Transcript of the Proceedings of:

PUBLIC MEETING

IN RE: DIABLO CANYON DECOMMISSIONING ENGAGEMENT PANEL

September 18, 2024

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MR. ANDERS: All right, welcome everyone. I want to welcome everyone to the 29th meeting of the Diablo Canyon Decommissioning Engagement Panel since its establishment in 2018. I want to -- this is an in-person and also webinar format, and I want to let everyone know that the agenda, the presentations after the meeting, and a lot of resource documents, including links to a number of previous meetings on spent fuel management are on the Diablo Canyon website, and that is Diablo Canyon Panel dot org, and you can go there and you can see the agenda and all the resource materials.

I'd like to turn it over to Linda Seeley, a panel member, to welcome everyone. Linda.

MS. SEELEY: Thank you, Chuck.

Welcome to all of you people who came down here to Grover Beach tonight and to all -- everyone who's watching online this evening. We are going to have a very interesting meeting tonight, because everybody's big concern in this community is about spent nuclear fuel. We have a lot of it at Diablo Canyon,

it's going to stay there for a while. We don't know where it's going to go, and so we're going to dig deep this evening into what the actual possibilities are for caring for the long-lived radioactive spent fuel. I would like Dylan George to please review our safety protocol.

MR. GEORGE: Thank you, Linda.

Good evening everybody. Thank you all for joining us tonight. Big thanks to the City of Grover Beach for hosting us. By way of a safety message, we have exits on each side, each of these, that door exits into a parking lot, this door over here exits into another parking lot, that door right there exits toward the police station, which may be an advantageous place to go.

We have two officers here, Officer Pulido and Officer Alsaed from the Grover Beach Police Department. We thank them for being here. In the need of -- the event of a medical emergency, Five Cities Fire Department is two doors down. Several of us from PG&E are CPR certified. There is also an AED right through that door that some of us are trained to use. And also the restrooms are right down the hall through that door should you need to avail yourselves of them. So thank you all for being here.

MS. SEELEY: Thank you, Dillon.

I'm going to defer reviewing our agenda, because I think everybody here has an agenda in hand, and in -- to save time, we would like to move this meeting along.

Our first -- let's see. Oh, right. Be sure to go to Diablo Canyon Panel dot org to -- after this meeting to find the resources that we've listed, there are many great resources, and to look at all the work that we've done. We're very proud of our work. Patrick Lemieux is going to introduce our first speaker.

MR. LEMIEUX: Good evening, everybody.

Chuck, presentation please.

As we're waiting for my one-slide presentation, I will very briefly, while it's coming up, tell you what's -- oh, there we go. Perfect.

So tonight's presentation is about spent nuclear fuel storage which started with the Atomic Energy Act of 1954, which mandated three different levels of storage. And I wanted to highlight this because we'll be using acronyms towards this evening that will become confusing if you're not intimately familiar with this world. And so the first level of spent fuel storage, the one that's currently being used at Diablo Canyon and at most nuclear plants across the

United States is called an Independent Spent Fuel Storage Installation, an acronym that you'll hear called ISFSI, and basically what it means is that the fuel is stored on site, it goes from a cooling pool on site to the ISFSI also on site. And that was meant to be the very primary first level of spent fuel storage for nuclear plants.

The second level, once the ISFSI is filled, presumably, would be to send that spent fuel to a larger storage area that would be made up of multiple power plants called Consolidated Independent Interim Storage, Consolidated Interim Storage, or CIS. This was meant to be the second level of interim storage for nuclear fuel where it ultimately was meant to end in a national repository of all nuclear plant spent fuel. So tonight's discussion is where we stand with respect to these three different levels. And with no further ado, I'm going to introduce our first speaker, Steve Nesbit, who will tell us the history of these three levels of storage and a lot more information regarding it, so please enjoy.

MR. NESBIT: Okay, well, thanks, Patrick.

My name's Steve Nesbit, and I'm going to spend the next ten minutes giving you an overview of spent fuel management in the US, and I'm looking forward to

the interaction here. It's a lot of information, so I'll be running through it pretty quickly.

Yeah, that's the slide, please. So actually, you can go to the next slide now.

So this slide is another way of communicating information that Patrick talked about. On the left side, you see what happens today in this country, in the green boxes. You have reactors that use nuclear fuel assemblies to generate clean electricity, and once most of the energy in those fuel assemblies are used up, they're referred to as spent fuel or used fuel, and they're discharged out of the reactor during a refueling outage and into an on-site spent fuel pool. And they stay there for several years at least as they cool down, and then because most spent fuel pools are getting full at this point in the country, we transfer them into on-site dry storage. And what that means is we load a number of the spent fuel assemblies into a metal canister or metal cask, we dry it out, we back fill it with inert gas like helium, and then we put it out in the reactor out in the yard, inside the protected area of the reactor, and it stays there.

And that's what's going on at virtually all nuclear power plants around the country. Everything besides the green boxes is speculative at this point, it

hasn't happened. But ultimately, you see on the far right, the goal is to get spent fuel into a geologic disposal situation or a repository for permanent disposal. Possibly the fuel will be collected at one or a few consolidated storage facilities, or CIS's as Patrick mentioned, in between there, but that hasn't happened yet either. And I also put up a box for reprocessing, only because it often comes up in the context of spent fuel management, but here in the United States, we do not reprocess spent fuel from commercial reactors, and I think it's very unlikely that much if any of the spent fuels that have been generated to date will ever be reprocessed. Next slide, please.

