was thought that is the DOE's responsibility, the utilities trying to deploy a system that is most cost-effective for them, and it relieves them from running out of storage--full core reserve. So that was the era. And so that's when the regulation was put in place.

So what are other parts of the Part 72 that speak to the transportability of the system. There is the Part 72.122(h)(1), which is specifically with regard to the spent fuel in terms of how well the spent fuel has to be protected during storage in order for subsequent removal for transport or for other purposes. So, as you can see, the requirement says, "The spent fuel cladding must be protected during storage against degradation that leads to gross rupture," so that is very clear, but, next part, "or the fuel must be otherwise confined such that degradation of the fuel during storage will not pose operational safety problem with respect to its removal.”

So the requirement is, okay, you’ve got to protect the fuel cladding, but there is the option--you’ve got to demonstrate that even if you have gross rupture, you have systems in place that do not create risk--they don’t create risk during operation--during the removal of fuel. So removal, again, one could relate it to transportation.

The next part of Part 72 that could be related to transportation, under 122(l), regarding retrievability it says, “The storage systems must be designed to allow ready retrieval of spent fuel, high-level radioactive waste, and reactor-related Greater-Than-Class-C waste for further processing or disposal.” So there is a requirement for the retrievability; but, again, it is not specifically--it says that the single fuel assembly has to be retrievable. It’s just the question you have to remove the spent fuel.

And in 2001 the staff issued a position paper interpreting that requirement, and at that time the position that the staff took is that the retrievability has to be both by assembly and by canister. That was the position that the staff took back in 2001, which I will talk later on, and that is, we are reconsidering that position.

Now, going to Part 71, from Part 72 to Part 71, well, Part 71 is all about transportation. But the Part 71 requirement is written in a way that it is a performance-based regulation. It does not pose specific requirements on specific components, systems, its performance. So that gives flexibilities in assigning the safety function. So when it comes to transport, if the applicant elects to assign a safety function to fuel, they could do that. If they don't want to assign a safety function to fuel, they have to assign it to some other system, canister, they could do that.

So the requirement--the Part 71 requirement, again, is performance-based. It just outlines what the transportation system--what kind of a protection it needs to provide. It is not a function of a specific component.

So I guess that's my second bullet, "The storage system components relied on for safety transportation must satisfy Certificate of Compliance conditions." It is actually very simple. We issue a Certificate of Compliance, everything that up to date we have reviewed is for assuming the components--they are in pristine conditions, the original analysis, as far as the package is considered, you know, any degraded condition.

So the system components under the transportation, basically the package is defined: content and packaging. Packaging is the same thing as cask, but that's a regulatory term that is used under Part 71.

So this is what the applicant has as their option: What kind of safety function do they want to assign to the fuel, inside to the canister, the canister, or to the overpack? So for transportation for the canister-based system, those are the, really, three main components that it could have. So that's the question that is asked, you know, under transportation. The applicant comes in, submits the application safety analysis report.

The first question is asked: What is the role of the spent fuel in satisfying transportation safety functions? What are the safety functions? Containment, for one. That's the most important part of transportation. Is cladding--is it providing--are you taking credit for cladding in order to provide containment or confinement of the fuel? What is the assumption about the fuel fraction release from the cladding? Those are the questions that will be asked. And those are the safety functions that the applicant has the flexibility, you know, to impose on the fuel or not, depending on the fuel condition.

In terms of criticality safety, okay, are you relying on the geometry of the fuel during transport? Because, as you well know, criticality safety -- one of the important parameters is geometry. And are you relying on the burned fuel, what is called burnup credit? And that is a safety function that spent fuel could perform in terms of--as one of the components for criticality safety.

So those are the things that the applicants through the design they go through--they need to go through this and think about if they can--if they want to take credit for the spent fuel assembly to perform any safety function, they have to be able to demonstrate. So that is the content. That's what I mean by content performing safety function.

Packaging, again, same thing as cask. That's what I mean. When you really think about it, it's very simple. I mean, you've got basically in the U.S. two main systems deployed; and then you've got variations of those. One is the direct load--is on the right. That is the direct load, non-removable basket, doesn't have canister. The other one is a canister-based system, and you have different variations of this. This is vertical. You could have this in a horizontal form. That's the NUHOMS system. The overpack could be storage-only overpack. It could be transportable overpack, for example, a Trojan, what they decided to do, to put a canister in a HI-STORM 100 transportation overpack.

So, basically, these are the two types of system you're looking at right now currently deployed on the commercial side, canister-based system, direct load.

So given these--these are the components that you have. The question would be asked, what the designer, the applicant, has to go through, okay, what are the safety functions that each of these components are going to perform? If the canister is going to perform a safety function--again, that goes back, I guess, to the earlier panel discussion. The premise of the whole discussion was, the applicant for transportation comes in, they want to take credit for a canister. Why do they want to take credit for canisters? You know, in terms of the overpack for transportation really is the one that does most of the safety function.

Under some condition for transportation that you might need to take credit for canister, that is, if you cannot maintain the fuel geometry under transportation condition, generally these days high-burnup fuel. The tests are not complete, so the designers, they don't have the data to demonstrate under the design basis accident they can maintain fuel geometry. They want to take moderator exclusion. And what does that mean? Meaning they have to have--what the staff has defined--if a designer wants to take moderator exclusion--because this is for criticality safety, because under Part 71 it requires the applicant analyze under the accident condition with the cask transport package fully flooded with fresh water.

So normally these designers, when they analyze fully flooded with the reconfigured high-burnup fuel and sometimes with burnup credit even, they can't make it; they can't satisfy the criticality safety requirement. Therefore, they ask for moderator exclusion, meaning that they have enough barriers. And the staff has defined, if you want to take moderator exclusion, you need to have two barriers. So, in that case, the designers rely on canister as one of the barriers, one of the two barriers. And that is under that condition that the canister is performing a water barrier safety function.

So the applicant should go through these, you know, asking the question: basket, canister, overpack. So not only on the canister, let’s say the storage canisters, if they rely on it–-IF--to provide the--be the water barrier to provide the safety function, they also rely on the basket inside the canister to maintain the fuel geometry. The fuel geometry, again, the separation between the fuel assembly, you could have a reconfigured fuel within the fuel cell. But that basket, the criticality safety analysis assumes that the fissile material even within for a reconfigured fuel, let’s say for high-burnup fuel, it is confined to that fuel cell inside. So the basket has to remain intact.

So if the applicant is relying for their basket in an aged canister that has been storaged for 20, 40, 60 years, to provide that geometry control they need to demonstrate indeed through that storage 20, 40, 60 years that there hasn’t been any degradation to the basket.

So, actually, this is more repetition of what I just said, that the qualifying different storage systems as transportation packages require different operations. I was basically going back to the same slide, that if it is a direct-load system, you know, that is different than these canister-based systems. Actually, we have processed both applications for both systems that have in storage for a while, and we issued the Certificate of Compliance for transportation for both systems.

So if they rely on an aged canister, remember that the Certificate of Compliance is issued for a canister that does not have any degraded condition. But they must have all the aging management program, the whole chain-of-custody that goes along with that canister if they want to rely on canister to perform a transportation safety function.

So these are some of the systems we've processed to date. A few years ago the VSC-24 applicant came in. This was one of the systems I think is on the DOE list; it's truly a storage-only canister. And they could not pass the first structural criteria. It's under a 30-foot drop. The basket could not satisfy the ASME code safety margin. And they had done the criticality safety. That system does not have even a poison plate in there. That VSC-24, it was one of the earliest dry-storage systems that one of the utilities deployed, and it is a storage-only, no poison, and it wasn't designed for transportation.

So when they submitted the application, I mean, the structure is really the first criteria you’ve got to go through under a 30-foot drop, if that basket can survive. I mean, you can play with the impact limiters to reduce the G-load to the package, to the overpack, subsequently to the canister. And so they wanted some relief from the ASME code. We told them, well, they got to go to the ASME code.

And with respect to criticality safety, they performed canister-specific criticality safety analysis. That means they did a calculation for each individual canister. So it was a combination of full burnup credit, and still some of the canisters didn’t make it. It showed they’re above .95 k-effective, and they were planning to come in for some kind of exemption. But, subsequently, because of the, really, mainly structural issues, the applicant withdrew their application.

TN-40 was the, I would say, first successful storage cask that went through the certification, and that took a few years. That’s a metal system. It was designed--it was robust enough to satisfy the transportation safety requirements, but it still ended up with a number of conditions in the certificate. And there was a long list of conditions, one of which, if they get ready to transport, they have to take the cask back, replace the seals. They have to insert spacers, because they had a few inches of gaps between the fuel and the closure--the cavity. And because of that large a gap, under accident conditions, that would result in the dynamic amplification of the load; and, therefore, it was the--it was going to be--you know, they would exceed the stresses. But still they agreed--I mean, one of the conditions also, they would replace the closure bolts, put high-strength closure bolts.

So there were a list of conditions that we put in the certificate that they have to satisfy and perform those operations before they can transport.

