UNITED STATES

NUCLEAR WASTE TECHNICAL REVIEW BOARD

TRANSCRIPT

Summer 2018 BOARD MEETING

Wednesday

June 13, 2018

Hilton Garden Inn

700 Lindsay Boulevard

Idaho Falls, ID 83402

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I N D E X

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>> BAHR: Okay. Good morning, we have a long day so I really wanted to get us started on time. Welcome to the U.S. Nuclear Waste Technical Review Board summer meeting. Today's presentations and discussions will focus on the technical issues that need to be addressed before the Department of Energy can begin an integrated nationwide shipping effort for spent nuclear fuel and high-level radioactive waste. I'm Jean Bahr, Chair of the Board and I'll introduce the other Board Members in a moment but first I want to briefly describe the Board and tell you why we're holding this meeting and what we plan to accomplish as many of you know the Board is an independent Federal agency in the Executive Branch it's not part of the Department of Energy or any other Federal organization. It was created in 1987 as part of the amendments to the Nuclear Waste Policy Act and its goal was to perform objective ongoing evaluations of the technical and scientific validity of DOE activities related to implementing the Nuclear Waste Policy Act. The 11 Board Members are appointed by the President from

a list of nominees submitted by the National Academy of Sciences.

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

And the Board also provides objective technical information to Congress, the Administration, DOE, Government and non-Government organizations and the public on a wide range of issues related to spent nuclear fuel and high-level waste disposition. Copies of some of the Board's most recent reports can be found on a documents table in the entrance of the meeting room and available on the Board's Web site at www.NWTRB.gov or at least they will be eventually available. We are in the process of uploading documents to our somewhat new Web site.

A lot of effort went into planning this meeting and arranging the presentations. And I want to thank the -- let's see -- I'm not sure if I'm on the right slide at this point. I should be. Yes.

I want to thank the speakers who have traveled to Idaho to make presentations at the meeting today. And I also want to particularly thank Dr. Linda Nozick, Steve Becker and Paul Turinsky who were the Board Members who acted as leads with the Board staff, particularly Dan Ogg, to put this meeting together. So now I'll introduce the Board Members and tell you about the schedule for the meeting. First during the introductions as I say their names I would like the Board Members to raise their hands so they can be identified.

I'll begin I'm Jean Bahr, the Board Chair. All of the Board Members serve part time so we also have other jobs and in my case, my other job is as a professor of hydrogeology in the Department of Geoscience at the University of Wisconsin-Madison. Dr. Steven Becker is the professor of community and environmental health in the College of Health Sciences at Old Dominion University in Virginia. Mr. Allen Croff is a nuclear engineer and adjunct professor at the Department of Civil and Environmental Engineering at Vanderbilt University. Dr. Tissa Illangasekare, the AMAX Endowed Distinguished Chair of the civil and environmental engineering and the director of the Center for the Experimental Study of Subsurface Environmental Processes at Colorado School of Mines. Dr. Linda Nozick is a professor in the School of Civil and Environmental Engineering and Director of the college program in Systems Engineering at Cornell University. Dr. Lee Peddicord is the director of the Nuclear Power Institute and professor of Nuclear Engineering at Texas

A&M University. Dr. Paul Turinsky is a professor of Nuclear Engineering at North Carolina State University. And Dr. Mary Lou Zoback is consulting professor in geophysics at Stanford University.

I've just introduced 7 Board Members plus myself not the full complement of 11. Due to other members, Dr. Susan Brantley and Dr. Efi Foufoula-Georgiou are unable to join us today. Dr. Brantley is a Distinguished Professor of geosciences and director of the Earth and Environmental Systems Institute at Penn State University. And Dr. Efi Foufoula-Georgiou is a Distinguished Professor in the Department of Civil and Environmental Engineering at the University of California Irvine. And the Board currently has one vacancy.

As I usually do at Board meetings I want to make clear the views expressed by the Board Members are their own not necessarily Board positions. Our official positions can be found in our reports and letters, which are available on the Board's Web site. If you would like to know more about the Board, a one-page handout summarizing our mission and presenting a list of Board Members can be found on the document table at the entrance to the room and you can also visit the Board's Web site www.NWTRB.gov. And eventually as we repopulate the Web site all of the Board reports, correspondence, testimony and meeting materials dating from 1987 to the present will be there.

During the meeting there are going to be two opportunities for meeting of the public to make comment. Before the lunch break and at the end of the day. We ask that if you want to make a comment you add your name to the sign-up sheet at the registration table, which is out in the hallway. Written comments and other written materials may also be submitted by providing the material to one of our staff members today. Or by sending the material by mail or email to the points of contact who were noted in the press release for this meeting. And the press release is also posted on our Web site.

Documents submitted by the public will become part of the meeting record and will be posted on the Board's Web site along with the transcript of the meeting and the presentations.

If you make a comment during the meeting, please use the microphone that's in the center of the room there. And be sure to state your name and affiliation first so that you will be identified correctly in the meeting transcript. The meeting is being webcast live so you'll see cameras around the room and depending on where you're sitting you might be part of the webcast. And I understand that we have some viewers today at rugby high school in North Dakota so a special shout out to them and go panthers.

I encourage the presenters to speak loudly enough so those in the back of the room can hear and it will also be helpful particularly to those watching the webcast if the presenters can summarize each question briefly before answering it. The webcast will be archived in a few days and then it will be available on our Web site. So that you can watch it over and over again if you have insomnia. And assisting those watching the webcast the agenda is also available on the webcast. The meeting presentations which are part of the webcast will also be posted in a few days for download on the Web site. Okay. So now I would like to provide some background information on the topic of this meeting and outline today's agenda.

For many decades the nuclear industry and the Department of Energy have been transporting spent nuclear fuel and high-level radioactive waste across the country in relatively small shipments. More extensive shipments by truck, rail, and ship have been conducted by several countries overseas.

And these transportation activities have been completed safely and have provided valuable experience in the licensing and logistics of moving radioactive materials. However spent nuclear fuel and to a lesser degree high-level waste have been accumulating at nuclear utilities and Department of Energy sites across the nation. And eventually these will need to be transported either to an interim storage facility or to a geologic repository or both and as required by the Nuclear Waste Policy Act the Department of Energy is responsible for the transportation of these materials.

I don't know if my -- this is where everything is located. I think I'm back at the right slide now.

Because there's significant quantities of spent nuclear fuel and high-level waste stored at a number of sites across the country in a large variety of sealed containers DOE will need a well-developed and coordinated system to safely and efficiently manage the transportation of these materials.

Such a large effort presents significant challenges both technical and non-technical. But in keeping with the Board's mandate we will focus on the technical issues that DOE needs to address before transportation can begin. So to help clarify what I mean by technical issues to be addressed there are a few examples listed on this slide for example DOE will need to complete fabrication, testing, and approval of a new railcar dedicated to shipping spent nuclear fuel and high-level waste. It will need to identify infrastructure and equipment upgrades that are needed to support loading and transporting nuclear fuels, especially at shut down commercial nuclear power plants and it will need to develop and demonstrate effective inspection techniques and equipment to examine waste containers to ensure that they are safe for transportation.

Some other issues exist that will not prevent the start of transportation activities but resolution of these will be necessary to achieve a truly integrated program. And two examples of those are listed on this slide.

For containers that have not been or cannot be licensed for transportation, it will be necessary to either remediate the containers or repackage the spent nuclear fuel into canisters that are approved for transportation and if repackaging is necessary a new repackaging facility will have to be designed, licensed and built. So these are just a few examples of the many technical issues DOE will need to address before it begins a nationwide transportation campaign. Our speakers today will help the Board explore some of the past around current experience in transporting nuclear waste both domestically and overseas the speakers will also discuss many of the technical issues focusing on those that will be most difficult to resolve or that will take the longest time to address. So we have invited several speakers to discuss these topics. To open the meeting this morning Dr. William Boyle in the Office of Nuclear energy in the Department of Energy will provide an overview of DOE programs and research related to transporting nuclear waste. Next Mr. Mark Whitwill of the Swiss nuclear power plant operator KKG will discuss the Swiss experience in developing and implementing an integrated program for managing spent nuclear fuel and high-level waste, from packaging and onsite storage to transportation and then to storage again at an interim storage facility. After a short break, Mr. Gary Lanthrum a Principal Consultant to NAC International and former director of the transportation program in the DOE Office of Civilian Radioactive Waste Management will present insights and lessons learned from prior U.S. experience in developing a large integrated program for transporting nuclear waste.

The last presentation of the morning session will be Dr. Mark Richter of the Nuclear Energy Institute who will describe NEI's transportation Task Force and discuss transportation issues of the nuclear industry believe should addressed as top priorities. After the lunch break Mr. Myron Kaczmarsky of Holtec International will provide the perspectives of a vendor of nuclear waste cask systems on these issues. Also Holtec has partnered with the Eddy Lee Energy Alliance in New Mexico to develop an interim storage facility for spent nuclear fuel. Next Dr. Erica Bickford of the DOE Office of Nuclear Energy will present details of recent assessments of preparations necessary to support shipping commercial spent nuclear fuel from several shutdown reactor sites. Then Mr. Ken Niles of the Oregon Department of Energy will provide a stakeholder perspective on technical issues that need to be addressed before DOE begins transporting nuclear waste through many states and local jurisdictions. Following the afternoon break Mr. Jack Wheeler also of the DOE Office of Nuclear Energy will describe the development of system analysis tools that DOE expects to use to design and plan its integrated waste management system.

Next Mr. Mike Brown of the DOE Carlsbad Field Office, which is part of the DOE Office of Environmental Management, will present lessons learned from transporting transuranic waste from several DOE sites around the country to the Waste Isolation Pilot Plant in New Mexico, and finally, we'll hear from Mr. Darrell Dunn of the Nuclear Regulatory Commission about technical issues related to transporting spent nuclear fuel on which NRC has been focusing its attention and Darrell will also discuss the advanced planning needed between DOE and NRC before a large transportation effort can begin. So, we have a very full program. If you will please mute your cell phones at this time and we'll begin with an interesting and productive meeting. To help keep us on time Bret Leslie this is for the speakers sitting at this table has a little 5 minute pages that he will try to flash in front of your face and I'll be watching that as well because it is going to be a long day so I'll do my best to keep us on time but we certainly want to make sure that we have time for questions both from the Board Members and during the public comment period for members of the public and my pleasure to turn the podium over to Bill Boyle who will get the meeting started.

>> BOYLE: Okay. Thank you for the introduction, Jean, and thank you for this opportunity. My first remarks are for anybody here who actually lives in Idaho Falls or nearby. I was not the originally scheduled speaker for this talk it was to be Ray Furstenau. Maybe some of you know Ray because he worked here for years and years and the reason I'm speaking instead of Ray is he's no longer with the Department of Energy. He moved over to the Nuclear Regulatory Commission and took the job of the head of the Office of Research. So that's why you have me rather than Ray Furstenau. So even Jean started off her introduction by using words that's very similar to what's on the Board's press release which came out April 26th and the day it came out someone who works for me who doesn't even work on transportation came in and said you know this headline can be read a certain way and here's the headline: “technical issues

to be addressed before the U.S. Department of Energy begins a nationwide effort to transport spent nuclear fuel,” and similar words on the second question for the talk I’m giving. And the person who came in to my office said you know those words can be interpreted that we've got a checklist of technical issues and as soon as we check them off we'll be shipping all over the country. That all that remains is to knock off these last few items. I don't think that's what the Board meant and I just wanted to assure people in the audience that's not the situation. There's nothing technical thwarting shipments of spent fuel or high-level radioactive waste in the United States. There's a due diligence aspect there's technical things you have to do to make sure you do it safely but instead the reason not much is really being shipped is sociopolitical issues mainly in the United States Congress. There are there are some members in Congress who want to resume Yucca Mountain but they don't have enough votes to get the funding to do that the people who thwart them would rather do something else but they don't have enough votes to get anything else other than Yucca Mountain authorized so we continue to do R&D in the meantime. But it's that stalemate of not knowing where to take it that is actually thwarting shipping.

I'm not the first person to make this observation in 2006 the National Academy of Sciences produced a report for transportation of spent nuclear fuel and high-level radioactive waste called Going the Distance question mark and then a much longer title after that and their first bullet of their summary and I'm reading -- I wrote it down as a quote, those authors could identify no fundamental technical barriers to the safe transport of spent fuel and high-level radioactive waste in the United States. However, there are a number of social and institutional challenges to the successful initial implementation of large quantity shipping. And when they wrote that in 2006 I bet they had no idea that those social institutions -- social and institutional challenges would only get tougher in the intervening 12 years. So what are we doing now given we're not shipping on a regular basis in the United States.

Next slide.

Before I go into the R&D and analysis that we do, there's this disclaimer that whatever technical or social and institutional challenges there are related to the storage and transportation of spent fuel, the commercial spent fuel in the United States is also governed by contracts between the United States Government and the utilities. And there can be contractual issues, as well. So I have this disclaimer, Jack Wheeler will, Erica Bickford will. It's just I'm the first speaker in DOE whoever asked for this slide and I asked the Office of General Counsel for it. It was for a NWTRB meeting in Hanford about five years ago and it's just to remind people that okay there's all kinds of challenges, including, in this case, sometimes there's contractual issues, independent of technical issues.

Next slide.

So this is just a brief status of where we are in the United States. The President's budget for Fiscal Year 18 and Fiscal Year 19 is requested funding for resuming the Yucca Mountain licensing and also to initiate robust interim storage. But Congress to date has not appropriated any funding to do that. Instead the Congress has been appropriating funding to do R&D and analysis which is what we continue to do. If Congress ever does fund Yucca Mountain the department will resume the Yucca Mountain licensing and it will be interesting to see what happens with the interim storage. If you look at the House appropriation bill that recently passed last week or the week before they go out of their way and say there will be no money spent on interim storage but they did provide funding for R&D related to storage and transportation. So at any rate we'll have to see how the Fiscal Year '19 appropriations turn out. Next slide. This is just to tell people that I will talk about some analyses and R&D. The picture on the left Jean also had a photo of the same test from last year where surrogate fuel assemblies went from Spain to Belgium to Baltimore and Colorado and back and made measurements all along the way to get insights in the transportation. You'll never be able to make out details of the middle slide. But that slide or ones like it has been shown many times before Nuclear Waste Technical Review Board meetings and the point you'll get if you can see the slide is under normal conditions of transportation there are no problems whatsoever related to stress and strain. A picture on the far right is of a storage system in Nebraska. Next slide.

So I don't expect you to read this. I included it anyway to show -- the next slide simplifies it and you'll be able to read that I just included it to show that yes people have done complicated analyses and there's a basis for the conclusions they reach. So next slide.

This is a simplification of the prior slide which now you can read you can see now I want to go back to the disclaimer I had on the second slide, this analysis, the conclusions you can draw from this slide are based on an analysis of we will pick up the existing dual purpose canisters at the utilities and ship those. That's not what the contract says so it's still an issue to be worked out in terms of what will be shipped from the utilities. It will be spent fuel but the details will it be the DPCs or something the Government provides?

That's an issue yet to be resolved. But in doing this analyses, the things you find and I think it's true for any number of the analyses no matter how we change the boundary conditions or initial conditions is National Environmental Policy Act activities typically turn out to be one of the potential long poles in the tent and before I leave that one I know I saw a couple of months ago -- an email went out within DOE -- that DOE and other agencies had signed up to greatly speed up NEPA analyses we'll find out if that actually turns out to be true. But in the past looking what we know from the past NEPA analyses can be a long pole in the tent as can be the line ”Obtain Casks and Hardware” -- purchasing things and fabricating things sometimes can be a long pole in the tent.

Next slide. Long lead time items. Well it's partly dependent upon the details but again I think actually building and procuring things will come up even as the details change those are likely culprits and you'll hear more about these topics from both Erica and Jack. Next slide.

Technical issues for transporting spent nuclear fuel. There they are, if you will. They will need to be updated, certificates of compliance. There's one-off type packages out there in the U.S. I assume everybody knows in contrast to France which is a vertically integrated system. In the United States every utility is free to do whatever it wants and they have and so we end up with odds and ends packages and things like that that the French typically don't have to deal with. Again, as I said earlier on, whatever technical issues there are, they are amenable -- it just takes work. It's not -- we're not in the same position that President Kennedy was when he said in the early 1960s we're going to send men to the moon and bring them back. We're not in that position. It's more just due diligence and the spent fuel and high-level radioactive waste will be able to be transported. Next slide. Here is what we're doing this year we are getting railroad cars fabricated to meet the American Association of Railroad Standard 2043. And over the next few years we'll purchase and actually have delivered the payload carrying car, buffer cars that you see to either side of it and even an escort car that you see at the end. We're doing a lot of analyses and we'll do another shut-down site visit. The fourth bullet -- initial site-specific de-inventory analyses. That's another example those analyses will most likely be premised largely upon -- we'll pick up what they have now which are dual purpose canisters which is not what the contract provides for but still it's good technical work and we'll go ahead and do that and you'll hear more about these activities from Jack and Erica.

My last slide I left plenty of time for questions I think.

>> BAHR: Thank you. Are there questions from Board

Members? I think -- Paul Turinsky and then Steve Becker.

>> TURINSKY: Are these on.

>> BOYLE: I hear you.

>> TURINSKY: If funding wasn’t an issue, how many years ahead of time would it take to have the infrastructure in place to be ready to ship in the repository -- when the repository opens.

>> BOYLE: I believe it was that complicated slide that I showed you. I believe a conclusion you can reach from that for that analysis was about 7 years. If we knew -- it's actually independent of a repository. If we knew where it was going whether it was interim storage or a repository, no matter where the repository was, it might take as many as 7 years, plus minus. As a technical matter, which again I'm sure the analysis didn't include any lost time due to lawsuits and things like that.

>> BAHR: Steve Becker?

>> BECKER: So if you were to -- if you were to put

your finger on the single most challenging technical issue related to transportation, what would it be?

>> BOYLE: Well for me challenging can be a relative thing but again it's not challenging in the sense what NASA faced in the early '60s getting men to the moon and back. It's, again, according to that one analysis I showed, what it comes down to is actually -- I don't consider the NEPA documentation really a technical thing. And arguably maybe it's not even the fabrication and procurement but it's things like that.

>> BECKER: Can I ask a second question.

>> BAHR: Yes, please.

>> BECKER: One other question -- looking at the 30,000 foot level which is what we've been looking at mostly how important is outreach to and engagement of communities and stakeholders to the success of a national transportation campaign. And I know others are going to talk about this but could you say something about the importance of that in the overall success of a national transportation campaign?

>> BOYLE: Sure and I'll refer back to that NAS 2006 report because that was another one of their recommendations that they do interactions with the public. The DOE does do that. We in the Office of Nuclear Energy essentially aren't shipping anything. Right now for all intents and purposes. Other parts of DOE do. The NNSA, the weapons people do. And the environmental management, we have a speaker from EM today, they do ship and they interact with the public as we do, as well, even though we're not shipping anything, we're reaching out now. Erica who is going to speak later, last week she was in Omaha because there was an Annual Meeting of the national transportation stakeholders forum and she participated. And she wasn't the only NE staff members. Two others participated as well as EM staff and NNSA staff.

>> BAHR: Dan Ogg?

>> OGG: Dan Ogg with the Board staff. Bill on your Slide No. 6 where you have that 7-year timeline, at the top you said in preparing for transportation you've got

some ongoing activities. And specified up there is coordination with NRC and DOT, Department of Transportation. Can you explain a little bit about what kind of coordination you're doing now with the NRC on this topic?

>> BOYLE: You know, I will defer that one to Erica. She's closer to that than I am. But I will -- even if there were little -- we're not actually shipping, right? This is premised upon you know the T -- at the start -- it is -- people are prepared to do it.

>> OGG: I understand it's preparation activities but I think there are important preparation activities that need to be done ahead of time and NRC is one of the key players in that. So just trying to understand what -- if there is some coordination going on, what is the nature of that coordination.

>> BICKFORD: Hi this is Erica Bickford from DOE-NE. We do coordination with the NRC not at a formal level at this point it's usually sort of through occasional information exchange. Again as Bill mentioned, we are

involved in DOE's national transportation stakeholders forum and NRC are involved in that as well several of them were out at the meeting in Omaha last week so we engage with them regularly on issues related to spent fuel safety, transportation, security and things of that sort.

>> BAHR: Nigel -- Mary Lou Zoback first.

>> ZOBACK: Bill, this might seem like a minor point it was wording but I think wording is important. And getting back to the issue of engagement with states and tribes. The way it's worded on the big version of your slide, beginning in the middle of T-7 it says works with tribes and states to develop transport protocol and policy and then in the middle of T-5 it says notify tribes and states of routes, scheduling and training.

I would have hoped there would have been an intermediate point where you actually work with the states and the tribes to do the planning of the routes, not just engage them and say we'll get back to you when we've made a decision. So is there any thought on that? Because words matter.

>> BOYLE: Yeah and again Erica is way more expert in this than I am. But I believe there's actually 27 criteria that are supposed to be taking into account in determining the route. And input from states and tribes is one of them.

But in the end it's the shipper taking all 27 criteria into account that actually they select the route. You know. People can provide input. But that doesn't -- it's not like it's a negotiation and the DOE and the states and the tribes pick the route. Ultimately the responsibility is the shippers. Taking all that information into account, plus 26 other criteria.

>> ZOBACK: When you say the shipper do you mean DOE.

>> BOYLE: No like the actual railroad or trucking company.

>> BAHR: I think there was a question from Nigel Mote.

>> MOTE: Nigel Mote, Board staff. Bill one of the issues you identified was with the utilities they packaged fuel in different forms and there's some resolution to be made on how you are going to deal with that. But that fuel is packaged. Within DOE we have a lot of fuel which is not packaged and package designs are not ready. How does that play into the 7-year lead time that you have here for transportation? And I realize we have a speaker later in the Office of Environmental Management which is responsible for that fuel but NE is responsible for the transportation so how does that play into a 7-year lead time for a transportation program?

>> BOYLE: I'll have to defer to EM because I can be a very compartmentalized worker in many respects. If I'm -- I show up with the transportation vehicle. Everything that happened before, that's your problem. Right? So -- and that's the way -- if EM has challenges

in getting it ready, you should really ask EM.

>> BAHR: So does that mean -- Jean Bahr Chair of the Board -- does that mean that 7-year timeline actually starts after EM has resolved all of those issues?

>> BOYLE: I don't know that detail of this analysis. And this -- for -- it may or may not have even included EMs. It might be -- Erica is shaking her head no. It was for commercial spent fuel only so that analysis, that example, didn't even include EM.

>> BAHR: Thank you. Other questions from Board Members? From staff members? From members of the audience?

>> Hi I'm Tammy Thatcher I live here in Idaho Falls. So your presentation seems to be suggesting that there's no technical issues. We just need Congress to figure out, you know, how to appropriate the money to us. It's just going to take seven years from the time they do that before we're shipping.

Why are there so many issues languishing them? Why are so many things not finalized? Canister designs, railcar designs. Why is this stuff not done then?

>> BOYLE: Well, some of it I can only speak for Government employees, we only work on things for which Congress has supplied money. We do what we do. And they have asked us to do R&D. So we're doing R&D -- and some of these things will probably only be resolved or only resolvable after a decision is made, we want it to go there, wherever there is.

>> BAHR: Other questions from the audience? Okay. Well, thank you, Bill. We're a little ahead of schedule. But I think we'll just move on in order to -- in case we lose some time a little bit later.

So our next speaker is Mark Whitwill. Is Mark here and mic'ed up? Thank you. Okay. So as I said earlier, Mark is with the Swiss -- KKG and he's going to tell us about the program in Switzerland that involves management and transportation and restorage.

>> WHITWILL: Thank you very much Jean, thank you very much also for the invitation. I'm very pleased to be here. And honored that you brought me all the way over from Switzerland. And I wanted to give you a short introduction, if I may.

So I will first of all talk a little bit about the Swiss context. Then I'll -- about my own company, KKG, backend strategy. And related transport issues we'll then look into more generic legal and technical constraints affecting transport in Switzerland and transport planning and finally lessons learned.

This is an overview of my plant as you can see it's in a beautiful part of the world as you can see the river Aare is meandering beside us there and you can see we're operating full steam.

So it's a Siemens design 3 loop PWR. It's been in commercial operation since 1979. And we are 3,000 megawatt thermal that's 1010 megawatt net. Last year availability was 93% and we made production of 8.154 Terawatt hours that's 8.154 billion kilowatt hours. Operating cost is around 2.4 U.S. cents per kilowatt hour which makes us the cheapest user in Switzerland even cheaper than many hydro plants I've got to say and that includes provisions of the backend of the nuclear fuel cycle.

We are privately -- a privately held company with five main shareholders. Alpiq is a publicly quoted shareholder, you can buy shares if you want. But it's partly privately owned and partly publicly owned the other companies are all publicly owned by local Government. Switzerland, like the U.S., is a Federal country. We have Cantons where you have states and it's the Cantons and some of the biggest cities who are our main shareholders. The current operation is based on 5 region core. We have 177 fuel assemblies in the core. An annual reload of 36 fuel assemblies per year. And the design is a Siemens design FANP 15 by 15 minus 20 with duplex cladding. It's very high performance fuel and that does give us some issues, which I'll come to later.

The current core is mostly comprised of reprocessed material which has been re-enriched.

The average discharge of this fuel is 65 megawatt days per kilogram. And in the past we also had MOX fuel mixed oxide fuel with plutonium we have burned 160 of these MOX assemblies and future reloads will be based on enriched natural uranium oxide. Our expected operating lifetime is over 60 years I'll come to that later as well -- subject to periodic safety assessments every ten years and we're currently planning to operate to at least 2039 and further life extension is feasible as long as the reactor can operate safely and is environmentally and economically acceptable.

The total Swiss production in last year was 58.5 terawatt hours. Nuclear generation was almost 20 terawatt hours of that. So even though we only have 5 nuclear plants they are producing around about a third of the electricity we use in the country. The mix is 2 BWR and 3 PWR.

And giving a total of 3.388 megawatt electrical.

The national energy strategy 2050 was recently adopted.

The intention of this is in the long-term to reduce energy demand and increase the use of renewable energy. And unfortunately that means no new nuclear plants will be built. But there's no artificial restriction on operational life unlike certain other countries like we mentioned Europe who have gone for a very early phaseout strategy. We intend to be there for long term.

Backend policy is also more restrictive now on to the new plan. Reprocessing is no longer allowed. But so our policies based on interim storage of spent fuel are both at the power plants and at a central repository or central storage facility I should say. I do apologize. Long-term storage will be in a deep geological repository. We have a process in German it's called the Sach plan I'm not sure how to translate that into English but basically we are looking for site selection now we have reduced the number of sites to about two or three. And a decision will be made the next few years which of these sites we go for and the repository is planned to operate in the period 2060 to 2075.

There is a map of Switzerland showing where we are located I'll go into detail most of the country is mountains as you would expect -- here in the central part is the Alps in the northwest you have the Jura Mountains and people are mostly squeezed between these two areas in a band reaching from Geneva in the west going up towards Zurich and beyond in the northeast. The nuclear power plants are fairly well concentrated -- we have a Mühleberg BWR there, Gosgen -- my plant, and then we have Beznau and Leibstadt, and in the middle, ZZL that's our interim storage facility Zwilag.

So in the past we did have reprocessing contracts with France and the United Kingdom. And this meant we transported fuel assemblies 695 fuel assemblies in the case of France plus 1 quiver with damaged fuel rods. And 273 fuel assemblies to England.

The last transport of spent fuel was made in 2006 when a moratorium came into place. And all reprocessing is now completed.

The next stage of course was bringing back the waste from England and France. High-level waste and intermediate level waste has all been returned now. 196 vitrified high-level waste canisters from La Hague were transported using TN81 and also the CASTOR CG 20/28 transport and storage casks and 228 compacted ILW canisters and 1 vitrified ILW canister were transported using the TN81 cask. This is quite interesting because we use this cask as a transport-only cask for several shuttle campaigns and then converted it to a storage configuration and then used it for one last campaign for transporting the glass. The glass is stored in Zwilag in the cask, whereas the intermediate level waste is stored in the vault. For Sellafield, we just had high-level waste and this was brought in three TN81 casks.

Here is a picture of the TN81 cask being handled at Zwilag, the interim storage facility. The railway unfortunately doesn't go all the way to Zwilag so we have an unloading station just about less than 1 mile from the plant and then it’s transported -- taken off from the railway and put on to the lorry for the final journey home.

The second part of our strategy has been to demonstrate the feasibility of dry storage in Zwilag and we have done this not only with the waste but also with spent fuel. And Zwilag itself I should explain is a jointly owned company. All of the utilities are shareholders in it our share is 31%. It was constructed in the '90s and been operating since 2001.

The transport of spent fuel from KKG took place in 2002 to 2003. We were one of the early users of the plant. The idea was to demonstrate that it worked. And we have 4 of these TN24 G casks each with 37 fuel assemblies. And then the transports of waste from the -- from La Hague took place from 2001 to 2016 and the transports from Sellafield took place in one campaign in 2015. Initially, we made the campaigns with single casks but as we got more confident we made larger shipments in the end we were making shipments of 3 or 4 casks at a time. Here is the Zwilag facility -- unlike a U.S. facility you'll see spent fuel is actually enclosed it's not out there on an apron it's actually inside a hall and this is where the fuel will stay until 2060 or maybe later if there's any delays when we have the final repository in operation. We also can deal with all kinds of other wastes here we have a plasma oven for example for dealing with low-level waste and the low-level waste and intermediate level waste is also stored in this one facility.

And as a special favor to the Government we also store waste from hospitals, research and so forth. Sorry too fast there. This is the inside of the storage hall. Some of our casks are there along with our fellow Swiss utilities.

The next of our -- next part of our strategy was to build an external wet storage facility. The reason for this is that KKG was designed with the idea of reprocessing so the reactor pool wasn't particularly large and even after re-racking which we did early on in life we only have 656 fuel positions and we have to keep 177 of those free for a full core discharge. Also some positions are used for other things so in the end we only have 439 positions so we identified the need for additional capacity. The question is should we go directly to dry storage or should we expand our wet storage. And the problem for us as KKG we have a very high performance fuel and no available cask designs. We had some low burnup fuel which we would use for initial shipments to Zwilag but that was all used up and the rest of the material was not suitable and it would take time, we knew it would take time to develop a new cask alternative. Wet storage also gives flexibility. We can also store the MOX fuel for example. And the additional cooling time allows for utilization of casks when we transfer into casks. We can then benefit from 10, 15 year storage which gives us cooler fuel and greater capacity.

And there is a possible use at the moment this is not planned but it's a possibility as an option to convert this for longer term storage and we simply want to keep that option there as a possibility.

The construction was basically on the KKG site just next to the reactor buildings. A short rail link of about 20 meters -- sorry 50 feet between the two buildings.

We applied for the permit in 2002 and commenced construction two years later and entered service in 2008. Currently we have only filled half the pool we have 504 positions and we can potentially double that in fact more than double that we are looking at options to increase the racking density which would give us possibly even 1200 positions.

The operation is we use a shuttle cask, the TN12/2B to transfer from the main reactor building into the external wet store and the cask can take 12 uranium fuel assemblies or 4 MOX and 8 uranium we generally have 3 or 4 campaigns a year. This ties in of course with our annual usage of 36 fuel assemblies so it actually keeps us in equilibrium.

At the same time we have been developing a new cask design. Which will give us the capability to deal with the high performance fuel we have.

Based on our current situation, we have enough capacity to take us up to 2027 so this sets a deadline for us. In addition, we have planned to operate to 2039 or later. And eventually when we shut down we want to remove all fuel from the reactor as soon as possible for obvious economic reasons.

We cannot buy off-the-shelf casks because of our very difficult technical requirements. We have highly -- not highly enriched but relatively highly enriched uranium fuel 4.95% U235 equivalent with a burnup going up to 70,000 megawatt days per ton. And the MOX fuel burnup is up to 60,000. And this new design needs to be developed and operating by 2027.

We worked out we would need a 15-year lead time to bring this about. So we started work with feasibility studies back in 2013. We issued a request for proposals to suppliers in 2015. And we made a selection and contract was signed in 2016.

I'll come back later on to give you a little bit more detail about this timeline.

The use of extended onsite storage to maximize fuel cooling is definitely part of our policy. That means we can think about having a fairly high capacity cask. We have allocations of cask positions in Zwilag of 77 we have used 14 already meaning 63 are still available with 32 assembly cask that gives us space for 70 years of operation. And I believe there are possibilities to increase this capacity beyond that.

But even based on today's capacity, we're well equipped.

The last part of our strategy has been post-irradiation examination. I just include this for completeness sake. We have had an extensive fuel development campaign over the years. We have PIE conducted offsite of course at the Paul Scherrer Institute in Switzerland and also the Institute for Transuranium Elements, ITU, in Germany so that means we have to arrange transport of these irradiated fuel rods and after examination, they have to be brought back we have return transports too so we have currently -- we are currently using R-72 and NCS-45 casks these are small 20-ton tasks which are adequate for this type of material and we are developing of course a long-term storage concept for these encapsulated fuels. Similar to what we're doing for damaged fuel rods. In the past we send them to reprocessing. That's no longer possible. So now, we need to think about storage or disposal - - maybe in quivers - - that's certainly one possibility but also looking at other options.

The legal and technical constraints. I won't go into too much detail here but I'll leave the references there. Everyone can Google them when they are interested but the basic situation is we have a Nuclear Energy Act which gives us the legal basis for nuclear power in Switzerland. We have independent regulatory organization, ENSI, which is your NRC if you like. We have various environmental acts we have to follow and of course lots of ordinances, regulations, at least 15 are relevant here. And ENSI guidelines at least 40 guidelines are currently enforced and more are being written as we speak.

Internationally of course we also have obligations we have nuclear safeguards obligations with IAEA of course and we're also a signatory in the nuclear non-proliferation treaty and we have bilateral agreements with many countries including the USA of course. And party to international conventions on safety and transport of spent fuel and radioactive waste and we also have to follow the transport safety standards the IAEA safety standards SSR-6 and there's also European agreement on international carriage of dangerous goods by road and by rail the ADR and the RID. This is of course extremely useful as many of our transports have been international transports and also there's the international Maritime Organization Code which was important to us when making transports to Great Britain.

Until now casks have always been licensed for transport in their country of origin. If you buy a cask from the U.S. it would be licensed in the U.S. here first. And then the transport package approval has been validated by our regulator, ENSI. Based on the safety analysis report produced by the manufacturer.

For the storage approval because the storage is taking place here in Switzerland, that's actually made directly by ENSI based on the topical safety analysis report.

For the new cask design being developed with KKG we will submit an integrated safety case which will cover both transport and storage and this means for the first time ENSI will approve both transport and storage aspects together. However they have also indicated they would be willing to do it the old-fashioned way. But importantly for us, they would be willing to license packages in Switzerland.

This is particularly important to us because countries like Germany are pulling out of nuclear power and therefore in the future won't have the ability to carry out a full licensing service.

Basic principles of transport are based on compliance with the SSR-6 and ARD, RID and so forth. And wherever applicable, the international conventions have been brought into Swiss law.

The transports of spent fuel and high-level waste require type B package approvals and the defined standards for shielding containment, heat transfer confinement and maintenance, as well as criticality of course all apply here.

For storage, the key guidelines are given in ENSI-G05 again that's available on the Internet if you want to look at it but it's in German I'm afraid.

So this is applicable to design and manufacturing and use of transport and storage casks, which are used for dry storage of spent fuel assemblies and of the vitrified high-level waste in interim storage facilities. This guideline defines the safety related requirements applicable to the casks. And each cask is inspected during manufacture to ensure compliance.

This adds quite a lot to the manufacturing timeline I can tell you.

The design specific principles for interim storage are set up in a separate guideline which is ENSI-G04. The key requirements basically demonstrate that the cask will withstand all static and dynamic loads under normal operation and accident conditions and the double-lid system is mandatory for casks with spent fuel assemblies.

Leak tightness for the entire period of interim storage under normal operating conditions must be guaranteed. Sub-criticality of the stored fuel also of course, including unfavorable arrangements and flooding.

Also demonstrate adequate performance, resistance to aging effects through the planned usage period of all materials. Welds of pressure bearing materials must be designed as fully penetrating welding joints and shaped to allow ultrasonic testing.

The cask must be sound after an airplane crash followed by kerosene fire and the radiation dose received by the public must not exceed 100 millisieverts. The cask must not tip over during a safe shutdown earthquake and adequate distance must be maintained between the casks after an earthquake. This earthquake, of course, is defined for the facility in question - - in this case Zwilag and dose rate and temperature limitations are also defined.