So a little bit about geologic disposal. The idea here is that you take the spent fuel assemblies, you put a robust package around them, and you put them deep underground in a stable geologic formation, so that way the radionuclides there which pose a potential hazard to people will stay there and they won't get out to the environment for thousands and thousands of years, because some of these radionuclides stay radioactive for that kind of a time frame.

The concept on the left is a mine repository where you basically reverse mine, you drill down in tunnels and then place the material in tunnels down deep

below the surface. The second concept on the right is a borehole concept where you drill a deep borehole, a big borehole, and you put the fuel assemblies in there one by one and store them, you know, kilometers under the surface. Next slide, please.

A little perspective on geologic disposal. First of all, it is the consensus international approach, not just here in the US, I talked about mine and boreholes, even if you reprocess or recycle, which we don't in the United States, you still need geologic disposing, you still end up with radionuclides that are very long lived and have to be separated from the environment. Now, if you don't believe me, go to France, because in France, they do recycle their spent fuel, and they're also developing a repository.

You still need geologic disposal, if you have consolidated interim storage, interim storage is good for a long time, but it's near surface and it is not a permanent solution for spent fuel management. So for that reason, geologic disposal, I call it the linchpin of a viable nuclear fuel cycle back in. Next slide, please.

So here's a little history. In the 1950's, US was generating a lot of nuclear waste as a result of weapons production during the cold war, and more and

more of this material was building up in 1957, the National Academy of Sciences did a study on it. They found that the waste could be disposed of safely in a variety of ways and at a large number of sites in the United States. That was their conclusion in 1957, but it hasn't happened yet. After that point -- so the Atomic Energy Commission was responsible for all things nuclear in the country in that time, and they started doing research on disposal, and that carried on into the 1970's. The focus was on disposing of high level waste from reprocessing, but we started to accumulate commercial spent fuel in the 1960's as commercial nuclear power plants came online, and there was a growing concern among various agencies and the public about the fact that nothing was really happening in this area. Next slide.

In the 1970's, in 1970, the Atomic Energy Commission, or AEC, made a designation of some salt formations near Lyons, Kansas, as the site for disposal of solidified high level radioactive waste from reprocess. However, the geologic investigations were still ongoing and they showed that maybe the site wasn't as good as people thought for isolating waste, the public and governmental relations weren't handled all that well, and the AEC shelved their plans for a Lyons

repository in 1972. In the mid 70's, the federal government terminated all plans for large scale commercial reprocessing of spent nuclear fuel in the US, and the implication of that was that now instead of disposing of high level radioactive waste from reprocessing, we changed our focus to dispose of spent fuel directly. Next slide, please.

In 1982, congress passed the Nuclear Waste Policy Act which is still, as it's been amended, the governing law in the country for managing nuclear waste. It established geologic disposal as US policy and said we're going to do at least two repositories for that purpose. It assigned the responsibility to the Department of Energy where it remains, and it started collecting money from nuclear power plant operators to pay for it, like PG&E. And there was a big fund and there's a lot of money there because not much has happened.

Nuclear Waste Policy Act amendments were passed in 1987 because the progress wasn't going as fast as some people wanted, so congress said instead of trying to figure out what the best side is, we're just going to say that the waste is going to go to Yucca Mountain, Nevada, as long as it turns out to be a decent enough site. And so that ended the work on a

second repository, and further, in 2002, the secretary of energy and the president formally selected Yucca Mountain as the site after further investigations into geology. There was a veto by the state of Nevada which was not happy with this development, but that was overridden by both houses of congress. Next slide, please.

That's a picture of Yucca Mountain, it's about 90 miles from Las Vegas, it's in the Mojave Desert. It's adjacent to the Nevada test site where the US exploded about 900 nuclear weapons during the cold war, and as you can see, it doesn't look like a bad place to get rid of spent nuclear fuel. Next slide, please.

However, that's pretty much a moot point now. The Department of Energy submitted an application for Yucca Mountain repository in 2008 to the NRC, and the NRC began its safety review. However, DOE discontinued all work in 2010, finding that it was not a workable solution due to opposition in the state, and our safety review started back up again a few years later under a court order and actually came out with a favorable safety evaluation, but by then, the operation was a success but the patient had died.

Congress hasn't appropriated funds for Yucca Mountain since 2010, but it hasn't amended the

Nuclear Waste Policy Act, which leaves us in the curious situation that we have a national law on what we're supposed to do with nuclear waste, but congress won't allocate the money to carry it out. No administration has requested funding for Yucca Mountain since 2018, and we quit doing work on geologic disposal. Other countries are making great strides, Finland in particular is already constructing its repository, but we're basically not doing anything on geologic disposal. Next slide.

I'm going to shift gears for just a second and talk about consolidating interim storage, this is what you're probably going to hear more about during this session of your decommissioning engagement panel. Consolidated interim storage is, as Patrick described, a situation in which you transport spent fuel from reactor sites to one or more large storage facilities. They can be a big pool, they can be dry storage, but in the US concepts, typically we talk about dry storage for consolidated interim storage, because the fuel's mostly already in dry storage containers.