The most recent one was MP-197. This was a big system. It was the overpack--it was--it came in as an amendment. We had already approved the MP-197, the overpack. It came as an amendment to transport a number of the NUHOMS canisters. And what was unique about this application, it had a high-burnup fuel. And this was the one they required moderator exclusion.

So the aging management program requirement was put in the certificate, so they needed to comply with that. And when the time comes to transport--because since they didn’t have the data at the time about how the high-burnup fuel cladding performs, they had to assume it was the total fuel reconfiguration under accident conditions; therefore, it made them to rely on the canister as the first water barrier. And so included in their certificate and the SER that we wrote is all the aging management program that they need to have to demonstrate at the time that still the canister satisfies the transportation requirement.

The other system actually was the HI-STORM/HI-STAR. The Holtec system uses the same canister, but they have two separate certificates. And although they have the HI-STAR system, they continued loading some of their storage systems--it’s the same canister design, but they continued loading for storage only. What I mean by, for example, for their transportation, the HI-STAR, they have full burn-up credit. As part of their full-burnup credit, in the certificate the requirement is they have to do high-burnup verification measurements prior to loading the spent fuel. And they have not done those operations, we know, for the canisters they have loaded.

But, of course, since then we issued--NRC revised the guidance on burnup credit, and we provided an alternative to the high-burnup verification measurement, do a misload analysis. So those systems--the Holtec has been loaded in the Holtec system. If they want to be transported, they have to do a misload analysis.

I think one other question was: What are the guidance that the NRC is working on? In terms of facilitating the compatibility within Parts 71 and 72, we recently issued a High-Burnup Regulatory Information Summary.

It is a roadmap between storage and transport regarding specifically focus on high-burnup fuel.

What are the licensing paths if you've loaded high-burnup fuel in the storage system and you want to transport, and what are the licensing paths that you can take in order to qualify that canister loaded with high-burnup fuel for transport?

As I mentioned, the NRC is right now reconsidering the Interim Staff Guidance-2, which I said in 2001 we issued a Position Paper 2001, which ISG-2 references. ISG-2 is about retrievability. In that ISG the staff position was retrievability both by fuel assembly and canister; and we believe that is sort of Achilles heel right now in terms of the damaged fuel, I guess we heard earlier, up to four percent of the fuel currently at the decommissioned sites, are damaged fuel. So that question about retrievability comes.

And we are reconsidering reexamining the basis for that, and we're going to go in to see if you've got a damaged fuel that is not canned--in a damaged can--can you still meet the Part 72 retrievability requirement, and do you still meet all the safety requirements for transportation and storage.

The other big piece, as I mentioned earlier, that we're working on, the staff, is the NUREG-1927, which is really focused on aging management, extended storage, and developing the aging management tables and the ten criteria, which is part of the aging management program and which that would sort of help the applicant when they come in and they want to make a case to take credit for any of those components that happen in storage for a long period of time, how they can qualify those components for transportation.

So that's my presentation. I wanted to provide sort of a more big overview of how things are, and I'll be more than happy to answer any questions you may have.

EWING: Okay, thank you very much.

Questions from the Board? Linda?

NOZICK: Nozick, Board. This might be a question between yourself and Melissa Bates from this morning. So the discussion of the stuff in storage at the stranded sites, there was a comment made this morning that either they were in transportation-approved casks or they were in casks that could be approved for transportation. How does that compare with the restrictions--so you've seen some of these that have come back for re-licensing with some restrictions. Some have been declined. Where does that put the inventory that's sitting out there now? Is there any new--how much work will it take to actually move some of that stuff?

Might take multiple people.

MAHERAS: This is Steve Maheras. Could you put up that slide again that had five casks, I think, that he had that had the issues? Those right there. Okay.

So if we take the first one, none of the fuel at the closed sites is in that cask or cask number two. Cask number three, we would use the MP-197 HB model, the one that was just approved by the NRC, to ship from SONGS, I believe. We also would use the HI-STAR to ship, but we don't have any fuel in storage in a HI-STAR cask at the closed sites. So, really, the only one in play for us is the MP-197 HB cask.

EWING: Yes.

BATES: I think the question is larger than that--and correct me if this is wrong--in that I believe you're asking not only for the closed sites, but also for the full inventory at the operating reactor sites. And my understanding--

NOZICK: I actually had the easier question, because I know the other one has problems with the other 427.

MAHERAS: Yes. So the answer to the question is that it really doesn't play in our analysis, because we don't really have fuel in those systems at the closed sites, by the grace of God; right?

NOZICK: Okay, thank you.

EWING: Yes, Paul.

TURINSKY: Turinsky from the Board. When you're certifying these casks, what do you assume about the transportation? Does that basically meet the worst of road, ship, you know, rail?

RAHIMI: When we are approving the application for transportation or storage?

TURINSKY: No, in approving the casks. There have to be some assumptions about how it’s going to be transported.

RAHIMI: Okay, storage casks, when we are approving the storage casks. Okay.

TURINSKY: Storage and transportation casks.

RAHIMI: No, we--the applicant--under our regulatory infrastructure the applicant submits either under Part 71 or Part 72. The applicant can--we haven’t had an application submitting under both, but each of them are a distinct certificate. And generally they come in, you know, for the storage. Historically, they have come in for storage only, but most of these--I think it was mentioned, especially recently--they have been designing the storage canister with transportation in mind.

But we cannot impose transportation requirements on them while we are reviewing under Part 72. That’s what we can enforce. We cannot go beyond--

TURINSKY: It just seems illogical, though.

RAHIMI: Well, yeah. In Europe, Germany, yeah, they require for a storage system to be dual purpose. All the systems they approve have to be also certified in transportation. But in the U.S. this is our regulation that

I explained earlier that when the regulation was developed in the late ’80s, ’90s, it was to provide relief to the utilities that were running out of storage; and they wanted storage-only systems. And that’s how the regulation was developed.

EWING: Jerry.

FRANKEL: Frankel on Board. So I’d just like to follow on to Paul’s comments and ask for a little more clarification of the terminology. So you talked a lot about transportation safety functions, presumably there are storage safety functions; right? So we’ve heard about structural aspects and criticality and water barrier and shielding and retrievability. So can you clarify what are the properties--I don’t know what you call them--so these safety functions for transportation and what they are for storage?

RAHIMI: Sure, yeah, I can quickly, I mean, without going into details about the regulation pages.

FRANKEL: Yes, that’s fine.

RAHIMI: If I were to sort of go sequentially from structural, basically under Part 72, what are the design basis loads? They--

FRANKEL: So, again, this is for transportation safety functions or storage? Which one?

RAHIMI: Starting with storage structural--

FRANKEL: Storage structural.

RAHIMI: --then go to transportation structural--

FRANKEL: Okay, thank you.

RAHIMI: --then go to contain and storage. So I will compare each of them.

FRANKEL: Okay.

RAHIMI: So under structural storage, the regulatory requirements are cask tip-over. It is not a 30-foot drop like transportation. And so the design basis loads are much lower than the transportation. So you can imagine what's the result. So you don't have all the stresses, you know, to the basket, fuel cell, overpack. And the cask tip-over is the transfer cask, really, during transfer of canister if it's a canister-based system.

There are requirements for tornado missiles, seismic events; all those requirements are applied for a storage system. But, really, none of them come close to the 30-foot drop for a transportation system, which supposedly encompasses 99.99 percent of the accident that the spent fuel cask might be involved in. So you could see that what it results in terms of the safety margin, in terms of requirements of the system.

On the other hand, on the transportation, as I said, the requirements are a normal condition or the vibration as far as structural is concerned. And then there is a puncture, there is a fire, there is a 30-foot drop. So it is a lot more severe that the transportation package has to survive. So the system has to be a lot more robust. You just can’t put it on a concrete overpack which is on the storage system and transport it.

FRANKEL: Right. And, again, the storage would have a function of protection from the environment so corrosion resistance, and that’s not a property that’s required for a focus of transportation safety?

RAHIMI: See, on the transportation you have the annual maintenance requirement, and they replace seals for every shipment. So, really, the age degradation doesn’t come into play. I mean, the certificate is written--the original degradation--it has to be, you know, I guess, pristine. So that’s what the applicant CoC holder maintains.

And they do annual maintenance on the entire system. When they offload, you know, they inspect the closure lid, the containment. And so we have—it’s not a storage system. So the age, you know, doesn’t come to play. Every year the seals have to be replaced. That is a requirement.

FRANKEL: So, to get to the point that was made by Paul, so the design criteria are very different--

RAHIMI: Very different.

FRANKEL: --for the two or for the case of both to--

RAHIMI: Yeah, design criteria--

FRANKEL: --satisfy both would be very different.

RAHIMI: That’s right, yes. I mean, the transportation is a lot more challenging. If a system really qualifies for transportation, it will easily qualify for storage, but not from aging. The aging comes into play, right.

FRANKEL: Okay, right. Okay, thank you.

EWING: Lee?