For aging management, a particular interest here is for long-term storage in Zwilag we constantly monitor the cask inter-lid pressure and report regularly to the regulatory authority. In the event of a problem, there is a hot cell facility in Zwilag where the seals can be exchanged and if needed the fuel could be transferred into another cask inside the hot cell. The casks will need to remain fully functional until geological disposal and then fuel will be repackaged in disposal canisters. I noticed the comments from Bill there in that respect. For us it's very clear we have to go down this route. For some casks this could mean 70 years interim storage based on current planning assumptions. And these planning assumptions could always be changed you never know revised guidelines for aging management are currently under development we're working very closely with Zwilag and other utilities to resolve all of the generic issues.

KKG's approach to planning, if I can summarize in very few bullet points is to be conservative in our assumptions. Always allow plenty of margin. Always have a plan B. Identify the major stakeholders and keep them closely informed. And look for synergies to optimize processes and reduce costs.

All our transports are governed by our quality procedures. We have very clearly defined quality plans. Of course safety first. Part of this process is pre-job and post-job briefings so we can apply lessons learned for the next transport.

What I've done here, I've taken a couple of examples to give you a feel for how the process works. And the first example is with high-level waste transport using an existing cask. This cask however was licensed for waste but it needed to be relicensed to cover the inventory of the material that we had to deliver.

We started the process in Year 1 if you like by carrying out feasibility studies for the cask designs. And particularly looking at the interface. Here we had of course to consider the interface with the reprocessing facilities as well as Zwilag and we identified some long-term investments on the cask handling infrastructure again similar to what Bill mentioned there that the rail wagons have to be bought in advance, we have a similar situation there, too.

And we started this process early. So it wouldn't be affecting us on the timeline later on.

Year 3 we selected supplier, negotiated contract, obtained Board approval. And Year 4 was the real kickoff with the start design and licensing work and also again commencing the forging. We had a lot of forging components that needed to be manufactured very early in the process.

Following year we submitted the safety analysis reports to the regulator in the country of origin and the following year after that we submitted this report and the topical safety analysis report to ENSI. We then -- following then we negotiated transport agreement and also took delivery of all of the accessories we had. Particularly the shock absorbers of course.

And delivery of the first cask was made in Year 8 and ready for loading. We couldn't actually load it until all of the licensing was complete. Approval for licensing -- sorry; licensing approval came in Year 9. And that cask was loaded then and in Year 10 the other casks were loaded and then we made the transport of the three casks to the Zwilag. If we're looking at a new cask design then the whole process is even longer.

In this example here we're looking at a spent fuel transport using a cask which we are currently working on designing. So everything is a little bit provisional at this stage. And at this stage we don't know yet whether we will need to have all of the tests which are required in SSR-6 guidelines.

But anyhow regardless of this, we carried out feasibility studies for the cask design and interface in Year 1. In fact we are looking at different cask designs in parallel.

One of the main differences between this and the waste cask is that the waste cask there are only basically two suppliers. It was quite simple but for fuel casks as you all know there are many suppliers. We were in negotiations, discussions, with 8 and in the end we asked for bids from 6. So there's a lot of work upfront for us there. We issued the RFP in fact in Year 3 and then in Year 4 we selected the supplier, negotiated the contract. And got the approval from the Board.

And started design and licensing work in Year 5. We intend to submit the integrated safety case to the Swiss authorities in Year 7 or 8. By Year 11 we expect to have licensing completed and then we commence fabrication of the cask and of course first of a kind is always the longest fabrication period but nonetheless by Year 15 we expect to deliver the first cask to KKG to have approval for loading and transport it to Zwilag.

Potential risks, there are many. But the main areas of risk are always I think in the design and licensing. During manufacture the deviations that can occur and the corrective work that's necessary and the approvals for such corrective work can add a lot to the timeline and finally the approval of manufacturing documentation which is required in Switzerland before we can load and transport the cask.

The transport planning the main areas of risk is safety and security, that -- that is paramount for us. Also it sounds a bit strange but we need to avoid clashes with major events, political events, sporting events. We have for example - - we have to negotiate with the local police for the police for the Canton and also with the national authorities if there's a major football match in Basel, they don't want a transport taking place at the same time.

And of course we also have to have appropriate measures to cope with demonstrations or protests of any kind. And of course part of this policy is public relations. And we also have a conflict here between the need -- desire to be open but also a need to maintain security. And there's a very careful balance to draw. And when you're dealing with other stakeholders we have to be aware that they also have different criteria. And not all have the same approach.

Particularly in international transport where we had to deal with the authorities in Britain, France and Switzerland simultaneously to get agreement with those three parties was no easy task, let me tell you.

Lessons learned. Always allow sufficient time for development and licensing and then add a margin on top.

Close coordination throughout the whole project, especially with suppliers, with regulators, with civil authorities, national and local Government, and police, other utilities with common interests, shareholders/investors and the public. And have contingency plans in place to deal with unexpected challenges. And in particular transport schedules must be flexible to deal with last-minute delays. They will happen. They happened to us. They will happen to you.

That brings me to the end. Please, if you have any questions, I would be happy to take them.

>> BAHR: Okay. Thank you very much. Do we have some questions from Board Members? And I see Dr. Peddicord getting ready to ask one.

>> PEDDICORD: Lee Peddicord from the Board thank you very much very interesting presentations I liked the pictures particularly.

>> WHITWILL: Thank you.

>> PEDDICORD: You mentioned early on in terms of utilizing first you burn MOX and now you're actually still utilizing fuel with reprocessed uranium.

>> WHITWILL: That's correct.

>> PEDDICORD: You talked about using 4.95 U 235 equivalent with burned in 236 are you actually above 5% U-235 in some of your fresh fuel.

>> WHITWILL: That's absolutely right some of the fuel is 5.03%.

>> PEDDICORD: Is that what you label the 4.95.

>> WHITWILL: Yes it's equivalent.

>> PEDDICORD: Okay. In terms of the cask you're using and the new ones that you'll be acquiring will those only be for Gosgen or is there a sharing among facilities in Switzerland with transport casks.

>> WHITWILL: With the waste from reprocessing there was some sharing - - that is we have the same waste with the same criteria so we can work in common with the other utilities and we had a shared program of transport to

reduce costs also. Our fuel is unique to us so the casks we're using and have used have always been unique to us although I think the casks we're developing for our fuel would be suitable with very few modifications for the Beznau reactors.

>> PEDDICORD: Then for your onsite wet storage do you take that fuel through a drying process for the 20 meter transport from the plant itself to your interim wet storage.

>> WHITWILL: Yes that's right. We have to do that. So we have -- we take the -- first of all, we let the -- we take the cask out of the water and let it drain. We load the cask -- sorry; we load the cask in a pond then we take it out of the pond, let it drain. And then we use a vacuum cooling to -- and make the transport under -- with helium but very low pressure helium.

>> PEDDICORD: So it comes to mind that this is kind of an interesting opportunity maybe fairly unique in the world as you have fairly high burnup fuel you're doing it fairly early after shutdown. Relatively speaking.

Drying it out. Then rewetting it and so on.

Will some of those rods eventually go to PIE at say the Paul Scherrer Institute to look at this drying of fairly hot fuel, rewetting, and so on for any potential effects?

>> WHITWILL: That's not planned at the moment. That's a very interesting point. At the moment we are sending some of our rods to PIE. But these are ones coming from the normal wet storage. And we're not doing this on the other rods at the moment. But that's an idea that I will take to my colleagues.

>> PEDDICORD: What would be the peak burnup of some of those rods you talked about average of 65 megawatt days do you have some actually higher peak burnups in these rods.

>> WHITWILL: Oh, yes, up to 75 even in individual rods.

>> PEDDICORD: That would seem to me a particularly

interesting opportunity to do some examination.

And then of the -- finally with the casks that you're -- which are now under design; how many of those do you anticipate finally acquiring.

>> WHITWILL: If we have 60 years operation we'll need 51 casks and then for every additional 10 years operation another 12 casks so I'm hoping ordering about 200.

>> PEDDICORD: Wow, merci.

>> BAHR: Steve Becker.

>> BECKER: Becker, Board, you mentioned the importance of effective coordination with the emergency services in transport planning. How is that actually done? Has there been a need for additional training or resourcing of those services? And have you utilized exercises and other mechanisms for enhancing that coordination and the effectiveness of emergency preparedness?

>> WHITWILL: We have a national emergency organization. And they coordinate with the utilities. But also with the police forces and the Department of Energy and the regulator all partied together. We have people permanently assigned to liaison with the N Ed Zed it's called national alarm central is the full name and also we -- and they have exercises. Also we have annual coordination with the police. This is the utilities and police get together every year to discuss general issues over and above the coordination we have with them on individual transports.

>> BECKER: Thank you.

>> BAHR: Yes, go ahead, Paul.

>> TURINSKY: Turinsky, the Board. When you load a cask do you do a detailed separate analysis for that or do you have some sort of generic rule showing burnup and enrichment and things like that - - I'm thinking criticality, heat loads, radiation fields.

>> WHITWILL: Good question. We actually draw up a loading plan for each individual cask so we're taking

account of the fuel not only to optimize but also to minimize the radiation uptake.

>> TURINSKY: You actually did calculations, rather than pre-calculated guidelines?

>> WHITWILL: We do calculations each time yes.

>> TURINSKY: The second question is based on your experience, what were sort of surprises when you actually started transporting fuel - - that had generic implications that you learned from over time. Can you think of anything that fits that category?

>> WHITWILL: I think -- the longer the journey the more risks you have. When we have international transports, there's a risk of perhaps demonstrations in one country and not in another. I want to say -- Switzerland is a very peaceful country. I can't say our neighbors are all the same.

(Chuckles).

>> TURINSKY: I'm thinking more of a design feature that if - - you wish you would have had certain designs from a design feature to address some issue during the

actual transportation.

>> WHITWILL: No I think actually because it's a long history of transportation I came into my current job as head of the fuel department -- fuel procurement in 2010 and before then I was working for KKG since 2002. But the transports were going on for a long time before then. I think probably adapted lessons learned during this long period and what I inherited was a well-oiled machine.

>> BAHR: Linda.

>> NOZICK: I would like you to finish the comment about demonstrations in one country and not in another. In the lessons learned what did you learn - - so yes I can see that that could happen but how does that fit into a lesson learned.

>> WHITWILL: Well you have to look at what's -- what your weak points are. For example, if you have a transfer from a ship to a rail head, is there likely to be a blockage there? Are there going to be demonstrators who are going to try to block the docks

for example. These are things you need to take into account in advance and not have to panic about on the day because there will be demonstrators and particularly abroad and I think the first time transport is made in the U.S., it may also have some opposition. I think when -- in Switzerland, when they restarted transport it was a break in the 1990s and they restarted the first transport attracted demonstrations. Since then we haven't had any. Touch wood.

But, we know that the Greenpeace and Friends of the Earth and so on was monitoring us and keeping a careful eye on what was happening, if not going to German style demonstrations.

>> NOZICK: Thank you.

>> BAHR: Other question? Mary Lou.

>> ZOBACK: –Zoback, Board. I too want to thank you for a very excellent presentation. You inspire a lot of confidence everything seems very thorough and well

thought out and I appreciate your additional conservatism on any estimate should have some margin of error so I just have a couple of minor questions. The distance from your plant to Zwilag is how far?

>> WHITWILL: Um, I'm thinking it's about 70 kilometers. Maybe is that 40 miles.

>> ZOBACK: Yeah, that's good. So about how long does that trip take?

>> WHITWILL: It depends how we take it. In the past we have made transports with railway and then we had to have the transshipment just about a mile from the plant. By vehicle. Again it's the best part of the day when you're taking everything -- in the future we're thinking of going directly more by road and that would be much quicker there would be no transshipment involved and the whole process is complete in an hour or two.

>> ZOBACK: Okay. Great and I think you answered the question when you were talking about the protesters but crossing the channel - - the shipments to and from the UK - - you load it onto a boat and were railcars loaded

on --

>> WHITWILL: Yeah it's a very complicated logistics. Starting in Britain it was loaded onto a railway and we had a transport frame which is loaded on to the railway wagon --

>> ZOBACK: Is that a standard railway car or specially designed.

>> WHITWILL: This is specially designed but of course the reprocessing facility of course has them because that's their business.

>> ZOBACK: That's their job, right.

>> WHITWILL: We didn't have to have new ones built for us but we did have to have new transport frames built and the transport frame was then lifted off the railway wagon and put on to the boat directly.

>> ZOBACK: Oh, okay.

>> WHITWILL: So it's a transport -- the transport frame was also used for the shipment itself. When it came to France, there is a wagon the Q80 wagon which is used for the transport within France and Germany and

Switzerland. And this wagon actually has an inbuilt transport frame so you don't need a transport frame. So what which did then we took the casks out of the transport frame and loaded it directly into the railway wagon.

>> ZOBACK: So you actually had many separate operations and they all had to go smoothly and they have.

>> WHITWILL: That's right. And to -- smoothly --

>> WHITWILL: To make it more complicated we had a short distance from the dock to the rail head in France to worry about, and a similar thing when we get into Switzerland with the Zwilag loading station.

>> ZOBACK: Thank you. The other question I have -- you mentioned I believe five nuclear power plants in Switzerland. Are there five separate operators?

>> WHITWILL: It's four actually. Because two plants, Beznau 1 and 2, are together and they are owned by the same company, Axpo. And then the other plants are all single plants. But there is some cross ownership. That is some of our shareholders -- Axpo is

one of our shareholders and they are also the owner of Beznau and a big owner of Leibstadt as well.

>> ZOBACK: So as you're now planning hopefully to start work on an underground repository do all four utilities meet together often to discuss things or are you all kind of carrying on your own operations.

>> WHITWILL: No we meet regularly actually we have a group which is called the Zwishenlagerung Entsorgung und Transport. That's the interim storage, disposal, and transport group which I'm the Chairman of. And we discuss four or five times a year on matters of common interest. So yeah, there's -- it makes sense to try and coordinate as much as possible. And I think we save a lot of money by doing that.

>> ZOBACK: Absolutely thank you very much.

>> BAHR: Jean Bahr of the Board a couple of questions. Your truck transport, is that just regular trucks or do you have to have a heavy haul type of truck to transport your casks? Are they small enough that they can be accommodated by traditional lorries –

traditional trucks.

>> WHITWILL: No they have to be special high weight trucks. We're talking here of casks that are weighing over 100 tons. So it's a special heavy duty truck and of course we need a special license for it.

>> BAHR: So that 70 kilometers of transport if you did it entirely by vehicle it would actually be moving fairly slowly then over the roads.

>> WHITWILL: It would be moving slowly yes.

>> BAHR: And then the cask that you're having designed, you told us a little bit about the fuel. But what are the -- some of the most challenging parts of the actual cask design? Because it seems like this is taking -- it takes a number of years to design the cask and then it also takes a number of years to actually fabricate it. Could you expand a little bit on what are some of the components of the cask that have to be specially designed or that are more difficult to evaluate?

>> WHITWILL: Well of course it's the licensing

rather than the design which is the key point here. But we have -- the cask has to be able to cope with fuel which is potentially up to 4.95% enriched. It's got potentially a very high burnup. We always have to look at the worst case scenario. And prove that it's still safe. And I think that is the most demanding thing is dealing with high burnup high enriched fuel. It's easier -- if we were a less ambitious power plant we could buy an off-the-shelf cask.

>> BAHR: So what are the special design features of the cask that are accommodating that high burnup? Is it the thermal connectivity to deal with the heat load? Is it the shielding? Is it lids and seals?

>> WHITWILL: Yeah, I think -- the shielding is one issue because of course the more shielding you have, the heavier the cask and then you end up with a cask you can't manage. We have also -- we have to think not only the transport issue of transporting this monster but also -- but also of dealing with it in our facility and the Zwilag facility. It's been built already we can't

change what we have. So we are very constrained by what we can do. But at the same time we have this ambition to operate as long as possible that means getting as much fuel as possible into a single cask.

>> BAHR: Thank you. Mary Lou.

>> ZOBACK: Zoback, Board, quick follow-up question. The new casks will have 32 fuel assemblies in them is that correct.

>> WHITWILL: That's correct.

>> ZOBACK: And that won't exceed 100 tons.

>> WHITWILL: It will weigh more than 100 tons, 100 tons is not our limit we can go above 100 tons.

>> ZOBACK: And you don't need a new heavy duty truck, you already have trucks that will suffice for that - - lorries sorry.

>> WHITWILL: I understand both, don't worry.

(Chuckles).

>> WHITWILL: The answer -- there are trucks available. We don't own a fleet ourselves but there are trucks available.

>> ZOBACK: So it's not going to exceed anything that capacity already exists for?

>> WHITWILL: I mean one of the issues we had for example is the shock absorber size with this monster cask you have to have monster shock absorbers. And then you have interesting issues like using the public roads. Getting through -- under bridges and so forth. The gauge is very important here. And also handling onsite at Zwilag is important.

>> BAHR: Tissa.

>> ILLANGASEKARE: Illangasekare, Board. Thanks for your informative talk. I have a question. You mentioned that 2.4 cents kilowatt hour that's what the consumers pay? That's the price the consumer pays and you mention that's cheaper than hydro. So that is generally true or specifically true for Switzerland.

>> WHITWILL: We are not selling to consumers we are selling in the wholesale market that's a wholesale price and we're competing against not only the Swiss producers but we're also competing against the rest of Europe

because we're integrated in the European grid and particularly of course we're competing against subsidized energy from Germany. Germany has a so-called energy vendor you have probably heard about it so they shut down most of the nuclear plants and they subsidize with billions of euros of solar and wind energy. Sometimes their energy is coming through free of charge. Sometimes it even has a negative cost attached to it. Then it's very difficult to compete.

>> BAHR: I think I saw Nigel first back in staff.

>> MOTE: Mote, staff. This may be a question that you guys don't face the same way as we do in the States. Do you have rail vehicles that are dedicated to a cask type or do you have rail vehicles that are universal and can put any cask on any railcar?

>> WHITWILL: Because we have developed a transport frame we basically use a flat roll which and then you fix the frame on to the flat roll.

>> MOTE: In the logistics of moving the casks any railcar will do for the casks but you have to have the

right frame.

>> WHITWILL: It has to meet the weight and strength that's the issue.

>> MOTE: Does it cause you any logistic problems because you need the right equipment in the right place at the right time and that's a major or significant constraint in planning the logistics of transportation operations.

>> WHITWILL: This has been a factor which is one reason we're favoring the idea of using road transports for new generation cask, rather than rail.

>> MOTE: Because road is more generic with the right frame but railcar is more complex.

>> WHITWILL: The issue of weight is very important. It's the allowed amount of weight on the bogie is also a deciding factor when you have the cask plus shock absorbers plus frame you're talking -- I don't have it with me -- but something like 150 tons. It's not easy to have that equipment available.

>> MOTE: Okay thanks.

>> BAHR: Dan Ogg?

>> OGG: Yeah, Dan Ogg, Board staff. Mark I would like to come back again to your new dual purpose cask design. If it's not sensitive information can you tell me what the name or the designation of that cask is?

>> WHITWILL: Well I can tell you it's being developed by GNS. And it's part of their geo series.

>> OGG: Now we're interested in the development time and licensing time, fabrication, et cetera.

You mentioned that it's a unique design for the high burnup fuel at Gosgen but is it based on a previous design to some extent? Or is it all really new, all the features are new.

>> WHITWILL: Obviously there's a lot of previous design work which has gone in there. And particularly the Castor V19 is an important predecessor to this cask design and as much as possible we'll try to use information -- sorry; design material which has already

been approved in the new design.

>> OGG: So your regulator ENSI has seen and licensed the previous versions in this geo series or similar GNS casks is that right.

>> WHITWILL: Yeah that's right. In fact Beznau is using the V19 cask for their fuel.

>> OGG: Okay. But this one does have a number of new features to deal with your high burnup fuel.

>> WHITWILL: Exactly right.

>> OGG: All right. Thank you.

>> BAHR: Linda?

>> NOZICK: Nozick, Board. If you move from rail more towards truck transportation, are there any public -- what's the public feeling about that?

>> WHITWILL: That's a good point because if you have a lot of transports I think the public would be very much against -- I mean fortunately we're talking of maybe a couple of transports a year. It's not too big a load on the population. When we had the transports of the waste from the reprocessor we had a lot of material

coming back and it was actually very good we could make the transports by rail I think in this case when we're making one or two transports a year that shouldn't be a big issue.

>> BAHR: Other questions from Board Members? Other questions from staff? Do we have any questions from the audience? Yes, please.

>> Hi, I noticed that you use casks rather than canisters. As I understand it. So you go to canisters for disposal but currently you don't use canisters, which is different than we have in the U.S. where we have thin walled canisters that have overpacks. Could you address some of the reasons why you chose casks?

>> WHITWILL: That's a good question. I should point out that one of the Swiss utilities, the operators of Leibstadt are in fact developing a canister based system but it hasn't yet come into operation. But at Gosgen we decided to stay with a thick wall cask we thought we would be more sure to get licensing approval on the time scale we envisaged we didn't want to take

any risks. And in any case - - and a big difference between the assumptions here and assumptions in Switzerland is that we know in 2060 we will have to transfer the fuel anyhow into disposal canisters and these disposal canisters are only taking four fuel assemblies each and there's no way we wanted a system based on canisters with 4 fuel assemblies in them - - so, that's why we decided to stay with tried and trusted if you like thick walled system knowing anyhow that we would have to transfer everything down the line into a canister based system.

>> BAHR: Bret, did you have a question? Okay. He's telling me we have 5 minutes left before our break. Are there any other questions from the audience? Okay. Well, we are -- Dr. Peddicord.

>> PEDDICORD: Is there a bit of time left.

>> BAHR: Yes certainly.

>> PEDDICORD: If I may.

>> BAHR: Yes.

>> PEDDICORD: Peddicord from the Board. As you look

in the longer term and looking towards Zwilag as you're inclined to build some -- you built some time into that 2060 date you mentioned for the repository, Mühleberg will now shut down next year so that's actually giving you a little more capability at Zwilag but particularly Leibstadt and Gosgen have the possibility for going quite a length of time - - you have a 70 year lifetime but could go longer given the ENSI approach to licensing, So, in your estimation, do you have the capability in Zwilag or might that require modifications or addition to that facility given the built-in uncertainties you're inclined to use.

>> WHITWILL: That's a good point. We have just started actually reviewing this issue. On a joint basis. And we are looking at ways that we could increase optimized capacity in Zwilag. The current planning is to have 200 spaces for casks. And we'll now look at whether we can increase that without making any building modifications. But we really just started that project. So it's far too early to say anything

about it.

>> BAHR: Any other questions? Actually I had one. You mentioned the repackaging. Is that going to happen at the repository or would the repackaging happen at Zwilag and then have the disposal canisters transported to the repository?

>> WHITWILL: That is a very burning question, you could say.

(Chuckles).

>> WHITWILL: It depends where the final repository is which of the sites they choose. If it's close to Zwilag it might make sense to have the repackaging at Zwilag and transport these canisters in some sort of overpack. If the repository is further away it may make more sense to have the repackaging plant at the repository. And also, again, we have just started looking at alternative designs for this plant - - so again it's early days yet.

>> BAHR: Okay. Thank you. Anything else.

Okay. We are scheduled for a break until 9:55. And we'll get back onto our published schedule in case there are people out in webcast land that want to join us in a timely manner. So see you in a few -- about -- a little more than 15 minutes.

(Break.)

(Standing by).

>> BAHR: Okay. Welcome back from the break. And trying to keep on schedule I would like to introduce our next speaker Gary Lanthrum who is a Principal Consultant to NAC International and he's the former transportation manager for the U.S. Department of Energy's Office of Civilian Radioactive Waste Management and I know that they had put together - - prior to the suspension of Yucca Mountain, they had been developing a nationwide transportation plan and we're going to hear a bit about that experience. And lessons learned. So thank you, Gary.

>> LANTHRUM: And thank you. And thank you for

inviting me. It's fun I haven't been to Idaho Falls for a while. I used to come here very often and it's a treat to get back to some of my old haunting grounds for a while. I've had the really lucky career benefit of working both in the private sector and public sector so my comments today will be built around my experience in both arenas and hopefully that will be helpful.

I also have more slides than I have time to talk to. A lot of the slides were included for background information and for context so my apologies to anybody that's watching online I'm not going to spend a lot of time on some of the slides. They are there. You can go over them and maybe whatever questions come in people can reference those but for the most part I'm going to dash through a couple of the slides.

And that is an intro. First slide.

This slide is one of the ones I'll rush through. It basically shows the historical safety record for spent fuel transportation and references the same publication by the National Academy of Sciences that Bill Boyle mentioned the Going the Distance report. And, in that, they said there were no technical barriers to the safe transport of spent fuel when it's done in accordance with the current regulations and that's just kind of a context. Then this slide I'll also run through the graph on the left is out of that Going the Distance report by the National Academy of Sciences and it shows the relative risk of harm from spent fuel transport compared with some other Hazmat materials including chlorine - - and spent fuel the risk is lower. Some of these have several orders of magnitude higher risks and a lot of that is because of the regulatory construct for spent fuel shipments the robustness of the packages but historically that's important.

This graphic is one I haven't updated for a number of years. This was from 2014. I got that from the Association of American Railroads, AAR. Anyway.

This is Hazmat shipments by train. And it breaks it down by Hazmat class. And most of the classes have a lot more shipments. This is actually two pieces of the pie right here. And the smaller piece is radioactive material in total. Not just spent fuel shipments. Spent fuel shipments are a very small subset of that.

So on a per shipment basis spent fuel shipments are less risky than some other hazardous material shipments and there's fewer of them so the total impact is lower.

And again this is a graphic that hasn't changed for years. And even if Yucca Mountain or some other repository were to start up tomorrow, the peak delivery rate was only anticipated to be 3,000 metric tons of heavy metal per year. That's about 60 rail shipments with 3 casks per train and the plan was always to use 3 to 5 casks per train so the relative quantity doesn't change.

And given the safe background and the relatively lower risk, I pose the question about whether anything needs to be done before shipments to the repository, wherever it winds up being. And the answer that I have concluded is yes there's a lot to be done. Most of that safety record to date is based on repetitive operations of shipments of spent fuel from operating nuclear plants where you have a lot of infrastructure. You don't have much variability in how it's done. And things are going to change.

And to be ready and to be safe, you need to accommodate that change and it would be nice if you have some way to practice it before it happens.

This is a list of challenges. I'm not going to go through these -- oops. I'm not going to go through these individually right now because each of these will be touched on later in the presentation one-on-one. And the NWTRB - - I had a couple of conversations with them before this meeting. And there were a series of questions they wanted me to answer and the first was what technical issues caused me the greatest concern? What kept me up at night? This is a list of the things that kept me up at night when I was there. And again each of these is going to be dealt with. So this is -- oops. Where is the pointer thing? There is the pointer. This is No. 1 A, B, C through E and following this is

1A and on 1A the topic was high burnup fuel transport. That was an issue that kept me awake at night when I was running the transportation program for Yucca Mountain because it was uncertain whether or not we would be able to transport high burnup fuels with more than 45 gigawatt-days per metric ton burnup. Since then there's been a lot done on HB fuels. There’s a lot of R&D being done and partnerships between the federal and the private sector. Bill Boyle referenced a major transportation with dummy fuel rods. That travel around the world by barge, by ship, by rail, by heavy haul vehicle. And it was mostly to look at the vibration and the other disturbances that fuel could see in normal transport and the conclusions were it was a lot less than anticipated. So there's a lot of work like that that's going on that will hopefully allow high burnup fuels to be shipped. But it's not a done deal. There's still some work to be done by the NRC. There's additional studies.

There's a study being done with the Electric Power

Research Institute looking at the consequences of hydride reorientation and other mechanical properties of cladding and changes that affect the ability to transport.

We do currently have the capability of transporting any high burnup fuel out there. And that is if each assembly is packaged in a damaged fuel can inside the canister or inside the transport cask. Some of the high burnup fuel that is awaiting transport and dry storage is in these damaged fuel cans and can be transported as-is. Other portions of it are not. So it's a mixed bag about what - - even though the capability is there, there's a division between what is out there that can and can't be transported until there’s updates to the Regs. I feel fairly confident that this is not going to be as big a deal as when I was there. I was trying to buy actual mechanical property and fission product data from vendors to support the ability to ship high burnup fuels when at DOE. Never had the funding to do it. But we had a program in place to try to collect data to contribute to the ability to transport high burnup fuels. It just never got off the ground because of funding.

This is a slide that shows 1b, the 1b problem I stayed up awake at night over was transport of EM spent fuel.

There's a pretty good knowledge about what's out there in the commercial spent fuel arena. All that fuel is fairly heavily burned. The composition doesn't vary a whole lot. There is licensing to cover all of those fuel varieties for transport. The EM spent fuel, there's a lot of cat and dogs. There's a whole lot of variety in what it looks like. There's a whole lot of variety in enrichments and a whole a lot of variety in burnups and there was actually a document called the waste acceptance system requirements document. We called it the WASRD when I was at OCRWM, and there was a Memorandum of Understanding or Memorandum of Agreement between the Yucca Mountain program and the Office of Environmental Management over roles and responsibilities for who would be doing what to package and transport that fuel. And in that agreement the Office of Environmental Management were responsible for characterizing the fuel and packaging it for transport and then the Yucca Mountain program would show up with a transport cask the package would be put into the cask and it would be shipped. Because of all of those cats and dogs that EM has, they decided some years ago at least while I was there that they really couldn't characterize each individual assembly so they broke this plethora of material down into groups. They were hoping to categorize it by group and gets approval for transport they were having meetings with the NRC. Part of the meetings was discussing getting moderator exclusion approved for their canisters and I was not involved in those meetings but I know that they stopped and I don't know where that lies right now. So there are challenges - - one of the most difficult challenges, as I read the WASRD, that waste acceptance system requirements document in the 2008 Memorandum of Agreement between EM and RW, was that EM would characterize and package the material. RW would certify transport casks for that material and in the NRC world there's a distinction between packaging which is the actual bucket you put things in to transport and a package and the package is the packaging plus the contents and there's not a good relationship right now between the packaging and the contents that EM wants to ship that would allow it to move down the road.

Since the Memorandum of Agreement says that RW or the successor organization would be responsible for getting the Certificate of Compliance for the package which includes the contents, I don't know how they would do that absent the individual assembly characterization data that EM has decided it doesn't want to pursue. So there's an impasse there that I don't think is adequately addressed by existing agreements and waste acceptance requirements documents.

On the high-level waste side there are some good commercial solutions that are in play. And I think progress can be made quicker when the Government incentivizes the private sector to come up with solutions and in the case of high-level waste there are a number of facilities that were storing high-level waste the Feds wanted to take down one of the prime example was at West Valley a large facility they wanted to D and D. They had to find some other way of dealing with the waste and put out bids to the private sector and NAC International won the contract to move that high-level waste into a dry storage configuration, much like what is done with spent fuel in a lot of plants around the country.

And in so doing - - this is actually the canisters or the storage casks for canisters of high-level waste at West Valley. And this is -- this is a picture of one of the canisters being lowered - - this is the dummy one why people are standing so close to it - - this is the dummy one being lowered into a storage configuration just to test the fit-up. But there are ways for the Feds to make progress by using the private sector to create solutions that are workable.

And the next slide just shows one of these storage casks with 5 of the high-level waste canisters in it. And there is at least one, there may be more transport casks that are certified for this content. NAC’s STC is one and I suspect other vendors either have or will have transport casks certified to transport this high-level waste content.

In those agreements between the Yucca Mountain program and the Office of Environmental Management there were a lot of discussions about the makeup of the glass that the logs of high-level waste would be poured into. That agreement and what was submitted in the license application and what the Yucca Mountain repository was designed for was potentially only one subset of all of the glass varieties that might ultimately be produced and the loading of heavy metals into that glass matrix was fairly low and I know Pacific Northwest labs and others are still working at DOE's behest to come up with higher waste loadings. If they are able to pull it off it's greater for efficiency you don't have -- you don't have as many logs of high-level waste to take all the material that you have to store and dispose of but it may run afoul of transport certifications and disposal capability. And so coordination between EM and whoever has the repository program as new waste formulations are proposed to be sure they can cover both transport and disposal is another important issue.

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DOE had contracts - - and Bill Boyle mentioned there are contractual issues with resolving transportation issues as well as technical and societal issues. And he pointed out that even though there is desire to transport canistered fuel, the contracts don't currently anticipate canistered fuel being transported and unfortunately the industry, the private sector, the utilities have moved to canistering all of the fuel that's in dry storage and there's a whole bunch of different kinds of canisters. Different sizes, different shapes, well they are all right circular cylinders but all different sizes, different capacities, different allowances for what kind of fuel can be put in them and how much burnup. And as I mentioned earlier the idea of the package where the package is both the packaging and the content there is a one-on-one relationship between these canisters that individual vendors have developed and the casks that have been used to transport those canisters. And as a result instead of the handful of transport casks that would have been needed to transport bare fuel, right now there are 15 transport casks required to handle all of the canistered equipment that's out there. Already out there. Each of the cask vendors has a grandmother transport cask that's big enough to take all of these contents but none of those big ones are licensed to take all of these contents and it's inconceivable to me knowing that the shock absorbers or impact limiters on these transport casks different vendors have different g-loadings and how those g’s are spread out during a hypothetical accident condition - - that has to be taken into account when the internals of the canisters are designed. Each vendor’s design of their canister internals are proprietary and I can't conceive of any way that one vendor could develop a transport overpack for another vendor's canister so I can't see a point where you can have one solution that could handle everything.

I think that the best that you could do is have 3 solutions, one from each of the major cask vendors Holtec, Transnuclear and NAC developed to handle all of the canister content that's out there and possibly all of the bare fuel content by changing out basket configurations in a transport cask.

The vendors don't have any incentive to do that on their own so incentives would have to be provided by the Feds in order for them to develop a single point it's actually better for the vendors if they sell 15 casks to the Feds to do the transport because that's a lot more activity for their product lines.

The other challenge with this is that that historical safety of transportation and all of these good vibes about how safe this has been and all of these shipments that have been done over time, how many metric tons have been moved in this country and internationally, senior managers see that and they go, why should we spend any money on transportation. We're doing it now - - spent fuel is moving now it does get moved on a regular basis. There's no need to spend money we have the capability it's safe as-is so what more is needed? And as a transportation director that was an eternal challenge for me because there are lots of things that have been done -- that have to be done and they have long lead times. The fact we have capability now doesn't mean we can move everything now. My budget was always much lower than I had anticipated or requested. And I suspect that whoever has transportation in the future will face the same problem. I never had the funding to buy the sufficient quantity of 15 different casks and have them available on Day 1 and unfortunately with the way the standard contracts are written, DOE doesn't know what's going to be shipped first. They got no clue. There's a priority system that allows the utilities to choose but it's based on the oldest fuel but the utility that has the oldest fuel gets chip number 1 for the first shipment, but don't have to ship that oldest fuel. They can use anything else in inventory so it's just a place in line for them. So, with a constrained budget and 15 rail casks - - varieties of rail casks with multiple copies of each I had no idea what to buy. Just clueless. It was a shot in the dark. And that's a bad way to design a system.

The other thing is that there are a variety - - since the utilities have developed dry storage on their own and in concert with the vendors that sell dry storage systems, there are a bunch of different solutions. And the systems at each plant are different. And what's going to be required, each shutdown plant particularly at shutdown plants you don't have the infrastructure for transferring fuel from storage into a transport cask that you do in an operating plant. You have a lot more capability in an operating plant. At a lot of the shutdown plants all you have is a concrete pad and some storage modules sitting out there and any crane capability you need, any other lifting hardware, all of that will have to be brought in remotely and because of the different solutions there is no one answer to dealing with all of that and that variability creates challenges for any transportation system to actually get implemented and the money was never there to deal with kind of combining those into a smaller subset of solutions.

Next up is the railcars. Bill Boyle talked about the work that's been done to develop railcars and the railcars I'm sure will be great railcars when they are -- when all is said and done. I actually spent some time in France and saw their rail transport system. They just had to use cars qualified for the weight that was going to be put on them. There's no special design. There are special designs required for railcars for spent nuclear fuel and high-level waste in this country and they have a whole bunch of special bells and whistles on them.

One of the challenges is the Atlas car that's being developed by DOE it's 12 axle car. It's 78 feet long between pulling faces. And the plan was to have three of these in the train with a buffer car between the lead one and the engine and a buffer car between the trail one and the escort car. Those three cask cars the buffer car and escort car, you're talking over 400 feet of connected length. Plants don't have 400 feet of rail parking space next to them and the logistics associated with where do you park this stuff. How do you get these casks from the railcars - - the empty casks from the railcars to the plant to load them and how do you pick the loaded casks back up again, what kind of storage facility in the interim would you use for the railcars, do the railcars go completely away or stay close until they are loaded. There's a whole bunch of logistics that revolve around these questions and the answer to those logistical questions drive how many cars you have to buy. If you just park them nearby until the cask are loaded and then bring them back to ship the casks somewhere, you need more railcars overall than if you're able to take them somewhere else. So there was a huge question about what the railcar inventory needed to be and that was another area that was complicated by the constrained funding.