The Nuclear Waste Policy Act amendments in 1987 provided for consolidated storage at government facility and a method of finding a site for that. However, the program was discontinued in the early

1990's without finding a site, primarily the problem was state opposition. In the meantime, there's been three private facilities actually licensed in the United States by the NRC for consolidated interim storage, one in Utah in 2006, one in Texas in 2021, and one in New Mexico in 2023. None of the construction -- the Goshute facility in Utah is pretty much history at this point, and the others are stalled by state opposition and legal action. And the moral of the story is that while you may find a local community that's willing to host a consolidated interim storage facility, getting state approval is much more difficult. Next slide, please.

So in summary, a few points to reiterate. First of all, the US government is responsible by law for spent nuclear fuel management, and that includes taking the fuel away from reactor sites and ultimately disposing of it. Unfortunately, the government has done nothing productive since 2010 when it canceled the Yucca Mountain repository project for political reasons. Utilities continued to store spent nuclear fuel safely at reactor sites in spent fuel pools and dry storage systems. And speaking of dry storage in particular, it is a proven technology that can work indefinite, if needed, but it's not a permanent solution for the

problem.

So I'm going to stop there, and I don't think we're going to take questions now, but I'll stick around for a while if there are questions that come up later. I'm not going to stick around until the end of the meeting because I'm on the east coast, but thanks for the opportunity to address now.

MR. LEMIEUX: Thank you, Steve. I really appreciate your talk. And I should emphasize that Steve is a past president of the American Nuclear Society, that makes him a prominent expert on the topic that he talked about.

Back to you, Linda.

MS. SEELEY: Thank you, Steve, and thanks, Patrick.

Next, we are going to have an overview. I know that every -- all of our people who live here and are interested in this topic are mostly interested in our local nuclear waste, how much is it, how much do we have, how is it stored, and what are the plans for it, and Al Bates of PG&E is going to give us the low down on that.

MR. BATES: Thank you for that introduction. Can you hear me okay? Okay, very good. Thanks for that introduction. I'm just going to index here. We can go

to the next slide, please. Oh, great, okay. Next. Okay, let's stick on that slide a minute.

Importantly, there's two facilities where spent or used nuclear fuel is stored. One is in the fuel handling building, which by the arrow, as you can see, it's kind of like east of the twin domes, which are the containment buildings. And then a second storage location is what we call the ISFSI, and we'll talk about what that acronym means in a minute, and that's up the hill and to the east of the plant, so that's to kind of orient yourself. Next slide, please.

Okay, we're there already, sorry, go back one. Very good. So let's talk about the wet storage and the spent fuel pool. So Steve Nesbit, our earlier speaker, talked about, you know, how fuel is stored and talked about the wet storage and the dry storage, so this is actually one of the pools at Diablo Canyon. What you're seeing there on the left-hand side in the picture is approximately 20 feet of ultrapure water, and then below that are these things that kind of look like egg crates, those are actually the racks where the spent fuel is stored and -- thank you -- and kind of towards the center of the picture into the bottom, you see kind of a big round kind of like almost looks like white ring, and then there's, again, an egg-crate structure. That is

actually a multi-purpose canister, it's the dry fuel storage canister which will become dry later, and I'll show you how that process works. And then kind of hovering above, it's actually being suspended by a crane, it's actually a spent -- or used nuclear fuel assembly. That assembly is about 12 feet long, it's about 10 inches by 10 inches, so that kind of gives you some idea of scale there. Again, you're looking through 20 feet of ultrapure water, and the workers are obviously safe where they are, above there, handling that spent nuclear fuel, because the water provides shielding from the radiation.

So we have 20 years -- enough space in these pools for 20 years worth of the used nuclear fuel, and periodically, we move some of that fuel out of the pools and into dry storage, and I'll talk about that in a minute. And this allows us to free up some space in the pools to be able to do what's called a full core offload, which is being able to remove all the fuel from the reactor core and putting it into the spent fuel pool and still having plenty of room for the additional fuel that's stored in there.

Okay, so let's see, I'm going to try this myself. There we go, okay, I'm flying. Very good.

So this is the ISFSI, and of course, nuclear

folks love using acronyms, so it's the Independent Spent Fuel Storage Installation, and this is what we called earlier dry storage. So I wanted to point out a couple things in the picture before I go through the words. So in the picture, you see up at the top a big blue pool, it's actually a pool of water, it has nothing to do with the ISFSI. The ISFSI is dry storage and it doesn't -- it's not reliant on any type of pumps, valves, any type of mechanism whatsoever. The fuel is stored in a dry condition, and heat is removed from the fuel by just natural convection, just like a chimney works.

MR. JONES: And if I could just add, I don't want people to confuse that with the spent fuel pool either that's in a separate structure.

MR. BATES: Yes, good, that is not -- there is no spent fuel in there; that is just a pool for raw water storage.