PEDDICORD: Lee Peddicord from the Board. I’d like to go back to the four percent number that we’ve heard a few times today, and this is kind of for my understanding and clarification. And if I understood correctly what Melissa Bates was saying this morning that this number of failed fuel, percentage of fuel was four percent on an assembly average. So is it correct to interpret this that it’s not up to four percent of the 10,000 fuel rods in a 32 P canister failed; it would be a failed rod in perhaps four percent of the assemblies, which would turn out to be a quite different number?

RAHIMI: Yeah, I’m not quite sure. I think Melissa can answer that. The four percent actually is today what I heard, the four percent. But I’m sure—I mean those what they have loaded, they’re loaded according to the tech-spec, you know, those failed, I assume, in a can, those—-

PEDDICORD: What I was really trying to understand is that four percent of the rods--it was four percent of the assemblies might have a failed rod in it. So--

MAHARES: This is Steve Maheras again. Yeah, that's exactly right. It's four percent of the assemblies may have a failed rod or other things that cause them to be classified as damaged; okay? So it's not every rod in each assembly is damaged. It might only be one rod, two rods in an assembly that's damaged. But according--

PEDDICORD: And it's not four percent of the 10,000 rods. It might be in--

MAHARES: No, it's four percent of the assemblies. But what's important to understand here is that there is quite a range on that number, too. So if you look at a site like the La Crosse site, you might find half the assemblies there are damaged, because that's an older site, stainless steel clad fuel, shutdown a long time ago; okay? Then you go to a new site, and it might only have a couple of assemblies that are damaged and have to be packaged thusly. So there really is a wide range on that number.

PEDDICORD: And, again, in an attempt on precision, those assemblies might have some damaged rods in them when you say a damaged assembly.

MAHERAS: Yeah, might have some damaged rods. But you have to understand, too, the way the utilities will sometimes consolidate damaged rods into one assembly and package that assembly as damaged, put inert rods in the other assemblies that the first rods came from, thereby not having to package them as damaged. So they may treat their fuel thusly and consolidate into one assembly with many damaged rods as opposed to sprinkling it around the inventory at the site, thereby avoiding that problem where you're only allowed to place four assemblies in the damaged fuel positions.

PEDDICORD: And it's not the way it came out of the reactor; it's due to the consolidation.

MAHERAS: Yeah, the consolidation took place after the fact, yeah.

PEDDICORD: Thank you.

EWING: May I ask a question?

RAHIMI: Sure.

EWING: Ewing, Board. So I was very interested to see the quotes from Part 72, particularly the quote that says, "Storage systems must be designed to allow ready retrieval of spent fuel, high-level radioactive waste"--I'll skip a few words--"for further processing or disposal." And what attracts my attention, of course, is "ready retrieval," because in our discussions about repackaging, one of the difficulties that's often raised is it's not so easy. "Ready retrieval" is not a phrase that I've heard before.

Also, high-level radioactive waste, the storage system, I presume that's the vitrified waste in a canister.

RAHIMI: That's right.

EWING: And so would that storage system be considered as readily retrievable for future processing? Could you elaborate a little bit on the--

RAHIMI: Sure, yeah. So what you are thinking about, you are thinking about on an assembly basis, yes. If you think about assembly basis, ready retrieval becomes an issue. I mean, that's why the staff is going back, re-examining the definition of retrievability. You could have a canister base that is readily retrievable, because you retrieve the entire canister, you retrieve the fuel. So that would still satisfy--

EWING: But it says "spent fuel and high-level radioactive waste." It doesn't talk about it being in the canister that's retrieved, because particularly it goes on and says "for the purpose of processing or disposal."

RAHIMI: Yeah, that is still--I mean, it doesn't say in the regulation, again, individual fuel assembly. This was the interpretation that the staff put in back in 2001. And in light of what we are seeing, especially for the extended storage, you know, as you go beyond 20 years, 40, 60, 80, 100, who knows how long the spent fuel is going to be in storage. Then, really, your technical basis saying that for the fuel, which you cannot see, you cannot monitor, you don't know, saying still it is readily retrievable on an individual basis, it becomes a little bit shaky.

EWING: But if processing meant, let’s say, reprocessing of spent fuel, you wouldn’t reprocess the package with the fuel; you would take the fuel out, right?

RAHIMI: Right, at some processing facility, right.

EWING: So it’s the connection of ready retrievable, spent fuel instead of spent fuel in a canister, and processing or disposal that really conjure up, in my mind, quite a different image than what’s described.

RAHIMI: Yeah, I mean, this is--you know, at that time, as I said, in 2001 the staff interpreted what you are saying on an individual basis. That’s why all the criteria that was put in to protect cladding, you’ve got to fit it against these other requirements in there. See? The spent fuel cladding must be protected during storage against degradation. I mean, it goes back there. Then if you do that, yeah, it is retrievable on an assembly basis.

However, you have the second part here that all the fuel must be otherwise confined. That’s why the use of the cans came about. Under current definition, damaged fuel--and we still store damaged fuel, right? How do we do that? We put them in a can that the individual fuel assembly can be readily retrieved.

EWING: But one difficulty, just my opinion, is that driving our understanding of the behavior of fuel or the vitrified waste into the can in some ways deprives us of the ability to really ask: How does spent fuel behave in certain environments when we come to the disposal part of the question? So this is the way it is, but to me it’s very revealing. I finally begin to understand how we got to where we are.

RAHIMI: A couple of years ago we issued a Federal Register notice. We invited comments about how do you define retrievability, and we got mixed comments. We got from DOE, from industry, you know. And so that was our first attempt to get the stakeholder input in terms of, are we really defining retrievability very strictly; are we making it impossible, especially given the extended storage, given that this fuel is going to be there, it could be, for hundreds of years and us not really monitoring, not knowing, because once it’s put in the canister or cask, sealed, I mean, there is no monitoring of inside of the cladding behavior.

We maintain the temperature. We’ve got these sort of a--these are the parameters that say, well, if you maintain the temperature below 400, okay, the cladding should be okay; there should not be any hydride reorientation. Then if the temperature doesn’t go below about 200°C, it doesn’t go through the ductile-to-brittle transition--see, we put all these temperature parameters. That’s the only one that we know of. But I think as you go further out, I mean, I would say that you’re stretching your knowledge about, you know, fuel cladding. And so it is time to re-examine the definition of retrievability.

EWING: Okay, thank you.

Jean, with apologies, if you can be really quick.

BAHR: Jean Bahr, Board. One of the questions that was posed to you says, “Please explain the action that the NRC is taking in order to reconcile differences between the requirements for storage regulations and transportation regulations that make it difficult or impracticable to transport some spent nuclear fuel held in dry-storage canisters and casks.”

And I’m not sure that I heard an answer to that question, because it implies that there are some sort of contradictory requirements in the storage and the transportation part that can’t be satisfied by a single type of canister system.

RAHIMI: I’ll give you a couple of examples. One example is this one, retrievability, that we’re talking about. In the storage there is a specific requirement about retrievability, but you won’t find that in Part 71. They could transport anything, I mean, you could--

BAHR: But that doesn’t make it impossible to have something that’s both retrievable and transportable. The question suggested that there were some things that were fundamentally incompatible or mutually exclusive.

RAHIMI: Yeah, I don’t think--

BAHR: I’m not sure if the question was well posed. I didn’t hear it answered.

RAHIMI: Well, I can give you another example. I mean, there isn’t--because it is through the design that the applicant has criticality safety. Let me give you another example. Under the storage, pretty much every system we’ve approved so far for criticality safety for PWR, the applicant has relied on the boron in the pool as the main means of criticality control, what is called boron credit. But you come on the transportation side, there is no soluble boron. You have to analyze with fresh water under accident conditions.

Why did they do that on storage? Because it was very tough, difficult to take a burnup credit approach. A few years ago, I mean, they had to jump through a lot of hoops, do a lot of benchmarking of the codes. The easiest way for them is to get approval on their boron credit for storage. But under transportation side, this wasn’t a difference in the requirements. It was what the applicant chose to do, the easiest path for certification that, hey, we’ve got this soluble boron on the reactor site for the pools, you know, they gave, actually, a burnup credit. But we allow to take credit for boron on the storage side. The regulation doesn’t go to that level. This is in the implementation of the requirement. It’s not in the regulation. That’s what the applicant chose.

But on the transportation they use burnup credit on HI-STAR/HI-STORM clearly you could see. So that created a difference. Right now the systems that they have put in storage in the HI-STORM, they’re all based on boron credit. If they want to transport that canister, it has to satisfy transportation requirements. That means they have to do burnup credit analysis now with the fresh water, not the borated water. They have to address the burnup verification, did they do burnup verification measurement, which we know they didn’t; or they have to do misload analysis. These are the misload analysis/burnup credit they have to do for that system if they want to ship it under that certificate.

So it is not the regulation, but the regulation actually is written at that level, high level. It’s performance based. It is what the applicants choose what route to take, you know, that has created that difference.