A lot of the sites no longer have rail access. So there will be intermodal shipments. A very big heavy truck - - and these casks for the modern canisters transport casks for modern canisters - - we're talking over 200 tons - - the canisters used here in this country for storage are larger than the transport casks that are used overseas.

So instead of the hundred tons that Switzerland was able to deal with we're looking at 200, 250 the Navy's railcar cask the M290 because it's a 290 ton cask it's a big honker. Dealing with these is not going to be easy. We do have intermodal facilities particularly at large ports. This is a big gantry crane at a shipping port that's able to take railcars off of trains and off of ships, move them over to a truck or vice versa, move them back and forth. That's a really nice facility and it would be great to have one of those every place that would be convenient for all of the shutdown plants that don't have capability. They don't exist where the shutdown plants are. So there's going to be some kind of a portable system used - - yet to be determined. And if you allow each site with all of the sites around the country to develop their own processes for doing these loadings you won't have any consistency. And without any consistency, you don't get any lessons learned out of your process. You never really improve. Each shipment winds up being the first of its kind. And you're reinventing the wheel every time you do a loading and that's a broken process. While I was at DOE we looked at both a transportation integration contractor that could have driven some uniformality across different sites so you weren't changing the process each time. And we also looked at regional support contractors as another way of dealing with to drive some commonalty. Both of those fell by the wayside because of funding and timing.

But some effort is needed to drive a little more consistency in the way that waste is transferred particularly from shut-down sites into the transportation system.

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And this is a slide basically about the -- I think -- yeah. Inconsistent and steadily declining funding that made a careful thought out development of a transportation program impossible. The first year I started and I was the initial national transportation director for the Yucca Mountain program, I had $64 million for the year. And that was anticipated to increase to $120 million the second year and grow more so assets would start being developed and we could do the shipments. Instead, the second year, it dropped from 64 million to 20 million and from that point on all I got was funding to cover the Federal employees and a few contractors just to do studies. We couldn't actually do any hardware development.

And that winds up being a major challenge.

It also in the future will be a challenge Section 180C of the Nuclear Waste Policy Act is the portion of the law that says that the Government must fund training and provide technical assistance to states and tribes along the transportation corridors for them to be ready for the emergency response requirements for these shipments.

Since we didn't know where the shipments were starting from the implication was you have to fund every jurisdiction all around the country on Day 1. That's incredibly expensive and the funding clearly wasn't going to be there based on my experience of challenging funding for transportation when there's all these hungry mouths in the repository program chasing for what little funds are appropriated by Congress. I think in a later slide I'll talk about it somewhat. But to ensure that the states and tribes that do get funding get adequate funding it would be helpful if the queue could be negotiated to concentrate on a region of the United States at a time so you have fewer mouths to feed during any given year. If you're trying to cover the whole country and Congress only appropriates a small amount of money you're dividing that small amount of money among more people. Constraining the number of people you're dividing it amongst gives them more funding so constraining the queue to a region would be helpful.

Another question I was asked was what kind of interactions with other Federal agencies do we have and how long did it take and how long would it be anticipated. There was a lot of time spent with the Department of Transportation and the Federal Railroad Administration. We were negotiating over things like a dedicated train decision. In Europe spent fuel shipments are done -- it's just a railcar carrying spent fuel in between a bunch of other railcars carrying other commodities. In France for example that whole train pulls into Boulogne, which is a transshipment capable place where a railcar with spent fuel is pulled away from the train the rest of the train is snapped back together and takes off and goes on its merry way. There was a desire to constrain shipments in this country so that shipments of spent fuel were in a train that carried nothing but spent fuel. And there are a bunch of reasons for that.

If you say that transport is safe for hazardous materials, then there's -- and that's true regardless of the train configuration, then you can make an argument that there's no need for dedicated trains. While I was at DOE we did -- got a policy statement signed by Secretary that was a policy decision to use dedicated trains based on economics. When the train goes through a classification yard - - the railroad configuration in this country is complicated. Each railroad owns pieces of track and those pieces of track so if you want to start shipping from some place in the northeast you will deal with multiple railroads on the way to get to where you're going. Each railroad goes as far as a classification yard where the consist - - the cars on the train are handed off to the next railroad.

And when you get to a classification car -- yard, because all of the cars in that first train aren't going to the same place, the cars all get broken up and reattached to other engines owned by the next railroad and they go their different ways to get to the next classification yard.

72 hours is a pretty normal time requirement for getting a railcar out of one train and switched over to another train leaving a classification yard. If you've got dedicated trains, you don't have that problem. Dedicated train pulls into a classification yard, as you change railroads all you do is change engines and the new railroad with their engine has their signaling information takes off with your train so the turn-around time is a lot less. And we calculated that the net cost savings was beneficial to use dedicated trains. So we had a lot of negotiations with the FRA and I suspect more negotiations are going to be necessary.

One of the big issues is for truck shipments, doing inspections of the cargo at state borders is pretty straightforward. Pull a truck over anywhere people can inspect it and say yeah it's good to go in our state go on your way. Railroads don't have turnouts at state lines they have turnouts where the railroads decide to put turnouts so doing inspections on a state by state basis becomes more complicated. That's one of the negotiations that wasn't resolved when I was at DOE. I'm not sure what the current stats is but that will require additional discussion and interaction. We had a lot of interactions with the Association of American Railroads the AAR over their railcar standard. The technical requirements are understandable - - they are silly in some cases but understandable. One of the silly things there's a requirement to have electro-pneumatic brakes. Well, in a normal train a train carrying just regular cargo you can have 120 cars on the train if it's a pneumatic brake signal when the engineer steps on the brakes in the engine that compressed air has to propagate all the way down the train it can take a long time before the brakes get turned on in the last car. If you have electro-pneumatic brakes the engineer flips an electrical signal that activates the braking on all cars at the same time good idea for a long train.

We're talking five or six cars in these trains. The electro-pneumatic brakes doesn't buy you anything on a train that short, but it's a requirement. The technical requirements can all be met. There are a whole bunch of monitoring requirements as part of the standard - - active bearing temperature monitoring and truck hunting monitoring. Truck hunting is how the suspension is moving back and forth and it has a lot to do with the railcar’s propensity for derailment and there's some limits for that.

There's a bunch of other active monitoring systems. A wheel flat as part of it.

Technically developing all of those monitoring systems and transmitting is easy. The question is what do you do with that data? If you have a signal that's out of spec does the train stop right there? Does it continue to a safe harbor and go to its destination and the problem gets fixed there? Those operational questions hadn't been resolved and that's a huge bone of contention over how these shipments will actually take place.

And speeding through. So that's something that's needed.

There's negotiations with the railroads over the cost of shipments. The DOE sued the railroads over the cost. They won the lawsuit. The court said negotiate with each railroad in the settlement and that's still ongoing and needs some work and then there will be state permits for heavy haul.

Another area that needs attention is improved integration between transportation, storage and disposal. They each have different drivers right now and it's not well integrated. The systems that are being used for storage currently aren't viable for disposal at Yucca Mountain and they are even less viable for disposal in other geologies if another repository is chosen. Repackaging will have to be done - - where would it be done - - how will it be done. Better integration between EM and whoever runs the repository program over their waste forms. Beginning integration with the Association of American Railroads on how to handle these operating requirements and complete negotiating agreements with the railroads.

Interestingly one of the new things that has happened is there are utilities now that are pursuing on their own the possibility of offsite storage at some other facility. San Onofre is a prime example and there are also two private companies that are pursuing the capability of accepting spent nuclear fuel for consolidated storage.

At the Institute for Nuclear Materials Management meeting this year there was a discussion about the legal contract construct that would make this possible without new legislation and without any Federal funding.

And under contract law when there's a breach of contract there's an obligation to minimize damages so if I have a house I'm leasing and the person that's leasing the house defaults and moves, I can sue them for the cost of the lost rent. But I'm obligated to try and minimize those losses so if I can find somebody else to fulfill the duration of that contract term, and they pay the full price, then there are no damages. There's an obligation to try and do that. If in fact, a private company can show that they can store spent fuel for less than the composite cost of a number of utility storage options, there is an obligation of the Federal Government -- of the utilities to pursue that. And so there is a way for the utilities to find a way to move this forward. And that creates a bunch of other questions. To what extent if it's an all private effort do the requirements of the Nuclear Waste Policy Act apply. If it's a private effort does the funding for emergency responder training apply? Legally, no, but there may be a practical reason to do it. So there's a bunch of issues there that need to be addressed.

I think there's a need to update the agreements between the environmental management program and whoever is running the repository. This is the question about how the operating standards for AAR operations will be done. I think that needs to be addressed. The settlement agreements -- settlement agreements for railroad costs for shipment have been negotiated with Union Pacific, with Burlington Northern Santa Fe and with Norfolk Southern. CSX hasn't come to the table yet. CSX controls most of the track on the Eastern seaboard so they will be a key player so that needs to be done. And then a list of conclusions that speak for themselves. But with that I'll conclude my remarks and open myself for questions. Have at it.

>> BAHR: Okay. Thank you very much. Are there questions from Board Members? Paul?

>> TURINSKY: Turinsky, Board. Can you tell me how your company, NAC International, interacts with the Department of Energy on these topics?

>> LANTHRUM: Well first of all I'm not a NAC employee. I was at one time. Now I just consult with them occasionally. So NAC goes to the Department of

Energy as do all of the cask vendors. And many of the cask vendors are also involved in consolidated -- private consolidated storage initiatives so there's a lot of discussions about what could be done.

The private sector goes into DOE frequently and says, here is something that could save you a lot of money if you pursued it. DOE nods their head. But they are not really in a position to move forward. They don't really have legal authorization to pursue consolidated storage. It's not in their mandate. The potential for that that was in the Nuclear Waste Policy Act is expired so the Nuclear Waste Policy Act amendments that is still pending getting through Congress could authorize it but they don't really have the authorization to move forward so there are discussions, there's exchange of information. But the Department is not really in a position to act at this point.

>> BAHR: Other questions from the Board? Steve

Becker.

>> BECKER: Becker, Board. You may not like this question. If you were in charge of transportation again, don't run.

(Chuckles).

>> BECKER: So if you were in charge of transportation again, what would your highest priorities be? And what would be the first thing that you would do?

>> LANTHRUM: Integration I think is the biggest issue. Because that has long-term consequences and the sooner you can come up with an integrated solution the quicker you can impact your long-term costs. For example, if there is a solution for packaging that would be amenable to any repository configuration, not just Yucca Mountain, and would also be efficient for storage and transport, that should be pursued right now. Because of the long-term implications on overall cost savings for the program. That's challenging, though, for a variety of reasons.

It would require some out-of-the-box thinking. It would require commitment to resources that don't currently exist. But that would be my No. 1 push would be integration.

>> BAHR: You mentioned the queue for moving fuel from shut-down sites. How is that queue established? And are there -- you mentioned some challenges associated with that. What kinds of things could be done to make that queue more compatible with deciding what needs to be done?

>> LANTHRUM: Great question and something that's on my mind a lot. The queue is established by the standard contract, so it's a contractual arrangement between the Federal Government and utilities. The utilities were told the Government would start picking up their fuel in 1998 and take that away and that utilities would get priority in that queue based on how old their fuel was. And the oldest fuel would give the utility the No. 1

priority and on down the line. How the utility chose to use that priority was completely up to the utility they don't have to ship the oldest fuel but having the oldest fuel gives them the first place in line.

It's a contractual arrangement. It's woefully inefficient the way it was constructed because nobody thought we would be where we are right now. When those contracts were signed, the Federal Government thought they would start picking up waste in 1998 and picking up bare fuel and putting it in a bare-fuel transport cask and shipping it to a repository. Where we are now is completely different. Because it's a contract it could be negotiated. The contract is now being tied up with litigation. There are still some utilities that have not settled with the Government over the lawsuit. Many have.

And because there is outstanding litigation, there is a -- a hesitancy to engage in conversations. I think they should get over it and start having conversations about what we're likely to be able to do.

All of the plans for a transportation system supporting a repository have been based on the idea that it's going to be golden in the future. We're going to have all of the resources we want. Everything is going to be smooth. We're going to have all of the casks. Ain't going to happen. There's always going to be constraints.

And those constraints are going to wind up in litigation because you're not going to be able to make the contract holders happy. You should be having those conversations now saying, I know what we signed up for. And I know that you're worried about being able to ship your canisters because that's not part of the contract we were going to take bare fuel. We can give you something, you can give us something, let's talk let's negotiate let's make this an efficient system that can survive whatever the constraints are in the future.

>> BAHR: Do you have some sort of general guidelines of what an efficient queue would look like if it were renegotiated?

>> LANTHRUM: My private sector experience tells me it should be economically driven. And the economics right now say green-field the shutdown plants first because of the high price that's being paid by the Federal Government. It costs between 8 and 12 million a year for each shut-down site that comes out of the taxpayers' pocket for damages. It costs about 300,000 a year in damages to the operating plants. Because they've got embedded security for the operating plant anyway their oversight and health physics all of that is shared between the plant and dried storage facility. So the queue should, I believe, prioritize shut-down

sites and it should prioritize them by region so that the application of funding for emergency responder training and technical assistance could concentrate on one swath of the country, deinventory the sites in that area and then shift to the next area. That would be my approach. But that's financially driven. Because this is a sociopolitical problem, not just a technical or economic problem, other factors are going to come into play before any solutions are developed. And I don't have a good appreciation for what role those are going to play and how they might impact the final solution. But from an economic and -- I'm an engineer. I make spreadsheets and I look at solutions. And I know how to optimize on costs and efficiency. I don't know how to optimize on political will.

>> BAHR: Thanks. I think I saw Nigel with his hand up.

>> MOTE: Thanks Gary, a very interesting presentation. You identified in the context with the railcar design what do you do if you get an alarm, what's

the action. That was a thoughtful look to the future but there are some real case experience maybe in existing operations. Has it ever happened that for example a road shipment changing moving over the line between states has found itself okay to go through State 1 but at the border, the line, State 2 says this is not a shipment we can accept for reason X? And what happened or what would happen in that case?

>> LANTHRUM: I'm not familiar with any. I know there have been some limited agreements where one state agreed to allow shipments to continue through their borders that have been approved by another state that they thought highly of so they didn't feel there was additional added value. That's a rare case. I don't know of any case where a shipment started somewhere, was approved and then stopped because of a problem. A problem with the shipment - - there have been shipments stopped because of problems with the conveyance. And that's more -- I believe more of a problem with trucks than it is with railcars. Railcars don't change the way

that trucks do. You don't have tire pressures to worry about you don't have -- the engine is separate from the railcars. So those problems don't exist. There may be models out there. I'm not aware of them.

>> MOTE: A quick follow-up.

>> BAHR: Sure.

>> MOTE: Did you ever try to get all of the states aligned so that for a shipment on a road route that's been approved by DOT, Department of Transportation, that all states would be in line that if once it's approved in State 1 going through 6 states all of them would accept it with no stopping for inspection?

>> LANTHRUM: We did - - that was part of the discussion and what used to be called the transportation external coordinating working group. It was not a position that was favored by most states so there was ongoing discussion but it wasn't resolved favorably one way or the other.

>> BAHR: I think Dan Ogg had a question.

>> OGG: Dan Ogg with Board staff. Gary when you

were in charge of the program and looking at integrating everything and transporting all of the existing commercial spent nuclear fuel, even at that time there were canistered systems of commercial spent nuclear fuel that were not designed for transportation, not licensed for transportation. Had you and your team begun to look at the solution for that? And did you find a solution? And if not, what would you recommend now as a way to handle that fuel?

>> LANTHRUM: We did look at that. Fortunately that was a very small subset of the overall canistered content and all of those canisters that were not licensed as packaged for shipment were at operating plants. So we weren't terribly worried about it because as long as they were at operating plants they could be taken back to the pool opened up and repackaged. That was always an alternative. There was also the thought by some of the vendors who owned the systems that were not licensed for transport, that they could get one-time authorization for a shipment and we were okay

with them trying that.

But if that failed, we knew the utility could take it back into their pool, cut the canister open and repackage it so it didn't get a lot of attention because there were two options that seemed to support moving that content ultimately. I don't believe there have been any shutdown plants, in fact I'm sure that shutdown plants are not allowed to shut down until all of the content that's in dry storage is in a ready-for-shipment construct with the exception of some high-level waste. High burnup fuel. That may not be in damaged fuel cans.

>> BAHR: Mary Lou and then Steve.

>> ZOBACK: Zoback, Board. Getting back to the queue and I think what you just also said, as I recall we had a presentation maybe 5 or 6 years ago specifically about the shut-down sites. And at the time I thought we were told that only 1 or 2 of them and I'm from California and I recall they were in California were

actually storing in casks licensed for transportation. So it seemed to me the logical priority should be start with the sites that already have licensed casks ready to ship. Is that not true anymore.

>> LANTHRUM: That is true. The cost of a storage container that is also licensed as a transport container is much higher than a storage container only licensed for storage where you take a storage container and put it in a transport cask. Humboldt Bay does have spent fuel stored in multi-purpose buckets that are good for storage and for transport. They don't have the impact limiters for those. There may be some other changes that are needed and it's a very small quantity. There's four or five canisters is all they have at Humboldt Bay it's a very small site. So I don't know that that would be relatively beneficial.

If you look at the bigger picture of deinventorying an area what the total costs are if you set up all of your infrastructure to address one site and it's done and that infrastructure can't be used for other shipments for other reasons, it's not a good investment. It should be part of what you consider. But it's not the answer in and of itself.

>> ZOBACK: Thanks it's clear there are -- it’s a very complex problem and a lot of coordination needs to be done.

>> BAHR: We're getting near to the end of our time but Steve had a question so we'll do that and then move on.

>> BECKER: Becker, Board. I like your recommendation the tabletop coordination exercises be conducted before shipments begin. Is that something that you would see as being done just at the beginning of the entire process or would you see it as being a value conducting those throughout the life.

>> LANTHRUM: You definitely want to do it throughout the life. You couldn't afford to do it everywhere at once. So, as your shipping program migrates around the

country you would want to redo it. The Navy does every -- every other year - - they pick a different location in the country and do a tabletop exercise. =Back when I was there I had discussions with the Navy about alternating years so they would do one one year the next year the repository program would do one a little bit different construct a little bit different engagement but every year there would be a test going on one with the Navy one with the repository program and I think that makes sense.

>> BAHR: Okay. Thanks, Gary. If members of the audience have questions for Gary, you can probably go back to those during the public comment period or a little bit later but we'll have to move on to the next speaker to keep on time. Thanks.

So our next speaker is Mark Richter from the Nuclear Energy Institute and he's going to give us a utility industry perspective on priorities.

>> RICHTER: Good morning, everyone. Hopefully you can hear me in the back. Okay. First I would like to thank the Board for extending an invitation to me on behalf of NEI and the industry to speak today. One thing did occur to me as I was waiting for my turn to step up to the podium. In the three consecutive conferences that I've recently attended, in a speaking capacity I have been the last person standing either between lunch, dinner or the evening reception. I'm not sure what that means or if it's just a happy coincidence but hopefully you'll bear with me as lunch approaches and we'll be able to enjoy the discussion related to our perspective on transporting fuel. There have been a lot of discussions here this morning about various technical aspects and some nuanced points on some of the very specific aspects of cask design and transportation, even some regulatory considerations. One of the things that the Board -- the Board specifically reached out to NEI was to gain some insights on how the industry is organizing itself to

address the issues that we're facing. And the issues are pretty broad. Of course we have the regulatory challenge. That's one of NEI's main roles in life is providing that regulatory interface. But we also are engaged at some level in the technical challenges because it's very difficult, as you know, to separate technical issues from regulatory issues because in most cases the basis for regulation is rooted in a strong technical underpinning. And then also and I think others have touched on it earlier, the politics, the social aspect, is playing an ever-increasing and influential role in what we do in used fuel and transportation as well as other aspects of nuclear. So what I would like to be able to do here is provide our perspective on that. And hopefully be able to engage with you if you have some follow-up questions related to that.

Now, I think it would be appropriate and I would be remiss if I didn't digress just for a moment to provide some context about our industry. And some of the real life real world challenges we face that don't necessarily have anything to do with used fuel or the transportation of it. But it's the harsh reality of life in the nuclear business right now. And that I hope will provide some context into some of the considerations we make, the pressures we're under, and some of the importance that we're placing on identifying opportunities for efficiency not just in the advancement of technology but in the regulatory space, as well. As we move forward.

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As most of you are aware, the industry has lost several plants to early shutdown for decommissioning. Others have announced their intention to do so over the course of the next few years.

There are a number of factors that have conspired to create the situation that we're facing. But I would say the biggest, most overriding factor, is cheap natural gas. And I think the fracking boom has been a large driver in that. And we have seen the market pricing for electricity continue to drop over the last decade or more, primarily due to that driver.

And in most markets the natural gas sets the market price for electricity and then also you have an increasing role for renewables such as solar and wind that have tilted the markets a bit, as well.

But there's something else, though, too, that we at NEI and in our industry we believe is important to recognize. And that is that in the pricing, the markets right now really don't recognize the full attributes of nuclear energy. And we think they are rather important and worth noting such as capacity, reliability, the carbon free production aspects, the nuclear -- that nuclear offers. Grid stability. The security of the fuel source both in terms of the physical security and even the pricing security that you get through the ability to purchase ahead your fuel supply. And without markets appropriately recognizing these other inherent attributes of nuclear our ability to really achieve the greatest potential or optimizing our revenue stream is impacted. So that is really -- it's part of the harsh reality of what we face. And that's something that we've got to consider in much of our decision making and strategy development.

Looking at spent fuel at present and what we project in the United States, this map indicates that there's a number -- a large number actually of independent spent fuel installations around the country. I don't necessarily want to read through all of the numbers, you can do that as well as I can.

But looking ahead to 2020, that's based on projections on the end of last year you're looking at on the order of 86,000 metric tons. 35,000 of which would be in an ISFSI with greater than 3,000 casks or modules loaded. Currently at 76 ISFSIs and at some point we will be dealing with the used fuel from 119 commercial reactors. So let's get down to the subject matter that we're here to talk about today. And that's transportation. So what is the so what as it relates to transportation.

Spent nuclear fuel safely stored we ask the question why is there such growing interest and even a sense of urgency to transport the fuel to either a long-term or an interim facility? And for us, and considering the context that we have just developed here with our market challenges, the management of the storage and the subsequent transportation is part of what we look at as the total nuclear value proposition and these backend activities do have cost implications. And performing them inefficiently may have future adverse implications on the revenue stream from an operating plant. And as you can imagine the implications of inefficient backend management will be evident in the operating and shutdown decisions for plants that are still operating and potentially on business decisions about construction going forward. I recognize as I'm sure all of you do there are probably greater challenges right now in terms of new construction than the backend. But again, it's all part of the total value proposition. And the other thing we have to consider too is again the increasing public and political pressure to move fuel from these shut-down sites and I'll use San Onofre nuclear generating station as a good example of the type of public and political pressure that can be brought to bear as it relates to used fuel and removing it. You know, it's sort of a paradox. The people that get emotionally exercised over used fuel and what to do with it they all want it out of their backyard immediately, make it go away but at the same time don't move it through my backyard so it's sort of a difficult challenge to meet both of those needs at the same time.

Move it but don't move it close to where I live. I just want it gone. So in terms of what we, the industry, are doing and NEI's role in trying to lead and manage a strategy for used fuel is going to be part of what we refer to as the National Nuclear Energy Strategy.

This is a bigger picture strategy that NEI has developed about two and a half maybe three years ago.

And our approach to the management of the storage and transportation of used fuel is going to be embodied in this energy strategy.

The NNES, it's a comprehensive and holistic strategy that focuses on near term challenges both in preserving and sustaining the existing fleet while at the same time developing a stable platform and a business sense for being able to drive enough innovation to deploy and commercialize new nuclear technologies and ultimately sustain a healthy and growing industry that can continue to compete and lead in a global market.

And just quickly touching on these four areas, the preserve area, that really has to do with protecting the existing fleet. And a lot of that has to do with getting the appropriate market recognition for the full value that nuclear generation offers.

Sustain, that aspect of the strategy has a lot to do with regulatory efficiencies and optimization. And that's where the used fuel management and transportation fits.

And I think I've touched enough on the innovate and thrive aspects to give you a sense of how all of this fits together.

Now as part of the national nucleus energy strategy we have identified a number of what we refer to as national imperatives.

The imperatives support and are linked to many of the positive attributes that nuclear energy provides and I touched on many of those earlier and these imperatives really provide I think a broad spectrum for stakeholders to engage and identify something positive, something good that nuclear offers and for them to rally around. Things like jobs and infrastructure, national security, clean air, climate change those are just a few of the attributes though most stakeholders regardless of their political stripe or their perspective on where our electricity -- what source of fuel should we use to -- use to generate our electricity there's something here for everyone to love.

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The industry approach, again, this fits within the context of our overall greater strategy, to deal with used fuel, we have put together our used fuel working group. And as I mentioned earlier, this is existing within the sustain portion of our overall strategy.

The transportation is an important element of our used fuel working. And the used fuel working group is composed of the dry cask vendor Task Force, dry cask storage Task Force and the used fuel transportation and each of those areas as their titles would imply address different aspects and have a different focus on the various aspects of managing the fuel and moving it. Of course our focus today is going to be on the transportation of used fuel. These groups exist under the auspices and sponsorship of NEI. They are usually managed and directed in part by NEI partner managers and other management staff. We typically identify industry executive sponsor to provide leadership in the overall governance and oversight of our activities but the real work is done by the working level staff and personnel at the licensees, at the suppliers. We also have consultants and other individuals that are NEI members that contribute to the effort.

And it's really the volunteer input and the volunteer resources from the licensees and our other member and supplier companies that really do a lot of the hard work and heavy lifting of these activities. And our role is to lead on the issues, identify what they are, and work to move the industry what we believe is a direction towards success.

I talked a little bit about the Used Fuel Transportation Task Force and how that fits into the larger working group. The Task Force has a vision and I'll state it here because it's short. And that is to prepare the industry to transport used nuclear fuel from independent spent fuel storage installation locations to interim and/or permanent storage facilities by 2022.

I got ahead of myself here.

Now, the Task Force, the Used Fuel Transportation Task Force is composed of 4 teams. External affairs. The preshipment. Planning and incident Management Team. Technical and regulatory team and the DOE interface team.

The external affairs, their focus is primarily on the public and political communications aspects of used fuel transportation. And also the management of the message. The public message and how we want to articulate that in terms of political strategy.

Preshipment, planning and incident Management Team focuses on the large number and many different considerations that must be taken into account to execute the safe shipment of fuel. All of the logistics, all of the safety security, states issues, you name it, that will sort of fall into that team's purview.

The technical and regulatory team focuses primarily on improving the regulatory path for transportation. And that -- for us that manifests in seeking greater regulatory efficiencies and what we refer to as the Part 72, Part 71 Part 72 transition.

The DOE interface team, their main focus is going to be in identifying areas of DOE obligation and support. And the associated details. And will establish interfaces within DOE and NRC because we recognize them as important partners and players in our success, as well.

And we're hopefully that DOE will participate in our efforts going forward because I really believe I know on behalf of industry we all believe that the DOE role and engagement with us is going to be pretty important going forward in terms of alignment and efficiency and our ability to be in a position to transport fuel in a timely manner.

Now I'll get to my cartoon slide.

I think the cartoon, you know, they say a picture is worth a thousand words. We have heard different perspectives on the ability to safely transport used fuel this morning. Whether or not we're ready to do it. A lot of people in industry will say, you know, what's the big deal? It's easy. We're doing it. We've done it for a long time. You know, we don't understand why there's, you know, all of this angst and concern on the part of some.

Others maybe on the other side of that perspective see a lot of complex challenges and unanswered questions. So the reality probably lies somewhere in between those two extremes. But it sort of takes us back to that old familiar saying do we need to reinvent the wheel? Or is the existing wheel okay with a few minor adjustments and checking the pressure before we depart on the journey to move fuel. And those are -- that's the $64,000 question that needs to be answered. And we're optimistic that we will reach those solutions and do so in an efficient way.

Now, others have talked and I will speak a little bit here on the transportation experience. It's really a good story. It doesn't have a lot of excitement and drama because the history is a long one and a safe one.

For 70 years, give or take, nuclear materials and used fuel have been moved through and around this country. There's no history of any harmful radiation releases. We've got -- we have a strong platform of proven regulatory requirements and industry processes that have supported such a safe track record. And our ability to take the steps that are in front of us, that being moving the used fuel to interim or permanent facilities is really supported by our past experiences and gives us a lot of confidence that we can do the things that remain in front of us to make those fuel moves when the facilities are ready.

Now, as I just mentioned, there have been no harmful releases of radiation, nor have there been any other serious accidents where anyone in the public has been harmed or threatened. There have been a large number of shipments of various sizes and shapes. Not just from nuclear power industry but research and medical fields, United States Navy has been moving fuel for quite a long time. And modes of transportation have been various from sea transport, rail transport, heavy truck over the highway, all of those modes have been utilized together to get from Point A to Point B and that's been done, again, with a high degree of safety and success.

So as we look at opportunities for near term transportation, we know that the potential is here for one or two interim facilities potentially to be ready to receive fuel sometime in the well we hope five years. It could be more. We hope not.

But regardless of when they are ready, we know that we've got an ample supply of used fuel that needs to be moved. This slide gives you a rundown of the shut-down sites that no longer have an operating reactor where spent fuel is stored.

Waiting transportation to a repository. Either long term or interim.

This table here provides a summary of premature nuclear plant closures. Obviously this information is useful in a lot of different contexts. But in terms of our discussion today, above the blue line those are the plants that have recently shut down for decommissioning. Below the blue line, you'll see 12 more that have already announced their intentions to shut down permanently for decommissioning by 2025. And just looking around the country, in other markets, there's a potential for even more plants shutting down that are on the bubble in terms of their financial status in the markets in which they operate.

So the point being here is that there's a significant amount of used fuel waiting to be moved with more to come. So I think certainly the pressures, both economic and political and social will continue to grow for we as a collective greater industry to be in a position to do just that.

So we ask ourselves well how are we going to do that, what are the implementation steps in being able to move used fuel.

This series of photographs captures that. Again, what we think of as the 72-71-72 challenge. We have fuel in storage at ISFSIs as you'll see in the pictures in the left. Then that fuel needs to be removed either in the cask or canister, whatever is suitable for transportation. Is transported then it's placed back into storage at another location.

And the one thing we can say with confidence, regulations exist in Part 72 for storage at both ends of this process and in Part 71 for transportation. Our challenge from our perspective is really to identify what opportunities are there to efficiently transition from storage to transportation and back to storage in compliance with the regulations in a manner that is efficient and optimizes our resources, our abilities, and the skills of the industry in order to accomplish this.

I know Darrell Dunn from NRC is going to speak later today I think in greater depth on regulatory considerations. But I'll just touch on them briefly here to again provide context on what we're doing as an industry. Again, Part 72 is all about assuring safety and storage. Both within the initial storage and then when it's relocated to its repository location. Part 71 is also about assuring safety during transport. And there are some other things, too, that I think are worth mentioning relative to being able to establish confidence in our ability to do this safely. I know that Sandia has conducted a pretty lengthy full scale test. I think they moved a fuel cask from different locations in Europe across the Atlantic Ocean. I believe to Baltimore across the United States. And they measured various loads and accelerations. And took probably more data than they know what to do with but the upshot of all of that is that there's quite a bit margin in terms of what that cask sees in transport such that there's every reason to believe that transportation will be nothing but safe. And again, that test we think shows that with more than adequate margin.

So if we look at the 72-71-72 challenge, again for us it's an issue of optimization and efficiency. Not necessarily reinventing the wheel. Our perspective is transport the easiest fuel casks first. Licensing of those that are designed for transport that are not already licensed may take some time. But it's doable from our perspective.

Those that aren't designed for transport, there's other pathways that may be considered. One would be a one-time use license. Or the possibility of some sort of a dry transfer system that could be developed by DOE.

Other options there that we can look at.

We also know that in support of assuring safety and transport and storage, infection and aging management regimes and programs already exist. And that's a product of a continuous improvement philosophy, a learning philosophy, that already exists in the nuclear industry. And what we do in terms of aging management inspection and -- at inspection, rather, has been captured in some of the documents that I have listed here. The MAPS report which is the managing aging processes in storage that's an NRC document. NEI has its NEI 14-03 dealing with operations based aging management. Again that's driven by operating experience and a learning philosophy in terms of risk informing what we do with the storage of used fuel. It's based on operating experience. NUREG 1927 is a complimentary document to that. The industry is in a position to begin to leverage the learnings that we have from operating experience with the aging management database which some of you may know as AMID, that acronym.

The thing that we're concerned about, though, and again, this ties back to our continual focus on being more efficient in what we do, especially in terms of regulation, is the possibility that we're potential on the precipice of implementing what could be a very conservative inspection regime. And we are hopeful that DOE and others could embark on some research that will align with some of the industry needs in those areas in developing a basis where the required inspections and other aging management activities are more appropriately aligned with what we believe is a very inherently low risk associated with transporting the used fuel.

But we can also say with some certainty that right now there is more than enough readily transportable used fuel locations -- at locations with fuel that's cooler than expected. And it could be ready to ship in a shorter period of time without doing a lot of additional research, that moving that first would certainly provide a window of time to address some of the other issues that we've just touched on here related to the storage and shipment.

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We've talked about some regulatory aspects and some of the market and economic drivers for our thinking and strategy with used fuel transportation. There's a couple of technical areas that are worth mentioning, one of which is thermal margin. And that's one that's getting a lot of attention and a lot of focus from industry right now. Primarily because we believe it offers potential for a lot of benefit.

Our ability now to validate thermal modeling with real data by being able to do that, we are now beginning to understand that the thermal margins are much greater than we had ever anticipated. And we're hoping that we can leverage that into some real benefits in terms of what we do with shipping.

And the potential that thermal modeling offers and the ability to improve the thermal margin offers what we see as a transformational opportunity. We see that the peak cladding temperatures we believe are artificially high. Actual temperatures that we have seen in testing are far below what we thought they would be and the design limit, as well.

So our conclusion there is really that the degradation of cladding, fuel cladding, is a very unlikely outcome.

So with thermal modeling, -- here we go -- there's a number of opportunities, a number of benefits, that we hope to achieve that really touches on a lot of the backend activities. And you can see this here -- sort of - - in the falling domino model - - but improving operational flexibility. Being in a position to apply risk informed principles. And certainly the ability to more quickly facilitate transportation at ultimate disposal are all benefits that we hope to realize from the application and integration of thermal modeling results.

Briefly some activities that the industry is currently engaged in. One, we're working -- and this is within the Used Fuel Transportation Task Force, we're looking at developing initially what would be a White Paper but may ultimately become a guidance document or some or more formal document that addresses how we meet regulatory requirements for transportation. And we're doing that in conjunction with the licensees, the suppliers, and our other members. I've already mentioned that thermal modeling results offer a lot of promise. Research is underway in that area. DOE and the national labs, EPRI, we hope to see increasing activity from them and others going forward.

Aging management protocols. Some have been developed. And they are being further enhanced. In parallel with that, there's recognition and there's work underway looking at inspection technology to better identify degradation, if it would exist while a cask was in storage.

And the other thing I wanted to mention, too, I heard Gary in the previous talk make reference to a tabletop exercise. And I know in a lot of -- in the context of a lot of peoples' thinking, a tabletop is more related to emergency preparedness and response type situations. We are in the process of designing a tabletop that addresses our thinking for satisfying regulatory processes primarily. And we're also going to overlay on top of that some of the political and financial aspects as well as some of the other issues related to transporting from state to state.

So for us, it's sort of a new approach but one that we're fairly excited about undertaking. And hope that it will increase our depth of understanding of the transportation challenge.

I know I'm getting a little short on time. I got the signal here. But real quickly, what you see displayed here is basically some overlay timelines dealing with transportation, consolidated interim storage, and Yucca Mountain.

And some of the big takeaways here, it's absolutely essential that any work that is undertaken to prepare sites for consolidated interim storage, licensing and operation, takes place in parallel with Yucca Mountain or vice versa.

Because without interim storage and no activity in Yucca, we'll find ourselves just kicking the can down the road again without really being in a position to look for a more permanent or longer term solution.

But outside and independent of any of the activities related either to consolidated interim storage or Yucca Mountain or some other long-term repository, that will have no impact on the industry's readiness to transport. It's our intention to be ready by 2022 or the end of 2022 to do this.

And this slide here again I won't delve into all of the details but HR Bill 3053 which was just recently passed by the House by a pretty large margin I think it was like 340 to 72 establishes a basis for providing a better financial footing for the management of used fuel going forward. And we can see from this graphic that we're reaching a point now where it's becoming more expensive to the taxpayer and the rate payer to do nothing than it is to actually solve the problem. So hopefully that will serve to provide some additional motivation to get this done.