So in there, you see a bunch of -- kind of to the upper right-hand corner, starting, you see a bunch of little dots. Each one of those dots is actually where a dry storage multipurpose canister resides, which is inside a fairly massive shielded container called a HI-STORM. I'm not going to go through the acronym on that because it's not important, it's just a big shielded container. Right now, we've -- and again,

the -- the ISFSI itself has enough storage for the total 40 years worth of storage, and right now, we're coming up on about half full. So we've safely moved dry storage canisters to the ISFSI, seven loading campaigns, we're actually on our eighth loading campaign right now, and as of today, we have 65 storage casks, which includes the seven casks from the ongoing campaign we are in right now. And that's a total of a little bit over 2,000 used fuel assemblies being safely stored up at the ISFSI.

So right now, we're involved with a campaign to move a total of 12 casks up to the ISFSI from the spent fuel pools, that picture I just showed you, and that's going to be a total of 384 used fuel assemblies. And right now, we have five more casks to go. So at the end of the campaign, the ISFSI -- so in a few months, the ISFSI will contain a total of 70 casks, which is about 2,240 used fuel assemblies, and as I said earlier, that's half full, so there's another 70 positions that are vacant right now by those little round dots you see there. Okay, I'm going to move forward.

Okay, so now here's how the used nuclear fuel gets up to the ISFSI into dry storage, it's a fairly complex process, it takes us about six days to move one canister of fuel from the pool to the ISFSI. It starts

off with the -- as we saw in the earlier picture, it starts off with the multipurpose canister being installed into the pool, so from there, we can then install the used fuel assemblies. And the picture on the left-hand side shows, actually, the multipurpose canister, it looks like a little grid or a matrix of holes, and then there's kind of like a white circle, and then hovering above that, attached to the crane, is actually the lid for that multipurpose canister. So the lid is being installed in the water, again, we're looking through 20 feet of water here.

So the lid's being installed, ultimately when that crane lowers, that kind of silver disk that's in the water will be all the way down and on top of that egg crate looking thing that's in the round circle. Now, on the right-hand side, you see that -- that the multipurpose canister with the shielded container with the lid on is being removed from the water. Right now it's about one-third of the way out, and as you can see, the workers are all safe because the shielded container is massive, it's a massive steel container that provides all of the shielding needed to keep the workers safe. They're actually hosing down the container to get pure water and ensure if there were any contamination on the canister that it would all be washed off before they

bring it out. And they take great pain to survey the canister and make sure there's no residual radioactive particles on it. Okay, so one canister is six days total from start to finish. So there's -- there's 31 fuel assemblies inside the multipurpose canister.

So now, the canister has been fully removed from the water, and it's brought over to what we call the cask wash-down area. So it's in a seismic restraint, so there's actually a big band around it that's anchored to the wall so it can't fall over or anything, and in the picture on the left, you can see the cylindrical shape of the -- what's called the high track, which is the shielded container. Inside that is the multipurpose canister, and attached to the multipurpose canister are hoses, one is an input, one is an output. Through those hoses, helium gas is -- is injected and removed and we -- actually, the process heats up to the point where any water that could be -- remain inside the multipurpose canister is dehydrated and dried, and then we have a wait time to ensure that all -- any residual water is completely removed. So at this point, the canister is truly dry, okay.

The picture on the right-hand side shows what we call the weld head. The canisters -- the lid is placed in the pool, it's obviously not welded at that

point, but at this point, we're welding up the canister and the canister is completely seal welded, every opening and even the -- where the hoses were connected to is sealed up and welded up, so there's no possibility of any interaction between what's inside the canister, which are 31 fuel assemblies, which are very large structures, and the outside environment. All right, we're moving on.

It is very interesting, you know, and it's a fascinating process.

So, now, this is the final step, so before I talked about that shielded container coming out of the pool, up at the ISFSI pad itself, we have a transfer facility where we transfer the multipurpose canister, which is containing the spent nuclear fuel, the used nuclear fuel, we transfer it from the temporary shielded container to the permanent shielded container which is called a HI-STORM. What you see in the picture is a whole array of HI-STORMs. These are those little gray dots that you could see earlier when we saw the overview of the ISFSI itself.

Now, here's one being put into its final place, and if you look closely down the bottom of this picture where the workers are standing, you can see what looks like big circles with -- well, they're actually

massive bolts that are sticking out of the concrete, they're bolt hole locations. And when this HI-STORM containing the spent nuclear fuel is bolted into this location, it's completely bolted all the way around, it's secured and tensioned, so it's impervious from earthquakes or any type of other disturbances. This is fairly unique to Diablo Canyon. Other sites actually just store them, have them sitting on the pad. In this case, we, with our seismic environment, we take nothing to chance and all of our storage containers are bolted.

So let's talk again, a little bit about -- okay, I've got to move it. Okay, so let's talk a little bit about used fuel storage. Again, we have wet storage in the pools, we have dry storage at the ISFSI, and in the future, as was discussed a little bit earlier by Steve, we have the possibility of the DOE at some point taking our spent nuclear fuel. I got to move one and two. Okay.

So we have a total of 60 years worth of fuel storage locations. We have 20 years in the pools, and we have 40 years on the pad. And as I mentioned earlier, we've only used 20 years worth on the pad right now. So each refueling, we place used fuel into wet storage, it comes right out of the reactor and goes into the spent fuel pool, and that's where it resides for a

while. There's a cooling-off period of several years. Used fuel will start being removed approximately two and a half years after we enter decommissioning, and as I mentioned earlier, each pool holds 20 years worth.