But this is one of the things we’ve been pushing, actually, in terms of--as it was stated earlier, what we see that more design are coming in really can qualify transportation, because a couple of weeks ago we had a pre-application meeting. We saw an applicant putting control rods in the assembly. For storage only they said, “No, we’re looking down the line for transporting. We don’t want to open up the canisters."

So they are thinking that way, and we are pushing from NRC side to provide that compatibility.

BAHR: So, just to make sure I understand, you're saying that there aren't any design features in the storage that would ultimately preclude it being licensable also for transportation; it's just that it's a different set of requirements that they have to satisfy.

RAHIMI: That's right, yeah. Most of the systems you look at is in storage. They do have poison plates in them. They elected not to go after burnup credit, because it was easier, because the pools, they've got boron in there. It doesn't require that much analysis. So that's how they chose to do it. But the systems, at least from criticality safety, you know, can be--if they go for burnup credit, if they do misload analysis, it can be qualified for transportation. Of course, it has to be evaluated under structural, the 30-foot drop--

EWING: Let me call the discussion to an end. And thank you very much for your presentation and answers to the questions.

RAHIMI: You're welcome.

EWING: We'll take a break now, and we'll begin, though, at 3:30 so that you have your full 15 minutes.

(Whereupon, a brief recess was taken.)

EWING: I'm standing here, because I want to, in a very prominent way--okay, you've been so good all day. So sit down and let's get started.

Now, I wanted, in a very prominent way, to say that this morning when I outlined the day's speakers, my opening remarks weren't updated by the most recent agenda. And so this afternoon's speaker is not the person that I announced, but rather it's Tony Williams of Axpo Power, and he'll be telling us about the Swiss experience in handling spent fuel.

T. WILLIAMS: Thank you, Mr. Chairman, ladies and gentlemen. Actually, I'm not so worried about being introduced as someone else, because if this all goes pear-shaped, then I can always blame someone else. I actually spoke with Mark, the other person, before I came, and we've kind of compared notes, so you're actually getting good value. You're getting input from two people.

So thank you very much for the opportunity to speak today. I have had a very interesting day so far. I've seen lots of parallels with what's going on in Switzerland and also lots of contrasts with what we're doing in Switzerland. And I hope to be able to show you a few insights and hope I'll be able to spark some questions at the end of my presentation.

There was a comment this morning comparing Switzerland with, I think it was, North Carolina.

SPEAKERS: South Carolina.

T. WILLIAMS: South Carolina. That's true, it's a small country. So maybe the comparison between the length of transport routes is not quite very relevant. But just don't forget that the density of population in Switzerland is something like ten times more than in the United States, so we have our own issues as well.

So what's also relevant is we've got almost everything in Switzerland. Whether that was a good thing or a bad thing, I'm not yet sure; but we've done dry storage, we've done wet storage, we've done reprocessing, we've done no reprocessing, we've done BWR, PWR, road transports, train transports. So I hope to be able to show you a little bit of all those things that we've been doing in the last years. I'm not going to be able to go into great depth. I'm not going to be able to fulfill your hunger completely, but I hope we'll be able to whet your appetite at least.

So that's what I'm going to talk about a little bit, first of all, nuclear power in Switzerland just to tell you where we're coming from and how do we manage spent fuel in Switzerland, how do we transport, a little bit about storage casks, regulatory requirements--and with that, I'll be able to answer the last question of the Board to the last speaker, I hope--a few slides on our quest for a waste repository, and then a summary and a discussion. I hope that’s okay for you.

So what’s happening in Switzerland over the last 50 years, we actually imported a nuclear reactor from the U.S. It came over in an airplane in the 1950s, and they left it there. And it was a research reactor, which was operated for many years, and I was actually working on that reactor in the 1980s. Then we built a further research reactor. We built our own designed underground heavy water tube-type reactor in the 1960s, then our first commercial reactor in 1969. Over the next 15 years then there were a number of commercial reactors built. I’ll come to those later.

Then the first negative signs appeared in 1989, obviously following Chernobyl and Three Mile Island. The first plans for a plant were cancelled. Since then we haven’t built any new ones.

In 2000 the ZWILAG interim storage facility was built. I’m going to talk a lot about that; 2008 the ZWIBEZ--that’s the same but slightly different, you’ll see--and in 2011 Fukushima obviously happened, and the government decided to phase out nuclear in the long term.

That’s a quick summary of what’s happened in Switzerland.

That’s a map of Switzerland. Those are the nuclear plants, and that’s what they are, five blocks on four sites. And we have generated--after 50 years of operation we will have generated 3,500 tons of spent fuel. I know that’s nothing compared with what you’ve generated over here. What may be interesting to you is 1,000 tons of that has already been reprocessed and recycled. Typical discharge burnups are around about 60,000 these days.

That’s our--it was originally our disposal route, our fuel management route. We had two options in the past. We could--obviously we stored fuel in the reactor ponds for a number of years, then we could decide. We could either send the fuel to reprocessing; the fuel will be stored in the reprocessing ponds for a number of years, be reprocessed; we would recycle the plutonium as MOX and the uranium as reprocessed uranium; and the vitrified waste would come back to Switzerland and be stored. Alternatively, we could store the spent fuel in a facility; and in both cases, of course, the waste or the spent fuel will go straight to the final repository when one exists.

When the plants were built, this was the preferred scenario. Therefore, the ponds were not built to be very large, because it was assumed that the fuel would be sent to reprocessing. Since 2006 the reprocessing route has been forbidden by law, and so we’re left with the open cycle or the direct interim storage followed by direct disposal.

That’s an aerial view of the part of Switzerland with the most nuclear facilities per square kilometer. This is the Beznau plant on the Aar River. This is the Rhine River. This is Germany back here. This is Switzerland, and this is the Leibstadt plant. And down here we have the famous ZWILAG facility, which is basically an interim storage facility, the sort of facility that we've been talking about all day, which you would like to build here in the United States maybe.

This is the ZWILAG facility, just a close-up of what's here. This hall is the high-level active waste hall, so I'll show you an inside picture in a moment. The other halls are things which are used for as a plasma oven for burning operational waste. There's a middle active hall for middle active waste. There's a low active waste hall for decommissioning waste, and that's just the administration facility-- also with the hot cells, which I will say something also about those in a minute.

This is the ZWIBEZ facility. For reasons that I want to go into in a moment, the Beznau Nuclear Power Plant decided to build its own dry storage facility, and that's what this hall is here. What you see there is a nominal capacity in ZWILAG for 200 casks and in ZWIBEZ for 48 casks, and we haven't yet used very much of that capacity.

That's an inside view of the ZWILAG hall. What you see are a number of casks. Some of them are CASTOR casks, a German-type fabricator. The other ones are TN casks. I'll come a little bit later into some details of which casks we've used and why.

This hall has a capacity not of 200 casks, but actually of a number of megawatts. I think it's 5.5 megawatts of heat generated. It doesn't have any active cooling, but the air is sucked in by means of natural convection through slots in the side of the hall and is released through slots in the roof, and that cools the casks through natural circulation. It's aircraft and seismic proof. And it's actually being used for spent fuel and for reprocessed waste, so vitrified waste from reprocessing.

This is something completely different. As a means of optimizing their fuel route, one of the plants, Gösgen, decided not to immediately use the dry storage facility in ZWILAG but to build a pond. And this pond is not actually in the facility but is about 100 meters away from their facility. It has a capacity for many years of production of spent fuel. It is home to 1,000 fuel assemblies and a heat removal capacity of 1 megawatt. That's passive cooling. They also have active cooling for accident conditions.

Interestingly, they don't transfer the fuel from the plant in wet state, but they dry the fuel within the casks, transport it or transfer it to the wet storage facility, and then re-wet it and put it into the pond.

This is the pond here, and these are the passive cooling vents.

This is quite a complicated slide. All I wanted to show you was the number of transports, the number of different types of casks which we've utilized so far. So looking--since 2000--I said in 2000, that was when the ZWILAG facility was commissioned. We've used a large number of casks. At the beginning these were high-capacity casks. That means low heat generation casks, so the first casks we loaded were TN97s, 97 BWR fuel assemblies, but with very, very low original enrichments and very, very low heat outputs.

As we moved forward and we went through the capacity of the pond, we were using hotter and hotter fuel. The casks which we needed to use then were more sophisticated, more shielding, and also less capacity; and our contemporary cask is the TN24BH, which has a capacity for 69 BWR fuel assemblies or 37 PWR fuel assemblies.

That's the number of casks as they were being delivered to ZWILAG. That gives you an idea of about how many casks per year are delivered. That's not very many. This is the number of transports. The gray on the graph shows you the reprocessing waste, and the red is the nuclear fuel which has been transported. What's maybe more interested is, this is the actual number of deliveries to ZWILAG.

What you see, for instance, in the year 2004 there were 22 deliveries of spent fuel. This is because one of the plants doesn’t have enough crane capacity or space in the pond for a big spent fuel dry cask. And so what it has to do, it has to make shuttle transports to ZWILAG, so it does 10 transports for every loading of the spent fuel cask. So what we’re doing here in these years, if they were to fill two casks, which will soon be happening in the future, they will be doing 40 transports per year on the road of spent fuel between this facility and between ZWILAG.