And real quickly here are some conclusions. I think we all recognize that used fuel may be transported as early as 2022. Industry has undertaken action in a number of different areas to be prepared to do just that. We're focused on being ready and doing the things we need to do to be ready. In an efficient and optimizing way. We don't believe it's an overwhelming challenge. We do recognize that some things need to be done in order to do that. And in terms of what will be shipped, I know some numbers have been bandied about earlier, we don't see that the increase in annual shipments will be tremendously or significantly greater than what's already being moved around the country now.

So with that I conclude my remarks. And hopefully there's time if you have some questions or comments.

>> BAHR: Okay. Thank you. Questions from the Board? To start out with. Turinsky.

>> TURINSKY: Turinsky, Board. On the reactor side, the industry and regulations have been moving probably at a slower pace than desired towards risk informed regulation. Part 71 and 72 tend to be much more the old style of -- considered the design basis sort of events. What's the industry's position on basically the backend of storage and transportation and moving more towards

a risk informed basis.

>> RICHTER: Well I think from the industry perspective I'll make this comment generally we certainly advocate the use of -- risk informed principles in all regulatory aspects as it relates to our industry but more specifically as it relates to used fuel. Certainly we have established a strategy and have undertaken a number of activities to support a risk informed approach dealing with aging management, using actual operating experience and developing a real strong technical basis to support the use of risk informed. So certainly that's a direction we would like to take. We know that we need to have the support and engagement of our regulators and other entities to make that happen. But we strongly advocate that.

>> BAHR: Dr. Peddicord.

>> PEDDICORD: Lee Peddicord from the Board. A couple of questions. With regard to the used fuel working group and the Used Fuel Transportation Task Force, when were they established? How long have they

been functioning?

>> RICHTER: The used fuel working group, I have to confess I can't tell you exactly how long that's been but it's been more than a few years. The Used Fuel Transportation Task Force has been a year.

>> PEDDICORD: In conjunction with that we heard from Gary Lanthrum the difficulty of getting arms around the problem in terms of transportation and I'm sorry I need to lean into this, I apologize.

So one question is would -- would the utilities then to make work what you have in mind forego this flexibility the oldest -- the ones having the oldest fuel can ship first but they don't have to ship the oldest fuel. Now it seems to me to take advantage of the thermal margin you really see key in the strategy you're looking at would your members, your members of NEI I assume forego that flexibility to actually get this moving?

>> RICHTER: That's a difficult question only

because I think there's a lot of moving parts. And it's difficult for me to really articulate a concise answer based on how the members would view that.

So unfortunately I can't really answer that clearly today because I think that's something we would have to look at in the context of what our total membership would desire.

>>PEDDICORD: But is that a topic under discussion within the Task Force?

>> RICHTER: In terms of the queue.

>> PEDDICORD: The queue and as I say, utility X lining up the queue saying okay I'm going to ship.

>> RICHTER: That's something that's been discussed. I have no doubt that it will be discussed further going forward. In terms of where we are with that, I'm hesitant to define a position standing here today. But only can share with you that it has been discussed and again --

>> PEDDICORD: Since it's going to be the official transcript.

>> RICHTER: Understood.

>> PEDDICORD: So in your timeline target milestones here in your 2022 aspiration, that's really very key dependent on the interim storage facilities one of them that go in at least for shipment.

>> RICHTER: That's correct that's the assumption we're working on.

>> PEDDICORD: But going to your next slide in your legislation coming out of the House for example that is not at all advocating the interim storage, not funding it and so on.

So is the NEI positioned to support the licensing and the operation of one of these two facilities that apply to the NRC?

>> RICHTER: Yes in fact we support really the licensing and operation of both. At the same time we

support the eventual completion of Yucca and we believe that both are essential elements in managing used fuel going forward.

>> PEDDICORD: You're making this case then to the House of where you want to go with your position?

>> RICHTER: We support and advocate the licensing operation of those facilities.

>> PEDDICORD: Thank you.

>> BAHR: Other Board Members? This is Jean Bahr, Board. I was struck by the variation and the timelines that we have heard this morning. Bill Boyle gave us a 7-year timeline. You've given us maybe a 4-year timeline. And Gary Lanthrum's perspective suggested that there were maybe some other challenges in there that might extend it even longer.

Has the Task Force really seriously done the kind of detailed logistical planning, looking at lead times and roadblocks that would support the 4-year timeline that you've put up here.

>> RICHTER: That is one aspect of what we're doing. I mean, right now our focus is really on addressing what we see as our path for the 72-71-72 transitional process. We are hoping that our tabletop exercise that we're going to be developing and running in parallel with the development of that position we will use one to inform the other. That's our primary focus.

In terms of some of the other actions and activities that are taking place at the labs, with EPRI and other entities, those are timelines that we're really not in control of. The one thing that we have pretty much decided, though, is that we would rather be in a position of waiting for the rest to catch up than being the one that's holding up the show.

So in terms of having a position established and a --

and guidance in place, process in place for doing this, we think we can do at least that part ourselves in the next four to five years.

>> BAHR: Okay. Other questions? I think I saw -- Dan Ogg?

>> OGG: Dan Ogg, Board staff. My question is related. And that is within the Task Force, the transportation Task Force, you have the technical and regulatory team. And if they are looking at transporting by 2022, that's coming up very soon. And so do you know, has that technical and regulatory team identified the one or two top priority items that need to be done? You know, that are the long lead items that need to be done so that you could actually ship by 2022?

>> RICHTER: Well there's a number of things or a number of items I guess that would fall into key to being ready. And you know I think in this business sometimes it's difficult to separate technical and regulatory because they are just quite naturally there's a strong link between the two. In terms of technical we're

looking at developments in inspection technology as it supports aging management activities and the ability to inform what we do with aging management as a means to be able to apply and use risk informed principles in what we're doing.

We're looking at thermal modeling, again, as a real opportunity to take advantage of what we see are greater than anticipated thermal margins and the ability to move and transport and ultimately store fuel.

So those are things that we certainly see as key from I guess primarily a technical standpoint to support what we're doing.

>> BAHR: Nigel Mote?

>> MOTE: Nigel Mote Board staff. Gary Lanthrum said that one of the key issues that he knows from experience are going to be important in putting a program together

is integration. And I see that under the Used Fuel Transportation Task Force you have a subgroup called DOE interface.

Could you tell us more about that? And how you are linking into DOE's thinking? One example following Jean's comment, you have a 4-year timeline to be ready to move to a centralized interim storage facility. Bill Boyle from DOE had a 7-year timeline to be ready for a transportation program. Which may be more comprehensive than that.

Could you tell us about how you are working with DOE to knit your program with DOE's view? And we all understand that DOE is constrained by issues like funding. But you have this Task Force subgroup here. So if you will, tell us more about the objective of that and how successful you are in being able to take -- put this program that you're seeing together with DOE's view.

>> RICHTER: Well first of all thank you for asking that question because I think it's a critical question and our thinking in creating that team as part of the Task Force was to really establish a strong communications link between our group and DOE. And quite honestly to date that really hasn't happened in the way that we envisioned. We have made some outreach to DOE. And I recognize that due to appropriations and other Congressional actions, they were pretty constrained and have been constrained as to what they can do and what they can engage with us on. But just as a general comment going forward, I think to the extent that they can, we would encourage DOE to reach out to us and begin to dialogue with us because I think it's only going to serve to improve our overall again greater industry efforts to be in a position to efficiently and safely move fuel. And I think right now that's an opportunity that's not really been taken advantage of

and we would certainly hope from our perspective that those links would be created and leveraged going forward.

>> MOTE: Thank you.

>> BAHR: Other questions? Lee?

>> PEDDICORD: Peddicord, Board, I wanted to come back - - use San Onofre as a poster child of some of the challenges that you're going to be facing. But the question that comes to mind is again going back to Gary's presentation does NEI yet have a position on the idea of a regional -- of regional approaches to moving fuel and things like that to again kind of get things organized, help expedite the movement and so on? Have you gotten that far in your discussions?

>> RICHTER: I really would only want to address that within the context of our Task Force and within the Task Force that's not been our focus. Maybe some of our policy folks might be able to speak to that in greater detail. I don't feel that I'm in a position today to do that but within the Task Force itself no.

>> BAHR: Other questions from the Board or the staff? Do we have any public questions? Or -- yes. Go ahead.

>> Is this public comment period or is this questions.

>> BAHR: This is questions and then we'll finish with the questions from the speaker and go to public comments.

>> LACY: I'm Darrell ,Lacy with Nye County, Nevada. Basically you mentioned that the need for Yucca Mountain and the consolidated interim storage to move together. I think maybe your timeline for CIS is a little optimistic. But --

>> RICHTER: Well I'm an optimist by nature. (Chuckles).

>> LACY: Just make sure that Yucca Mountain design did include aging pads that could be called interim storage but they were aging pads which are essentially the same in design and could actually be built and operated before the repository was available for opening and accepting waste.

So is that an alternative potentially to speed things up by bringing it to above-ground storage in an aging pad at Yucca Mountain at an alternative to consolidated interim storage?

>> RICHTER: That is a good question. I've heard that mentioned before. I do know, again, within context of the Task Force our focus is on supporting the two locations now that have applications under consideration. But putting an above-ground pad at Yucca I've heard it mentioned I know it's been on the table in the minds of some.

>> LACY: I guess I do -- I don't think it's been discussed a whole lot but if we did go to consolidated interim storage that does mean we're shipping everything twice the second time we ship it the material is considerably older you mentioned some of the needs for aging management. Potentially that second shipment is going to be 60 to 100 years down the road

so I don't know if we've taken all of those impacts of using that as part of the process.

>> RICHTER: I think to some degree you're kind of preaching to the choir. You know. If we had our way, this would all be handled in much more expeditious manner such we either didn't have to move it twice or the timeframes we would be looking at for a second move would be a lot shorter. But -- but you understand the politics as well as I do, or probably much better.

>> LACY: I don't know if anyone is educating Congress on some of these impacts thank you.

>> RICHTER: Thank you.

>> BAHR: I'm not sure if we have anyone signed up for public comment on the list outside. Did . . . okay. Well, it looks like we have someone who wants to make a public comment so I'll invite you to do so. We have about 12 minutes remaining before our lunch break which we need to take.

>> WILLIAMS: I have a handout for the Board please treat this as a personal communication don't publish it

because I can do better work than this.

>> BAHR: I think that anything that's provided to us is supposed to become part of the public record. So if you don't want this to be placed on our Web site, we'll give them back to you.

>> WILLIAMS: I would just as soon let you place it on the Web site then. I'm Bob Williams. I came here with my hair on fire because I misinterpreted the note from the press release. It gave me the impression that there were -- they were gearing up to do a lot of spent fuel shipping it looked to me like the only place they could go to would be Yucca Mountain.

And this paper that I've handed to you makes the case that I feel like the one big mistake I made during my career in nuclear energy was to go along with the idea of burying spent fuel. Since I retired, I retired in 1994 from full-time activity, consulted on the Hanford K basin project for 8 more years. But I've really been out of the loop ever since then. One of the things I worked on, though, just for fun, has been the whole question of California water. And as climate changes due to this sea level business water is going to become a very big problem in California. And so back to the line of reasoning in this report, the water investigation led me to believe that the million year disposal criteria would require scheduling or taking into account six ice ages. I don't believe hydrology can be predicted over six ice ages.

So if I were a member of a City Council or something else leading this proposition, I think you have given the City Council an impossible job.

So I think the only way out of that box is to go back to the admonition that we're only going to dispose of reprocessed waste.

I think it's possible to make reprocessed waste that has only 5 or 10,000 year period of hazard. That will fit into the recommendations of the Blue Ribbon Commission back in 2012. And so this paper that I've handed out was something I put together about a year and a half ago. To argue we should take another hard look in the context of the recommendations that we have -- of the Blue Ribbon Commission but we should start little. We should avoid going to Congress and having the second Nuclear Waste Policy Act. We should take advantage of the programs that are already underway in the Department of Energy. We should have the defense nuclear waste safety Board take a look at what would be an appropriate criteria for reprocessed waste.

And then that -- to some of the other comments here, forgive me I guess I should have had a drink of water before I got up here.

I truly think we should try to avoid two shipments. And so the bottom line in what I was recommending and suggesting is that -- is if you don't think you'll build reprocessing plants on the banks of Hoover Dam in Nevada then don't ship a whole bunch of fuel out to Nevada.

So my bottom line is to start with a very small program, ship fuel to the H canyon in Savanna River and let that material that comes out of that process be -- become a grist for reactor program either a fast reactor or breeder reactor is the only way we can take care of long-lived nuclides in my opinion so I would argue strongly to send the utilities some money to pay for the onsite storage that's needed to do whatever is needed in terms of commercial impracticality in a lawsuit that says I signed up for something that's impossible so the common law permits you to make some changes. And the common law adjudication between the utilities and the DOE would be let's do a common sense program going forward. We'll make you whole with money for onsite storage but we're going to start a reasonable breeder reactor program.

The final thing I'll end with is just the comment that the nuclear industry, in my opinion, has been under a terrible burden. If the automobile industry were under the same burden as the nuclear industry has been we would still be driving Model-A Fords and straight 6 Fords we would have never had a V 8 engine and other things. So I truly believe that if we do breeder reactor development at the major Federal reservations, Hanford, Idaho, Savannah River, perhaps Sandia, we can have a meaningful breeder reactor development program that will actually permit time for feedback and learning. We won't be stuck with the first of a kind or a second of a kind reactor.

>> BAHR: We appreciate your comments I do actually have three more people who signed up for public comment so to give them time but thank you we look forward to reading your full report.

>> Thank you.

>> BAHR: Darrell Lacy. We already heard from a little bit earlier.

>> LACY: I'll be quick because I made some other comments I just want to thank the Board and Madam Chair here for what you're doing. It's very important work and it needs to be maybe better publicized and somebody needs to be beating the drum about some of the issues that are discussed here. Gary Lanthrum made some comments that may need to be discussed a little more about the impacts of uncertainty and not making some decisions.

The I think a lot of the work was done earlier on in the program thinking Yucca Mountain was going to be the site and until that decision is made we can't make all of the final decisions about transportation routes, packaging handling, what's going to happen with fuel aging just so many uncertainties there until we make some decisions. And one of the advantages of the Yucca Mountain is it can handle large packages and it's retrievable which I think this Board in your most recent report said retrievability is very important so I think that's something that needs to be communicated to people some of the benefits of Yucca Mountain, the importance of making the decisions, and if we don't go with Yucca Mountain there's going to be a lot more time, a lot more cost and potentially a lot more radiation exposure if we end up having to repackage all of the fuel into smaller packages if it goes into a different type of repository thank you.

>> BAHR: Thank you for your comment. Tammy is it Thatcher?

>> THATCHER: Hi, I would just --

>> BAHR: Could you say your name correctly because I may have mispronounced it.

>> THATCHER: My name is Tammy Thatcher I'm from Idaho Falls. I understand the presentations have to be kind of at a high level and for a variety of audiences. But I guess I feel like some of the presentations are trying to be a public perception exercise rather than a let's get down to the nubbins. One of the things I would like more information about I understand there are really no inspection techniques for canisters that have spent fuel in them and that stress corrosion cracking can happen in a fairly short number of years, especially near the ocean where it's salt I happen to know here on the Idaho desert our water in the aquifer has high chloride – and we had stressed cracking in stainless steel because of exposure to groundwater so I'm hoping some time there's more detail on what if a canister cracks? Are we really not able to detect if it's cracking? What are we going to do if one is cracked? Supposedly those cracked canisters cannot be

transported according to current NRC requirements so that is an information request for the future thank you.

>> BAHR: Thank you. I would say that the Board has been monitoring the research that's going on related to stress corrosion cracking and we're also monitoring the research that's going on in terms of inspection technology. And these public meetings are only part of our fact finding efforts that go into the reports that the Board puts out. We do have a short fact sheet on stress corrosion cracking on our Web site. So thank you.

Rebecca Casper.

>> CASPER: I think it's still morning so I'll say good morning. I stand before you not with a technical comment but instead with appreciation for your technical expertise. And for the work that you do. I serve as the Mayor of the City of Idaho Falls and I have to tell you that as a local level policymaker I will say

that I have learned that one of the things that cuts through political will, there are two things that cut through political will. One is fear. And I certainly don't want fear-based policymaking. The second are facts.

And the more that your Board can do to not only get the information, process it and repackage it in the form of intelligent recommendations, the more that you can do that, the better off our policymaking processes will be.

We all know that we have I guess I would say a problem with how we handle spent nuclear fuel or used fuel or whatever we're going to call it. And for our policymakers to be able to make good decisions, they really do need to hear the hard hitting truthful recommendations that -- and august bodies such as this can put forward so I just encourage you to not pull any punches. They, we, the public, and policymakers need to hear not sugar coated facts but real hard and -- hard-hitting facts. So I thank you because it appears that that is the model that you aspire to or that you hold yourselves to and I appreciate it and I wanted to express my gratitude and thank you for choosing to hold your meeting here in Idaho Falls. We are actually having a beautiful day on your behalf.

(Chuckles).

So enjoy it while you can. And let us know if there's anything we can do to make your visit more successful today. Thank you.

>> BAHR: Thank you. We do have about 5 minutes left if there are any additional people who would like to make comments. And please identify yourself.

>>KLEVORICK: Good morning still. My name is Phil Klevorick. I'm the Program Manager for the Clark County nuclear waste division in southern Nevada. I just want to go to the announcement that NWTRB posted

and it's basically the meeting will consider technical issues that need to be addressed in developing a large nationwide effort to transport spent fuel and high-level waste. I'm going through the agenda. A few things come to my mind. Excuse me I apologize for my nasaliness.

(Chuckles).

If that's such a word. Public safety, security risks need to be addressed. That -- those to me are pretty technical issues. I don't see it on the agenda. And no matter where these items end up around this country, that is absolutely probably the No. 1 priority for any community to be buying into a transportation component. Moving anything around this when it comes to hazardous materials.

And the brain trust that's in this Board I think can take a significant lead in trying to determine some of that value that's got to come out of that.

I'm going to segue in that into a new paragraph. I represent an affected unit of local Government. We are designated under the Nuclear Waste Policy Act but yet the Federal Government chooses to not include us in the discussions because their argument is that they are not funded. Yucca Mountain is not on the table. Well, that's ridiculous. The President says it is, the Secretary says it is. This whole meeting says it is. Everybody says it is.

May not be on the table in the next two years may not be on the table for ten years we may not come to a solution but it's ridiculous to exclude the AULGs from being a participant into the discussions. Yes we have open dialogue, public comments -- but there's a lot of other stuff that's going on and I think it's kind of ridiculous to think that there's nothing in the Nuclear

Waste Policy Act that excludes AULGs because of lack of funding. It doesn't say that. And you can tell I'm pretty passionate about this policy about public safety transportation. But the big key that comes down to all of this is if it's not all inclusive and trying to be open dialogue now as things come closer to fruition and the timelines become more constrained, I'm going to say it's probably going to be much more difficult to accomplish that task later on in life.

The final thing I'm going to bring up, though, and I think it was Gary, excellent presentation by Gary, by the way and others. Very valuable.

But I think it's something that people need to understand. If Yucca Mountain does materialize and you have 15 different transportation casks and there's no railroad that takes you to Yucca Mountain, all of those intermodals have to occur somewhere. So southern Nevada including my counterpart back there Darrell representing Nye County and other counties not just deal with rail but with road and we have 15 different potential transportation components. So you have it at the sites of generation. You have the disposal site but there will probably be an intermodal somewhere in southern Nevada probably I think it's important I'm just trying to make you all realize why it's important to have it included in these discussions so I thank you for your time I appreciate it.

>> BAHR: Thank you for your comment. Okay. Any remaining comments? We have 2 minutes. Okay. Well, let's break.

Now we're scheduled to restart at -- in just an hour. So we have a pretty short timeline for lunch. So we'll see you back at 12:50.

(Break.)

(Standing by).

>> BAHR: Okay. Well welcome back from lunch I'm trying to keep us on schedule and it looks like we have a quorum of the Board Members and staff so even though some of our audience are not quite back, I think we're going to get started. So our next speaker is Myron Kaczmarsky from Holtec International. He has a long experience in many different aspects of spent fuel and radioactive waste and we look forward to hearing his perspectives on an integrated planning for packaging, transportation, and storage of commercial spent nuclear fuel at a proposed interim storage facility.

>> KACZMARKSY: Well good afternoon I would like to thank the Board for the opportunity to make this presentation.

In this presentation I'll briefly discuss a little background on Holtec International. Briefly discuss our spent fuel storage experience and in particular I would think our experience in the Ukraine would be of interest to the Board. And focus on the transportation aspects or movement of spent fuel to a consolidated interim storage facility. I'll move through the initial slides very quickly and in addition some of the material that I have in my presentation has been covered by Gary and Mark so I'll move through those. They covered it very well so I'll move through those very quickly, as well.

Holtec was established in 1986. And has grown steadily in the nuclear and energy industries most significantly in the nuclear waste segment of that market. Holtec began providing thermal equipment and wet storage systems and moved into the dry cask storage business in the mid-1990s. Over time Holtec began vertically integrating the entire supply, scope of supply, for the dry cask storage systems and wet storage systems and the delivery of dual purpose transportation casks including fabrication, design, licensing, construction of the ISFSIs and operation of pool to pad cask loading services. Holtec continues to diversify into areas of the design and fabrication, future fabrication of small modular reactors and nuclear plant decommissioning.

Today Holtec has three manufacturing facilities in the United States one located in Orrvilon Ohio, where the Metamic fuel racks and the Metamic baskets for our storage containers are manufactured. One in Turtle Creek, Pennsylvania and a new advanced manufacturing facility in Camden, New Jersey. Combined Holtec has over 1.3 million square feet of manufacturing space and over 200,000 square feet of storage capacity in our facilities and we're currently running three shifts per day at our Pennsylvania facility and one shift per day and growing in our Camden facility manufacturing up to 30 multi-purpose canisters and 30 dry cask storage systems a month so we have that capacity right now. Again just very quickly I'll move through the slides. Holtec has maintained a single overall safety program for all the operations and manufacturing facilities and maintains a very high standard for safety and quality. Our EMR is always less than 1. And consistently has been trending down over the years since we started manufacturing in the mid-1990s.

In addition, Holtec's quality assurance program which began in 1986 meets all of the requirements of 10CFR appendix B, NQA 1 and ISO 9,000 it's one overall QA program that's applied again to all operations and manufacturing facilities. Holtec also holds all of the ASME code stamps used in the nuclear and non-power nuclear industries.

Holtec's core business today is associated with the deployment of safe and secure spent fuel storage technologies. Over 100 nuclear plants worldwide utilize Holtec dry cask storage systems. Almost one half of the total available nuclear market in the world.

Over 60% of that available market in the nuclear market Holtec has supplied high density in-pool storage racks, as well.

The top photograph shows several of our high storm dry cask storage systems and two of the high store transport casks. The lower photograph is one of our high density spent fuel storage racks at a nuclear power plant.

Holtec has provided dry cask storage systems to countries on five continents which includes today 59 nuclear plants in the United States and 46 nuclear plants in 12 foreign countries. Holtec is the largest exporter of nuclear related capital equipment in the United States.

Holtec has been involved with the consolidated interim storage facilities since 2003. First involved with the licensing of 4,000 dry cask storage systems for the private fuel storage project in Utah and most recently with the central storage facility in the Ukraine which is currently under construction.

With regard to the Ukraine, these are photographs of the ground breaking activities in 2017. At the central storage facility located in the Chernobyl exclusion zone which will provide dry cask storage of spent nuclear fuel from Energoatom’s 9 Russian VVER reactors. This facility was licensed under the Ukrainian state regulations and will be completed in 2019.

This is the second storage facility in the Ukraine for spent fuel. The first already operational was built for dry cask storage of the spent fuel from the 3 shutdown RBMK reactors that weren't damaged in the accident. Both facilities are located within the Chernobyl exclusion zone.

The Ukraine central storage facility will utilize the NRC-licensed Holtec Hi-Star 190 cask for transport and storage and the Hi-Storm 190 overpack for dry cask storage. The photograph on the left is a double walled multi-purpose canister for the VVER spent fuel. The photograph on the right is the steel sections of a HI-STAR 190 overpack which will be shipped to the Ukraine and filled with concrete once onsite. Holtec is under contract to supply 90 dry cask storage systems to the Ukraine with all handling equipment beginning in the mid-2019.

All equipment is being manufactured in the United States and both of these photographs were taken at our advanced manufacturing facility in Camden, New Jersey.

In addition to the dry cask storage systems, Holtec has designed the 8-axle and 12 axle railcars for the shipping of spent fuel storage casks from Ukrainian nuclear plants to the central storage facility. The two 12 axle railcars and one 8 axle railcars have already been fabricated. These have been designed and fabricated to meet IAEA and European standards.

The initial fuel moves will occur in 2019. One of the 12 axle railcars is shown in this photograph. Again, which has been delivered to the Ukraine.

Some spent fuel is now stored on 78 individual utility sites in the U.S. and over $30 billion have been paid to utilities by the DOE as default litigation and settlement damages. Holtec's view of consolidated interim storage offers DOE the opportunity to follow through on the Government's promise to defuel nuclear plant sites. The plant supplements long-term repository disposal allows for the removal of spent fuel from nuclear plant sites sooner than waiting for the repository and provides temporary retrievable storage in an area with strong local and state support.

An artist rendering of the HI-STORE consolidated interim storage facility is shown on the slide. The Holtec and Eddy-Lea County Energy Alliance formed a public-private partnership in 2016. The HI-STORE CISF development strategy has been for Holtec to fund the

HI-STORE and HI-STORE UMAX license applications and Holtec will provide the staff to operate the facility while the Eddy-Lea Energy Alliance will continue to own the property.

The HI-STORE CISF site is located on 1,000 acres in the southeast corner of New Mexico midway between Carlsbad and Hobbs. This site and the future facility has the endorsement of long-term residents in New Mexico with two National Laboratories, three Air Force bases, one Army base, the Waste Isolation Pilot Plant, and the URENCO enrichment facility as state neighbors. The utility infrastructure is available -- is readily available at the site, as well.

On this slide are the letters of endorsement from city, county and state officials.

The HI-STORE consolidated interim storage facility will utilize the HI-STORM UMAX technology. This artistic rendering of the UMAX below-grade dry-cask storage system is shown on this slide. The slide and rendering show the design features and attributes of the UMAX technology including the storage space -- a storage -- the storage space dimensions which will allow for interim storage of all canister types currently in the U.S. nuclear plants.

This slide shows an artist rendering of the HI-STORE CISF site layout, which is being designed for transport cask receipt by rail and use of an onsite cask transport build the initial storage capacity will be for 500 spent fuel canisters and a total storage capacity will be licensed for 10,000 canisters. The overall site will utilize 500 of the 1,000 acres which -- with licensing to be complete in 2020. And the CISF could conceivably commence operations in 2023.

This slide depicts the sequence of operations inside the HI-STORE CISF cask transfer building. The cask receipt is followed by below grade placement. Anyway . . ..

Followed by again and then transferred to the transporter in a shielded transfer cask and then placement in the UMAX storage cell with a vertical transport vehicle.

Now, with regard for the spent nuclear fuel canister transport to the HI-store consolidated interim storage facility. Specially designed railcars 12 axle railcars will move the spent fuel canisters in NRC licensed transport casks. The railcars to be used in the U.S. will follow strict regulations that comply with the Association of American Railroad Standard S 2043. Transportation will follow strict NRC and U.S.

Department of Transportation regulations. Holtec is proposing to utilize two different transport casks. The HI-STORE 190 already licensed by U.S. NRC. And has a cavity dimensions to transport all canister types in U.S. nuclear plants. And the HI-STAR 100 MB currently under NRC review is designed to be matched up with the Holtec HI-STORM dry cask storage systems currently at many of the nuclear plants but has design features for high burnup fuel.

The transport the wide range of commercial spent fuel canister designs currently at use in nuclear plants the consolidated interim storage facility therefore has two options. One to utilize the original transport cask that was approved for the canister in several of the largest transport casks are shown here at the bottom of the slide.

Or, utilize a HI-STAR 190 or HI-STAR 100MB transport cask. Licensing non-Holtec canisters is not a technical issue. With the HI-STORM UMAX storage system the system is currently under license for using the MPC 37 for PWR fuel and the MPC 89 these are Holtec canisters for BWR fuel. And we're in the process of licensing through a CofC amendment a multi-purpose canisters from AREVA the TN 24 PT 1. Note that for transport the canister itself is not the containment boundary which makes it easier for licensing. There are no technical issues to be addressed before the commercial spent nuclear fuel transportation can begin.

The only issues are with regard to logistics for transportation and overcoming public perception issues. Transport casks are available and the DOE is currently in the development process for a 12 axle railcar to be utilized by the commercial industry.

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This slide shows the typical Holtec transport cask designed with multiple layers of steel, led and neutron absorbing material. For reshipment of commercial spent fuel for final disposition in the repository after some years of storage, the dose and temperatures will be much lower so if anything, the transportation will be much easier. Once again the canister is not a boundary for containment for shipments. The longest possible lead time for spent fuel transportation in the United States might be the qualification and fabrication of the railcar.

This slide shows the future location of the HI-STORE Consolidated Interim Storage Facility and the current rail access. The local area has a well-developed railroad infrastructure. An additional rail spur to this site is less than 10 miles. Transfer to the rail spur will be relatively easy. The site specific license is currently in the NRC review process.

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The transportation of spent nuclear fuel has been proven to be safe in the United States and internationally. Reports from Oak Ridge National Laboratory, the U.S. NRC and U.S. Navy have shown that thousands of shipments have been made worldwide without injury loss of life or any radioactivity release. However so far there's been no transport of a wide range of commercial spent nuclear fuel canister designs to an interim storage facility in the United States. Other countries that have central interim storage like Sweden do not use canisters. Spent fuel is packaged in dual purpose transport storage casks and placed directly into storage. The only potential issue I see is the repackaging of non-canister based spent nuclear fuel storage systems into canisters for transportation.

This slide shows the timeline for licensing of the HI-STORE consolidated interim storage facility in southeastern New Mexico. We are currently in the public review process, the public meeting process we anticipate receiving the NRC license in 2020 and could have the construction complete and receiving shipments by 2023.

This slide lists the timeline for the approval of the amendment to add the Areva TN-24 PT1 canister to the HI-STORM UMAX Certificate of Compliance. Holtec is using this amendment as a trial to identify the potential issues with the Nuclear Regulatory Commission before proceeding with additional industry canisters stored at the various nuclear sites in the United

States. Approval by the U.S. NRC is anticipated in 2020.

So our overall approach and plan and licensing strategy is to establish the HI-STORE site specific license in parallel establish a process for amendments to the HI-STORE UMAX Certificate of Compliance initially with one additional canister and then proceed with amendments through all of the current canisters that are currently stored at U.S. nuclear plants.

This last photograph that I have in my presentation is the actual HI-STORE UMAX fully licensed constructed and in operation at the San Onofre Nuclear Generating Station currently under decommissioning. You can see the vertical transport vehicle with transport casks moving the spent nuclear fuel canisters to HI-STORE UMAX locations. That concludes the presentation if there's any questions I would be happy to address them.

>> BAHR: Thank you for a timely and concise presentation do we have questions from Board Members. Paul Turinsky.

>> TURINSKY: I have several. Who arranges the transportation and who is owning the fuel at that point.

>> KACZMARKSY: Right now there's no arrangements to be made for transportation because it's still in the future you mean to the actual storage facility.

>> TURINSKY: Yeah.

>> KACZMARKSY: They haven't been made yet as to who will be doing that.

>> TURINSKY: What about inspection; we heard a question earlier about inspection of the canisters.

>> KACZMARKSY: Inspections are performed at the fabrication facility.

>> TURINSKY: I'm talking about the aging inspections.

>> KACZMARKSY: Once it's sealed and put in place there are no additional inspections. We know our

canisters are double lidded and welded. Also inert gas helium is used inside the canister as well. At this time there are no additional inspections that are performed once the canister is placed.

>> TURINSKY: Then my last question is when putting it inside a transportation cask, don't -- especially when you're looking at a competitor's canister, don't you have to know something about say the basket integrity, what loads it can take, et cetera? And is that information really available from your competitors?

>> KACZMARKSY: Again that's something that we're again going through the trial process with the TN-24PT1 again proprietary information again is difficult to obtain. However we have enough information to actually submit the amendment to the U.S. nuclear regulatory commission and again the plan is to proceed through all of the different canisters in the United States with amendments to our current CofC.

>> TURINSKY: Okay. All right. Thank you.

>> BAHR: Additional questions? Mary Lou?

>> ZOBACK: Yeah, Zoback, Board. Thanks, that was a really interesting presentation. And I think one of my questions was answered. Basically the temporary storage facility that you're proposing is basically the same as the San Onofre one are there differences.

>> KACZMARKSY: Yeah, no except it's going to be much larger.

>> ZOBACK: I understand but the basic concept of how you move things around.

>> KACZMARKSY: Exactly.

>> ZOBACK: That's like a small working model.

>> KACZMARKSY: Exactly.

>> ZOBACK: Okay. Great. So you know it works already.

>> KACZMARKSY: Yes, in fact we also have it at Callaway, the same technology has been used at Callaway, several other nuclear stations.

>> ZOBACK: Okay. The other question I have which is a naive one I suppose, so who decides what spent fuel

goes to your facility? Who makes that decision? And how do you manage that.

>> KACZMARKSY: Well again those decisions are to be made in the future you're talking about moving to the consolidated interim storage facility.

>> ZOBACK: is it your decision since you're operating it or is it DOE's decision because they own it once it leaves the utility site? I'm confused.

>> KACZMARKSY: Once it leaves the utility site? I mean the --

>> ZOBACK: Doesn't DOE own the fuel once it leaves the utility site the spent fuel.

>> KACZMARKSY: Correct.

>> ZOBACK: Who is going to make the decision -- are only Holtec customers going to get in your site first.

>> KACZMARKSY: Well this is actually at a current customer location.

>> ZOBACK: Yeah, I know. I was just referring in general to your proposed consolidated -- CF whatever --

>> KACZMARKSY: CISF, yeah.

>> ZOBACK: How are you going to decide who gets slots there? And in what order they get them? Or do you decide it or does DOE decide it.

>> KACZMARKSY: Bill can probably --

>> BAHR: We have Bill Boyle.

>> BOYLE: Yeah Department of Energy. A number of things. DOE is not going to own this.

>> KACZMARKSY: Right.

>> BOYLE: To make it clear.

>> ZOBACK: Own the spent fuel.

>> BOYLE: Correct even when it leaves the utility site to use as a perfect example of that, Private Fuel Storage facility in Utah licensed by the NRC. The Government had absolutely nothing to do with it. The fuel was going to leave the sites and it was going to end up in Utah so it's only if the Government takes possession of it as it's leaving the site does it become DOE's and DOE is not involved with either Holtec's proposed facility or the WCS facility next door in Texas.

>> ZOBACK: So you get to make the decision.

>> KACZMARKSY: Well it's the customer. The customer will be making the decision on what's being shipped when from -- it's an operating facility.

>> ZOBACK: But you're controlling the facility so you control who can put it there, right? I'm just trying to understand. Is this going to be a bidding process who pays the most gets the first slots or what.

>> KACZMARKSY: Those are good questions. We haven't really addressed the process.

>> ZOBACK: But you're ready to go in just a few years, right?

>> KACZMARKSY: Yeah it will be available in a few years. Right now the money hasn't been -- there's no contracts in place to move the fuel or the Government hasn't decided that any of the money from the settlement agreements or the damages will be shifted over. That's all part of the policy -- Nuclear Waste Policy Act that's currently being looked at potentially amended.

>> ZOBACK: If I may just one more follow-on

question.

>> BAHR: Sure.

>> ZOBACK: So your initial phase of your CSIF is 500 -- capacity of 500 whatever.

>> KACZMARKSY: Yeah.

>> ZOBACK: Could you take all of the current orphaned sites could you take all of their fuel and put it in your storage facility.

>> KACZMARKSY: Yes we could eventually. Yes.

>> ZOBACK: Thank you.

>> BAHR: Okay. Did we have a question over here? Tissa.

>> ILLANGASEKARE: Illangasekare the Board. So, this design assumes that no water will ever get in.

>> KACZMARKSY: I'm sorry.

>> ILLANGASEKARE: No water will ever get in.

>> KACZMARKSY: Correct. That is correct.

>> BAHR: Other questions from the Board? From the staff? Dan Ogg?

>> OGG: Yeah Dan Ogg, Board staff. Myron, on your

Slide 25 you talk about the path forward here and this may actually get at some of these other questions. At the bottom there it says -- Slide 25. There it is.