In dry storage, every 3 years or so, and this happens to be one of those 3 years, we move 8 to 12 canisters, multipurpose canisters, to dry storage, and it holds up to 40 years worth of used fuel. So incidentally, the reason why we call them multipurpose canisters is kind of interesting. Multipurpose canisters were an industry effort several decades ago which allowed the industry to get together and figure out what is the best way to -- to store our spent nuclear fuel so they could be immediately transferred to a DOE facility, so hence the term multipurpose canister, it's one, it'll be stored here, but then it can also be stored at a DOE facility if the DOE chooses to store our fuel in that manner. In other words, there would be no reason to un-can it and put it into another storage system, although it could be enveloped into another storage system.

So the future options, for the sake of time, I'm not going to talk about too much, because we will hear about this a little later, but there is some pretty strong bipartisan movement forward on the consolidated

storage. In my career, this is probably more movement than I've seen in quite a few years. And a lot of people say well, how are you going to get it there? And used fuel is routinely transported across the country, mostly defense fuel, but certainly, commercial fuel has been in the past transported across the country, and so this is not a new thing, and it can be done safely, and there will be a demonstration project in 2027 to actually demonstrate being able to transport high burn-up fuel from one location to another, and this will prove that high burn-up fuel can be safely transported which has been, you know, an industry question for a while. So last slide.

So I wanted to touch on three scenarios. The first is if we enter decommission, you know, essentially next year. So we would take the fuel from the reactor and put it in the spent fuel pool and let it cool down, we would then start unloading fuel from the spent fuel pool, those fuel assemblies that are capable of being removed. And then at about two and a half years, we would remove the rest of the fuel and put it into storage. It's a fairly long process, as I said before, remember I said about every six days, we could do a fuel assembly, so it will take a while.

So if we entered decommissioning in 2030 with

license extension, we'd really just continue doing what we're doing, it's a status quo. And then we'll continue to review and assess our storage options for post-decommissioning period, because at this point, no actual action is needed on our part. We know that in the future, we will be making decisions relative to storage, but until we're closer to the decommissioning date, we can -- we have the -- we're afforded time in order to make assessments of how we would store all of the fuel coming out of the pools.

And then, you know, scenario C is hypothetical, because we don't have license extension beyond 2030. But as was discussed earlier by Steve, there is a potential for moving fuel from a lot of nuclear facilities off site into a DOE CIS. And that's my presentation. So questions later.

MR. ANDERS: Do the panel members have any questions? Patrick, and then Michael, then Linda.

MR. LEMIEUX: Thank you, Al, for the presentation. I have a couple of -- I have two questions and I'm going to ask them to you at the same time to save time. First, you mentioned high burn-up fuel, but that's not really defined. I'm wondering if there's such a thing as low burn-up fuel in contrast to it and how that compares to Steve Nesbit's presentation

of high level waste, are those both one and the same? And second, we know that a little over a year ago, PG&E changed from the Holtec HI-STORM system that you spent this presentation talking about to a new manufacturer of multipurpose canisters with the big difference that the orientation of the canisters is now horizontal instead of vertical, and I'm wondering if you could say a few words about how that affects the long-term storage that you've talked about.

MR. BATES: Right, good. So high burn-up fuel is fuel that's been through the reactor quite a few times, and there's actually a number of -- it's -- a reactor engineer understands it, but for the sake of expediency, it basically means that the fuel has been in the reactor a long time, and when fuel is in the reactor a long time, there's effects to metal and other things, and so the high burn-up fuel was a concern or a consideration within the industry, a lot of testing has been done, and the concern is that the fuel would not stay integral either in the transportation process or when it got to its final destination. So the industry has spent a great deal of time on it, lots of research has been done on it, and this actually the final step in that very deliberative process to show that high burn-up fuel can indeed be safely transported from one location

to another. This transportation package which the DOE has designed has all kinds of instrumentation on it. It'll measure how many G forces it's received, and it will also indicate the integrity of the fuel inside, and the fuel will actually be taken out at some point and validated that it remained integral. It's a key step, because there are some high burn-up fuel assemblies at almost every site around the country, and this will just ensure that all of our theoretical calculations are actually manifested in reality.

And then high level waste is more attune to if you did reprocessing and you separated out the material from all of the rest of the isotopes, high level waste is really that subset of things and it doesn't -- typically wouldn't have the same form as our used fuel has, which is a very solid -- you know, a structure 10 inches by 10 inches by 12 feet. High level waste could take many forms, it could be vitrified glass, hopefully not a liquid, but it could be other things. We don't deal with high level waste at Diablo Canyon and we don't generate high level waste. Do you want to --

MR. ANDERS: We need to move on.

MR. LUCAS: One thing I wanted to say that you didn't mention is those casks are periodically inspected to look at the corrosion and the bolts and things like

that, and so far they've been successful, I saw one of those myself.

MR. BATES: We can literally spend an evening just talking about aging management.

MR. LUCAS: But looking at your scenario C, I mean, obviously the people in the room, and this is my biggest concern, is scenario C-5, or whatever it would be, assuming you go on the 20-year license that's been applied for, although the state hasn't endorsed it, you would need more ISFSI if there is no temporary storage, correct?