So yes, we’re small. We’re not even as large as South Carolina. But we do a significant number of transports in a country which is a very high population density.

This is one of those transports. Someone this morning right at the beginning said, “Imagine a spent transport cask driving through a small south U.S. town.” This one has just, actually, traveled through a small north Swiss town, and no one noticed even.

This will probably be a better photograph.

At the beginning when we started to do the road transports, we did them at night, because, one, we didn’t want to disrupt traffic and, one, we didn’t want to cause any media interest. In the meantime, we realized that there isn’t actually any media interest, and the transports now take place over lunchtime in the afternoon. What we don’t do, we don’t inform the media in advance. We inform the media when the cask has arrived at the facility.

The casks are not covered. That’s actually for heat dispersal reasons. If we were actually to use a canopy, then it would actually limit the heat content of the cask, and so we actually decided not to cover them. So that’s just a bare cask you can see there being transported.

What we also do, we transport by rail to ZWILAG. There is also a rail connection to ZWILAG. We tend not to transport by rail inside Switzerland, not because we can’t or because it’s difficult, but because it’s more expensive. So it’s a purely economic reason that we transport by road.

What this is, this is a transport of three casks of high-level waste coming back from the reprocessing plant. That’s transported by rail through France, through Switzerland, to ZWILAG; and then it comes to the transfer facility where the cask is picked up from the train onto a low loader and transported into the ZWILAG facility.

In this case, the information to the media is somewhat different. As soon as the cask leaves La Hague in France, the media are informed. So they actually know that there’s a cask on its way to Switzerland. Even so, until now, touch wood, we have had no great media interest or any problems with the permits.

Just a few developments, a few observations, which were made over the last few years. And now we're coming onto maybe some subjects that we've just been talking about. We use dual-purpose casks. And contrary to what was just discussed and what was just commented on what's been happening over the years in the U.S., we don't choose between a storage cask or a transport cask. We have in the past always used dual-purpose casks. That means a cask which has been, first of all, licensed for transport and then afterwards licensed for storage within the same licensing process so that we transport on the transport license; we take it to ZWILAG, for instance; we convert it into the storage configuration and it's left there; and then it carries on with both licenses effective. I'll come back to that in a moment what the differences are.

As I said, first of all, old and cold fuel was used and loaded into high-capacity casks. And as the hotter fuel started coming, we needed more sophisticated casks, casks with more shielding, casks with more boron, with more neutron shielding.

Modern high-burnup fuels are beginning to push the limits of the casks. At the beginning we only used one cask supplier; that was AREVA. What we've noticed is that we really have needed to diversify in our cask suppliers. We now have a policy of aiming for two suppliers per plant to give us a diversity, to give us a technical diversity, and to give us, of course, the commercial leverage which we need.

Something that's special for us is that we don't have any cask suppliers in Switzerland, so we have to license casks abroad. That means that we're dealing with other licensing authorities. That means that our licensing authority would provide us with a storage license. But, for instance, the NRC would provide us with the COC and the DOT for the transport license, and that has led in the past to, let's say, some cultural differences between the two authorities, at least one problem which you don't know.

That's a list of casks which have either been used or are being used now or are in the licensing process. Gray means we've used them but they're no longer being actively licensed or used, so they're stored. Green means the casks which are currently in use, and orange are the casks which are currently in the licensing process. For instance, the HI-STAR 180 that's just been mentioned has been granted transport license and is now going through the storage license process in Switzerland.

It was also just said that any cask which can receive a transport license can easily receive a storage license. Not necessarily true in Switzerland. As I said, there are different cultures in different lands, and the storage licensing is not proving to be trivial for this cask.

And the yellow are just casks which are potential candidates.

So a long, long list of potential casks and alternative solutions which we can draw upon if necessary.

That's just a few pictures of the casks. Interestingly, as I said at the beginning, until now all the casks we've used have been dual-purpose casks that have been licensed for transport and for storage. With the TN NOVA we've tried to do something different. We've tried to separate those two functions. Interestingly, you're doing your best to combine those two functions, and we are desperately trying to separate those two functions, because, you know, as has already been said, the transport capabilities of a cask are generally much more than those required to stand the cask in a hall for 40 years.

And so it forces us to buy and to license and to load casks which are much too good for the purpose of just storage, let's say, and we're only intending to do two transports with that cask. We're going to transport it to ZWILAG, and we're going to transport it to the final repository. And with the TN NOVA we've tried to separate that function.

We have the MP-197--we've also heard of that--which we intend to use to transport the cylinder. The cylinder will be a welded cylinder. And then when it gets to ZWILAG, we'll put that into a storage configuration until it needs to be re-transported again. That gives us a possibility always to have a licensed transport cask, because something you probably also don’t know is these casks, they are transport licensed according to the IAEA regulations, and the IAEA regulations change every five or seven years. And it’s not actually possible to keep these casks--it’s physically not possible to keep these casks licensed for transport under the existing IAEA regulations, because they change every five years. And after 40 years, that means we’ve already had eight changes, and by definition a cask which was loaded 40 years ago will not adhere to the current regulations.

So there have to be regulations as to how to transport these casks under special regulations or--in fact, last week in the meeting in Vienna solutions were starting to be discussed how to do this. And there will be a solution. There will be an administrative solution. It will have to do with maintenance of the casks over the 40 years, alternative proof of how these casks can be transported, although formally they don’t have the transport allowance anymore. Complex topic.

So that’s just--I think I’ll just--we’re not going to spend very much time on this. As you know, the transport of the material is given by IAEA Safety Standards. That’s updated every few years. In addition, we have the national and international transport regulations, the ADR and the RID;

and these standards require a demonstration to be able to withstand a series of accident conditions, which for storage we don’t need.

For storage, however, our country is responsible. And we have also our guidelines. And, as someone asked before, what are the requirements for storage? And those are our requirements for storage in this list. That’s the complete list. Static and dynamic loads, including aircraft impact, something that a transport license doesn’t need to prove. Requirements for the lid system, needs to have a double lid system. We need to have continual surveillance. That means we have to have a monitoring system on the lid continually monitoring the gas pressure within those two lids. Obviously criticality requirements.

Material aging over the stored period, we have had significant issues in recent years of aging of the basket material and not for storage, but for transport. So over 40 years the basket material will age, and will it still then fulfill the transport conditions under accident conditions.

Pressure barriers. Aircraft impact I’ve already said. Earthquake, we heard the cask is not allowed to fall over. Dose rates on the surface, temperatures of contents, and removability of fuel we’ve also heard.

Some current issues, transportability of--oh, I wanted to show--sorry, just forgot.

What I would like to show you is just one of the things which we have to do, which you don't have to do for transport--if you click on the top box, please. This is one of the tests we had to do for aircraft impacts. You can actually see this in YouTube already. There is a cask, actually, in here. That was meant to simulate the center of a jet engine impacting the most critical position of a cask, and the idea is to show that the cask even under those conditions will remain leak-tight.

If you could show it once more, one more time?

SPEAKER: Which one?

T. WILLIAMS: One more time, the same one.

This is actually a rocket on rails with a specially designed missile to bring the correct impact to exactly the parts on the test.

If you can next go to the one below.

So this is a slow motion picture of the same test. That's the cask, a mock-up of the cask. It's instrumented, of course, to measure the impact, the impulse, and afterwards we measured to see whether it's still leak-tight. This is a bolted cask, by the way.

(Pause.)

It's coming.

(Pause.)

This is a specially designed--it's actually not a metal missile; it’s actually a plastic missile, which is designed to provide exactly the right impulse over the right amount of time. This was done in the Aberdeen military base in the U.S. And the box behind has nothing to do with the test. It’s just that the last time we did this test the cask flew so far, it was difficult to find the cask afterwards. So that’s just one example of something that a transport cask certainly doesn’t have to withstand.

You can go back to the presentation.

Okay, go to the next--oh, I can do it. Sorry.

Current issues, which issues we’re dealing with, I just said transportability of the cask after extended storage. By extended storage I mean 40 years. This is not necessarily a technical issue. It’s more of an administrative issue, because, almost by definition, the license won’t be able to be renewed after 40 years, because the regulations will have changed so drastically. But this is being dealt with at a high level of the IAEA.

Behavior of the content during storage, I have the--this is maybe a controversial comment of mine. I have the feeling in the meantime there’s quite a large body of knowledge on the behavior of fuel in spent storage. Particularly, there is going to be a paper presented at the TopFuel conference in Switzerland in September, some interesting results from a research institute in Switzerland, which actually shows also under some very critical conditions for the storage of spent fuel, actually, the expected or the proposed migration of hydrides through the cladding doesn’t actually necessarily happen as we think it does. Rather, the radial hydride phenomenon in this particular paper is actually not confirmed.