Okay. It says you're going to proceed pending agreement with DOE and/or the nuclear utilities. Can you talk about that a little bit more? What is involved with that step? And can you also talk about funding when you talk about that?

>> KACZMARKSY: That's the biggest issue right now is who is going to pay for the movement of that fuel to the CISF. And that is either by policy decisions yet to be made through amendments to Nuclear Waste Policy Act or if the utility decides to actually pay for it itself. I mean California has its own sort of issues that they are dealing with with regard to potential movement of fuel outside of the state.

>> OGG: But if you're planning to operate this by 2023, that's very soon really. In the grand scheme of

things. So are you working with DOE now or are you working with the utilities and DOE to try to reach these kind of agreements?

>> KACZMARKSY: We're working with utilities right now, that is correct. The Department of Energy is more dictated by policy than what we can do in terms of a private company. We're actually privately -- we're privately funding our efforts with regard to the license application. And with the initial whatever preliminary activities are associated with the initial --

>> OGG: This is an important point where it says pending nothing happens below that pending bullet until you reach these agreements.

>> KACZMARKSY: That's correct. Basically that's absolutely correct.

>> BAHR: And the railcar will be available?

>> KACZMARKSY: Well that is under development by the Department of Energy right now the 12 axle railcar.

>> BAHR: If this is -- but if this is all funded by

the utilities, will that railcar be available to you or is that a railcar that's only available for DOE shipments?

>> KACZMARKSY: Well, I guess the plan is to have -- Bill, I don't know if you want to respond to that? Thanks, Bill, for staying on.

>> BOYLE: There would be a limited number of cars available by 2023 but it's property of the United States Government. The Government doesn't typically say here anybody who wants to use our property -- there would have to be some other way of -- that's just not typically done I'm not saying it's impossible. But it was not -- the work we're doing now was not done with the thought of turning it over to third parties for their use. I'll put it that way.

>> BAHR: Mary Lou.

>> ZOBACK: Zoback, Board. So if they have a working solution to the problem, why would the Government not want to cooperate?

>> BOYLE: I didn't say we wouldn't cooperate but

there are laws and regulations governing the use of Government property. It's just not -- you know, I can't give you my cell phone and say here make an international call on it. You know it helps you out.

>> ZOBACK: Right but we're talking about helping the nation out right now.

>> BOYLE: Yeah even if you were doing something with my cell phone that arguably helps out the nation I still can't do that.

>> ZOBACK: But a positive attitude would be helpful. (Chuckles).

>> BOYLE: I think following the laws is a perfectly positive attitude.

>> ZOBACK: I'm not advocating you break the law.

>> BAHR: Steve Becker.

>> BECKER: This may also be a naive question. You say you designed a built a railcar in Ukraine.

>> KACZMARKSY: That's correct.

>> BECKER: Is there any relationship between the work that was done on that and what might be utilized

in a U.S. setting?

>> KACZMARKSY: It doesn't -- I mean it wasn't built to the AAR Association of American Railroad association standards. It was built to European standards. It would have to be recertfied for use. The design could be utilized. I mean the Navy has an operating transport railcar, as well. They have one that's perfectly -- it went through the AAR process but the answer is yes, it could be. Just have to be recertfied under that AARA standard 2043.

>> BAHR: Other questions from staff members? Board Members.

Questions from the audience? Oh, okay. Dan, I'm sorry; I didn't -- somebody else's head was hiding your hand.

>> OGG: Dan Ogg Board staff. This is kind of going in a different direction here. Holtec manufacturers a large number of spent fuel storage cask - - canisters

and you're planning to use them at your storage facility. One of the questions that frequently comes up is what is the condition of these canisters after long-term storage. And what kind of inspections may be needed. Has Holtec looked at this at all and do they have any old, old canisters laying around they can use as test specimens and take a look -- has that been done or has Holtec thought of that.

>> KACZMARKSY: It hasn't been done at this time but it can be.

>> OGG: I don't know how closely you work -- how closely you work with the folks who manufacture the canisters.

>> KACZMARKSY: We manufacture the canisters.

>> OGG: No you personally. But my question is do you have a -- an opinion or a sense of how robust they are and the likelihood of corrosion like stress corrosion cracking that may occur in these canisters that have been in dry storage for 10, 15, 20, 30 years.

>> KACZMARKSY: For example for the San Onofre

facility the customer was concerned about chloride induced cracking so we adopted a laser-peening process for all of the canisters delivered to the San Onofre nuclear site which again has been proven to eliminate the --

>> OGG: Sure that's good for new canisters coming in to be loaded but I guess it's still a question about the ones that have been out there for 20, 30 years the condition of those.

>> KACZMARKSY: There's a lot of studies that are being done or have been done or are continuing to be done and we'll look at those and sort of determine whether or not there's any potential. So far there's no indication of any studies that have been done that would indicate that there would be a degradation of the canister over a long period of time.

But again from a transport perspective remember I mentioned earlier that the actual canister is not the containment boundary under the Part 71 process.

>> BAHR: Steve Becker.

>> BECKER: Are there any useful technical lessons learned from the operation of facilities such as the one we're looking at right here that might be useful in terms of the larger facility that you envision?

>> KACZMARKSY: Again that's something that we're sort of assessing, lessons learned. This is so new and we just have kind of started the process here. We added an additional inspection process at the factory after the peening because the canister is rotated 200 times in this laser peening process. so we have adopted an additional inspection after the peening process so there's a double inspection before the canister leaves the manufacturing facility. One minor lesson learned from a manufacturing process.

Cask handling and cask placement is fairly straightforward. We haven't really run into any issues.

>> BAHR: Turinsky.

>> TURINSKY: Very much following up on what you just said. Do you provide services where you folks actually do go and load the canisters and place it?

>> KACZMARKSY: Yes that's correct I would say about half our customers actually contract us to do the pool to pad cask loading services.

>> TURINSKY: Okay.

>> BAHR: Nigel Mote?

>> MOTE: Myron I would like to couple together two things one Dan Ogg's question and another one was part of Gary Lanthrum's presentation this morning.

Dan's question related to your Slide 25. And the items below the pending agreement line.

>> KACZMARKSY: Okay.

>> MOTE: I'll give Jayson a moment to get that up. So the line saying pending agreement with DOE and/or so

let's take the or in that it's utilities so that says if DOE is not involved the agreement could be between Holtec and the nuclear utilities.

>> KACZMARKSY: Correct.

>> MOTE: Gary this morning repeated part of a presentation at the INMM meeting in January this year where a legal interpretation of mitigating your costs that the utility should follow would be if you're going to sue DOE to reimburse you for cost of storage because of partial under the Nuclear Waste Policy Act that's not collecting fuel in 1998 then the utilities are obligated to minimize the costs.

>> KACZMARKSY: Correct.

>> MOTE: If your costs are low enough and they can demonstrate that moving their fuel to your site is cheaper than them continuing to store at their own site and the case of the shut-down sites would presumably the ones most convincing in that, then you wouldn't need DOE and you would be able to proceed immediately on a commercial basis and in 2020 an operational basis

without any other issue than title to the fuel. And Holtec is on record as having said that you're considered taking title to the fuel.

>> KACZMARKSY: Correct.

>> MOTE: So putting those pieces together you wouldn't need DOE and you wouldn't need pending agreement you could forge the agreement now.

>> KACZMARKSY: That's correct.

>> MOTE: Can you comment on is that -- given that all of those things have been said in the public domain, how does that work and could you therefore find a straight line through to taking the first shipments in 2023 with nothing other than commercial agreements between commercial entities.

>> KACZMARKSY: Everything you said is correct. And we are pursuing some of those discussions with some of the commercial customers.

>> MOTE: Okay. So your pending agreement is a cautionary statement other than it's a roadblock until so you can drive straight through that. You're just not

assuming that you can -- that you're going to.

>> KACZMARKSY: That's correct. Every statement you made is correct.

>> MOTE: Thanks.

>> BAHR: Did I see another hand back there? I have one more question, Jean Bahr from the Board.

In your concept, who is responsible and is there infrastructure in place for moving the fuel from where it is currently in storage at the ISFSIs to the transportation network to the railcar or is there is there handling equipment is there available heavy haul trucks if needed if there isn't a rail spur long enough into the facility? Is that part of your planning? Or is that --

>> KACZMARKSY: We are evaluating all of that. Because there are heavy haul trailers, cars that have moved steam generators to nuclear sites for steam generator replacement projects the answer is yes and we

are looking at some of those options, as well. So moving --

>> BAHR: Would that be part of Holtec's activities in this process? Or would that be --

>> KACZMARKSY: It could be.

>> BAHR: Would that be the responsibility of the utilities.

>> KACZMARKSY: It could be. Again depending on the nature of the agreement or whatever the contract that we may have with the customer or whether we take over responsibility for the spent fuel.

>> BAHR: Okay. It looks like -- Lee?

>> PEDDICORD: Peddicord from the Board. In looking at the artist conception of the facility in the Ukraine. Is that in essence going to be the same as what you're doing in San Onofre and Calloway and proposed at Eddy-Lea.

>> KACZMARKSY: No actually they have ISFSI style pads. They are above ground storage and dry cask storage and we have two by the way there's two in the

Ukraine in the exclusion zone of the Chernobyl exclusion.

>> PEDDICORD: Both above ground.

>> KACZMARKSY: Yes.

>> PEDDICORD: As Holtec has done both of these what do you see as pluses or minuses or pros and cons for one vis-a-vis the other one above ground compared to below grade.

>> KACZMARKSY: Above ground addresses a lot of potential issues obviously the visual, the ability for security. You can see the entire facility. Airplane crash -- all of the potential issues we're dealing with right now going through the licensing process with the Nuclear Regulatory Commission, the HI-STORE UMAX system has a lot more attributes that will make it a lot easier for the licensing process.

>> PEDDICORD: Then in the Ukraine what was the basis then of going to above grade storage.

>> KACZMARKSY: Moving quickly and cost. They wanted to move quickly. They wanted to separate

themselves from Russia. I don't know if you know all the story. Russia charges the Ukraine for fuel. And they also charge to take it back. And by moving our onsite central storage facility quickly we're saving the Ukraine over $250 million a year out of their treasury so they are very happy to separate themselves from Russia.

(Chuckles).

>> ZOBACK: Zoback, Board that exclusion zone will remain forever an exclusion zone.

>> KACZMARKSY: Yeah in fact the dry cask storage systems we provided have been licensed under the Ukrainian legislation for 100 years.

>> BAHR: We have a few remaining minutes and it looks like we have someone from the audience who would like to ask a question or make a comment.

>> KLEVORICK: Good afternoon Phil Klevorick, Las Vegas, Nevada. I missed the first five minutes of your presentation so I apologize.

>> KACZMARKSY: It was mostly the marketing stuff.

>> KLEVORICK: Excellent so I didn't miss anything.

>> KACZMARKSY: You didn't miss anything.

>> KLEVORICK: So from what I understand the meetings didn't go as well as expected in New Mexico. I mean it wasn't as I'm using air quotes friendly, receptive as possible. And I'm probably understating that a little bit from what I hear. Maybe you could spend a couple of minutes explaining what you can get from the state of New Mexico and maybe from local jurisdictions as far as permitting and for the licensing itself. You know the process of what has to happen in order for the next thing to happen and things like that.

>> KACZMARKSY: I'm sorry; but what's the question?

>> KLEVORICK: Well the question is --

>> KACZMARKSY: The permitting is already -- we have already moved through that process with the state.

>> KLEVORICK: Don't you have to get permits for transportation of the materials.

>> KACZMARKSY: Eventually, yes.

>> KLEVORICK: That would have to come from the

state.

>> KACZMARKSY: Correct.

>> KLEVORICK: Are you working on that right now.

>> KACZMARKSY: Yes we're anticipating all of that right now.

>> KLEVORICK: And your conversations with the state of New Mexico has been receptive.

>> KACZMARKSY: Very positive with the state officials, that's correct. It's been the public meeting and the intervener process that's been challenging.

>> KLEVORICK: I have a different perspective but again I'm not in the business so I'll be following it very closely thank you.

>> KACZMARKSY: Yeah, please.

>> BAHR: Any other questions from the audience? Okay well to keep us on time I want to thank you very much. And we'll move on to our next speaker.

So our next speaker is from the Department of Energy Erica Bickford who has been working on among other things some of the shut-down sites and readiness for transport from those. And she's going to give us a presentation on insights gained about technical issues to be addressed.

>> BICKFORD: All righty. Thanks very much. Thanks for inviting me to speak today. As a little bit of an introduction my name is Erica Bickford I'm the transportation Program Manager in the Office of Integrated Waste Management at DOE I work under Bill Boyle and Nancy Bushman who is here in the audience I'll be speaking on some of the technical information that came out of our six initial site-specific deinventory reports that we've produced so far.

My National Laboratory lead on this work is Matt Feldman from Oak Ridge National Lab he's also in the audience so I may call on him if you ask questions that are too hard.

All right. So Bill mentioned this morning we have this disclaimer that we use. This analysis that I'm going to present today was conducted based on the current state of spent fuel condition in the country at the site's evaluated. As has already been discussed, the standard contract exists that focused on transport of bare fuel to the extent there are conflicts between the information I present and the standard contract it's the standard contract that prevails.

All right. So for today's presentation I'll first go through a little bit of the background on the deinventory reports that we have done, sort of what their genesis was and what their scope and limitations are. I'll give you a snapshot of 2 reports from two of the sites to give you an idea of sort of what was covered and what some of the information that came out with them focusing on Big Rock Point and Humboldt Bay and then as requested talk about some of the technical issues to be addressed both sort of issues that are common to all six sites we have looked at so far and some of the unique challenges that have been identified for specific sites.

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So as some of you may be aware DOE Office of Nuclear Energy has been gathering data from shut-down sites for the past number of years going back to 2012. This is really a knowledge management activity because it was shut down and staff leaves and sort of information about what is at the site, what transportation activities have been conducted at the site you run the risk of losing that knowledge.

So we've been visiting sites we visited all four of the shut-down sites and all of the information gathered from those site visits is catalogued in DOE's preliminary evaluation of removing used nuclear fuel from shut-down sites more commonly referred to as DOE's shut-down sites report. So when we do these site visits we of course meet with the site personnel we submit to them in advance a list of questions so they can be prepared to address the information that we're looking for.

We involve local tribes and state representatives on those site visits, as well.

We interface with the U.S. Department of Transportation through the Federal Railroad Administration and bring Federal Railroad Administration staff on those shutdown site visits to provide their rail transportation expertise and also hopefully give access to rail infrastructure and we include other stakeholders as appropriate.

So as I mentioned this work has been going on since 2012 as the work started to mature in terms of we're continuing to gather the information and then the question was but what next. So the idea was to build on the good work conducted in the shut-down sites and take it one step further in terms of with the information that we have how would a competent entity propose removing the fuel from the sites looking at the tasks and equipment needs and the interfaces necessary to do that. So that's how we embarked on these initial site specific deinventory reports. I want to emphasize they are initial these are not a recipe for tomorrow if you wanted to go take that fuel from the site this is your how-to guide. This is sort of a step further on the shut-down site data that we have in terms of moving it more into an operational space but we don't go and look at bridge weight limits and bridge spans and things of very high level detail that you will need to do before you actually embark on moving the fuel.

Again these are really a first look how on integrating contractor or someone with this type of experience would recommend removing these canisters from the site.

They are really one contractor's perspective - - so it's not necessarily the one solution but it's a solution. And it doesn't necessarily represent how DOE will plan to remove the fuel in the future again it's a recommended approach.

In the analyses the contractor used something called a multi-attribute utility analysis as their framework for identifying the mode and route alternatives so what they did was look at all various factors, use their corporate experts to weight the relative importance, look at different modes and route combinations and then identify what was preferred and from that preferred combination is what was developed. They developed a concept of operations including estimated schedules and costs of those operations so that's where the output comes from.

In addition in conducting this analysis the contractor also made use of DOE tools, particularly the stakeholder tool for assessing radioactive transportation the START tool it's a web GIS based tool that maps transportation infrastructure and also has a routing capability. So that was used both for their purposes and to provide DOE some feedback on how to improve the tool. Similarly as DOE-NE continues to develop additional system analysis tools - - START and NGSAM, some of which my colleague

Jack Wheeler will talk about later today we can also integrate those tools into the decision making process as we go forward so this is sort of a building endeavor.

So in terms of the scope and limitations of these reports - - all six reports done to date were conducted by a contractor team of AREVA Federal services which has since rebranded to Orano I'm told it sounds better in French. For all six reports, they teamed with MHF which is a transportation logistics company and three of the sites they coordinated with NAC and those three sites were Connecticut Yankee, Maine Yankee and Kewaunee, where they have NAC storage systems employed on site so it was useful to have input from that vendor for those sites. There were ground rules for conducting the reports based on the resources available, to do this analysis they were sort of scaled based on what was available at the time. Of course they relied on their staff and corporate experience.

They used information provided by DOE primarily the shut-down sites report. And they did not talk with shut-down site personnel or state or tribal stakeholders or rail carriers and the rationale for that was both in terms of scope of analysis didn't include resources to be traveling around everywhere in addition specifically with tribal members the Federal Government has a Government-to-Government relationship with tribes. And therefore, it would not be appropriate to send contractors out to interface with tribes one-on-one without a Federal Government present there for the interface. So that was the rationale for limiting the scope of these reports to sort of the information available on hand in most cases. Again these reports only focus on technical and logistical considerations don't address public policy considerations or public perception or any other social issues. It's how do you move big heavy things from

Point A to Point B irrespective of sort of the other aspects to the system.

So here is the map that shows the 14 sites that are shut down around the country.

The color coding indicates what storage systems or what canister systems are employed at the site. We have four different systems in use at the sites. The sites with multiple colors use two different types of systems.

You'll notice that there's only one site that uses this green color and that's at Big Rock Point. That's the only site among the shutdown among all of the nuclear power plant sites that uses that system and that creates some unique circumstances which I'll talk about later.

As I mentioned we have visited all of these sites and cataloged the information from these visits in the shut-down sites report and completed 6 initial deinventory studies to date. All of the triangles are sites that have had reports completed and those have all been publicly released at this point, as well.

Next I'm just going to give you a bit of a snapshot of what was looked at for two sites on Big Rock Point up here in northern Michigan and for Humboldt Bay in the coastal Northern California which was a subject of discussion earlier. So for Big Rock Point here are some images from the site as you saw on the map it's located on the eastern shore of Lake Michigan the closest town is the town of Petoskey about 11 miles away. At that site it's limited inventory. It's got 8 canisters total. 7 are spent fuel canisters and one is greater than class C waste, or GTCC. As I mentioned they use the Fuel Solutions storage system which was -- it's a one-off system. Which is unique.

Here you have in the overhead shot here is where you have your ISFSI which stands for independent spent fuel storage installation just a fancy word for storage facility and then you have a security building. Here is again where you have your pad with storage there's not a lot of infrastructure left at the site it's been more or less completely deinventoried except for the spent fuel on the site. So again AREVA in conducting their analysis looked at various options for transporting fuel from the site and various modal combinations you can see outlined in this graphic here. What they ultimately determined was they assumed that the likely transport package from the site TS125, which is the transport package that corresponds with the canister stored at that site. The route and mode they recommended for moving fuel from the site was to do a heavy haul truck transport to Petoskey, where it could be transloaded onto local rail service that could then transported down to Durand, Michigan where it could be transferred over to Canadian National which is a larger rail carrier with more national service from there transported to a destination or a suitable interchange point with another rail carrier.

Due to the unique situation with this site and the canisters in use what was recommended was doing 8 mini campaigns of one cask each. The idea being you only buy one of these transportation packages and then do eight transports because after you move the fuel from this site, this package it's a lovely door stop. There's nothing more to be done with that package. And so, what they estimated based on the operations of the loading time and transload et cetera was five to seven days to load the cask up get it configured for transport and move it to Petoskey where it could be transloaded onto rail.

The round-trip transport takes about 25 days so that gives you overall an estimated deinventory timeframe of about 36 weeks at a cost of $7.3 million and that cost estimate does not include the cost of the cask or railcars because in general for the other sites the cost of cask and railcars are systematic costs not site specific costs you don't want to unfairly add additional costs on to the site. So this is the situation for Big Rock Point. And this was the outcome of the analysis. Moving over to Humboldt Bay again in Northern California located on the shore of Humboldt Bay which is near Eureka, California about 260 miles north of San Francisco. At this site again sort of a small site in terms of their inventory they have 6 casks. The fuel here is stored in the HI-STAR HB storage system this is a transportable overpack it's stored in. So in theory, you just need to add on impact limiters, get a cradle, it's good to go. You have five cans of spent fuel and one can of GTCC and here is a map of where the facility is on the coast.

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All right so the analysis from the contractor looked at a variety of mode and route options. Mapped here. Looked at the likely transport package for this side is clear the HI-STAR HB assuming you're moving the canistered fuel. With the recommended mode and route combination for this site was to do a heavy haul truck transport two miles to Fields Landing which is a barge pier in proximity to the site then barge the fuel to Concord California which is -- there's a military facility it's the Military Ocean Terminal Concord or MOTCO is what it's called. Then from there directly loaded onto UP or BNSF railroad and transported to a destination and interchange. I should clarify in terms of using a potential DoD facility there were no discussions with DoD, so this is purely hypothetical and not necessarily an agreement with DoD to be able to use their facility.

For this site, the contractor proposed conducting one campaign of six casks. So move it all out in one shipment and the transportation was estimated to take 20 to 24 days. The operating time was expected to be about 5 weeks. And a cost of $2.7 million which again does not include the cost of the impact limiters in this case or the railcars et cetera. So that gives you sort of the highlights of what is looked at in the deinventory studies as I mentioned before they are initial and don't necessarily -- they don't include things like route clearances for rail transport for overhead like size and wide, weight limits, curvature things like that. They are sort of an initial look at those things based on what equipment has been transported to –the extent that information is available. So this is just the first look.

So in each report at the end chapter there's a section on recommended next steps. And just to be clear these are not necessarily recommended next steps that DOE needs to run right out and start tackling right away. These are recommended next steps for when the program is in an operational status when you get to operations and planning actively for transportation these are some of the things you'll need to do.

And so the recommended next steps come from a couple of different sources. Of course the shutdown sites report which in and of itself builds on a lot of earlier work done under the RW program. The FICA reports, the near site transportation infrastructure reports. Some of them I think Nigel Mote in an earlier life worked on some of these. This is work done in the 1990s to early 2000s so we never try and reinvent the wheel if we don't have to and try to build on the information that we have available.

Of course at the sites that had NAC storage systems their corporate expertise was used. And in some cases there was additional data obtained from the sites as requested by the contractor. So an example of this was when we did the report for Kewaunee there was consideration of whether barge would be a feasible mode to transfer from Kewaunee - - it’s located on Lake Michigan - - directly from the Kewaunee site. At the time the report was being conducted NAC was in the process of loading the fuel at the site and they were partnered with AREVA so one of the team members of NAC at the site went down and took photos of the barge haul path down to the lake to see if they could figure out what the grade was, what the condition was, what kind of upgrades needed to be used or whether it was even suitable to be used for barge at that site.

But otherwise they use already available information.

All right. So among the six sites that have been looked at so far there are a number of common themes in terms of the issues or tasks that need to be addressed in advance of preparing to transport the spent fuel offsite. So one of these is we talked a little bit about this earlier today is verifying that the dry storage canister contents are allowed by the transportation COC so we have fuel in canisters again assuming we're transporting canister fuel whatever you have in the canister is compatible with the transportation overpack and meets the requirements of the COC which is the -- I just lost it. Certificate of Compliance from the Nuclear Regulatory Commission. So it's kind of referred to oftentimes as licensing from NRC actually for the packages it's a certificate or COC. These are valid for five year periods and are renewed every five years in theory so it's important to keep current on what the status of the COCs is and whether there are any issues.

One of these is verifying that any changes made to storage canisters through NRC's 10 CFR 72.48 process which is a process that allows minor modifications to the design without going through a full NRC review and that exists only for the storage package doesn't exist for the transportation package so if there are changes to the canister we need to make sure those have been propagated through to the transportation COC. An issue that's been current recently you might be aware of is with the Holtec canisters there's a shim pin issue that's come up at San Onofre and to some extent at Vermont Yankee too so we'll have to maintain awareness as that issue is resolved to figure out if there's implications for potential transport. Of course you need detailed equipment needs for transportation so for sites that need casks you need transfer casks and impact limiters spacers, cradles, personnel barriers. You also need additional equipment as needed, mobile cranes have been discussed that the infrastructure at some of the sites that have fully deinventoried there's really not much available onsite so you need to bring in equipment from outside and you need to make sure it's all compatible with the storage system that you're moving. Rigging equipment. Et cetera.

Additional common themes is of course you'll have to have some kind of power at the site. With the infrastructure at some sites really taken down you'll need to figure out how to get your equipment onsite powered. This is not an insurmountable problem. It's done every day. But just something that is common to all sites. You'll likely need to establish or in some cases re-establish onsite and near site transportation infrastructure. I have these helpful images at the bottom from some of the sites on the left this is Maine Yankee, you have a rail spur coming to the site that's been paved over so that needs to be spruced up a bit and on the right you have a similar photograph from Vermont Yankee although I understand they have since refurbished this rail spur so again this is not a big problem to deal with.

You also have to conduct route clearances so clearances again are making sure you have the infrastructure you're transporting on can accommodate both the size and weight of your package.

You may need to do permitting for heavy haul routes in addition you may have to do clearances of heavy haul routes if you're moving over bridges or culverts you have to -- you may have to make modifications. You'll have to coordinate with local utilities et cetera if they need to come lift power lines or take down power lines et cetera.

In addition if barge is a transport mode decided to be used at a site you may need to dredge in order to accommodate the draft of the barge and that may require some additional permits, as well.

So those are some of the challenges that are common to all of the sites that we have looked at. And now I'm going to talk a little bit about some of the unique challenges. I talked about some of these before. But just to further elaborate starting with Big Rock Point as we mentioned they have a unique storage system at that site. In the case of the transportation cask that's compatible with that storage system, the TS125 the transportation COC needs to be updated to allow for fabrication and use of that cask to transport the canister and to allow of transport to the GTCC waste that's one option. As an alternative rather than finding a fabricator for TS125 because that was Fuel Solutions or Energy Solutions that's not currently in the game of fabricating storage and transportation canisters and it's not clear if they would want to do that in the future. You could consider modifying the transportation COC for another vendor’s transportation cask to allow for transport of those canisters. Potential benefit for them to be able to reuse the cask at other sites but again that's something to be considered.

For Kewaunee the transportation CoC for the MAGNATRAN transportation cask has not yet been issued by NRC but again that's something that's fairly commonplace and not seen as a huge issue.

Humboldt Bay has a couple more interesting elements to it. For the transportation COC for the HI-STAR HB needs to be revised to allow for transport for lower enrichment spent fuel and for the GTCC. As I understand it, this is an activity that’s in progress by Holtec and they are looking at some things in the area they suspended it when they consider whether they need to modify their SAR or not. So these are things, again, that are expected to be addressed as a normal course of business.

There's also potential issues associated with fuel channel thickness and reduced effective thread length at the lid bolts. Also need to clarify vacuum drying, helium back fuel et cetera. In the context of some of these, these issues I'm presenting, I'm presenting them as general issues that need to be addressed for the site but not indicating that DOE is necessarily the responsible party. As Bill mentioned earlier today, sort of the framework model for transporting spent fuel is under the Nuclear Waste Policy Act the Department shows up with a transportation package and utility loads the package and the department transports it away. So in the case where there may be issues with the COCs for the transportation canisters or casks the expectation is in many cases resolution of these issues will really be led by the utilities and the vendors in concert with the Nuclear Regulatory Commission and that DOE will not really have a leading role in resolving these issues. It's important for us to be aware of these issues and be in communication with these parties about them so we are all on the same page at the end but not necessarily be the driving force to resolve them.

And then the last issue here is using the existing vertical cask transporter that currently shared with Diablo Canyon. If you're wondering what a vertical cask transporter is the image to the right shows what it is, it's kind of a walking crane so there's a question of what's the condition of it. It's still viable for current use. Is it going to be available because it's shared with this other site? Do you need to bring in another piece of equipment to make these loads work? Et cetera.

So in summary we have conducted these initial site specific deinventory reports. Really builds on the work we have been conducting with the shut-down site analyses what these reports give us is proposed next steps. Also tasks, equipment needs, and interfaces necessary that are the recommendations from an integrating contractor that has experience in conducting this work.

We've identified that some sites have some unique challenges to them. And then there are some common challenges across many sites. But sort of the key message here is that there's really no showstopper technical issues identified among the sites. This has been mentioned before in the 2006 National Academies report really no technical obstacles to prevent the transport of spent nuclear fuel. There are issues certainly to be addressed. But nothing that causes us a great deal of concern at this time.

So with that, I will take questions.

>> BAHR: Okay. Thank you. You said there are no showstopper issues but there are things that have to be done that some of them take longer than others. Can you from what you've been looking at, do you have an idea of what are some of the items with the longest lead times that might be faced either by DOE or by the utilities and NRC.

>> BICKFORD: Sure some of the COC issues might take longer to address. I think from the information I

presented things like resolving the transportation package issue with Big Rock Point if you're going to modify another package to be able to transport that fuel or if you're going to go ahead and update the COC for the TS125 package and find a vendor who will fabricate who will fabricate the package that's probably one of the longer lead times for these sites.

>> BAHR: You mentioned you didn't include the cost of fabricating a new cask in your one analysis. But just for my own sort of curiosity, what's the typical cost for a unique cask? If they are only building one of these.

>> BICKFORD: I think the ballpark number I've been working with and I welcome anyone to correct is on the order of 3 to $5 million apiece including the impact limiters.

>> BAHR: So that's half again the cost that you estimated for the transportation part of it.

>> BICKFORD: Right.

>> BAHR: Okay.

>> BICKFORD: And again in most cases, ideally you would be using those packages for multiple sites so you're sort of spreading the cost amongst several operations and the Big Rock Point is potentially a unique site unless you can get another package to be able to use there.

>> BAHR: Okay questions from other Board Members? Steve Becker.

>> BECKER: Becker, Board. In cases where there's a need for infrastructure renewal or establishing new infrastructure, whose financial responsibility is that?

>> BICKFORD: That mostly comes down to a legal question so I don't want to insert myself as a lawyer but the guidance I have been given from lawyers is infrastructure within the site boundary of the utility so within the fence line is the utility's responsibility and infrastructure outside the fence line is DOE's responsibility or -- it's possible that there could be co-benefits if there's a local industry that's

interested in refurbishing a rail line something like that. But essentially inside the fence line it's the utility. Outside the fence line it's DOE and/or other interested stakeholders.

>> BECKER: Thank you.

>> BAHR: Dr. Peddicord.

>> PEDDICORD: Lee Peddicord from the Board. A couple of questions. At the beginning of your presentation you said you were going out engaging with the communities I guess I forget who you were engaging with but you're engaging. And you have a list of questions. Could you kind of give us a sample or examples of what those questions would be.

>> BICKFORD: Oh my goodness what you're talking about is when we conduct our visits to shut down sites we involve a number of interested parties and those activities in advance of the visit we provide a list of questions to the utility so they can be prepared to answer our questions.

And that list has varied over the years. Sometimes it ends up being like a 14-page list of questions which we found can be a little overwhelming and sometimes lawyers pop up in the room so we scaled it back at different times to not overwhelm the utility but make sure that this is going to be our one shot to get this information potentially before layoffs happen and staff are scattered to the wind so we want to be sure we're comprehensive. So the types of questions we ask are is there any damaged fuel and how is it packaged? What's the site's experience with moving large heavy equipment in and out of the site? What modes have been used? What considerations were there? What was the status of the infrastructure if you move things by barge, how was that done? What rail carriers did you use? What other infrastructure considerations at the site? So in terms of if you were doing heavy haul transport, is there a bridge overpass nearby that has considerations for use, et cetera?

>> PEDDICORD: Good. Then you also -- at both sites you cited where they have greater than Class C waste. So is DOE obligated to take the greater than Class C waste.

>> BICKFORD: That's a good question and it was raised recently so in the case of GTCC that's at commercial nuclear power plants it's kind of a unique scenario so in general in the universe of waste in the U.S., the Office of Environmental Management is responsible for GTCC. However, due to a court case associated with the nuclear power plants it was established that in the case of the GTCC at the nuclear power plants the GTCC is classified as high-level waste for the purposes of the standard contract and the Department of Energy is responsible for taking it.

>> PEDDICORD: So not to get too lawyerly here but can you then take that to say either one of the proposed consolidated interim storage facilities because G -- greater than Class C waste kind of falls in a gray area, as well. But from a different set of perspectives than

I think what you're referring to.

>> BICKFORD: Yeah that's also a good question and again since the Department of Energy is not involved in those private facilities, I can't speak to what the scope of their facilities plan to accommodate.

>> PEDDICORD: Then at Humboldt one often hears about this excruciating overland option. Can you transport by barge out of Humboldt? Or what kind of approvals will you need to get to transport by water?

>> BICKFORD: So the site visit that was conducted at Humboldt Bay was before my time so I'm relaying third party information but to my knowledge the information relayed by the site staff was that in order to utilize barge transport in California you need a permit from the California Coastal Commission and that could be quite difficult to obtain. Hence why these analyses strictly look at logistics and not those type of elements.

Of course there is also the option to heavy haul transport from that site however it's a very lengthy heavy haul in the order of 200 plus miles through windy mountain passes so that makes it less ideal in many respects and unfortunately once upon a time there was a rail line that went up very close to the site. Unfortunately it was abandoned in the 1990s and I think there have been some efforts in Northern California to look at re-establishing it for other commercial interests and the cost is just sort of prohibitive for the economic use.

>> PEDDICORD: Kind of one last question, first of all, you cited the two studies and the associated projected cost 7.3 million at Big Rock Point, 2.7 million -- this sounds like an incredible deal. Let's take that in the grand spectrum of doing things with anything nuclear with the Federal Government. This is down in the noise level but for example at Humboldt for the 2.7 million you talked about needing to bring in some of this heavy equipment to move things. Is that included in that estimate.

>> BICKFORD: Yes the estimates do include the equipment costs as well as the labor costs.

>> PEDDICORD: We ought to do that this afternoon 2.7 million.

>> BICKFORD: You write the check.

>> BAHR: Paul Turinsky.

>> TURINSKY: Turinsky, Board it will be sort of a funny question. Are there any studies being done by DOE of this nature based on the standard contract?

>> BICKFORD: In terms of oldest fuel first.

>> TURINSKY: Based on shut-down sites.

>> BICKFORD: Moving bare fuel? I know we have done some analyses looking at the transportation logistics of oldest fuel first and what that would look like but not to this level of detail.

>> BAHR: Other questions from the Board or the staff? Dan Ogg.

>> OGG: Dan Ogg Board staff. Erica thanks really good information. Two things, first these are really good studies, these site specific deinventory reports.

What are DOE's plans to do the other shut-down sites.

>> BICKFORD: I think our plans are to the extent we keep getting valuable and useful information from these reports, we'll continue to do them. Of course in this space with all of this uncertainty these type of analyses do have a shelf life so you also want to be conscious of not having to continually redo them every decade or so.

But to the extent that they provide valuable information we will continue them and we do have some funds allocated for FY18 to do one or two more studies.

>> OGG: Good. Then the second question this one is more technical. Did the AREVA Federal services team including all of the folks there when they went to these shut-down sites have access to the safety analysis reports that are associated with the storage systems.

>> BICKFORD: One clarification the AREVA Federal Services did not go to the sites. That was one of the

limitations in the scope they had to work with available information. Information that DOE provided was publicly available and that they had from their corporate experience. So if the safety analysis reports are publicly available, then they had access to them and if not, then they didn't. Unless in the case of because of use of TN storage systems or through their partnership with NAC if that information was provided.

>> OGG: And part of my question then is in a number of the safety analysis reports, either for storage and it may actually be for transportation there's a section towards the end of the report that talks about the preparation steps needed in order to transport the cask. And did the team look at those preparation steps for example inspection kind of steps? And are those factored into the cost and schedule that they estimated?

>> BICKFORD: I believe again to the extent that -- I see Matt is nodding. To the extent that information is available, they incorporated all of the available information into their analysis. I know for example in

the next steps one of the items that they reported on for all the sites was they need to check what the lift height limitation was for the cask without impact limiters and things of that nature to figure out the loading operations.

>> BAHR: Linda Nozick.

>> NOZICK: Nozick, Board. Is there an interface between this work and the development of the systems analysis tools?

>> BICKFORD: Yes, there is. I mentioned that we use the START tool for this analysis made available to the contracting.

>> NOZICK: That's the routing one but the NGSAM all of those other ones, is there a connection?

>> BICKFORD: I know some of the data and estimated costs and schedules that come from these analyses are being incorporated into some other work that we're doing.

>> NOZICK: Okay. Thank you.