MR. BATES: At some point, in the process of decommissioning, which again is, you know, it's five years, normally five years from now, if the license gets approved, we would have to evaluate that, and there are technologies that could be applied. I think last December I talked a little bit about this. We can actually increase the density and getting back to the Aronno question. We could actually increase the density of our storage and just go with, you know, what we have. So it will be dry storage, I can ensure you that, because eventually, we will want to take all the fuel out of wet storage and put it into dry storage before we could complete decommissioning.

MR. LUCAS: But you don't have any studies

that we've seen, but you have done enough work to know that the area that PG&E will control when decommissioning begins is satisfactory to store the other fuel that might be there in dry casks?

MR. BATES: So the amazing thing is thinking back to that first picture, that's the -- that area of the ISFSI can contain 40 years worth of nuclear fuel from two very large generating units generating clean power, so it's a small footprint. You know, it basically comes down to the fact that it's a small footprint to store the spent nuclear fuel, and there's many technologies we can employ.

MR. LUCAS: Thanks.

MS. SEELEY: Thank you, Al. When was the last time you moved spent fuel into dry storage before this?

MR. BATES: It was about I think five years, about five years ago. So we were a little -- we didn't do it in the normal kind of three-year cadence, and really, that was because we were heading to decommissioning.

MS. SEELEY: Right. And another thing is that you said that -- in the slide, it said that if you go into 20 years extra operation beyond the license that it will be the same scenario as if -- as like if you were going to close down now, I don't quite understand what

that means.

MR. BATES: So if we went 20 years beyond, remember we have 60 years total worth of storage, so for example, I don't have to go and find more space for my fuel for an extra 20 years. We already have 60 years worth of storage on site. Eventually, we'll want to get it all into dry storage, and at that time, we can address that issue, and certainly, the dry storage systems that we're using now would be capable of doing that.

MS. SEELEY: So you're saying that you have 40 years storage on the pad, 20 years storage in the pools?

MR. BATES: That's correct.

MS. SEELEY: Right. And your plan would be if you get the extension of the license to put the fuel into the pools and then hope to be able to get a permit to build another ISFSI maybe?

MR. BATES: I mean, that's far in the future after we would, you know, be in decommissioning if that was the 20-year period. In the interim, we can easily store all the fuel we have in the pools, we've got ample room, right, so we don't have to move it to dry storage immediately. 40 years plus another 20 years, 60 years total.

MR. JONES: I'll just take on the regulatory

part of that, Linda. The 20 years is quite hypothetical at this point. We don't know what X is yet, right, we have a volumetric storage problem that depending on how long we run will determine how we modify the dry cask storage pad. That location, we would use the existing licenses and permits and amend them. So remember, from decommissioning, the only component of storage that's part of the EIR or the decommissioning plan is the greater than class C waste. What we've always looked at is that we handle the dry cask storage facilities both at Humboldt and at Diablo Canyon as separate licensed and permitted facilities, because obviously we see their lifetime is much longer, right, so we look at them on a longer term, but again, we don't know what the volume is yet.

So that will drive that ultimate decision. Look for it to be in that upper plateau, that 310-foot area, and as Michael had asked, how does that work with the future? We have plans to isolate that area for both maintaining transmission and dry cask storage and water storage in the future separate from what happens down below where the power block and the marina is today.

MR. SEVERANCE: Can I ask a corollary question about this just like five seconds? Yeah, yeah. I mean, isn't it conceivable that, you know, we could have CIS

established somewhere in 15 or 20 years and you wouldn't need to build an ISFSI even if you ran for 20 years more?

MR. BATES: Correct. Just to give you an idea, and Manuel and others will talk about this later, but if CIS is available to us, we will certainly take advantage of it.

MR. SEVERANCE: Okay.

MR. HOUGHTON: I had a short terminology question. When you were talking about high-burn fuel, you mentioned the fuel must remain integral, and I was just hoping you might translate that for the rest of us. What does that mean?

MR. BATES: So there were fears, and this goes back 20 years, that the fuel would become more brittle, the rods themselves would become brittle, it's a metallurgy issue, it has to do with the neutron flux hitting into steel, or in this case it's inconel, so that's been proven to be hypothetical in nature by laboratory tests and the demonstration test that's going to be shown because of our confidence in the research that's been done. This will just be the final stroke to show that high burn-up fuel can be safely moved around the country.

MR. HOUGHTON: And just keeping it all

together so it doesn't fall apart?

MR. BATES: Yeah, so you want your package to remain integral, you want all the fuel to -- that nice 10 inch by 10 inch by 12-foot structure, you want that to look exactly like that when you take it to its final destination.

MR. HOUGHTON: You've answered it, thanks.

MR. BATES: Sorry about the interval.

THE COURT REPORTER: Sir, can I get your name, the gentleman with the yellow shirt?

MR. ANDERS: I'm sorry, we'll have some questions after, but we need to move on to this next agenda item.

THE COURT REPORTER: This is the court reporter. I just need his name real quick.

MR. ANDERS: That was Dave Houghton that just asked the last question.

THE COURT REPORTER: Thank you, sir. How about the gentleman on the podium, what was his name?