And so, as far as I’m concerned, we haven’t solved the problem of the behavior of fuel in long-term storage yet, but I think we’re well on the way, and there’s a growing body of knowledge to support this. But it’s still an issue also in Switzerland.

Optimization of the post operation phase, that’s something that’s becoming more and more. We have to unload the ponds as quickly as possible, because we need to shorten the--we need to take the nuclear license away from the plant as quickly as possible. But this is just economics. This is not a technical issue.

And high-burnup and MOX fuel, of course, is a challenge to any cask.

I was also asked very, very briefly to talk about our plans for a final repository in Switzerland. This is the northwest part of Switzerland, and the dark brown area--excuse me for the German, but I didn’t have neither the time nor the desire to translate all this into English. But it’s very simple. The dark brown area is actually the clay rock formations which we intend to use for the disposal of waste, of high-level and low-level waste, in Switzerland. This is also the part of Switzerland which is least susceptible to seismic activity.

This is a very simple demonstration of how we intend to do this with a canister, and the canister will either have a number of fuel assemblies within the canister and welded--we haven’t decided yet whether that will be a steel or a copper canister. It will either have fuel in it, or it will have highly active waste from reprocessing in the--this will be emplaced several hundred meters underground in a stable clay formation, and the emplacement will be backfilled with clay. There will be no space around the canister.

As I said, 500 meters or so underground. There will be a ramp, and there will be a row of tunnels in which these canisters will be emplaced horizontally.

This is a timeline, also in German, but the important thing to see is that we have a long process. The final decision from our government will be in 2027, and the beginning of the operation of the high-level will be in 2060, and the low-level will be in 2050. So that’s kind of the time scales that we are planning on.

Also interesting to note, we were talking this morning a lot about consent process. We call it participation. The local stakeholders have been involved in this process for years now, probably for ten years now. They can't decide where the repository will be. That will be decided on purely technical and scientific criteria. But what they can decide is: What will happen on the surface? Where will the reception facility be? What will it look like? Will it be in the woods? Will it be in the town? Where will the rail connection be, etc.?

They're involved in the process, and they understand the reasons for putting a facility where it eventually is going to have to be. Doesn't mean to say that there's no resistance to the process, but it certainly helps the process.

I was saying at the lunchtime, it makes it difficult to plan, because if there is resistance, if there are additional questions, if there is additional uncertainty, you can't just carry on unheeded with the process. You have to deal with those questions, and that can lead to unexpected delays. But that's better than having a Yucca Mountain. Excuse me.

So that's the participation process I mentioned.

The search for the repository is carried by an independent body, by NAGRA, and the process owner is the Department of Energy. The money belongs to us and is fed into a fund, which is administered by an individual body, but it still appears in our books. So it actually belongs to the utilities still, the money. And the costs are re-estimated every year. Current costs are 20 billion Swiss francs for the whole program.

And that's the recent decision from January this year. It was decided in all those--from all the area of rock in the northwest of Switzerland, there will be two areas chosen, one here just north of Zurich and one here close to the power plants, both of which--this one is just for high-level waste, and this one can be used either for high-level waste or for low-level waste or for both together. And now the aim is to investigate both of those sites closer, more scientifically, to decide on one, to make a proposal to the government, and to decide on exactly which place will exactly be the place where the material goes into the ground.

Wellenberg was a suggestion. Wellenberg is kind of the Yucca Mountain of Switzerland. That was chosen by NAGRA many years ago, maybe 15 years ago, and there was some local participation but not enough obviously. And the proposal was made to use Wellenberg as a low-level waste facility. The influence of the public was underestimated, and eventually it was actually turned down. A lot of money was spent, and now it's been abandoned as a facility.

Summary--I'm coming to the end--I claim that the storage route for spent fuel and reprocessing waste is well established. It’s working. National and international transports take place regularly without any public or media attention. The importance of a stable or long-term storage have been emphasized by current events: premature plant shutdown together with delays in the repository process.

There are technical issues. There will always be technical issues, but I think they’re not insurmountable. They just have to be dealt with.

Transportability of casks after storage is an administrative but also a technical issue, but it’s being addressed at many levels.

And this is something which is contrary to what’s been said by other people today: the conflicting requirements of storage and transport potentially leading to overregulation. What I’m saying is, the casks which are stored at the moment are too good for storage essentially.

I don’t know how much time we have now. I have a brief video.

EWING: We have time.

T. WILLIAMS: I would like to show you just a brief video, which is a little bit of a PR show that actually shows you some of the--actually shows you many of the things that you’ll see in a movie.

(Whereupon, the audio portion of the video presentation was transcribed:)

NARRATOR: The correct treatment of waste is a serious responsibility. The raw waste is recycled. The last residual waste remains. This is exactly what we do, except that our waste is radioactive.

We receive spent fuel elements and operational waste from nuclear power plants, as well as low-level radioactive waste from medicine, industry, and research. As for high-level radioactive waste, spent fuel must be kept in intermediate storage until it no longer emits any decay heat. Low and medium-level residual waste is also kept in intermediate storage until a deep geological repository is available.

It is for this purpose that our company, the ZWILAG Zwischenlager Würenlingen AG was established in 1990 and commissioned as a facility in 2001. Our task is to condition the radioactive waste produced in Switzerland and to keep it in intermediate storage for the time being. As we are a nuclear facility, we are also subject to the same laws and regulations as the nuclear power plants.

As producers of the waste, the nuclear plant operators finance ZWILAG proportionately to the amount of electricity they produce. Together we safely guide the radioactive waste to a deep geological repository.

MALE SPEAKER: I work in the Health Physics Department. For me, the responsible treatment of radioactive waste means that safety culture has become an integral part of my work. I always act in compliance with the concepts of safety and protection. The safety of people and the environment takes central stage. And because this is continuously monitored and jointly applied by everybody, I can count on reliable and hazard-proof operations.

NARRATOR: High-level waste from nuclear power plants or reprocessing is packed into casks suitable for transport and storage on site. These casks are delivered to us by train several times a year. We unload the casks at a railway transfer station built specifically for this purpose and transfer them to the reception building on special vehicles. Here the waste is tested comprehensively and prepared for interim storage.

Low and medium-level waste is brought to us by road transport. It is delivered in waste drums or as packaged goods. The raw waste is tested for composition and sorted. The internal waste drum transport system is constantly monitored and permanently tracks and identifies every waste drum as part of the operational process.

MALE SPEAKER: I work in the Operations Department. As whenever technically feasible, our work is done by machines. It’s very important that automated and manual tasks are synchronized. To this end, I am constantly optimizing our operational processes. I can use my own innovations to improve processes or introduce new ones. I am supported in this task by a corporate culture that respects innovation as a tool to safeguard the long-term operation of our facility.

NARRATOR: While high- and medium-level waste is taken directly to the intermediate storage facility, low-level waste is sent to conditioning. During this process the waste is free from radioactive contamination in an effort to reduce the volume of waste as much as possible.

The first step is to decontaminate as much of the operational waste as possible. Where the contamination only affects the surface, different mechanical, electrolytic, and chemical methods are used to clean the waste. The waste is then no longer radioactive and can be tested to confirm that the levels of residual radioactivity are below regulatory limits for free release. It is then recycled as normal waste.

Low-level waste that cannot be decontaminated is taken to the plasma facility. This is a unique facility for the processing of radioactive waste. Although this process does not reduce the radioactive contamination, it reduces the residual waste to only a quarter of the original volume.

The drums containing low-level waste are transported automatically to the furnace where they are cut open and thermally decomposed or melted in a plasma burner at temperatures of several thousand degrees Celsius. During this process all organic matter is totally dissolved. The melt is prepared for deep repository by adding the substances required for vitrification and packed into drums.

With our decontamination and plasma facility, we can reduce the low-level waste by as much as 80 percent. Our facility also boasts a hot cell, which we use to inspect and repair casks containing high-level waste. We can also use this room to transfer spent fuel elements to different containers if necessary. Everything is controlled remotely with the help of cameras and indirect eye contact through a lead glass window. As the handling of high-level waste requires the most stringent safety measures, the hot cell is built to be secure against internal influences such as earthquakes or airplane crashes.

MALE SPEAKER: I work in the Technical Department. Employees must be well-trained in order to optimize the monitoring of operational processes. I can attend internal and external training courses and exchange experiences with other plants to improve my understanding of day-to-day operations. This valuable transfer of knowledge helps me to work safely together with the modernization and upgrading of the facilities. It also guarantees operational safety at ZWILAG.

NARRATOR: Our waste is now ready for intermediate storage. The casks with spent fuel elements are stored in the cask storage hall for high-level waste. The casks are built to block radioactive radiation while at the same time protecting the contents from external influences. The high-level waste emits heat. Air is let into the storage hall through vents in the side walls and escapes through vents in the roof. This passive natural convection cooling system allows the heat to escape at all times without the need for ventilators or other mechanical equipment. It takes around 40 years for the waste to stop emitting measurable heat.