>> BAHR: Bahr, Board, how long do each of these

analyses take? If this kind of work has to be done prior to any kind of the planning if we're thinking about a timeline how quickly could one of these be completed?

>> BICKFORD: One thing I'll caution you again these are initial. So these are not the be all end all to be ready to transport so even with the sites that we have completed thus far, in order to really be ready to remove fuel from that site there would be additional information analysis needed but in the case of the studies that we have done so far they take on the order of months. You know, sometimes we do them two at a time so there's some efficiencies there sometimes they are one at a time but on the order of three to five months.

>> BAHR: And your estimate of how long it would take to get that additional data that you would need to actually be ready to transport.

>> BICKFORD: I think that depends on the site and how complicated any particular site is. If it's a site that has direct rail access and it's just a matter of really refurbishing the rail and doing some route

clearances I think that's pretty straightforward if it's a site where you might be doing multiple trans loads and having to establish the transload locations to do that and set up security for those, et cetera, then it would be a more involved operation.

But I would expect -- I mean, again --

>> BAHR: Are we talking months again or are we talking years?

>> BICKFORD: You know I assume it could be done on the order of months given sufficient resources. So it's always a matter of how many resources you have available.

>> BAHR: Sure. Thanks. Mary Lou.

>> ZOBACK: Zoback, Board, thank you for a really interesting and informative presentation. I agree with my colleague Dr. Peddicord here that the kinds of numbers that your analysis came up with, you know, keeping in mind not all costs were included but they are

budget dust basically. And so how do these numbers and of course I don't know if you know this but how do they compare with the costs that the utilities are paying saying on an annual basis to maintain the waste of these sites do you know.

>> BICKFORD: Well I think the numbers there were some numbers thrown out earlier something on the order of 8 to $12 million for the shut-down sites a piece per year and just to be clear the numbers, the cost numbers reported are just the cost of the activities for that site. Not the holistic program and having a facility and all of your staff and all of that stuff that's a much, much bigger number.

>> ZOBACK: Thank you.

>> PEDDICORD: Peddicord, Board, a follow-up to that question and maybe you don't have this right handy. But for PG&E or Consumers, are they receiving payments under the settlements with the standard contract? And how much are we paying for not doing things as compared to your very attractive numbers to do something.

>> BICKFORD: So the Department of Justice is a lead for the litigation so I do not speak for the Department of Justice. I think there are numbers on the order of 6 billion has been paid out thus far.

>> PEDDICORD: Altogether.

>> BICKFORD: Altogether yeah.

>> PEDDICORD: For these two specific ones you don't have that number off the top of your head.

>> BICKFORD: No and I don't know if the site specific information is publicly available.

>> PEDDICORD: Is that right.

>> BICKFORD: Well because it comes out of the judgment fund -- or the General Fund so to the extent that payments out of the General Fund but I don't personally have the individual site information.

>> PEDDICORD: If I can ask one other technical question. For those casks with the fuel are the content all characterized in terms of the fuel assemblies, the burnups, when they came out of the reactor and so on do you have good data what's in those casks.

>> BICKFORD: For the shut-down sites we visited we have fairly good data we have through the GC 859 data that the utilities submit and when we do the site visits if we don't have detailed data on their loading maps then we ask them for it I can't speak to whether every site in this analysis has comprehensive data. That is something that they are looking at and conscious of because obviously the GC 859 is geared towards individual assemblies and canistered fuel is kind of a different thing, but that's something we're actively trying to get to the extent we can.

>> BAHR: Other questions from Board Members? From staff? Bret Leslie.

>> LESLIE: Bret Leslie Board staff. Erica good presentation and this is a knowledge management question. This is one by one deinventory sites in the end the Department of Energy will be responsible for all of these things. How are you consolidating the information from these sites to figure out if there's some commonalties and efficiency through the system or

have you planned to do that? And just I know you're focusing right now on the individuals. But in the end, you're going to have the whole ball of wax.

>> BICKFORD: To the extent right now we do consider efficiencies in the system but it's really more of an anecdotal nature as we get this information we sort of internally have these discussions but it's hard to fully consider efficiencies unless you know what the shape of your system looks like. We have discussed you have the standard contract consideration. And under that you would be transporting potentially onesie twosies from sites which is sort of a different type of operation from what these reports assume is full site deinventory all in one go. So it does provide useful information in terms of schedules, et cetera. And we're ever mindful of ways to try to be more efficient. I think it was discussed earlier Bill mentioned in France you have this lovely vertically integrated system that gives you all these efficiencies. We're not that system. So we have to work with what we're

given. And we do of course -- of course we consider in a perfect world we would have some standardized packages. Or have a single standardized package ideally because in a transportation space that's much, much easier to work with but that's not what we have so we try to do the best with what we have and there have been many proposals made. Gary mentioned the possibility of asking each vendor to come up with a single universal cask for their fleets. So that's a possibility, as well. But a lot of these things are yet to be determined pending larger policy decisions and also of course the availability of funding and resources.

>> BAHR: Jean Bahr from the Board. Sort of a follow-up. Is all of the information contained just in these deinventory reports? Or do you have some sort of a database where you're synthesizing that information so that it might be accessible for different kinds of analyses in the future.

>> BICKFORD: We are using the data from these

analyses in some of our systems tools and looking at costs and optimizations. All the data that comes out of these studies is in -- contained within the reports.

>> BAHR: So it's not contained digitally somewhere else besides the reports.

>> BICKFORD: In terms of -- it's a contracted activity. So we receive the final product as a report and then we can take the data out of that report and put it into some of our own databases and other analysis tools.

>> BAHR: Thank you, Mary Lou.

>> ZOBACK: Sort of a follow-up on route planning for the shut-down sites I thought Gary had a great idea that a regional approach so you can focus on just a few states or relatively few states. So is that being factored into your planning.

>> BICKFORD: It's certainly considered it goes back to Bret's question about efficiencies if you have no external constraints then there's a certain way you might approach this activity to make it as efficient as

possible. But unfortunately we live in the world of external constraints. And so we dream of how we might do things if we had full control of the system but also have to live in the reality of what we may or may not be able to do but certainly yeah if you can do regional approaches from the -- you know there would certainly be efficiencies certainly in terms of funding state and tribal governments in terms of emergency response planning, and communications. You could do more focused communications outreach and engagement work and move it around rather than trying to do all things at all times.

>> ZOBACK: Right. Let's see. I can't remember what I was going to ask.

>> BAHR: Other questions? Seeing none from the front of the room. Do we have any from the audience? Comments, questions, thanks Erica.

>> ZOBACK: I just remembered the one I wanted to ask.

>> BICKFORD: All right.

>> ZOBACK: Looking at -- knowing the terrain in

Northern California, the idea of long haul trucking -- it seems ridiculous. So have you had any conversations? Not you personally. DOE. With the California Coastal Commission? You know, I think the -- we, the American public, sort of never view -- we view everything as an individual effort and I'm sure there would be a lot of protests against barging offshore but if the alternative is either leave it where it is with its inherent risk or try to take it on these windy mountain roads which are a challenge even for a BMW in places it seems like just starting a dialogue would be helpful. Have you done that?

>> BICKFORD: I haven't personally, and to my knowledge those conversations haven't been started again in this space with so much uncertainty you also want to be careful when you do have these engagements, have these discussions that they have a shelf life. And I don't know what the California Coastal Commission, I don't know if the members -- I assume they rotate.

So you run the risk of somebody's thumbs up at one point in time, 5, 10, 15 years later someone's thumbs down so I think the idea is when you have a facility on the horizon to receive spent fuel and are actively in the operational planning stage you'll be reaching out to all of these organizations. But certainly yeah there are tradeoffs there's opposition to barge transport the thing I didn't say is the MATCO facility that's being proposed, that involves going into San Francisco Bay and under the Golden Gate Bridge which will likely going to cause some consternation but again there's a tradeoff so it's that or it’s heavy hauling on mountain roads so it's what is the best path forward.

>> ZOBACK: Right I guess my -- you're right, the California Coastal Commission commissioners rotate. They’re political appointees but still it just seems like starting to have a dialogue somehow we have to get the public thinking you can't oppose everything because then you're stuck with a lot of bad choices. So anyway.

>> BICKFORD: Yeah. That's a point well taken.

>> BAHR: Okay. Well, thanks, Erica.

>> BICKFORD: Thank you.

>> BAHR: So our next speaker is Ken Niles with the Oregon Department of Energy and also the Western Interstate Energy Board and they are a different group of stakeholders in these issues. And he's going to provide us with their perspective on some of the issues to be addressed. Thanks, Ken.

>> NILES: Thank you and good afternoon I appreciate the invitation we've heard a lot of information and certainly I'll give you a very different perspective than what you've been hearing. The title of this talk or this portion was so long I could not fit it on my title slide.

(Chuckles).

>> NILES: So I did a little editing and I looked at it and did a little more editing which I'll show you right here. Stakeholder is a funny word. Certainly states are a stakeholder of DOE but at the same time we

have expectations and the desire to be their partners in developing a transportation program for spent fuel and high-level waste so kind of broadening that just a little bit.

So I've been involved in radioactive material and transport planning on behalf of the state of Oregon since 1992. During that time I represented Oregon on two different western state transportation groups. One was through the Western Governors' Association which worked with the U.S. Department of Energy to develop the transportation program for transuranic shipments to the Waste Isolation Pilot Plant.

The other group is a lot of the same states and people. It's through the Western Interstate Energy Board. We have focused in 30 years of discussion with the Department of Energy on planning for spent fuel high-level waste shipments to a repository or a storage facility, whatever we might end up with.

So this latter group called the high-level radioactive waste committee I've chaired for most of the past 20 years. What I'll relay to you today is really the perspective officially I guess from one state but I will share with you some official positions and perspectives from both the WGA group and from the WIEB group and we have a bunch of handouts so you have a lot of different material to look at. There's a lot to cover. So let me just dive right in. So the experience in working with the Department of Energy to develop the transportation program resonates very strongly with me as it does with I think many other western states. And the fact that here I am a representative of a state speaking on behalf of a DOE program I think should say some things to you. We had a partnership in developing that program. We have as much ownership of how that program came to be and what it consists of as the Department of Energy.

And I think it's especially interesting that a state person is willing to stand up next to DOE at public meetings on a topic that generates a lot of controversy and concern among some members of the public and the media. That to me does make a strong statement.

We'll never convince everyone these materials can be transported safely. But I think having the states on board along the transportation corridors, willing to stand up and make that statement, as well, will help satisfy some of the concerns.

In terms of the discussion we're having today that's only going to happen if in fact we get this opportunity to help develop a transportation program that we feel we should be a part of. So the directive from Western Governors going way back in 1988 was to work with the Department of Energy to develop a safe and uneventful transportation program and that's a phrase you'll going to hear it from me several times and the philosophy is important to understand. You've already heard a little bit. Some folks in DOE and the transportation industry believe that just using the existing Federal laws combined with the robustness of the transportation cask is all that's needed to do. We have heard some comments. We're ready to go. What's the big deal? We've done this for years and years and years.

It's true the transportation casks do -- are required to pass rigorous tests or simulations in order to demonstrate they would maintain their integrity even in a severe accident but in the opinion of the Western Governors back in 1988 and confirmed numerous times through the passage and updating of Western Governors' Association resolutions, that's not enough. There are many additional things that can and should be done to reduce the likelihood of an accident to make these shipments both safe and uneventful.

These are common sense things such as requiring highly experienced and highly trained drivers. Rigorous independent inspections of the trucks. Bad weather protocols as a few examples to keep those trucks off the road when the conditions are bad. All backed up by a well-developed emergency response program for when accidents do occur. That's the program that was developed for all WIPP shipments with some minor modifications that's the program that still exists today.

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Western Governors' Association policy resolution 2016-03 covers the transport of radioactive waste including shipment of spent nuclear fuel and I'll highlight some of the policy statements within that overall resolution and that's part of the information I provided to you.

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So here are those words again. Safe and uneventful.

Western Governors believed the safe and uneventful transportation of radioactive materials and spent nuclear fuel must be paramount in all Federal policies regarding such transportation and with regard to all transportation modes. Earlier coordination and effective communication with state, tribal and local governments is essential.

I'm having a little trouble with the clicker here.

The WIPP transportation program is an excellent model for transportation planning and a similar guide should be developed and used as a base document for DOE transportation program for shipments of spent nuclear fuel and high-level waste.

Rail shipments of these materials Federal agencies working with states to design a transportation system should receive full commitment and cooperation from the rail industry. Congress or the DOE may need to explicitly address this need. And I'll explain the reason for that in a few moments.

And the governors believe it is the responsibility of the generators of spent nuclear fuel and the Federal Government, not the states and tribes, to pay for all costs associated with assuring safe transportation and effectively responding to accidents that may occur.

During the 1990s when the WIPP transportation program was being developed DOE provided funding to the states for their participation in the process. Most western states receive sufficient funding for up to or more than a full-time FTE plus all of their related costs. That funding somewhat reduced has continued through the operational for the last 19 years of WIPP shipments.

As I mentioned we've had 30 years of conversations with DOE in planning for spent fuel shipments. DOE has typically but not always provided funds for meeting and staff support. The states have never received sufficient funding to allow us to dedicate staff to develop the procedures and the protocols that we believe are necessary for a comprehensive transportation program for shipments under the Nuclear Waste Policy Act.

Through the years, DOE has also wavered as to whether or not they want to engage with the states at that level of detail. At the moment due to funding limitations and uncertainty about program direction, DOE's nuclear energy program has mostly not entirely but mostly disengaged with the states and tribes. We know from past experience that once lost momentum the transportation institutional work can be hard to regain. State regional groups and the tribes collectively asked DOE recently to reconsider that decision. We were unsuccessful with that request.

Both the funding, the level of engagement will have to change in the years going forward. The funding at least will likely require some Congressional action.

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So during the past two years, shifting kind of from the Western Governors and the WIPP transport, the WIEB high-level waste committee has worked to document its positions on a number of topics relating to spent nuclear fuel transportation. These are also part of the handouts that I've provided to you.

We've developed five policy papers. Developed by a committee approved by the full Board. Many others are in development. These papers again I mention as part of what I provided to you.

So I want to focus on one of the 5 and then I'll mention briefly the other four. One of those does endorse again the WIPP transportation program as a model for its application to spent nuclear fuel and high-level waste transportation. So let me highlight and briefly discuss the four policy recommendations within this paper. And I am going to take them a little bit out of order.

So first of all, again, here we go, safe and uneventful. It is a consistent theme. And I can give you examples of shipments we have had that have not been subject to the WIPP protocols that have been involved in accidents that should not have been on the road. Were on the road legally. But again, with that higher standard would not have been.

So the Western Governors have endorsed this as a policy the WIEB Board has endorsed this as our policy, as well. Follow the WIPP model as closely as possible for highway shipments for spent nuclear fuel. We know there will be shipments perhaps many shipments of spent nuclear fuel by highway so following the existing program.

There's two recommendations related to rail transportation safety programs. First of all in developing -- I think we have a faulty battery here.

In developing a rail transportation program, use that WIPP transportation safety program as a starting point. And commit to a collaborative approach to develop a rail transportation safety program.

It seems sometimes there's a feeling that what worked for highway can work for rail. And that's really not the case. I'm really having trouble with this. As one example the rigorous and consistent highway inspection program developed through the Commercial Vehicle Safety Alliance developed for WIPP shipments something like that does not exist for rail.

Back in 2003 DOE considered for a time developing a rail program for shipments to WIPP. WIPP is rail accessible. And there was a time where DOE said we believe it might be a good idea to start shipping transuranic waste by rail so they asked the states, the western states to join in the planning of what it would take to basically convert this highway transportation program we have to rail. We got just far enough along to realize it was a major undertaking. A lot of those specific procedures and protocols we had for highway just did not translate well to rail.

At the same time, the railroads started really pushing back saying they did not want the states at all involved in their business. They had been moving hazardous freight for over 100 years. They didn't need some states meddling with their routing, with their scheduling, anything like that.

DOE did not back the states at that point which was a problem. And for some reason this whole thing fell apart I'm not sure whether it was DOE reconsidered in terms of whether or not they wanted to ship waste by rail to WIPP or whether just the difficulties that they experienced with the states, with converting this program and with the rail companies just kind of undermined that whole approach.

So we have four other policies approved by the WIEB Board on transportation.

Here they are. I'll talk very briefly. So physical protection requirements for spent nuclear fuel transport really encourages DOE to use NRC physical protection requirements instead of using shipping under their own authority. Which they are allowed to do.

Ship oldest fuel first which from the standpoint of the states would reduce that potential source term that's out on the road and could greatly lessen the impacts of an accident. Also has impacts, as well, on inspectors and repeated exposures to shipping casks, things like that.

Rail route safety, which recommends the Federal

Railroad Administration's rail safety program be fully implemented and rail shipment inspection which recommends again this reciprocal inspection program for rail shipments which there has been discussion with DOE and through other states and tribes. But we haven't yet got to the process of developing that.

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You would think I had never used one of these. In addition we're finalizing at the moment policy papers related to social risk and spent nuclear fuel transportation, full scale cask testing and cask confidence. Origin site coordination. And state and local emergency response. We'll make sure that once these are finalized, these are forwarded on to you and to your Board staff.

So let me touch on a handful of other issues that are all related. You've heard a little bit but they are kind of piecemeal as well just a bit. I mentioned the funding aspect in terms of state participation and the planning of a transportation program but it's a lot bigger than that. You've heard earlier about Section 180 C of the Nuclear Waste Policy Act which directs really the providing of funding for training. It's very restrictive. Over the years DOE at times has had even more restrictive interpretations. Sometimes their interpretations have been a little bit more lenient.

But in no case have they said, okay, yes, we can pay for all of those developmental program costs. We can pay for all of the operational costs. We can pay for all the training. And no one expects the 180 C funds to be available without action by Congress to be authorized for use of a private storage facility going forward. So that's a big deal for the states.

So we heard mention earlier Congress recently passed House Bill 3053 the main focus of which to get Yucca Mountain going again. I think a lot of people feel that it has absolutely no chance of getting passed in the Senate. But regardless of your feelings on Yucca Mountain, there is one point of this legislation that was passed by the House I did want to mention.

So it did amend Section 180C to be a little bit more broad. So the words there safety activities, which is a whole lot more broad than training activities. And could be interpreted in a lot of ways.

There's been through the years through the past 20 years there's been a lot of different legislation that's been passed by one house of Congress or the other or introduced by one house or the other a lot of it has had a lot more broad language like this than Section 180C and certainly we're hopefully that -- hopeful that any legislation that does go through does incorporate broader language to allow a broader use of the states and tribes and local officials in terms of preparing their routes and preparing for shipments.

Sufficient lead time could potentially be a big issue. You've heard about 2022 or 2023. It does seem unlikely to me that one of these sites is going to become quickly available. And that everybody is going to be in a rush to begin shipments.

But this is unchartered territory. I'm not quite sure what might happen as we move forward. But there is a lot left to do. And regardless of what happens with these, unless things get started, unless there becomes some clear definition we're going to find ourselves just struggling to catch up.

So you've also heard seven years. Maybe to develop a whole program. We heard a more detailed discussion of that last week in Omaha. The states through WIEB have talked in recent years of once the routes are identified, what's the destination is identified, once the routes are then identified, once you have the process to finalize those routes, the states feel they would need at least three full years for training.

So at least three years after all of this, after all of the cask design and acquisition, the railcar acquisition and design, all of the institutional things, just three years at least for the training.

So again, there's a lot to do. Again, if we come up under a time crunch it will be a scramble to get things done.

I want to talk about the shipment queue just a little bit. It's been talked and mentioned a couple of times. From a state perspective and a transportation planning perspective, the shipment queue is just completely unworkable. The fact that one reactor on one side of the country might have shipment rights. No. 1. And another reactor in another part of the country may have rights No. 2.

You know does not mean that's the way it should be transported. We find it incredibly difficult -- and you've heard from DOE and others that trying to figure out what might happen.

I guess what I would say is that from our perspective is DOE is a contract holder with the utilities. There needs to be some really tough negotiation that leads to a common sense approach for transportation because the queue as it is and identifying on the fly where shipments might come from with a very short turn-around time is completely undoable.

They have talked about maybe starting with the shut-down sites. And when I look at our shut-down site in Oregon the former Trojan nuclear power plant there does seem to be a lot of logic in that. Depending on how many casks the DOE makes available for shipment of the spent fuel at Trojan you could look at 6, 7, 8 trains and we're done. And it's cleaned out, it's all gone. And that's a similar site or a similar situation at other shut-down sites.

So again you'll have the pressure of the operating sites that want to relieve their own burden. So it's going to be a big, big deal. And whenever we try to talk about it, the logic that needs to apply toward the shipment queue, it is a big deal.

Finally, to wrap up, there has been mention several times of this document. There's a lot of great materials already out there in terms of transportation planning. Going the Distance has great recommendations, thoughtful analysis. If you've not read this book or seen this book, we highly recommend it.

There's other documents. A lot of documentation. One of the handouts I had, as well, was state expectations.

It was agreed on by all four regions from throughout the country in terms of what we would like to see in terms of transportation planning going forward.

So with that, I am happy to try to take your questions.

>> BAHR: Thank you very much. You mentioned three years for training. And that's once the routes have been selected and all of that. And you talked about using the WIPP transportation program as a model for developing another one.

How much time did it take to develop that WIPP transportation plan? And how much time do you think it would take to develop a comparable one with the state involvement that you think is necessary.

>> NILES: We have a lot of uncertainty as well in terms of when WIPP would open because DOE thought they would open WIPP in 1991. Declared it ready for open.

Litigation and Congressional action, a lot of other things delayed that for 8 and a half years.

So we had -- and during that period, there were other times where we thought well maybe it will open in a year or two years.

So we had really the whole decade of the '90s to develop and refine the transportation program. We knew we had a lot of time to do things. DOE worked with the states to develop a lot of training modules there's a modular training module which is very highly regarded by the emergency responders throughout the nation. DOE has offered through the WIPP program has offered training for the states so the states can use those materials themselves.

But just the experience we've had in trying to get a route ready knowing that shipments would come up or a state that has had shipments for example in Oregon, if we went on our existing routes. I think we could get a route ready in a couple of years. For a state that maybe has not had much in the way of shipments, I think it would be three to four years.

>> BAHR: Thank you. Other questions from Board Members? Lee Peddicord.

>> PEDDICORD: Peddicord from the Board. Very interesting stuff. As you say, kind of a different perspective. So that's really intriguing. So a couple of different things, has the Western Interstate Energy Board also -- so you endorse kind of the WIPP approach.

>> NILES: Yes.

>> PEDDICORD: Does the Board have a position on the Navy transportation system?

>> NILES: In terms of whether that would be a model for --

>> PEDDICORD: As a model, it's operating. So you've got -- there's a couple of different things moving through the Board's territory. So that is yet another one. And then you have the NNSA model which is yet something else with other materials. So I was wondering if the Board had looked at these three different approaches. And had made any judgments since you do like WIPP but how about the other two?

>> NILES: Well, they are very different in terms of engagement with the states. And the shipments are done relatively in secret. Certainly the weapons shipments there's no notification and for the Navy shipments I think just a few of the tribes get notification so it would be a whole different dynamic if DOE were to go along that path.

>> PEDDICORD: Let me ask are there not some training programs associated with the Navy shipments as well for preparation along the routes.

>> NILES: The Navy does an exercise every two or three years. But they don't do ongoing training.

>> PEDDICORD: I'm just not familiar.

Also the Board you have a rather different set of members in the Western Governors' Association. And if my Google skills are up to it you have three Canadian provinces associated with the Board.

>> NILES: We do.

>> PEDDICORD: Is the Western Governors' Association and WIEB pretty much consistent on your approaches on this and of course you have quite a diversity particularly among the governors in terms of parties position so I was wondering are you all consistently ending up on the WIPP model as a good one.

>> NILES: I would say we absolutely are. The western governors through their resolutions have endorsed it dating back to really the process beginning in 1988 and have affirmed that in I think they update their resolutions every three or four years and the WIEB Board has unanimously voted in favor of that position.

>> PEDDICORD: And the last point, in your role with the state of Oregon Department of Energy, and you've got the Trojan site and it looks like you have a fair number of casks there I counted like 34 on the graph.

>> NILES: There are 34.

>> PEDDICORD: Which compared to what we heard about Humboldt Bay and Big Rock Point is a significant bigger number. So do you find yourself with different concerns as you're a state of Oregon individual wanting to I'm sure move Trojan material out of the state and then as you're kind of coordinating that with all of your colleagues in the Western Interstate Energy Board.

>> NILES: I think the main thing to say is that the states individually have looked at their own situations and really through the years have identified the power of unity on these transportation issues. So in developing the policies that the WIEB Board has approved, I would say that there has been a consistency state by state in endorsing that whole aspect of it. You know there's no place to send Trojan fuel right now.

It's not highly on my radar in terms of something I need to be worried about or doing right now. I did help develop our WIPP route and opened our WIPP route back in 2000 so I know what it takes at least to do the training and the public information and interacting with political officials and just all the different things that go into that.

When you look at Trojan as an example, the rail route almost likely will go through Portland which politically amplifies the shipments way beyond what we have in northeast Oregon which is a sparsely populated area in comparison.

So it will be a big deal. There's no doubt about it. And I expect that we will have a couple of years to prepare that route. And I hope that I will have the opportunity and the reason to stand up next to DOE when they are talking about it and say yes we believe in this program. That's where I want to get to because that's where I am with the WIPP program.

>> PEDDICORD: Thank you.

>> BAHR: Steve Becker.

>> BECKER: Becker, Board. I would like to follow up some more on the anticipated it sounds like two to four years of training that's anticipated in connection with moving spent fuel.

So you mentioned that one of the things that came out of the training process associated with WIPP was a series of training modules that have been very successful. I'm wondering, are there other things that have come out of that WIPP training experience, other lessons learned, that could potentially be applicable to this new shipping process. And do you anticipate that the future training would need to have, for example, things like full scale exercises for responders.

>> NILES: You know I think we have certainly learned a lot. You go to a rural community that has volunteer firemen only and they have -- especially when you're talking about a radioactive material shipment as an example. They are not that common. And the time that a volunteer fireman has to devote and dedicate to training they are going to focus on the things they are most likely to come across first. There is an issue that just because we have training and a great training program and we're willing to come provide it doesn't mean they are all that eager to sign up for it.

And so you may be developing or delivering an 8-hour course 2 hours a night once a month for 4 months. Just to meet -- you know, so we have learned a little bit about some of the needs and the ability of the emergency responders just to do that. You also have a lot of turnover in some cases in those small rural areas so you have to do refresher training you have to go out and do that repeatedly. And those are really the -- the training is so much reinforced by having exercises from table tops to small scale limited exercises to big full blown multi-day exercises. So absolutely I think that that needs to be a part of it and there are other things as well DOE has done things they call a show and tell with their cask so if you have a unique looking transportation cask that's going to be used on your route and you bring it in and you stop it off at each fire department and let them say you know it's a great training opportunity, as well. And DOE has been really good about doing that type of thing for the WIPP program and I would expect they would do it again for spent fuel shipments.

>> BAHR: Mary Lou?

>> ZOBACK: Zoback, Board. Thanks. This was -- you know you guys have been so thoughtful and so thorough and continuing this effort over this long time. It's great.

My question is I looked at the Western Governors group and your group and the Western Governors group is much larger and I guess my real question or the focus is how much -- so in the Western Interstate Energy Board, how much -- I assume there's a central one that includes -- I'm thinking of Texas primarily since it's such a big state and so involved. So how much coordination is there between other state energy boards, interstate energy boards? Or are there other interstate energy boards I guess I should ask.

>> NILES: So Texas is I think the term is associate member. Is that right? Is an associate member of WIEB.

>> ZOBACK: So they send people to your meetings?

>> NILES: They do send people to our meetings. You know someone mentioned earlier the fact that WIEB has some Canadian provinces. They are not part of a high-level waste group because they are not part of the

transportation thing when it came up for a vote I think for the most part they just deferred to their colleagues who were more impacted and the Western Governors' Association, there are about 10 states that see WIPP shipments. The other ones don't and I think in that case, as well, those other governors respect the folks that are impacted and have signed on, as well.

>> ZOBACK: Thank you.

>> BAHR: Other questions from Board Members? From staff? Did you have another one, Steve? I'm sorry you have to hold your hand up so I can actually see it.

>> BECKER: Becker Board so I think you during the beginning of your presentation really emphasized the importance of state engagement in the process.

>> NILES: Yes.

>> BECKER: If you were to identify three things on your Wish List for increased state engagement in order to make this a more robust and effective process, what would those three things be?

>> NILES: Boy, well it certainly would take funding

to be more engaged. There are things that can be done now. You know there could be work done to develop a lot of these transportation protocols that I've talked about. The rail inspection program could be developed now. You don't have to have a destination. All of the route specific things will be very difficult until you actually get a destination and a route.

But in terms of developing a transportation program, when -- again dating back to 2003 when we started looking at this highway program and converting it to a rail program, let me give you another example so bad weather protocols. So with a highway shipment, there are certain National Weather Service watches and warnings that if those are in effect the shipment is not going.

Well rail is a different animal. Rail is not impacted nearly as much by the wind and snow and things like that.

But do you need to take into account the ability of a first responder to get to an accident that might happen in those bad weather conditions or the inspectors to get -- I mean those discussions we've just begun to have at times. We haven't worked through all of those issues in terms of what the actual protocols would be. And the railroads need to play an important role because they are the experts in terms of the operation of their railroads and what the impacts are and we haven't had that level of engagement in that level of detail. So that's one thing that I guess I would say is begin that process of doing some of those things.

And I don't know if I can get to three because -- you know that one kind of opens up the door for a whole lot of other things to be done.

>> BAHR: Okay. Thank you, Nigel Mote.

>> MOTE: Nigel Mote Board staff. Ken, I asked Gary Lanthrum a question this morning and he answered it from

the point of view of a planner at the Federal level so let me ask you to answer from the state and also separately the regional level with operational experience.

If you have road shipments that are being passed from state to state and you have an inspection and one state does not accept a vehicle coming in from a previous state have you handled that or how would you handle that and just to put a smile on your face and put it another dimension how would it be different for rail.

>> NILES: So the whole idea behind the Commercial Vehicle Safety Alliance inspection protocols for WIPP shipments is to have a uniform protocol that all states buy into that's what we do so the inspections that are done before a WIPP shipment leaves the Savannah River Site is the exact same inspection done at Idaho and there's reciprocity and there is the opportunity for pass-through states. So when we had shipments from

Hanford to WIPP when they first started state of Washington and they have throughout inspected every shipment. Oregon border is about 30 miles away so on some of those early shipments we sent our inspectors to Washington to observe. I think we stopped two or three shipments to again give that experience for our inspectors. The rest we let through. We recognized that inspection was done by Washington. As it continued Idaho did not inspect the shipments Utah didn't inspect; Wyoming didn't inspect most of those shipments; Colorado inspected all of those shipments because it's a requirement of their state law and the same with New Mexico. So you have a process that all the states respect we all have the opportunity if we wish to stop and inspect those shipments because it does have a requirement for defect free condition that if through the hundred or 300 or 500 or 1,000 miles something gets out of alignment, and an inspector notices it, it has to be corrected. But that was the whole idea behind building an inspection program like that.

The same idea the same principles we would expect would be enforced for rail shipments.

As noted earlier, it's a different animal in terms of there isn't the port of entries and the weigh stations but again that can all be worked out in advance is you know if Illinois is an example which has an inspection requirement if they have to come into an adjoining state because it's more opportunity to stop that, I think Illinois would be willing to do that. If that was worked out in advance. And not all states would want to do that inspection. Not all states frankly have the capability because they don't necessarily have the FRA-certified inspectors to do that which, again, is part of our -- part of our policies is we would like to see that program more fully developed in terms of the number of inspectors.

>> BAHR: Dan Ogg.

>> OGG: Dan Ogg Board staff. Ken thank you very much it's a really great perspective and I want to pursue something you mentioned a couple of times in your presentation and that is having better engagement by the Department of Energy. So that I can understand a little better and maybe so the Department can understand a little bit better my understanding is right now the Department of Energy Office of Environmental Management funds the national transportation stakeholders forum. And that has an Annual Meeting and gets a lot of people together.

And then in addition to that, DOE-NE runs a transportation core group that meets with state, local and tribal representatives. And maybe once a year --

>> NILES: Twice a year.

>> OGG: Twice a year. So I guess what I would like to ask is do you recommend that there be more frequent

meetings of those types or do you recommend also that there be an additional type of interaction between DOE and the states and tribes and local groups.

>> NILES: So right now the core groups have been cancelled the core group meetings because DOE again doesn't have the funding and the program direction. Yes we do have the NTSF and it's great to see Erica there last week and see her here today, as well.

But WIEB and the other regional groups have their own meeting usually in the fall or winter at the moment DOE-NE is not able to travel to those. And give us an update. So they have pulled back, which is unfortunate. I certainly understand a lot of the rationale. But at the same time ongoing discussion is always a good thing.

>> OGG: Thank you.

>> BAHR: Other -- Mary Lou.

>> ZOBACK: Yeah getting back to the rail and rail

safety, I'm just thinking of the recent derailments because -- and maybe this is all Amtrak, I don't know. But they just simply have not complied with the rules to have the proper automatic braking systems on board. So I mean, how do you get onto bigger problems if they are not complying with very basic problems? And is that just a specific Amtrak problem or something or is it more ubiquitous? I don't know.

>> NILES: I wouldn't be the right person to answer that. I have no idea.

>> BAHR: Bret Leslie?

>> LESLIE: Bret Leslie, Board staff. Are there any lessons learned from the transport of the Trojan reactor vessel?

>> NILES: The Trojan reactor vessel and actually the steam pressurizers, as well, were all transported by barge. So the Navy has been transporting by barge on the Columbia River since 1985. The reactor compartments for nuclear power submarines and cruisers and the Navy takes it -- even though it's activated

metal, technically low level waste, the Navy takes these shipments very seriously they have backup tugs they have an escort vessel they have the specially made barges with if you take on water, they have got so many different compartments. When the folks at Trojan came to us saying what would you like us to do in terms of these shipments we said do what the Navy does and they did and those shipments went off well.

I will mention Erica talked about the site reports. I went with them to Trojan. And I found the information that DOE has provided very useful.

When we were at Trojan there was a little bit more focus on that barge slip than I was comfortable with. Because I was thinking I don't know where you're planning on shipping by barge from Trojan.
(Chuckles).

>> NILES: Although later their reports talked about 2 miles across the river to get to a rail head or things like that as opposed to it's not going up to Hanford. And it's not going out on the ocean I'm sure it's not going to happen like that.

So those site visits, the one I went on, was very -- it gave me a lot of information.

>> BAHR: Go ahead.

>> ZOBACK: Zoback, Board. Why -- you just said how well the Navy did in getting -- I realize these are reactor -- reactors is a different thing but why wouldn't waste go out through the Columbia River.

>> NILES: Where the thing would be where would you take it?

>> ZOBACK: Oh okay you don't mind it going out it just wouldn't have a destination.

>> NILES: Yeah, where would it go? And I think if you were going -- there is direct rail access to Trojan.

Now they took out the spur and I think one of the reports that Erica shared with us estimated about $700,000 to rebuild that spur and I was pleased to see their top two options were rebuild the spur and ship it either south or east. Which to me makes the most sense. I think people would get a little bit excited about spent fuel in the Columbia River.

>> ZOBACK: Yeah I could see that but I was just curious since they have successfully done --

>> NILES: It's less the function it's more the where would you take it.

>> ZOBACK: Yeah it just sails around the world. (Chuckles).

>> BAHR: Okay. Well, unless there's one more burning question we're at time for a break. And we're scheduled to resume at 3:25. So about a 15-minute break.

(Break.)

(Standing by).

>> BAHR: Okay. If we can get people back in their

seats, we still have a few more speakers this afternoon. The next is Jack Wheeler from nuclear energy portion of DOE and we've heard a couple of mentions in some of the talks earlier today about some of the systems analysis tools that DOE has been developing to try to analyze and design transportation systems. So Jack is going to tell us something about those.

>> WHEELER: So good afternoon. My name is Jack Wheeler and I work with the Department of Energy's Office of Nuclear Energy as was mentioned and I oversee the development of the system analysis tools for integrated Waste Management efforts that are taking place and so I would like to have the opportunity here to be able to present to you some information. In the past the presentations have been provided to Board Members on -- on the tools by Dr. Josh Jarrell and what I wanted to do here today is have the opportunity to present to you, give you some illustrative examples on how these tools could be used to help inform planning for transportation systems.