MR. ANDERS: I will work with you after this meeting to identify the people if there's a problem. So...

THE COURT REPORTER: Okay.

MR. ANDERS: Thank you for your help, though. Appreciate it.

All right, Linda, you want to bring us into the next topic?

MS. SEELEY: We're moving now into the national spent fuel storage efforts to create a repository for national -- for our whole nation, and Paul Murray is going to be speaking to us about this. He is the deputy assistant secretary of the Office of Spent Fuel and High Level Waste Disposition at the US Department of Energy.

Paul, are you here?

MR. MURRAY: I am.

MS. SEELEY: Okay, thank you.

MR. MURRAY: All right. First of all, thank you for inviting me to talk this evening. I'm actually sorry I'm not there in person. I'm actually in Idaho, I've been watching a Navy transportation demonstration today. I'm originally from the United Kingdom, I have 44 years in the commercial nuclear industry, and in 1986, I was working on the UK commercial reprocessing plants and also supporting overseas commercial reprocessing plants. In 1996, I moved to the US with my family. In 2007, I joined Areva, which is a French reprocessing company as part of the Global Nuclear Energy Partnership, looking at reprocessing of commercial spent nuclear fuel in the US.

In late 2023, I joined DOE, so just over 10 months ago, I joined the Department of Energy. I'd like to start my talk by saying as we sit here today, talking, there are no technical issues stopping me from executing my program, it's just building public and political trust to actually go out and basically do my job. So next slide, please.

So in the US, there can be 94 operating reactors at 28 different states. We also have 20 reactors that are completely shut down, and in some cases, those reactors are being decommissioned, and all that remains at the sites now is spent nuclear fuel. So today, as we sit here, I'm responsible for 95,000 tons of spent nuclear fuel that has been discharged from reactors. At the end of the current operating life of the reactors that we have today, not new reactors, not advanced reactors, but the current reactor fleet, there will be 140,000 tons of spent nuclear fuel. Next slide, please.

I'm also responsible for the DOE high level vitrified waste, so this is liquid waste from reprocessing that has been turned into glass. Each glass canister is approximately 2 feet in diameter and about 14 and a half feet tall. They are being made at Hanford in Washington state, potentially at Idaho, at

West Valley and upstate New York, at Savannah River in South Carolina, and in total, we are planning on moving 21,000 canisters of vitrified high level waste at some point in the future. Okay, next slide, please.

So this is the history, and we've heard a lot about the history tonight from several of the speakers, I'd just like to call out a few things. The Nuclear Waste Policy Act that congress put into place in 1982 made DOE enter into a contract with the utilities to manage to spent nuclear fuel, so it's a binding contract, and the utilities actually paid us to manage their spent nuclear fuel, and the money went into what was called the Nuclear Waste Fund. Today, the Nuclear Waste Fund stands at about $47 billion, and each year, due to interest, we accrue about another billion dollars into that nuclear waste fund.

In 1998, into the contract, we were supposed to start picking up the spent nuclear fuel from the US utilities, that didn't happen. In 2010, congress defunded the Yucca Mountain project, and then at that time, there was over 200 federal employees working on the Yucca Mountain project. Congress defunded it, a small number of those people moved into the Office of Nuclear Energy. DOE Nuclear Energy is primarily a research organization. So for the last 14 years, we

have been doing -- conducting generic R&D.

In 2014, the utilities basically stopped paying into the Nuclear Waste Funds and then started to sue DOE for partial breach of contract for not picking up the spent nuclear fuel. So every single year the federal government is sued by the utilities for not picking up the spent nuclear fuel. Next slide, please.

So here here's the liability table. The liability table is published every year. The liability only deals with the cost of not picking up the commercial spent nuclear fuel. It does not take any account of the liability for the DOE fuel or us not picking up the high level waste canisters or us managing the Navy spent nuclear fuel. So the first column, so in September of 2023, the estimated total liability was $44.7 billion of which the federal government had paid $10.6 billion. Last year we paid $500 million, and our estimate of our liability, outstanding liability moving forward, is $34.1 billion. So every year DOE does not take title and ownership of the fuel, we can be sued. Okay, next slide, please.

So what are we actually responsible for? So DOE is responsible for transporting the commercial spent nuclear fuel to an interim storage facility, and then if the country then decides we need a repository, we will

be responsible for moving it to a repository. We are also responsible for picking up the DOE high level waste, the DOE spent nuclear fuel and moving it to a future repository. The Navy will move their own spent nuclear fuel to a future geological repository. To give you some idea of the time frame, we're hoping that an interim storage facility will open in 2038. 140,000 tons of spent nuclear fuel, even if I can move it at 3,000 tons a year, it will take me 50 years to move all the spent nuclear fuel in the US to a consolidated interim storage facility. Once I have the repository open, it will take me another 50 years to move the fuel to a repository, then I have to move the DOE high level waste, the Navy fuel, and the DOE fuel, and then I have to leave the repository open for 100 years. So this is probably a 200 to 250-year program, once we seriously get going on the program. 250 years ago, George Washington was still alive. Next slide, please.