Final waste drums with low and medium-level waste that are ready for deep repository are stored in the storage hall for medium-level waste. The location and contents of each individual drum can be called up at any time. We regularly check the condition of all stored waste. The drums are stored in large containers, remotely controlled, stacked in concrete pits, and covered by three concrete lids.

Here, too, the multi-layered cover and solid construction of the building shields the waste and protects it from external effects.

The waste ready for final disposal now remains in intermediate storage until a deep geological repository can be commissioned. The waste will then be transferred to this repository located deep underground within a suitable geological environment.

(Whereupon, the video presentation is concluded.)

T. WILLIAMS: So, as I said, sorry for the corporate blah-blah, but I hope you could enjoy some of the other pictures.

So with that, actually, I would be finished, so happy to answer any questions.

EWING: All right, thank you very much.

Questions from the Board? Linda?

NOZICK: Linda Nozick, Board. I'm curious about the process by which routes for shipments are actually identified and schedules for those. For instance, you made the comment, "We ship at night initially." Accident rates are generally higher at night. I'm wondering how this process goes to sort that out.

T. WILLIAMS: Accidents may be more often at night. Of course, there's less traffic at night. And the type of distances which we're traveling are--we're not talking about thousands of kilometers. We're talking about a one-hour transport or a two-hour transport. We have police accompaniment. We have accompanying vehicles in front of and also behind the truck. We have only a truck pulling. We have also the truck pushing to brake in case there was an accident. Also, there are many technical measures taken. I would have difficulty agreeing that there is a greater danger at night than during daytime.

NOZICK: What's the process by which that conclusion gets reached?

T. WILLIAMS: A difficult question to answer. I think probably the correct answer is, it wasn't considered that there is a safety issue between night and day, and it was just a media issue. That was all.

NOZICK: What about different routes or the route that you pick? I just picked on that as an example.

T. WILLIAMS: Okay. So different routes, as we heard before, obviously you have to have a route which we can take the waste. Obviously the technical conditions are to be fulfilled. And so many options we don't have in Switzerland. You may have two options, and we would just basically take the road which is wider or less steep or--total technical issues. That's all.

NOZICK: Does the public have any--have you seen any public investment in that decision?

T. WILLIAMS: It's not been necessary, and so no, no.

NOZICK: Okay, thank you.

EWING: Other questions? Lee?

PEDDICORD: Yes. Following up--Lee Peddicord from the Board. Following up on Dr. Nozick's question, so are the community officials, the Govinda (phonetic) president for example, notified that there will be a transport through their community? You mentioned that the media is not. But in terms of safety officials, emergency response, again, elected officials, do they receive notification before they transport through--

T. WILLIAMS: Right. Obviously there is a list of bodies who are informed before the transport, not including the media, so obviously the safety authorities, the Department of Energy, the police, and the local stakeholders, but only a minimum of local stakeholders.

PEDDICORD: But typically the community officials?

T. WILLIAMS: Yes, yes.

PEDDICORD: Second question, also related to transport. Now that the decision was taken not to reprocess more fuel in 2006, so do you have a specified date now that you know when the last of the vitrified waste will be coming back from La Hague, and did you do anything at Sellafield or was it all at La Hague?

T. WILLIAMS: We reprocessed at La Hague and at Sellafield. The transport of waste from La Hague will be completed in the next year or two; and Sellafield, the latest I think, certainly before the end of the decade.

PEDDICORD: Merci…

EWING: Other questions? From the staff? Nigel.

MOTE: Nigel Mote, staff. Tony, I was interested that you said that you decided to diversify at each station, and you heard the presentation before by Josh Jarrell talking about standardization. Can you tell us why standardization was not the preferred route? And would you make a comment on the timeliness or otherwise of when the U.S. may make a decision and the impact of that on how applicable it would be based on your experience?

T. WILLIAMS: As far as I've understood, standardization in this country means developing something which can also be used not just for interim storage, but also for final storage. And the concept in Switzerland at the moment is, we do interim storage; we transport to the surface facility of the final repository; and there the fuel is unloaded and repacked into the final repository canisters, the ones I showed you. So, for that reason, there is no need to standardize our interim storage casks, because they will anyway be transported to the final repository.

Of course, we could ask ourselves, why don't we do that? Why don't we load the fuel--as you were asking yourselves, why don't we load the fuel now into final repository canisters? But as you see, the final repository canisters are much smaller for heat reasons. Also, the concept in Switzerland in the clay formation is to backfill, and that configuration requires that the heat of each canister should not be higher than 1.5 kilowatts. That would limit us massively in the interim storage of fuel at the moment.

And just a final personal comment: I would almost guarantee that if you load today final repository canisters that in 40 years you will be unloading them and loading into something else, because the concept will have changed by then. That’s my guess.

EWING: Nigel.

MOTE: Tony, I’d like to clarify. The standardization is indeed with an objective that you can use the same container all the way through to disposal. But, also, it is limiting the number of types, number of variants, so that Plants A, B, C, D, E, and many will use Type One, and then plants of a different sequence may use Type Two in the interest of standardizing handling and overpack requirements for a large program of moves.

So it’s not only standardization in going all the way through the handling system, but--or the process system--but standardization in limiting the number of different types. What you’ve done in U.S. terms is to multiply the number of lifting systems and training programs and sealing requirements, and the U.S. is trying to get away from that. But I know you have a smaller program. There is still an implication in terms of complexity and timeliness.

So I’m interested in why you would go to different types even at the same site when in this country there seems to be a move to say, if we limit the number, there are some economies not only of scale, but of limiting types and variants that will result from that.

T. WILLIAMS: I guess everything in life is an optimization. Simple is often good. But simple in this case would also mean committing to one supplier, and at the moment we consider the commercial aspects, I mean, not just costs, but also diversity and security of supply are just as important as standardization. We don’t consider that having to have one or two different types of lifting gear is a big deal.

It’s not that we intend to change our cask supplier every five years. Certainly not. But at the moment we’re in the process of, what should I say, of discovery, and we are in the process now of choosing those suppliers who will supply us for the next decades. And it’s not going to be one, and it’s not going to be ten, but it’s maybe going to be four or three.

MOTE: Okay, thanks.

EWING: Okay, Dan? No? Okay, Bob.

EINZIGER: In one of your slides you mentioned that you thought that the issue will hydride reorientation was basically solved and little needs to be done. A recent report in draft form, based on an ASTM workshop on the issue, indicated that there might be a significant amount of work that needs to be done before that issue gets solved. So I was wondering what the basis of your comment was.

T. WILLIAMS: Okay, I think I was very careful not to say that we--I didn't say that we solved the problem. I just said that I have the feeling that there is a growing amount of material, which tends to indicate that it's not the enormous problem we thought it was maybe ten years ago.

And there are also--just as there are papers saying that a lot of work needs to be done, there are also papers which say that, actually, hydride reorientation happens differently than we thought it happened. But I'm really--don't misunderstand me. I'm not saying it's solved. I'm just saying that there is an increasing amount of information, and I believe that we're well on the way to understanding the processes. That's all. If I gave the impression that I think it's solved, that's not the case.

EWING: Other questions? Staff? Board members? Yes, Sue.

BRANTLEY: Sue Brantley, Board. I find it curious, with the presentation of how swimmingly everything is going, that in 2011 you decided to phase out nuclear. Can you just comment on that sort of incongruity?

T. WILLIAMS: I'm the wrong person to ask, really, but I guess the short answer is, it was a political decision. I guess that's the long answer as well.

BRANTLEY: Well, was there public outcry after Fukushima?

T. WILLIAMS: No, on the contrary. Of course, the nuclear industry in Switzerland yearly does public opinion polls, and before Fukushima I think 70 percent of the population believed that nuclear power was necessary for the energy supply, the security supply of Switzerland. And after Fukushima it was 65 percent. There is no indication in the public that we want to pull out of nuclear. It was a political decision.

BRANTLEY: That makes it even more curious.

EWING: This is why we have a poster session.

BRANTLEY: Oh, is there a poster on this political decision?

EWING: Other questions?

All right, Tony, thank you very much.

T. WILLIAMS: A pleasure.

EWING: You brought a wonderfully fresh perspective to the discussion.

So now we've arrived at the point of public comment. We have three, and so we'll start with Gary Lanthrum.

And if you could say your name properly, I probably mispronounced it--

LANTHRUM: Pretty close.

EWING: --and give your affiliation, please.

LANTHRUM: Gary Lanthrum, NAC International. I consult for NAC. My comments are as Gary Lanthrum, independent contractor, though.

I'd like to thank the Board for its continued interest in storage and transportation issues. They will always be important as we move forward to a final solution. And I'd like to thank DOE for its continued efforts in R&D to address some of the optimization challenges that lie ahead.

My real comment, though, is on the presentations that talked about efforts to standardize on canisters. I believe that we've reached the point where we will not be making larger canisters in the industry for thermal issues. I think the large canisters that are in play now are likely to be as large as they get. The movement towards standardizing canisters is looking at shrinking things to accommodate various repositories that may have thermal limits.