So let's see here. So again our standard disclaimer you have seen this before in presentations by my previous colleagues. I did just want to emphasize here we have example analyses in the presentations. We do these to test out the tools to see how they perform and also to be able to glean insights on interactions that take place in integrated Waste Management systems so they are illustrative only and they don't really represent departmental position or policy. In terms of content for my presentation today, I wanted to just after a brief discussion on the needed value for integrated system analysis is to talk to you about a brief overview of the system tool set we currently have and are working to enhance as well as -- and then moving into talking about some of the site level data and constraints that have a bearing on how the system performs and from that move on to the higher level system analysis that looks at the bigger picture before wrapping up.

So we've seen charts previously during today's meeting about the nature of the problem before us. And the challenges in terms of the quantities of fuel and the various types of fuel, the various types of canisters and the complexity involved. So the nature of the problem lends itself well to using system analysis, system energy principles to be able to in a way look at different approaches and being able to evaluate those in comparison to one another. So anyway that's a basis for a motivation for developing the tool set. So in the Office of Nuclear Energy we've been working on coming up with a toolkit, if you will, to be able to look at evaluating different scenarios for managing spent fuel. We look at a variety of different architectures looking at capabilities that would be able to be used to evaluate different architectures to provide a solid basis for decision making and we look at a holistic approach where we're not just looking at transportation but this looks at how transportation integrates and the interactions it has with other parts of the system and that's the real value that this integrated system analysis approach provides.

Oops. Went too far there.

Okay. So this is just a simple overview slide on the tools that we have been working on in the colored boxes and I'm going to talk a bit about the relationship they have with each other. But -- sorry; it starts down here with having a foundation of data that feeds into these. So this data is collected from a variety of sources. It's collected from and publicly available safety analysis reports for packaging, certificates of compliance, the nuclear fuel survey information collected by the energy information administration so all of that is kind of gathered together we keep it in what we call the unified database. And that's the database that we use to be able to perform integrated system analysis with tools that we can use to do thermal analysis, criticality analysis, also various types of shielding and dose rate analysis.

So this provides some more fundamental information and data kind of at a site type level. And then also down at the site type level we have the START tool mentioned previously which is a stakeholder tool to look at routing and evaluate different types of routes.

So those two tools then feed information into what we call these higher level system tools. We look at. And we feed these higher level system tools with information about the system we want to analyze in terms of configuration and how the system is set up. And what rates might be for receiving fuel and being able to manage it. And so with those inputs then we run system architecture analysis what we call. We use a next generation system analysis model, NGSAM for doing that type of analyses and look at various performance metrics on how the system –performs. We look at long timeframes and total inventory of spent fuel and look at the dynamic effects that take place. And then this tool over on the right-hand side the execution strategy analysis, is another tool that's more focused on how we get from here to there in terms of implementation. If we have a particular system configuration that you might want to pursue, what are all of the necessary steps, logic, sequences, flows, to be able to get that implemented. We'll talk briefly about that at the end of the presentation.

And then providing some -- a way to be able to process these inputs from higher level analysis tools is what we call the multi-objective evaluation framework and that allows decision makers to look at these various inputs on performance metrics in consideration of different values or weights that they might place on them and be able to make decisions going forward.

So starting at the more the site specific type analysis tools, we discussed briefly a bit about START. The stakeholder tool for analysis of radioactive transport. And it allows evaluations of different routes when you can feed it information that would allow it to minimize trip time or minimize surrounding population or say provide it with some restrictions that's not passing through certain places or passing through others. So information from this analysis tool then feeds information on trip durations and mileage for use in the higher level integrated system tools for further analysis.

At the more detailed level, too, with the collection of data I mentioned the unified database collects a number of attributes on the various components that ultimately comprise the system. So we're looking at collecting information on the fuel itself in terms of burnups, in terms of enrichments. And then also factoring that information along with the information on the canister, canister attributes, cask attributes, where they are located at the sites.

The database also contains information on economics for doing cost analysis and additional information on potential future facilities where it might be shipped to or transportation infrastructure.

It's a relational database so there's -- it provides an ability to map different parameters with their corresponding counterparts. So being able to map what the attributes of a fuel assembly and where that fuel assembly would be say put it into a canister even be able to be mapped to a particular cask to a particular site.

So this is just a diagram showing a sample mapping of how you can map canisters to particular transportation casks. So all of that has to be kind of tracked and be able to be integrated in terms of being able to correspond data one with another. Here are some examples of cask attributes data that get accounted for. These are 17 different transportation casks for which the Atlas railcar was designed to accommodate so there's information on physical dimensions as well as their masses. There's information on certificates of compliance data for that, for casks.

So that all gets captured into here and presumably if there's additional cask designs that get certified have a COC that could -- they presumably could be accommodated on the Atlas railcar with an appropriate cradle design.

Now I wanted to provide some illustrative examples of how some of the analysis tools can be used for doing this at the site level. So here is one example I'm looking at being able to provide information on when a particular canister of spent fuel could be shipped so there's -- in this one example we're kind of looking at assembly decay heat. So there's a requirement in the Certificate of Compliance for the assembly decay heat to be at a certain level. That's represented by this red line here. That's in the transportation COC. This is for a canister that would have 61 boiling water reactor assemblies. So what it shows is that these assemblies have -- their decay heat has to get down below that red line prior to shipment to meet that technical requirement in the COC.

This particular canister was loaded around 2008 so it was put in a storage cask configuration. It has a higher allowable decay heat. And so by doing decay heat analysis of the data that we have collected, we can show that in this one case it's about 6 years after loading into the canister that that cask would be -- canister would be ready to be shipped in the transportation package.

So for the same package you also have another example here. This one is another COC requirement. This one is related to dose to ensure that the assemblies and the payloads stay within the safety envelope for meeting the dose requirements. And so the assemblies were discharged here. On this date represented by the blue circles and the COC requirement there's a minimum decay time or minimum cooling time I should say to be able to meet that requirement. And it varies as a function of burnup so that the higher burnup assemblies require longer cooling time in this case about 19 years.

So for -- so if you look at here, again, the loading date of 2008 in this case you can see that all assemblies meet the required minimal cooling time in about the year 2020. So this is about 12 years after the assemblies were loaded into the canister for storage they would be ready to ship to meet this requirement. So out of just those two particular parameters in the COC, this one is the long pole. Sometimes it's the other way around. It depends on the particular canister of interest.

Next I wanted to just show you some work that was done related to operating sites. My colleague Erica Bickford, talked about some of the shut-down site analysis. This one was some analysis that was done to look at constraints of shipping fuel from operating sites.

So operating sites, you have to shut down for refueling outages and that's an all hands on deck operation. There's a lot of activities going on at the site. So there's windows of opportunity to be able to move fuel out of the site and -- but during and around a shutdown, the ability to do that is constrained.

So this one looked at categorizing the existing set of operating sites into categories 10 PWR and 10 boiling water reactor categories based upon their reactor operating cycle length, how many pools they had. Whether they were shared or dedicated. And how many units were operating at that site.

So -- and so looks were done to look at like three -- here are some examples where a single unit site on the bars on the left-hand side and three unit site on the bars on the right just showing the more constrained situation larger number of units you have and the ability to be able to move in sometimes there are -- this looked at ability to receive fuel from the pool as well as the ISFSI at the site the independent spent fuel storage installation so this data was collected and ultimately turned into a determination on how many weeks per year would there be availability - - we looked at conservative and more aggressive efforts to be able to access that and that in turn is collected and is a Waste Management 2017 paper summarizing this work and that's being fed into our higher level systems tools to make sure the constraints on the number of fuel that can ship per year is not unrealistic or doesn't impact -- adversely impact reactor operations.

So I wanted to move at this point from some of the site level data and analysis to the broader and higher level system analysis where we're looking at multiple sites.

So this level of analysis we look at variations on number of parameters. In terms of packages, our focus has been on commercial spent nuclear fuel so we look at reusable non-canistered packages and dual purpose canisters and also triple purpose canisters that might be designed for disposal as well as storage and transport we call those STADs, Standardized Transportation, Aging, and Disposal canisters. We also look at combinations of these. We’ve also looked at different transport rates 3,000 metric tons per year, approximately 225 casks per year, and then higher transport rates, 4500, 6,000. Just to kind of test out the system.

And also looked at different shipment priority algorithms some of this was talked about today in terms of the oldest fuel first algorithm in the tool that essentially allocates priority based on the oldest fuel first at a reactor site. And then looked at an algorithm that prioritizes shutdown reactors sites -- or reactors that shut down by 2020 a listing of which is on the right-hand side of the slide.

So say giving priority to this set and then after that those sites are cleared and then moving into an oldest fuel first priority logic. And then also an algorithm that just looks at prioritizing shut-down sites throughout the scenario so I'll give you an example of some of that analysis a bit later here.

So here is one illustrative analysis that looks at the state of the system. Assuming there's no transport what happens. And so this is what we call a SAND chart here you can see the total inventory initially has gone up about 2,000 metric tons per year and then that starts to tailor off as in the U.S. plants shut down and there's a significant number of plants shutting down in the 2030 to 2050 timeframe. Assuming a 60 year life -- license for those with a -- with a 20 year extension.

So in this scenario then essentially this inner circle here or slice of the SAND chart is really the amount of fuel that's in the pools. You have fuel being generated about 2,000 metric tons per year going into the pools but then also about 2,000 metric tons per year coming out of the pools into dry storage and when these reactors shut down there's an increase or essentially we make an assumption that about 5 years after shutdown all of those pools are being emptied into dry storage so that rate increases significantly about 5 years after the reactors shut down so between 2035 and 2055, that rate of fuel being moved into dry storage increases significantly.

And then over here on the right we did look at transportation of uncanistered fuel just to see how much say of this fuel might be able to move. And this chart just shows how that can vary depending upon the start date for receipt for such a facility so starting in say around 2030 you'll be able to pull certain amount of fuel out of the pools, 2035, somewhat less, 2040, less, because it's all being pushed into dry storage here so the ability to access that becomes less with the later startup dates.

And then I just want to make a note here, too, that -- so that analysis is for uncanistered spent fuel. But if you're looking at moving fuel from the pools into say a triple purpose canister or STAD that window is also closing here in this period as well, too. Essentially this has to go -- these are going into dry storage for some package. So there's that window is also applicable for moving it into a STAD.

So talking about using that as a segue to this next slide, I just wanted to point out that we look at the ability to -- look at interactions on transportation with other parts of the system. So this slide is based upon some work that was previously conducted in a published report by Oak Ridge National Lab and it shows that for what we call a status quo scenario where things go on as they are going on today in the sense that the fuel from the pools is being moved into vertical or horizontal dual purpose canisters at the site these are larger capacity systems, 32 or 37 PWRs typically. And versus say triple purpose canisters or STADs these are smaller capacity systems. Looked at a small STAD of 4 PWRs and one of 12 or a larger one of 21 or concepts at 24. So since these are smaller capacities they require more transport. So the number of cask miles when you look at the whole scenario over time increases.

But there's tradeoffs. So there's as -- on the right-hand side it shows that the number of canisters should the dual purpose -- fuel in the dual purpose canisters needs to be repackaged into a waste disposal canister then the DPCs which may need to be disposed as low level waste increases so that's also a function of time and this scenario we kind of looked at if STADs were introduced in 2025 then you had a disposal facility that could accommodate these smaller type capacity STADs and then that quantity would be cut short the longer it takes to introduce that, the higher the potential number of dual purpose canisters that would need to be repackaged.

And then this in turn also drives motivation to look at DPCs and the system -- the data that we collect and use can also be used to perform analysis on looking at direct disposal of DPCs and again criticality analysis to say, well, maybe what fraction of these might actually be disposable from a technical standpoint.

So before I talked about shipment priority logic and algorithms, so this is some illustrative analysis to show the effect that that can have on the integrated system. So this starts off with the oldest fuels first logic. And in this mode one of the performance metrics that we look at is sites with spent fuel in the country. So over time looking at how does the overall system perform at clearing those sites as a function of time.

So we're starting with over 70 reactors sites with spent fuel on them. And oldest fuel first you're taking relatively small amount of fuel from a number of reactor sites over time and so this -- eventually this will start reducing the number of sites that are cleared of SNF they have all been removed there's a large drop-off on the end and over on the right you can see the number of sites that are shipping in this scenario per year so with a certain ramp-up rate it gets up to between 60 and 70 sites within this 2040 to say 2050 timeframe are shipping simultaneously per year to be able to take this -- all of this fuel from the system. The second scenario looked at was when we gave priority to this initial sites shutting down by 2020. So in this case the sites get cleared relatively quickly going to one site clearing it going to the next site clearing it so it can bring that down then after you got that done then the algorithms switched to OFF oldest fuel first and then levels out and again drops at the very end you're starting to take the last bit of fuel from each of the reactor sites. So again initially the number of sites shipping this is relatively small at first because you're focused at these shut-down sites then when you move to oldest fuel first it jumps up dramatically because you're starting to take it from large number of sites at the same time. Then lastly we looked at this logic scenario giving priority to shut-down sites throughout the scenario and that's this last one which shows if you're going -- again you essentially kind of drop this as you go. It's called the sprint scenario. It still takes a good bit of time here. But in essence in this scenario, it does clear the sites of spent fuel relatively quicker compared to other scenarios so sites in the United States are being cleared of spent fuel more quickly under this logic algorithm.

Then also there's the number of sites that are being worked at a given time is significantly smaller since it's being able to be focused on essentially what you're seeing there maybe 10 sites per year versus 60 to 70.

This next slide kind of shows some work that we would like to develop further. It's kind of in progress. But it says we like to use our system tools to be able to provide inputs on number of commodities we'll need in terms of railcars and types of casks and packages. So an approximation was done. Really this first slide was really just based upon inputs on a certain rate of shipment, say 225 casks per year. Maybe making around -- using the casks to make about 10 round trips per year in a certain ramp-up rate and then over on the right was the results for the logic scenarios that we were looking at before. And this shows as you go from oldest fuel first to some of the approaches where you're focusing on a site and then moving on is that the number of casks that you need kind of spreads out over time. By a few years.

So you don't need all of the certain types of packages right upfront you can spread it out a little bit more. And this is -- we'll kind of refine this further but based upon inputs we're getting from some of the deinventory studies and additional review of the assumptions. And then there's interest on what are some of the long poles or items that take a long time to work so I wanted to kind of wrap up here and talk about the execution strategy analysis tool. Which looks at how do you get from here to there and comment that -- first make a note that the detailed slide that was up in Dr. Bill Boyle's presentation was -- the execution strategy analysis tool was to help use to support development of that particular chart.

So -- and what I did here was just take a simplification of one set of activities that could be used to talk about it. So essentially what it does is you kind of come up with what would be a success point, what's your definition of success. So here it's transport and then what you do is you work backwards and kind of come up with all of the precursor activities necessary to be able to support achievement of that.

So you come up with a success precedence diagram and be able to identify time requirements associated with these. You can also allocate costs. You can look at ranges and be able to come up with identified risks, as well, too.

So in using this tool, I kind of just put up here is this is one of the long pole activities. This falls on critical path that -- at one point in the charts that you have seen before with Bill is the cask acquisition. And being able to fabricate casks. So if you're looking at just this part here in the middle section, to be able to go out and order casks get them delivered and everything that process is probably going to take like maybe about four and a half years, including the procurement in there.

And then also there's railcars that need to come in.

These are kind of looking at the casks taking longer. So this one isn't on critical path in the sense of being able to come into meeting our time of need. But then if you have to design a new cask say from scratch and certify it then you're adding on this upfront part and this was talked about previously in some of today's presentations, this can add about another like five and a half years onto your schedule so essentially you could be looking at about ten years to go all the way through that from start to finish.

So the scenario you've seen earlier on for the 7 years is really based upon that was looking at where you have existing DPCs and you can have certificates of compliance available for transportation packages that are already there or can be modified or the timeline is shorter so this can give or take a couple of years too you might be able to streamline procurement but it could also take a little longer too so that's a long lead activity if you're looking at designing new packages.

So in summary, I just wanted to say is we've developed a set of analytical tools that we think can be useful in informing planning activities for transportation as well as other facets of an integrated Waste Management system. We have been focusing on commercial SNF but these tools could be applied to DOE SNF and HLW. The value that they provide is being able to look at things from a holistic perspective and be able to ascertain what the impacts are on different parts of the system and also gives information on a dynamic perspective on how the system performs. That could be important to decision makers.

So with that, I'll conclude my talk and accept any questions at this time. Thank you.

>> BAHR: Okay thank you very much, Jack. Are there

questions from the Board? I see a hand in the back there, Steve.

>> BECKER: Thanks for a very informative presentation. These sorts of tools can obviously be very valuable in planning. Can you talk a little bit about some of the challenges in populating the unified database and in keeping -- keeping it up to date? What sorts of challenges do you face? And how are those being addressed?

>> WHEELER: Well I guess the big challenge is there's a lot of information. So you know collecting it and -- is -- and then keeping it current are activities that are -- take place. And -- but I would say and I have to compliment our lab team. They are very I think proactive at being able to collect this information and be able to stay up with it as things change within the industry. They provide a reference traceability to sources, such the data that's collected is tied back to a particular source document. So they can be found out where that's originating from. And its

pedigree assessed for use and analysis.

And it's also controlled. So being able to just keep control of the information so that it's -- you understand what particular set of data was used for a particular analysis and you can tie that back as it changes and gets updated. So maintaining an ability to map back to the data that was used for particular analysis is another activity. But they build that into the processes in doing the analyses and maintaining the database.

>> BAHR: You showed an example of a particular set of fuel assemblies that were loaded into a cask and they had temperatures and they had decays and so were those the type of data that you need for each cask that's loaded? And are those data readily available from the utilities?

>> WHEELER: That's a good question. The data that was used there was very specific. It's one particular

canister that would go into a cask at a particular site. For doing the system analysis what we have done is the analysts have looked at that type of information and developed algorithms based upon that type of information that will then get incorporated in the analysis tool. So the analysis tool will then kind of factor -- use the algorithms in determining say an acceptable transportation based state based upon thermal considerations as well as dose considerations. And then I'm sorry; there was a second part to your question.

>> BAHR: The question is do you need to do that kind of analysis for each cask as it's being prepared to transport? And if so, are the data that you need to do that readily available from the utilities? And are they reliable data?

>> WHEELER: Right, yeah, thank you. So as far as the availability of data goes, the nuclear fuel survey information, the GC-859 data is being used to get the information that the utilities provide to the EIA so

that's information that can be used to be able to determine these types of parameters and when particular canisters might be able to be shipped. It's I think quite -- I think I would say that in some cases we have more information than others in the sense of like the loading maps as Erica talked with before. And we're working with EIA in being able to get better information for the next cycle that's coming up in collecting information. So as it goes on, I think we're going to be continuing to get better information. And improve -- will lead to improved analysis too.

>> BAHR: Are there -- Tissa.

>> ILLANGASEKARE: Illangasekare, Board. So you mentioned the dynamic effects. So what do you mean dynamic effects means that can you handle like weather? If you are taking a certain route, let's say while you're on that route and then suddenly weather -- something -- what if an extreme weather event happens?

>> WHEELER: Yeah, I think I was referring to dynamic effects in terms of just looking at as a function of time

overall system performance rather than on --

>> ILLANGASEKARE: Not on real-time.

>> WHEELER: Yes, correct. I mean this is -- these are more I think planning tools. As you actually get closer to operations you might look into more tools that are operationally research based and really kind of things that would effectively manage fuel real-time and being able to address those type of logic considerations and maybe having to adjust to some different types of events that might come up.

>> ILLANGASEKARE: In one of your boxes you had multi-objectives so are you trying to optimize in a traditional or operations research sense or you're just putting constraints to --

>> WHEELER: Yeah, that's a good question, too. We're not really focused so much on observation as far as really understanding -- being able to provide a set of performance metrics that might be able to be used by decision makers based upon certain value preferences or stakeholders.

So to do optimization problem you would really have to know what you're wanting to optimize on.

So we use that information to be able to glean insights kind of like multi-attribute utility analysis to be able to help inform that.

>> ILLANGASEKARE: Thank you.

>> BAHR: Linda?

>> NOZICK: Nozick, Board. Would you mind talking a little bit about the verification validation process for all of these tools?

>> WHEELER: So as far as the tools go, they are being developed. They go through review at the sites that are being developed. So they do usually independent technical review on the tools themselves. We're going through a verification effort with NGSAM to be able to kind of do checks and make sure it's operating as

intended to be able to have reliability and confidence in the results that it's generating.

You know, for validation, we can do that more on the site specific type level tools where you kind of have data that you can actually map like the UNF standards tool, the analytical tool. Uses tools that have a fair degree of validation. It invokes tools like COBRA SFS for spent fuel thermal analysis which has been validated against empirical data from cask tests out at Idaho and also uses a SCALE code too which has received a fair degree of validation work, too.

>> NOZICK: Thank you.

>> BAHR: Paul Turinsky.

>> TURINSKY: Yeah I have two questions. Do you have financial information here, also? Because I mean some of those scenarios there's no -- the budgets that would vary from year to year would be so dramatic that it would be hard to believe that's possible. So could you

constrain it to a certain budget amount and then see what that impact is.

>> WHEELER: Uh-huh yeah that sounds like an interesting analysis. We do have the ability to come up with cost information. And looking at different sectors of the system. So the cost at reactor sites. The cost for transport. The cost at a receiving facility. And being able to kind of roll those up and then look at how they vary depending on particular scenarios but we haven't done analyses where we constrain the system based upon the costs. Usually those will get factored in and there will be certain inputs like how fast you can ramp up a facility or the time -- timeframe on constructing a facility. But most of it is pretty much schedule driven at this point. And then the costs are kind of an output of what it is.

>> TURINSKY: Okay. And then a question, the data you're getting from utility none of that falls under NQA-1 programs is my understanding so therefore can't be used in a licensing setting. So how is that going

to be addressed? Or is licensing going to fall to somewhat -- are you going to get the data under an NQA1 program that will allow it to then be used?

>> WHEELER: This is an R&D effort right now looking at having analysis tools that can support planning and be able to inform systems work. And if we get into a licensing effort, you know, at some point then I guess there's -- what can be done to see how the data can be looked at for pedigree.

>> TURINSKY: The longer you wait the harder it is to get that data from utilities because sometimes utilities they don't have any plants anymore and what they have retained in their records that's under NQA1.

>> WHEELER: Uh-huh.

>> TURINSKY: So it's something I think that's sort of like a time critical item.

>> WHEELER: Uh-huh. Yeah, I mean they do provide the information with GC-859 but I understand what you're saying with regard to that.

>> BAHR: Additional questions from Board? From

staff, Nigel.

>> MOTE: Nigel Mote, Board staff. Jack, on your Slide 16 you have three cases for removing spent fuel from the nuclear power plant sites. And if -- thank you. One more back, please.

>> WHEELER: One more back, yes.

>> MOTE: Can we go to 16? Thanks. So in the left diagram I can see the objective of the yellow line which looks a little green on the screen there, the objective there is to clear individual sites early and there's obviously an advantage in doing that and I can see that reflected in the right hand curve because the total number of sites you're working on in a year is much less.

But the consequence of doing that is if I take a site that you show being cleared in 2035, it has had a concentrated transportation program for maybe two, three or four years. So if I then go back to one of the slides that Erica showed, the two cases she had were

Humboldt Bay where they have already got 6 casks but they need 6 casks to be able to ship in one campaign. By comparison, Big Rock Point has no casks yet. So if they are going to design the cask or produce the cask that's intended, that one cask will do six cycles so those two are sort of the extremes.

The green curve there would be the case equivalent to Humboldt Bay where you need a lot of casks for a short period in commercial terms it means you don't have a lot of business to amortize them over so I would have expected that to see a much larger purchase requirement for casks. So if we can go now to Slide 17, and I'm afraid the bars don't show up on there but the yellow case in the printed copy does not show a large number of big factor more in the number of casks required.

So the tradeoff I would have thought was clear the casks early. Excuse me; clear the sites early. Clear the sites and therefore there's operational and cost savings and a lot of benefits from doing that.

The tradeoff I would have thought was a much higher requirement for casks and I'm not seeing that there.

Can you talk about whether you're looking at those sort of tradeoffs and how you are analyzing the overall benefit for the program as opposed to individual sites and the utilization of the equipment and the hardware that you are buying.

>> WHEELER: Yeah. We haven't focused that much on the commodity piece of it yet. This is an area that we are kind of wanting to move into more.

They do get factored into like the total number of the

-- I mean the system can end up calculating the total number of casks and be able to use that for cost information purposes. It depends on scenarios you're talking about kind of factors - - if you're looking at different consist sizes, that can have a bearing on the number of casks you have because of the number of round trips you have to make, too.

So . . .

>> BAHR: Nigel, I think the label --

>> WHEELER: I'm going to refer to Mark Nutt here who might be able to provide additional information.

>> BAHR: I was also going to say the number of cask types, it's not the number of casks.

>> WHEELER: Thank you, yes.

>> BAHR: So it's the different cask designs.

>> MOTE: Okay.

>> BAHR: So it could be many casks of a particular type that are required.

>> WHEELER: Okay. Yeah, thank you.

>> BAHR: Is that what you were going to say? Okay.

>> MOTE: I'm expecting if we did see the number of casks there would be --

>> WHEELER: Yeah, significant.

>> BAHR: Other questions Dan Ogg.

>> OGG: Dan Ogg Board staff. Jack thanks for putting this altogether. My question is about the system analysis tools in general. I know that the NGSAM tool has matured quite a bit and can be used to run some total system analysis at least with commercial spent fuel. And the UNF standards tool is pretty mature and being used for analyses but how mature are the other tools? And when do you think they will be complete enough to really help you the Department of Energy design the whole waste management system.

>> WHEELER: The execution strategy tool is fairly mature, too. It's been used to help look at different scenarios that kind of looking at to be -- being able to be put together. But some of these things are also

-- it's not just the tool themselves but it's the model. So you have to come up with particular models and so that takes some time.

And to the extent there's new scenarios that are desired to be looked at, that requires some additional effort.

The multi-objective evaluation framework is probably -- has received less emphasis as of yet. We've been some exercise with that to look at to be able to use it and apply it based on some of the inputs to test it out. So that's again also dependent upon different inputs that would be received as well too.

So I think START is fairly well developed, as well.

>> OGG: So does the department have an overall schedule for completing these tools and moving into more

of a system design and can you give us an idea of a timeframe for how all of this fits together?

>> WHEELER: Well, I think there's still a good piece of work to do yet with regard to being able to get things to where we want. But they are actually being -- proving to be useful right now. So I would be hesitant to put a number on it. Right offhand. But I think we're -- we're looking at right now focusing probably more on that verification efforts and being able to improve confidence and reliability so that's kind of our current focus on it to get as we're kind of maturing through development now kind of more into more into that type of a phase to provide that additional confidence on the results that are being generated.

>> BAHR: Okay. I think it's time to move on to the next speaker. Thank you very much.

>> WHEELER: Okay. Thank you.

>> BAHR: So our next speaker is Mike Brown from the Carlsbad Field Office. We heard a little bit from a state perspective about the WIPP transportation

program. And we're going to hear from Mike from the DOE-EM side of that same program.

>> BROWN: I would like to thank the Board here for inviting us and allowing me to speak and the guests here. And first off you're probably wondering from my title where am I here. And I wasn’t always in this job.

In 1996 on I dealt with packaging. I got the RH 72B cask through the NRC and DOE because they said I had to certify it through both entities so I got it through there. And then from 2000 to 2013 I managed and built and fabricated TRUPACTs, HalfPACTs, Type B packages, 12 casks, and I helped on the TRUPACT-IIIs - they were done by the contractor but all those other units I reviewed every data package and was there in the factory and did a lot of the inspections because some of the vendors were proprietary operations so they wouldn't allow their contractors to do their NQA-1 audits I did that. So, that's how I got here. Another thing I want to point out since a lot of you are professors whatever you're teaching for physics and radiation I learned a lot from the public hearings and outreach that you weren't teaching me so you might want to go back and look at your programs because I learned so much about radiation from those public meetings that wow they never taught me that or boy this is new.

So I just want to point that out.

Since Ken Niles brought up safe and uneventful if you haven't already looked at the second slide how many shipments do you think WIPP has made? Anybody? Over 12,000.

So when you look at that, as of the 6th of June there or so we were at 12,167 shipments since our restart, 273.

And for the restart I was the QA manager from December 2013 through all of the restart just until 2018 here.

So we're doing about an average of 8 shipments per week at one time we were doing between 17 and 31 shipments a week. Per week.

And from Idaho, Oak Ridge, Waste Control Specialists and LANL that's where they were now. In the past we did do quite a few from Hanford. I want to say around 200 and some shipments out of Hanford. And then 719 remote handled waste shipments.

And we did it all by truck. And so that's how we did ours.

Now, when you look at what got us open and the initial challenges, I guess the delay in getting WIPP open it was really ready for waste in '88 is what my hard hat said I got the sticker still on my hard hat so we were trying to get open in '88 then the rules changed and we had to go through the EPA and we had to do some new things.

So things in life changed a little bit. But one of the first things was coordination with the local, state and tribal groups. And, the first part of that is identifying contacts and it was already brought up that there's a lot of turnover. And so that's part of it.

The public trust and confidence, we went out and we did a lot of outreach. We went to the high schools. We went to the fire departments. We went to the first responders and the police departments. And those were the ones that sold it to the public. Because if you get the high school kids believing in you or the grade school kids then they will go out and tell their parents and if you can get the first responders and the State Police and the police departments to have faith in what you're doing then that goes a long way in all of these communities because they are normally well respected.

The next one is we highlighted the use of the NRC approved Type B shipping containers and the safety requirements of our carriers. And our carriers for example to be a driver you had to have originally a half million accident free miles. You couldn't have any DWI or speeding tickets in your private vehicle or a commercial vehicle. We relaxed that a little bit because some of the State Police said they couldn't -- well they couldn't be a WIPP driver because they only looked for ten years. So we modified it to only go ten years back in the history. But any DWI in the past ten years of your driving history will prevent it whether it was in a commercial vehicle or private. So we have probably our drivers are in the top 1% in the nation.

We did the development of protocols and transportation management plans. So we covered the inspections and when they were talking those CVSA Level 6 we helped with those classes we normally furnish our trucks and containers for that. This is the inspection guide. It's 300 pages. A normal inspection of our truck prior to departure takes an hour and a half. They get the creeper, the State Police go under it. They measure the brake throws on the brakes, any leaks or anything and we generally steam clean our engines every trip. They are that clean because any fluid leak of any type is a disabling thing.

We talked about breakdowns. Our carriers and their contracts. And we went and developed those requirements in our contracts working as far as we could with the Federal acquisition regulations with the state groups. So the WGA furnished a group that helped us with a contract and on the statement of work. And so they looked into that for us.

And then the communications including the scheduling, how we did that, because a lot of times you had a delay in departure so how are we going to handle that and if you're going through these other states how do you communicate that and make sure everybody is okay with it.

And then on the protocols when they were talking weather and so forth, if we have a high wind warning, I don't go. And I have to have the 200 -- first 200 miles of the area are clear to go through. And you know in the winter in the northwest here that's sometimes a challenge. 200 miles and farther. And sometimes we got asked why don't we make sure all 1,000 miles or 1500 miles are clear. Well in some of those cases we would have never left we would run up to the weather but we would make sure the first 200 miles were clear and where we can park we don't have save havens we qualified it at safe parking because our stuff isn't quite as sensitive as the fuel shipments and stuff you're talking about so we developed protocols from where that could be. Normally DOE sites were No. 1. DOD sites No. 2 and then there was a list of areas that were considered first. Obviously population density, security and all of those things were part of that criteria we would work with the states and a lot of times if we had bad weather, they would put us up in their inspection garages or maybe in their highway transportation yards. Because one of the things that worked out was trying to get the drivers off the clock because one of the drivers had to provide security 24 hours we lost driving hours. And so we were trying to maintain those and meet DOT requirements.

The route training and opening. I agree it takes a long time so we had from 1988 to 1999 to work on that and improve how we did that because of delays in getting WIPP open. And, for right now for reopening, it took several months or a year because we could do it a little bit quicker. But training of the first responders including the hospitals and medical personnel took a lot of time. And originally WIPP did most of that themselves when the land withdrawal act came out it said our training classes had to be OSHA occupational safety and health department approved which they never approved courses so it was a first for them as well. And then we went to the TEPP or MERRTT training they talked about which makes it a little easier and a lot of that is online.

And then the states certify the routes are open not DOE and that's a big change for some of the people in DOE and stuff. No the states aren't ready. They want more medical personnel trained at the hospitals to deal with how you would have to deal with radiation, contamination and so forth. And so we worked with the folks to send them to training at Oak Ridge and other places to learn how to do that.

And then equipment for the states and tribes. We worked with our funding to get equipment. And so like in New Mexico there were small rural fire departments that when we started training did not have -- they couldn't have responded to a Hazmat event because they had no Scott air packs or anything they had no protective clothing other than the bunker gear so we bought some of that equipment for them some of the gear then when you're talking radiation instrumentation the states had all good programs and did that but when you were dealing with some of the tribes and you're talking check sources how they calibrate equipment and how they check it all of that some of the things became a little more problematic in dealing with that. So we helped them work those issues out, as well.

Now we have what we call TRANSCOM. What that does is it allows the states and everybody to see where the shipments are so they get to see the TRU waste shipments going through their states and areas and they can follow them and see where they are and we query our system about every five minutes and we can query it more often if we have to to identify where it’s at. So qualification and training of Level 6 inspectors was another one. It normally takes about three weeks - - they have to have experience they have to have hazardous materials training before so you have to have some knowledge of a class 8 diesel tractor and those kinds of things and trailers and stuff before you go to a class and then we're two weeks of classes I think it's now down to one week plus about one week of inspections you have to do in the field as an apprentice or OJT if you want to call it on-the-job training. Then we did full scale preparedness exercises, and to do all of these things and to do the show and tell you need prototypes and so that's - - is something we had to have. Now the full scale exercises what we did we had one for the Western Governors states, the WGA, with the state groups on those corridors would agree in which state we were going to do it this year so we did one a year over that route. And we always did one in New Mexico because everything went through New Mexico. Then on the southern states they belonged to the Southern States Energy Board and they would do it and on the Midwest we did it, as well if we were shipping through the Midwest. So that was a big thing. Now I put the other bullet because some people don't understand that the incident commander comes from the state that the accident happens in so it may be the first responder until the State Police gets there or somebody like out of Ken Niles' group gets there and takes over that function as the incident commander but normally the DOE folks are not the incident commander like they would be when it happens on a DOE facility.

So that was a big thing for people to understand and learn that the state is in charge of it.

And we pointed out multiple activities there must be done. You show us -- some of the things. One of the things that the first responders had problems with was with our type of radiation - - know you can go in and rescue the people because they would see the radiation stickers when we did the drills and stuff oh can't go in and they would wait and it would take them hours on a drill before they would go in. And of course the accident casualties would bleed out or whatever and be dead.

And so that was one of the things we had to overcome was, no, if you've got your bunker gear on, your respirator you're safe to go in even if it is leaking but oh by the way we don't think you can get this package to ever leak under normal accident events or hypothetical accident conditions. Whether it's a fire. Whether it's a liquefied propane truck blowing up next to it or something, it won't leak.

What will probably cause the damage is when this cask rolls over and falls on your Toyota or whatever and squishes it.

Now, we already -- some of the people pointed over the turnover and retirement of trained and experienced staff. And the state and tribal WIPP coordinators and regional group representatives and the CVSA Level 6 inspections and enforcement personnel and then the local emergency responders because like it was pointed out most of them are volunteers. So one day I'm sitting in my office I get a call from a police chief in a small town in Colorado. He just got elected police chief he says I see these WIPP trucks going through is there anything I need to know about them. Okay so we got with the state of Colorado and they arranged the time and the places as pointed out when you're a volunteer, I'm not going to give up 16 hours during a weekend to sit in training class. So it's how do you arrange it so they get all trained and qualified. The continued training again is a challenge and we tried to go online with a lot of the courses so it's a little bit easier that way.

But a lot of it they still have to see the cask. They still have to see some of this online. And again drills and stuff is a good way to work with them.

And that goes back to the things.

Now the other thing we've had trouble with because of trucking is local curfews or limited windows for transportation can impact shipment departure and arrival times. Especially like Colorado - - we arrive from Idaho about 12:30 at night and sit in Wyoming until about 6 because they don't have a Level 6 inspector come on because of the state law that says they have to do every Hazmat shipment with a CVSA inspection we have to be inspected. Well then when we get inspected and they get done with the inspection we have to wait until after 9:00 o'clock because for all of the populated corridors they don't want us going through towns for certain times. And if you're talking overweight shipments, it becomes even more restrictive because you can't do it on holidays and weekends in most states you can't ship after dark in a lot of states and those things start impacting your shipment times. Things start impacting your shipment times. Now the other bullet I put on the bottom was packaging load securement and I pointed out the inspectors guide it actually has detailed information of how to check the tiedowns because people were writing us up saying the tiedowns are loose and they are spring loaded so on the TRUPACT-III, it's spring loaded it has an indicator saying here is when it's good it's easier to see and inspect but they wanted to retorque our bolts on the tiedown and things on the cask and redo them and it's like no that's away from goodness you can't retorque our bolts once they are torqued and in if it's finger loose or loose yes but if it's torqued and tight don't be redoing the stuff there.

There was a lack of knowledge in general. And it affects us. And it won't affect your fuel shipments but

Type A and Type B. We put Type As inside our Type B and we use Type As onsite for handling it and take credit for it in the documented safety analysis. But the other is about Type Bs and that goes into the testing that's done and why we think it's robust and why it won't have problems and how you use it.

The advanced notifications coordination of inspections and escorts. Some states wanted to escort our shipments and right now we would probably propose if we only have a very limited number of shipments to go through the state that might be the easier way to go than training all the personnel along all of the routes. Have a follow-on group of people that are emergency response trained and so forth. Because one of the other things that go into all of these first responder meetings did was when people called you, they knew who you were. You know so they saw us. And we had been in their communities working with their fire department or something.

So if one of those people had a question, they knew who was on the other end of the phone and that was a good thing.

And the other thing we used a lot of people they were first responders and EMTs so when they went out to train them, they were the same type of people.

The last one and I don't want to get too much on that because that will get me in hot water either way but costs associated with maintaining open shipping routes where you're not going to use them for a period of time. If you're going to keep everybody trained and do all of the retraining but you only have one shipment a year then maybe two the next year it's a very big investment.

Or maybe like at Hanford we haven't used that route for several years. For TRU waste. Or coming out of California.

Now, I get into packaging and this is where I may have a few -- mine is based on experience, okay? Of going through -- we have done over 30 NRC amendments to our packages. The TRUPACT has around 29 and the cask about 7 or 8. So -- because I've been away from it several years and haven't had to go directly in. So we've gone back and forth with NRC a lot of times.

And we got the first square Type B package certified which is the TRUPACT-III because most of your pressure vessels are what, circular in shape. And TRUPACT-III is not.

So the first one is design. It takes about a year. Or more to do that.

It depends on the complexity and what you're going to do with it. But then you may have to do test articles.

Now we qualify the TRUPACT and HalfPACT by full scale testing and the TRUPACT-III. Well when you do full scale testing that makes the mods harder because what you know from the testing is what it passed I don't have the margin of safety calculated and all of that and the reason we did that originally is the TRUPACT is a deforming container. It's like a Volvo or something in an accident it deforms. The 72B we used only quarter scale model testing and only full scale tested the impact limiters because it's a Mack Truck and the analysis data for circular pressure vessels and stuff is well understood and that kind of thing so it was easy to go the other way. The testing full scale or per components - - to build some of the components we got in trouble with the TRUPACT-III because the NRC asked a question after we drop tested the first full scale model. And then the easiest way to answer their question was what? Drop another full scale model. Because if we went into these debates in qualifying all of the analysis that we had done, it would take about the same time because you still had to drop components to get the software qualified.

And so it took another year about to build a second container to drop on that one question.

It wasn't a glad you asked question. Okay? (Chuckles) it was one of those oh, okay.

The next one is NRC review and issuance of a Certificate of Compliance. If it's a brand-new container we're looking at 18 to 24 months and probably 30 months is our experience. The fastest we ever got one through was about 9 months. And so they are good. They have qualified people. But when we're talking turnover, that turnover also can affect the NRC because when you have worked with these certain managers or people they are experts on their shielding folks or something and all of a sudden that person accepted a new job or transfers out of that group now you have to reeducate the new person and give them a comfort level with what you're doing and show them here is how we're doing it.

And so when talking turnover personnel it also does it. The next one is trailer design and handling and operations. You have to come up with all of that.

Fabrication, limited number of qualified suppliers is becoming a bigger challenge right now. The lead times on materials, most materials aren't made in the U.S. Our lead pours like I was said it was done in Canada, Spain or Mexico probably. The training and qualifications of all of your personnel. Operational demonstrations, readiness activities. And approximately 7 years start to finish but it took us with a TRUPACT-III 9 and a half. And that was the last one we did. Carriers, contract award, training and qualification of drivers, equipment, road shows, readiness. Now, other topics, interfaces and operating agreements this is one that's going to be a big issue with your fuel stuff here, shipments characterization of waste or payload. You guys have kind of asked around it. Big issue for us, emergency team for recovery. You got this big cask it's along these very isolated routes how is the railroad working with them, the agreements, liabilities, how are you going to recover it? If you did have something happen.

Design, construction of ancillary equipment and facilities because loading and onloading as pointed out with a 250 ton cask or something is not a minor issue. And then on active sites especially the safety basis document changes at your hosted facilities - - it takes them some period of time. Do they have to modify the NRC license, do they have to do anything? And that concludes my presentation.

>> BAHR: Thank you very much, Mike. Questions from the Board? Linda.

>> NOZICK: Nozick, Board. I really enjoyed your presentation. Thank you.

Within DOE is there a mechanism to share the lessons learned at WIPP, especially the ones dealing with the public with the people who will -- who are focused on this problem, the spent fuel?

>> BROWN: Yes at one time we worked with different people and I think Gary Lanthrum can confirm they came and asked us a lot of questions and interviewed and they did some reports and stuff that were put out. We're still glad to share any of that lessons learned - - history is important despite what some people say.

>> NOZICK: Is there some of this knowledge being stored up for when they gets restarted.

>> BROWN: It's getting stored because we've had a lot of turnover.

>> NOZICK: Exactly.

>> BROWN: Most of the people I used to work with, Ken is a stable entity but most of the other states they have had turnover in their groups lately so the people that worked with us so long to get WIPP open, they are all retiring or they won the lottery so they are not playing anymore.

(Chuckles).

>> BROWN: I didn't want to say they died.

>> NOZICK: I prefer the won the lottery euphemism.

>> BROWN: So it's -- that group is moving on, right?

>> NOZICK: Thank you.

>> BROWN: It's hard.

>> BAHR: Steve.

>> BECKER: Becker Board. Great presentation lots and lots of useful insights. You mentioned sending the medical and hospital personnel to REAC/TS for training - - to Oak Ridge, was that to REAC/TS?, and at any point did REAC/TS people come out to the local areas to do training?, or was it all…

>> BROWN: Originally we did it internally and now it's involved into that program. Yes you have to arrange and some of the hospitals sometimes you need to have people come and -- because again some of the rural hospitals and other places you have to go see them.

>> BAHR: Other questions? Anybody from the staff? Questions?

>> BROWN: I would like to say the NRC has worked really well with us and has tried to meet. I cannot schedule them or anything but they have been responsive

to all of our amendments and they have put a lot through.

>> BAHR: Are there any questions from the audience for Mike? Okay. Wait. Sorry. I went too fast.

>> ZOBACK: Zoback, Board. Again, thanks so much. A really great presentation and you're just a wealth of knowledge so don't win the lottery.

(Chuckles).

>> ZOBACK: I guess my question is going back to the point -- one of the points you made about how much -- well your opening comment about professors and what you learned about radiation and then later in the talk the importance of engaging the public and buying support and stuff and you've heard a lot of different presentations today from different perspectives. Do you think -- and I get a sense there's a general feeling it's too early to start on any of this because we don't know what's going to happen. I just want -- I would like your comment about public engagement and should be -- just ignore it until later or what do you think.

>> BROWN: You have to do it as early as you can with

ours because we're making mainly road shipments. You needed a prototype to show the people because it was going through their communities on the road and it was interesting with rail you have a few different challenges but where do all of the rail lines go through? Right through the center of all of these towns. And then who is going to respond and liabilities are more interesting and they all want to know.

So there's going to be some challenges because the railroad will tell you it's their private property they will clean it up on their property. So where do those responsibilities of those first responders lie? And I think you've got to go out and you've got to get to them as early as possible. But you've got to have something to show them.

>> ZOBACK: Yeah.

>> BROWN: The towns the big towns where they have professional fire departments and stuff those are a lot

easier because you have continuity and those people are trained all the time if you have to do training or something they will dedicate so many hours.

>> ZOBACK: But in general the routes will be avoiding those types of towns right.

>> BROWN: Yes and the recovery is more challenging in a lot of those rail lines. They go along water routes. They go through the mountains and places where there's no roads close. So how do the recovery crews get there? It's been pointed out. It's not just a --

>> ZOBACK: I appreciate you bringing up the issue of recovery. There seemed to be a general sense that nothing will ever happen. And you can't plan for that.

>> BROWN: Yes, ma'am.

>> BAHR: Did I see -- Dan Ogg?

>> OGG: Yeah, Dan Ogg of the Board staff. I've seen some news reports that either local communities in New Mexico or the contractor at WIPP or maybe even DOE have suggested that there could be other waste types accepted at the WIPP facility. And some of those --

>> BROWN: No comment.

>> OGG: No comment? Okay what I was going to get at was it might be likely those require rail shipments and I was wondering if there had been any advanced planning yet to look at other waste types or rail shipments into WIPP?

>> BROWN: We looked at the rail -- I'm not going to address any of the new forms for our land withdrawal act and state permits and agreements we can only accept transuranic waste. End of statement.

When you looked at rail, we did a lot of rail studies and there's a couple of challenges with there's. For our facility they spiked the throughput so you go along and you would have minimal so we had to have at least 20 more packages or 13 more packagings the reason being I had to have the empties on the way back I had to have a group there being loaded and I had a group being unloaded so it meant more packagings for us. You have to have a backlog of waste when you were characterizing waste and I didn't have the backlog with fuel you have a backlog so it makes sense, too but where they were characterizing trash and certifying it I didn't have a backlog and therefore if you stopped characterizing today then oh I can't ship from there this week. And it's hard to take a dedicated train which is more expensive or if you're going commercial rail get them to change everything for you, pay to merge on all of those cars or however you're doing it and switch. And instead of going to Idaho I'm going to Savanna River this week. With rail you can't make those switches quite as fast as I can with trucks. And so there were some reasons we did that. And then we got into the inspections and the other issues of dealing with the rail lines and I was one I talked to the Vice President of marketing in Burlington and their load managers and they said well you would be less than 1% of our business we don't care at the time. And then we were talking about over 20 some rail companies to get to Carlsbad.

Now it's with all of the consolidations and buydowns it's a much smaller group but they were not really interested.

When you said I have to be there within so many days, that created challenges for them. And us.

>> BAHR: Okay. Any more? Last call. Okay. Thanks very much, Mike.

So our final speaker for today is Darrell Dunn with the Nuclear Regulatory Commission and he's going to talk about challenges to be addressed in regulating a national program for transportation of spent nuclear fuel and high-level waste.

>> DUNN: Thank you for the introduction again my name is Darrell Dunn I'm with the Office of Nuclear Materials Safety and Safeguards in the Division Spent Fuel Management. And so here is an outline of my

presentation this afternoon. I have a couple of slides first one talks about where we are with independent spent fuel storage installations and commercially stored spent fuel which you have heard about a lot so we'll go through that quickly and then I'll talk a little bit about the consolidated interim storage facility before I jump into the questions that were -- that I was asked to address that I have summarized here. So let's get started. So where we are today with independent spent fuel storage installations. We have, by my count, dry storage at 72 different sites we have a wet storage site GE Morris. We actually have about from the data I have from April of this year is 2742 dry storage systems loaded. In -- and 2121 of those are dual purpose systems which could be transported after a storage period.

We have initially all of these storage systems and specifically licensed ISFSIs were licensed for 20 years and as part of our regulatory requirements for renewals when a specifically licensed ISFSI or a Certificate of Compliance that's used at a generally licensed ISFSI goes through renewals they have to have -- they have to do an aging management review and then they have to have aging management activities to address those potential aging affects. They can include time limited aging analysis or aging management programs for structures, systems and components that are important to safety and I'll talk a little bit more about those and why they may be significant in some of the later slides.

The NRC has received two applications for a Consolidated Interim Storage Facility - - the WCS site in Texas and the Holtec site in New Mexico.

The WCS site, that application was suspended for a period of time but that's going to get restarted. Maybe as early as next week. So we will have two of those going through review.

Both of them were -- went through the acceptance review process. And were accepted for review. And Holtec -- that facility is a little bit further along even though they came in second, they have continued the effort.

Those applications include spent fuel that's currently stored in canisters. These are again dual purpose systems. That are at existing ISFSIs sites licensed under Part 72 and those canisters are going to be removed from their storage overpack systems, transported under Part 71 and then subsequently placed into storage at the CISF under Part 72 and this is the 72-71-72 problem that we have identified or it's not really a problem it's just something that we probably didn't really consider when we initially started thinking about Part 72.

So I'll talk a little bit more about that because that's a subject of the first question. But we have these applications in-house. The applicants have proposed different methodologies for doing non-destructive evaluation and testing to demonstrate that those canisters are suitable to be placed into storage again at the CISF and we're going to have to review those applications as we receive them but we're also going to develop some guidance in the event in the future we have to deal with this again.

So the specific questions, the first one really dealt with this 72-71-72 problem and explained the guidance development for the transition of commercial spent nuclear fuel from storage to transportation to storage possibly in repeating cycles. So again we recognize that we do need to have guidance developed. And you might ask well if you're going to approve or review these CISFs and presumably approve them why do you need guidance, you have already done it. Well we have learned that just because we approve a license application doesn't mean it actually gets used.

We may in the future have to deal with this again. And the evaluation that we do for the CISF applications will be a safety evaluation report and that's not a good vehicle for conveying guidance to staff to review something. That's -- that's an assessment of what the licensee has provided to us and whether or not it's acceptable. It doesn't provide guidance for the staff to conduct these types of reviews.

So that updated guidance will probably be added to our new draft standard review plan for spent fuel storage systems and facilities and that's NUREG 2215 the guidance itself hasn't been developed the NUREG has been drafted and gone out for public comment and we're addressing those comments before that document is finalized and issued.

The guidance for this 72-71-72 issue will consider a number of factors. The status of the spent fuel storage system, whether the system is in its initial period, licensing period, or it's in a renewal period where there's potentially aging management programs that have been executed to perform inspections of these systems to look for indications of aging. The requirements for transport and I'll talk about canister integrity for moderator exclusion on a subsequent slide.

And then the acceptance testing that will be done at the second or the subsequent storage sites. So what are the acceptance testing that will be done and what are the acceptance criteria for that type of testing.

So for a little bit more on the subject. So for transportation after storage this is going to be done under Part 71. As many other speakers have stated the transportation packaging provides the containment. But we do have systems that have been approved for transportation of high burnup fuel that rely on the integrity of the canister for moderator exclusion. And so these particular applications or systems, one of them is the MP 197 HB. COC 71-9303 and HI-STAR 190 which is recently approved which is COC 71-9373. These systems have a specific protocol where they do evaluations of the canister to make sure that it's -- it will provide moderator exclusion that's necessary for the transportation of the high burnup fuel.

So there's the -- in this case the certificate holder has developed systems for doing testing and NDE of the canister for moderator exclusion. But again, if we're talking about something in the initial storage period there's no inspections that would have occurred in the initial storage period but if we're talking about a renewed license, then there could potentially be some aging management programs that would have done inspections of the canister and the question for us in developing this guidance is can we credit potentially credit some of these aging management programs some of the inspections that would have taken place of these canisters can we credit this in this 72-71-72 guidance development.

So then before returning canisters to storage after transportation again this is covered under Part 72 we have the same types of variations are we in the initial storage period. Are we in renewed period where we have aging management programs that could potentially be credited and were there examinations performed on the canister because you wanted to take credit for the integrity of the canister because you were presumably transporting high burnup fuel. And we looked at different testing and NDE either for canister integrity or for that have been proposed for different aging management programs for storage systems and these include canister helium leak rate testing, visual examination, and if necessary surface or volumetric non-destructive examination. The canister leak rate test is something that would likely have to be conducted inside of a transportation packaging. After the transportation package was received at the second or subsequent storage site.

And the purpose of that particular test was to verify that there were no canister breaches prior to and/or after transportation.

The acceptance criteria for this type of test is something that we're talking to some of the DOE laboratory staff about. We know that they have done quite a bit work on this subject. And they have done some analysis. And it's really good work. And we know that they are going to do some proposed testing to get an idea of how well this canister helium leak rate test could be conducted. So we'll take a look at what they have done in their analysis and gain insights from that before we develop our own guidance. The visual examination is something that's been done for canisters that have been in storage for aging management programs. And it's used to identify potential areas of aging effects and can also potentially identify handling defects. And surface and volumetric NDE is something that would probably be performed if the visual examination indicated there's some type of aging effect.

And again, we have the vendors for -- that have Certificate of Compliance for transportation for transportation of high burnup fuel where they need to take credit for the canister for moderator exclusion they have developed systems to do different types of NDE on their canister including some surface and volumetric NDE to detect things like cracks, pits, and defects on the canister surface.

Eddy current and ultrasonic are probably the most likely potential methods to be used. And again this will be done through characterized aging and handling effects.

Oops. I think I missed one. Ah, okay.

Yeah. So I have a slide in here on contingency planning because we did have one of our CISF applications didn't really do this very well.

We anticipate the number of canisters that would -- that are found to have indications of aging are going to be very limited. But there is still a need to have an acceptable plan for addressing canisters with aging effects and that's expected to be contained in the CISF application.

There have been to be procedures and controls to limit occupational exposures and site boundary dose limits. There has to be corrective actions that are going to be taken to return to normal operation. And there are a number of regulatory requirements 104 and 106 are dose limits. And the other is in 72.24 deal with things like -- that are required in the safety analysis report for a site licensed ISFSI that deal with the receipt handling package and storage of spent fuel and they address things like descriptions of structures, systems and components important to safety. And an analysis and evaluation of the design and performance of these structures, systems and components to show that there's an adequate margin of safety under normal operations and expected operational occurrences that could occur within the life of the ISFSI.

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Okay. The second question was what steps are necessary to license spent nuclear fuel that has been in storage for a period of time. Greater than 20 years and to assure it's safe for transportation.

We have guidance that's -- and I apologize for the acronyms here ISG is an interim staff guidance document this is actually a document that's written by the NRC and it directs the NRC staff on how they conduct reviews. But ISG-11 Rev 3 is well known in the industry because it deals with the temperature limits for spent fuel in storage and during drying operations.

So the answer to the question is for low burnup fuel we think the guidance that's in ISG-11 Rev 3 covers what is needed to demonstrate the fuel is safe for transportation.

We have another draft NUREG document it's NUREG-2224 the title of that is dry storage and transportation of high burnup nuclear fuel. And again this is a draft document that we hope to get out by the end of the year. And I'll provide some additional information on some subsequent slides about that.

Of course the compatibility of the storage system and loading parameters for transportation have to be addressed. We can -- you can typically load things storage canisters to a much higher heat load than you can transport those dual purpose storage systems. So one of the issues will be what's the heat load of the canister and transportation and has to adhere to the transportation COC because there's heat load limits for that. And there's other relevant interim staff guidance documents, ISG-1 is fuel qualification and what constitutes damaged fuel. ISG-22 deals with rod splitting. ISG-24 is the -- deals with how you could potentially use a high burnup fuel demonstration program and ISG-25 deals with pressure and helium leak rate testing of the confinement boundary.

So this slide has some information on ISG-11 Rev 3 and this basically just summarizes the requirements that are in ISG-11 Rev 3 so the maximum calculated fuel cladding temperature should not be above 400 degrees C during normal conditions of storage. For low burnup fuel a higher short-term temperature limit -- short-term temperature limit may be used if the cladding hoop stress is equal to or less than 90 megapascals and then we have limits on the number of cycles, thermal cycles which would typically be experienced during drying operation so that should be limited to less than 10 cycles with a cladding temperature variations that are less than 65 degrees C each.

Then temperature limits for off-normal and accident conditions maximum cladding temperature limit should not exceed 570 degrees C.

So for high burnup fuel we have a -- again this draft NUREG that's going to be out by the end of this year we hope. And this is a picture of Figure 4.1 of that draft NUREG and this is transportation of fuel previously in dry storage longer than 20 years and this is -- it says supplement the application with either of these approaches and one of them is a confirmatory demonstration and the other one is a safety analysis. And so I have put the contents of those slides in the subsequent slides here.

The confirmatory demonstration is supplement the application with the results of a surrogate demonstration program. And that program could provide field data obtained confirming that the fuel configuration has been maintained before transport.

And the applicant can refer to Appendix B and D of NUREG-1927 revision 1 which is our guidance document for renewal of dry storage systems and Appendix B deals with the aging management program for high burnup fuel and Appendix D is essentially the same thing as ISG-24. It's how one can use a demonstration program to show that there hasn't been degradation of the fuel if storage.

The alternative is to do a supplemental safety analysis. And that would invoke demonstrating the transportation can still meet all of the regulatory requirements assuming that a hypothetical reconfiguration of the fuel contents into justified geometric forms. And that demonstration has to consider the regulatory requirements of Part 71 for containment, thermal performance, criticality safety, shielding after the required tests for both normal conditions of transport and hypothetical accident conditions.

So those are the two ways that an applicant can deal with high burnup fuel.

Question 3 was in planning for a transportation campaign, what is the time necessary to get applications through the NRC? So we have some metrics for reviewing applications. The storage metric is 80% of those applications have to be completed in 13 months and greater than 90% in two years. That timeframe does not include response time from the applicant. So when we get an application in we do an acceptance review if we find that that application doesn't have everything we need, we submit a request for supplemental information. And at that point we're off the clock. We're no longer on this 13 month or 2 year clock because we're waiting for the applicant to respond. After we accept the application we do the same thing we do a detailed technical review and we also can submit requests for additional information if we have an issue that we need to get additional information about. So that we understand the application. And again, we're off the clock at that time.

The storage metric includes 5 months for NRC rulemaking. This is OGC review our Office of General Counsel review. Our EDO review. And a public comment period.

For transportation the metric is 80% in 5 months greater than 90% in 2 years. Again it doesn't include response time from the applicant. And I've pointed to what's called a regulatory information summary. This is publicly available and we send this out to specific addressees in fact each one of these will identify the addressees. In this case it's Part 71 and Part 72 applicants. So storage and transportation applicants. And this particular RIS dealt with recurring requests for additional information.

So we want to identify okay these are the things we see routinely and you can help yourself out by not falling into that pothole.

Make sure your application is complete. And doesn't address -- doesn't have some of these deficiencies.

And I have some examples of some recent reviews. These are not -- they are certainly not the longest reviews we have ever conducted. They are not the simplest. They ran approximately concurrently in -- completed in 2017.

In 2017 I think we did 48 transportation cases and 11 storage cases. But some of the transportation cases involve very, very small amounts of staff time like maybe 20 or 24.

Both of these applications are probably in the thousands of hours or over a thousand hours for sure for both of these applications to be reviewed.

So the TN Americas EOS application from the time the application was received to the time the COC was signed is about 2 years and about the same thing for the HI-STAR 190.

Okay. So the next question was what if we want more applications? What if we want you know four, six or more or eight maybe.

And so again I'm going to point to some regulatory information summaries that we have -- we have put out.

Lessons learned from the review of 10 CFR Part 71 and 72 applications and our timeliness goals and prioritization.

And so let me address the points in here that come up.

The preapplication meetings, we encourage preapplication meetings for our applicants. It gives them an opportunity to explain what it is they want to do, why this application is being put in, if there are unique features or unique properties or unique analyses that are going to be used, they can explain those. It gives the staff the opportunity to ask some additional questions. And clarify what type of information might be needed if they are going to take some type of unique approach.

And so it's beneficial for both the staff and the applicant to have preapplication meetings and we regularly have preapplication meetings with our applicants.

The informing NRC of future licensing actions and COC actions. Our budget planning process is currently about two years out so we just did 2020. And if you're -- we can accommodate the onesie and twosie that we didn't necessarily expect but if you're talking about multiple COCs, that really needs to be put into the budgeting process and the time to start engaging the NRC is before we start with that budget development.

So think three or four years out, if that's what you really want to do.

The prioritization of -- we used to be called the spent fuel project office in case you're wondering but anyway prioritization of workload, we do have in this RIS a workload prioritization. And it's a logical way of doing it. You know it's operational safety. Maintaining full core offload capability for an operating reactor. Supporting decommissioning is three. And then four winds up being other things that are budgeted in the budget.

So we do have a prioritization. But we also recognize and we have seen in the past that we have applicants that will give us multiple COCs to review. And they are all being priority 4 in that case we have to go back to the applicant saying which one do you really need first? Which one do you want us to review first because we don't know what your loading schedule is we don't know which customer wants it sooner than the other one so you have to tell us that so we can at least try to help you out and process the reviews in the order that you're actually going to use them.

So that's the best answer I can give to 4. I will point out that we don't have a good crystal ball looking long range except for storage renewals. Because we know when those are going to come in. And right now we're -- oops, wrong one.

Right now we're dealing with Trojan, TMI 2, and Rancho Seco. We understand that maybe -- where is it? Maybe Advanced NUHOMS, we actually had a preapplication meeting with them a couple of weeks ago and we hear Humboldt Bay might come in early because they are going to have a brain drain problem all of their guys are going to retire not win the lottery but retire so they want to come in early so they can support that renewal with their brain trust so they may actually come in many years before. We actually might get that application later this year.

Obviously we're going to be pretty busy in 2020. We've got a large number of renewals that are going to come in. And then some of the other things that are important in this context is we also have two CISF reviews to do. They are supposed to be completed by 2020.

And then if we really do get a large number of plants to shut down we are going to see additional either COCs but certainly amendments to COCs to review because they are going to want to start unloading the pool. And we're going to get those reviews to come in.

So that's something to think about, if -- and engage the

NRC early so you express your plans and what you're going to do.

All right the last question was how does the NRC get involved in individual shipments assuming that there's already a COC.

So there's multiple agencies that have regulations concerning the transportation of radioactive materials. Obviously DOT and NRC are the important ones. You are probably only going to have to deal with TSA when you get back on the plane to go back home and USPS because you're not going to ship things that way. But if you do barge shipment you have to deal with the Coast Guard so that's something to think about.

We approve transportation COCs and that COC specifies the contents. So the activities that the NRC is involved in is really not so much in individual shipments. We do do transportation route approvals per 10 CFR 73.37 these are security requirements.

Typically a -- and I'm not an NSIR guard -- nuclear security incident response guy. I don't do these types of reviews. And I did get some information about these. A typical truck, simple truck transportation route takes about 45 days to turn around. I couldn't get information on a rail review. It's longer. And then if you want to do something multimodal like you want to do a heavy haul to a barge and a barge to rail spur or something like that, that's a more complicated review and it's going to take a longer period of time. Truck route is good for five years. Rail route is good for seven.

There's a couple of documents that are important. Somebody I think it was Erica mentioned the 72.48 process for storage. We do have an ISG that deals with what's allowed for transportation package changes without prior NRC approval. But -- so it's good information included in that ISG. In general you know if it's a change to a safety significant structure system or component that's in the drawing or the content specs or the package operations or the acceptance test and maintenance program, then it requires an amendment.

There's also another document that our security guys have put out. NUREG 0561 revision 2 it's physical protection of shipments of irradiated reactor fuel and that has good information about how route approvals need to be done and what the requirements are.

And I think my last two slides, there's that. Okay.

So I mentioned a bunch of interim staff guidance documents. I've listed all of these and given you the title of those. This might be the last time we'll ever do that because we're rolling all of these interim staff guidance documents into our revised standard review plan. I mentioned NUREG-2215 this is a standard review plan for storage. We're also developing NUREG-2216 which is the standard review plan for transportation package approvals and I talked previously about the high burnup fuel NUREG.

And that concludes my presentation so I would be happy to answer questions.

>> BAHR: Okay. Thank you very much. Questions? Lee?

>> PEDDICORD: Lee Peddicord with the Board. So you pointed out this perhaps bit of an unknown of the

possibility of plant closures, the interest then of starting to get fuel out of the core and so on. And the need then to review, do some modifications, COCs.

Is that particular exercise -- how straightforward is that? Or is that a lengthy one? Or can you even characterize it or will there be so many different kinds coming in?

>> DUNN: Let's talk about individual applications so typically what would happen the most likely path forward is vendor X has a Certificate of Compliance. But they need an amendment because that fuel isn't in the tech specs or they need to make a little bit longer canister to accommodate that fuel or there's some other type of change that they need to make to accommodate that fuel.

We give you -- to give you a specific case, we had when Vermont Yankee wanted to unload their fuel, we got a COC amendment because they wanted to load fuel that was cooled for a minimum of two years not five.

So we got an amendment to address that.

That amendment was stacked with another amendment. So the prioritization problem came into play. That unfortunately delayed the review of that amendment. And so what Vermont Yankee wound up doing is said okay forget all of that we're going to send you an exemption request.

So what could have been simple, one COC unfortunately got kind of tied up in this whole stacked up amendment and then we got instead of one we wound up getting three out of it to deal with that. So that was unfortunate.

But the time necessary to do that, it's the same metric. Generally a COC renewal or a COC amendment that's limited number of changes doesn't take 13 months.

>> BAHR: Other questions from the Board? Staff? Nigel?

>> MOTE: Darrell, you talked about the peak loading if I can call it that for the storage renewals coming up over the next couple of years with a max in 2020.

That storage and transportation will have its own peaks and troughs to what extent are the staff mobile between the two. Is there a difference which means that transferring is difficult? Or is there really a common pool with a relatively easy transfer and duplicate skill sets required, which means that that's a more fluid environment.

>> DUNN: Right so we have for all of the technical review staff, thermal, criticality, materials - -which

I am, there's a qualification program. And there's specific -- well there's general requirements that cover everything to do these reviews. And they include both storage and transportation. So if you're a qualified reviewer, you're qualified to do both. Now people because of other circumstances tend to play in one area and not the other necessarily. Some people do kind of equal workload between storage and transportation. But the straight answer to your question is any of our qualified reviewers are qualified to do both storage and transportation reviews.

>> MOTE: Okay. So what I was thinking in the longer term was -- as the number of sites shutting down reduces, which it will in the longer term, the transportation requirement will increase. By then you'll have had a turnover of staff -- I realize that -- but that transition is something you can take in your stride given that you're going to know it's coming several years in advance. It's not you have to turn over staff or go through complete retraining.

>> DUNN: No we don't have to go through completely new training unless we need to get additional staff to accommodate the work.

>> MOTE: Understand, yeah, thanks.

>> BAHR: Other questions? Questions -- Bret?

>> LESLIE: Bret Leslie, NWTRB staff. Darrell, thanks for the presentation. It was informative and thanks for sharing part of the draft NUREG and giving us some insights and being responsive to the questions.

One of the presenters earlier today talked about the thermal limits. Thermal modeling so on and so forth it might help us understand better is peak cladding temperature a point or does any point on the rod exceed that or what was NRC's thinking in setting those limits? And what I'm getting at is how receptive is NRC going to be to relaxing that.

>> DUNN: You should probably ask Bob Einziger this question by the way. So the limit now is basically the

peak rod temperature during drying can't exceed 400 degrees C unless you're low burnup fuel and then you have the flexibility of saying okay with this temperature my stress is less than 90 MPA so I can go to a higher temperature.

We recognize that in -- I think there's different ideas about the margins. Some of the calculations for the temperature were -- used some very conservative inputs and so when the high burnup fuel demonstration program when they loaded that cask they got nowhere near 400 degrees C. They just -- they just couldn't. And even though their model said you'll get pretty close if this is what you load they didn't get close to that at all and they instrumented -- they had I think 70 different thermal couples in that cask. So they had a range of temperature measurements across the diameter and the depth of that system.

So we recognize that the models you know have a lot of conservative built into them. And so that conservative could be taken out and you could gain some thermal margin that way. If you're talking about thermal margin of well we know at 400 degrees C it doesn't all turn to dust, we're looking at that for this. And you'll recognize in the history of the ISG-11 we've gone from okay short-term temperature limit during drying is -- was higher and then it was reduced when some additional data came in. So we're looking at the data that's available. As more data comes in and we'll evaluate whether or not that temperature can be adjusted upwards and gain some thermal margin.

>> BAHR: Other questions? Dan.

>> OGG: Yeah Dan Ogg safety -- I'm sorry; NWTRB staff.

This one, Darrell, is another pretty technical question.

You showed the ISG, I think it's ISG-3 that talks about burnup credit for low burnup fuel is that right?

>> DUNN: I didn't -- I don't think I cited ISG-3 --

>> OGG: You did.

>> DUNN: In the listing of the documents is that what I did with it.

>> OGG: I'm sorry ISG-11 Rev 3.

>> DUNN: That's cladding considerations that's temperature limits.

>> OGG: Hold on let me see.

>> DUNN: No I didn't talk to burnup credit.

>> OGG: Well my question, whichever ISG it is --

>> ISG-8.

>> OGG: ISG-8 does that cover burnup credit? Yes. Okay.

That addresses primarily low burnup fuel and using burnup credit to assist with the Certificate of Compliance of transportation for low burnup fuel. When you look at the existing fuel that's in storage at a number of the storage locations, there are quite a few spent fuel assemblies and a number of different canisters that can't meet the requirement you know the burnup versus initial loading curve. And so one solution to that is using burnup credit in order to show that your fuel can be successfully transported. But the guidance from the NRC addresses primarily low burnup fuel at this time.

Is there a sister ISG or some other guidance maybe in the new draft NUREG that addresses burnup credit for high burnup fuel or for BWR fuel?

>> DUNN: So it's been talked about for BWR fuel. But I don't know that that guidance development has -- I don't know that that's been done. So it's a good

question. I don't have a good answer for you. Because that's not the normal area that I work in. But I do know it's been discussed for BWR fuel. I can't comment on the high burnup fuel. I don't think that's addressed in the high burnup fuel NUREG.

>> OGG: Okay.

>> BAHR: Any other questions? Any questions for Darrell from the audience. Please.

>> Tammy Thatcher from Idaho Falls. As we have seen sort of the best case scenario for how many decades of transporting spent fuel to somewhere would take, it was you know maybe best case five decades. I can't -- between four and six or more decades. So thinking about the design life of the canisters and again how quickly stress corrosion cracking happens when you have chloride, when you have the conditions for it to occur which at some sites you definitely have, I guess what I see is the statement that at a facility a CIS at like a potential Holtec facility in New Mexico that if you have a leaking canister that the approach is going to

be to say, oh, the doses are low. Well, this is going to be continuing on for quite a while.

And I'm not so sure that the number of canisters leaking is going to be so insignificant.

Is DOE -- is NRC unwilling to consider a canister within a canister? If you find one leaking type of system. That's my question.

>> DUNN: Okay. So let me address just in general the CISCC stuff. The NRC has been looking at this for -- since probably 2005 and I was involved very early on in this in looking at the CISCC problem chloride induced corrosion stress cracking problem we understand there's a lot of bad information out there in the public domain about how fast cracking can occur. There have been multiple analyses that have been performed and you know the idea that you can get cracking of canister in less

than 20 years is not supported by any analysis that we would be willing to hang our hat on. It just doesn't occur that fast.

As far as the direct answer to your question canister in a canister approach, yeah, we would consider that. I think that's probably the last thing that a licensee would want to do for a number of reasons. It basically involves -- it essentially involves an amendment for a storage system because now your confinement boundary is now this outer shell that you're talking about. Then if you wanted to transport that canister in a canister afterwards you'll have to have a transportation system to accommodate that so you're talking about not only amendment to a storage application, you're talking about potentially amendment to a -- well you're certainly talking about an amendment to a transportation application, as well.

So that's a potential solution to a problem if you did find a canister that was leaking or that had damage. The most likely scenario there is you're going to find a canister that has aging effects and there's a concern that that canister may not be able to provide moderator exclusion in a hypothetical accident scenario. And so then you'll have to deal with that.

There are other repair technologies that are being looked at. The NRC is not developing those. Industry is developing those. We're aware of them. We're looking at them. But you know they haven't come in. And proposed that as a potential solution.

There are multiple industry reports on inspection technologies that are available. These are publicly available reports. I can provide that information to you.

>> (Off microphone).

>> DUNN: Huh?

>> THATCHER: There's no cracking inspections.

>> Can you use the microphone.

>> DUNN: No. The technology that's been developed now will examine for both localized corrosion and stress corrosion cracking any current inspection is the way that stress corrosion cracking is identified in stainless steels and this is the material we're talking about. That's the methodology that gets used. If you have deep cracks ultrasonic testing is the method that's used and both of those technologies are being looked at for different inspection systems. So the idea that there is no inspection technology that will work and nothing is -- can be used to inspect canisters is not a true statement. We know there's plenty of people out there in the public that profess that, and they get a lot of mileage out of that, and they get a lot of people listening to them but it's not true.

Any other questions?

>> BAHR: Okay if there are no more questions for Darrell, we do have a public comment period scheduled. There's no one signed up but if there is someone who didn't sign up who would like to make a public comment, I would invite you to do so now.

If not, thank you, all, for your attention during a long day. And you can watch this again on the webcast.