Perhaps a better opportunity for optimization is on transportation cask standardization. You can take a large transportation cask and, with the use of sleeves and spacers, make a single transport cask amenable to transport both the large and all of the smaller canisters that are out there. Right now the fleet of transport canisters that would be required, along with their impact limiters and all of the handling gear, with the wide variety of canister sizes that are already in play, plus the added canister sizes that may come into play, can be an extraordinarily expensive and complicated system. Standardizing the transport canisters may be an area of inquiry that would be worth following.

EWING: Okay, thank you very much.

The next public comment comes from Phil Klewrick (phonetic). You'll have to say it yourself.

KLEVORICK: Good afternoon, Board. My name is Phil Klevorick. I represent Clark County in Nevada, which, basically, no one has an idea where that is, but that's where Las Vegas is located.

So my comments--I'm going to shift gears slightly, and I'm going to move away from the technical side of things on cask size and design a little bit. But I think a few points that were missed or should be addressed by this Board at some point is the 180(c) issues for funding emergency responders and planners and everything that would come along through the routes, being one of those 800-plus counties where more than likely shipments will come through.

Uniquely, counties throughout this country will receive their X number of shipments, and whatever the number of shipments that will be potentially destined for Yucca Mountain, I could tell you exactly how many shipments that Clark County will potentially receive. So I think there is a risk-based assessment that needs to go along with that assessment on either the funding side of things or risk assessment.

And that brings me to another point is this perceived risk aspect of it. Both the National Academy of Scientists and the Blue Ribbon Commission also recognize that there is actual facts that go along with the perceived risks, and I would encourage this Board to evaluate this at some point and encourage whoever follows up on what your recommendations are from these meetings and going forward that there is more value that goes into establishing what this perceived risk is and the cumulative impacts that could be evaluated on a local basis.

Uniquely, every little county, every little community, will have their own little issues. But, ideally, when the funnel effect occurs, there is no doubt that Nye County--and my colleague left earlier--which is 2,000 square miles larger than Switzerland, and Clark County, which is almost exactly half the size of Switzerland, we will end up getting almost the entire shipments through there. We cannot forget that there is no rail to Yucca Mountain.

And so, you know, if we're all looking at this and the reasonable aspect of it, probably there is a chance that there will be an intermodal need. And if these large casks are designed, and they're going over the highway system, and the highway system is not capable of handling it, and it creates more transportation risk because potentially Clark

County could be receiving by rail and by truck and then end up going up our highways, there is going to be a need--and I’m not going to pick on Switzerland--there is going to be a need for shipments to be altered around time of day, time of year. And you certainly don’t want to be bringing it to Las Vegas on July 4th weekend or any of those long weekends, because, ideally, there will be massive traffic issues.

I just wanted to bring these few points up to you guys. Thank you very much for your time.

EWING: All right, thank you.

Next, Steve Frishman.

FRISHMAN: I’m Steve Frishman with the State of Nevada. Thanks for knowing my name.

EWING: Over time.

FRISHMAN: After listening today and also with the Board’s interest and everyone else’s interest in casks and standardized casks and DPC’s through the last couple years, I feel like I have to put this sort of back in context. And it’s similar to something that I observed to this Board over 20 years ago. And that’s that, yes, it’s really interesting to talk about casks, transportation cask designs, how the industry is dealing with casks; but we have to remember, our goal is to figure out how to create the safest underground method for isolating waste for a very long time.

The last time I brought up this point was when there was long discussion and beginning of action about the multiple-purpose container. And the warning then--and I think the warning still exists, and Nigel's questions sort of touched on it a little bit today--and that's that we don't want to get into a situation where the design of the cask, whatever range it is or however standardized it is, that the design of the cask ultimately, one way or another, puts constraints on the repository design and safety case.

If, as in Switzerland, they've decided, we need a container that matches the best safety case we can create in that geologic medium, and they want to do something else on the surface, that's fine. But we need to be in a situation where we don't have whatever the standardized or large mix of casks, wherever it results in limiting repository designs to where, one way or another, we actually have to compromise on our thinking about a safety case or lose options for a safety case that is better than it might otherwise be if we were constrained by such things as very large casks having to go into a repository or very hot casks having to go into a repository.

So I just want to keep that in the context where yes, all this conversation is very interesting, but it's peripheral to our goal. Thanks.

EWING: Thank you.

Any other comments during this session? Yes, please. Sorry, you were on the previous list.

ANDREWS: My name is Richard Andrews. I live here locally. I've been involved with the nuclear industry a long time back with NRC directly in licensing uranium mines and mills in the early part of the fuel cycle, so I have some history in this. I haven't been involved with the industry since about 1979 or '80, I admit, but it was at that point that I decided I could not be involved. So since then I have been only willing to do things that would shut down the business as opposed to facilitate it. That's just a little background.

I'd like to make some main points. Recently the NRC went through a generic environmental impact statement that they earlier called the Waste Confidence Rulings. I submitted testimony and detailed technical information to them at that time, and a little bit later EPA began some process dealing with their carbon reduction programs. Some of the same analysis was very applicable for that purpose.

And the analysis focused on the fact that spent nuclear fuel sitting all over our country, primarily in major metropolitan areas at the nuclear power plants, either closed or operating, represents a major hazard to the public health and to our national security. The analysis that I did had to do with the potential of those materials being highly vulnerable terrorist targets or targets for sabotage. I went through the same analysis programs that Oak Ridge developed and NRC uses in modeling the possible outcomes of such an attack on a spent fuel facility. And I used as a test case the Indian Point reactor, sitting, as you all know, just a short number of miles north of New York City.

The potential exists, and I believe that any terrorist willing and with the motivation can do anything he wants to any time he wants to despite the fact that post 9/11 there were security measures put in place by NRC, by the Department of Homeland Security, by the DOE to help reduce that risk. However, the risk is still there. We only need to look at the headlines on a daily basis what’s happening around the world with terrorist activity.

So my message is: We need to not continue to store these very dangerous materials at these sites. I am, unlike most of the--I consider myself a very environmental activist in many ways, but I’m not one of the Mobile Chernobyl crew that says, “Don’t move the stuff.” I very much support the idea of interim storage until such time as we can get a legitimate geologic repository that is well designed and can receive the waste. And those interim storage sites shouldn’t be near metropolitan areas either. We should put them at the most remote location as we possibly can find.

And so this is where this gets into the transport issue, which you are dealing with today. Transport has its risks, but I think probably the risks are much, much greater with the existing status quo of these materials being stored on site. So that’s my assessment.

When the NRC wrote its generic Waste Confidence Ruling, it did, in fact, deal with the issue of terrorist potential. And in some of the tables they had in that impact statement, they said, “Well, the probability of such an event is very, very low; therefore, the risk, which is a multiplier of that probability times the consequences, is also low.” In the very next page they admitted and said the probability is unquantifiable of such an event. So that was just a blatant misrepresentation of the truth in what they wrote.

And this gets at the fact that I believe overall the U.S. government continues to be in a multiple-D mode, and that’s the D of Delay, Denial, Distraction, and one other D that you can’t remember at the moment, but those are good enough.

So my message to this group and hopefully--the DOE is sitting here as well as the Board that’s in front of me, as well as the NRC, and EPA ought to be in the room, too. Unfortunately, I don’t see anyone. You all need to get your act together, coordinate--which I don’t see happening--and get this project’s process solved.

I was born in April of 1945, and that was when essentially, you know, the dawn of the actual active nuclear age occurred. Shortly--a few months later--I grew up in eastern Kansas--Kansas was the site of a study on salt repository waste disposal back in the 1950s. We still are not doing it. It’s time to engage. I don’t want to wait, you know, another--I mean, I’m not going to be around by the time this happens.

And we just need to get our act together as a nation; take some cues from what Switzerland has, in fact, done; take some cues--and primarily I call upon this group as well as our entire country to realize that as long as we keep on making more of this stuff, the problem is only compounding. It’s time to stop, just like Switzerland has decided to do. Thank you.

EWING: Okay, thank you.

Any other comments from the audience or public?

Let me make a few announcements before we adjourn. First, to the Board and staff, there’s been a change. Breakfast will be at 7:00 in the Monarch Room, and remember we start our meeting at 7:30. So this is our internal business meeting, and you can see we continue to work.

Also, immediately after we adjourn the poster session is in Salon E. If you go out the doors, turn left, make the corner, and we’ll see you all there. We look forward to continued discussion with all the participants of this meeting. And I think that’s all.

Any other announcements that I've forgotten?

All right. I'd like to thank the speakers and also the audience for the questions and participation all day. It's been an interesting day and, I think, very informative.

So the meeting is adjourned. We'll see you at the poster session. Thank you.

(Whereupon, the meeting was adjourned.)

C E R T I F I C A T E

I certify that the foregoing is a correct transcript of the Nuclear Waste Technical Review Board's Summer Public Meeting held on June 24, 2015, in Golden, CO, taken from the electronic recording of proceedings in the above-entitled matter.

July 5, 2015 s//Scott Ford_________________

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