So what are we doing? This is actually a good news story. So we are funding 13 consortia to go out and start raising public awareness of what spent nuclear fuel and high level waste is. So there's been several meetings around Diablo Canyon, as you can see, consortia are trying to reach out across the country. The problem is there's 370 million people in the US, and we have 12

consortia starting to reach out and talk to people. Next slide, please.

This is published on our website each year -- each month. So people want to know what we're up to, what we're spending the money on in consent-based siting. So we have 13 consortia, I have 5 federal members of staff working on consent-based siting. The two takeaways that we need to take from this particular slide is two schedules, the two time lines on the bottom. The bottom right shows you where the consortia currently are in their contracts, they're over halfway through their contracts. On the left-hand side is the schedule for DOE. We are currently preparing the sites and criteria for future facility. Next year, we will go out with an RFI, looking through it, for those communities to come forward. Next slide, please.

This summarizes what we're doing. Between April and June, we'll prepare all the documents we need, cites screening criteria, starts really through the average, July through September, the expression of interest will be released. We recognize that some communities and some stakeholders are not prepared to respond against a formal DOE discussion of interest, so we will do a second call to make sure we have equity and people are interested in coming forward. Then DOE will

start to review it and then start to move forward. Next slide, please.

Federal consolidated interim storage facility. In May of this year, we passed -- we became a DOE capital acquisition project, so we are now a formal project within DOE, the design is proceeding on schedule, the liability estimates I showed you assume the facility opens in 2038. It's initially sized to take 20,000 tons of spent nuclear fuel, and it's scalable. We are currently authorized to look at one or more consolidated interim storage facilities.

Looking at the US, I estimate we need about five interim storage facilities. It will be in Nuclear Regulatory Commission license sights, so we're designed to obey requirements so the facility and design will be safe, but DOE will become an NRC licensee and we have to have the organizational culture to allow us to design and operate this facility. Next slide, please.

How are we going to move the fuel? Great question. One of the things -- there's several things we found from consent-based siting, some initial findings are that one, people believe that consolidated interim storage without a geological repository won't happen, people are worried that then the sites then become the de facto repository sites, people are worried

about moving spent nuclear fuel, okay, how are we going to transport it safely? And the third thing that we found out is some of the communities that currently have spent nuclear fuel aren't so interested in that spent nuclear fuel going away. So DOE in collaboration with the Navy developed what we call the Atlas Railcar, it is the safest railcar in the US for transporting spent nuclear fuel. It's fully instrumented, we can tell if anything's going wrong with the railcar, and in summer of 2024, this Atlas Railcar was certified by the Association of American Railroads to transport weights up to 480,000 pounds, so each railcar can transport one spent nuclear fuel cask. In a consist, we will transport between five and seven casks at a time, okay. Next slide, please.

The high burn-up demonstration project, we heard about this earlier. It is currently supporting the long-term storage of high burn-up fuel, so that's fuel that's been in the reactor a long time, and a lot of the energy's been extracted from it. Most fuel that's discharged from reactors now is high burn-up. This one demonstration cask is currently supporting over 60 of the current commercial fleet. To say that nothing is happening to the spent nuclear fuel is tremendously boring, literally nothing's happening in the cask.

In 2027, so just over two years time, we are looking at moving this cask, which contains 15 tons of fuel, from North Vanner in Virginia to a new home. So we're currently evaluating potential DOE sites where we can take this cask. We are going to open the cask, we will take the fuel out, we will examine the fuel to show that everything's good, nothing's happening, we'll put all the fuel back in the cask and then have someone else put that cask to be used on to help me with the disposal problem. Next slide, please.

So as I've said, people are worried about transporting spent nuclear fuel. I just saw the Navy demonstration today. The Navy has done over 900 shipments of spent nuclear fuel from the west coast to the east coast to Idaho. Their package is actually bigger than any of the commercial packages that are on the rails. Well, we recognize that the general public is worried about this, so we put together the idea of doing a package performance demonstration. We will take a spent fuel package, and we will drop it, crash it, set it on fire, drop it in a lake, push it out, put it on the back of a railcart, drive it off into the sunset. There's currently an expression of interest on the street, there's webinars from my group asking for public feedback on this demonstration. What are people most

worried about in the transportation of spent nuclear fuel? If we can get a consensus on what people are worried about, then this demonstration, which is going to take place over a period of five to seven years, we will try and address those fears and concerns. Okay, next slide, please.

Geological repositories. The US has not decided that we need a geological repository. As Steve said, every other country has a nuclear program, with the exception of Spain and the Ukraine, they do not have a repository program, everybody else does. So at the moment, I am conducting, looking at all options in line with the Nuclear Waste Policy Act. I will continue to support international R&D where people are building real repositories, if I can do stuff which I can learn from, I am supporting. I am going to try and send my DOE engineers and managers to work on international projects.

I'll also try and work with US industry to build capacity so that when we do decide we need a geological repository, we can move forward quickly, all right. Next slide, please.

So in conclusion, what are my risks? Communication and controlling the message. This is a very sensitive subject, very politically sensitive, very

sensitive to members of the general public. Schedule slip will be effective to the US taxpayer. In the last ten years since the Office of Civilian Waste Management was shut and we moved to DOE NE, the schedule has slipped 17 years, and we are at risk, we don't get funding, we don't get people, that schedule's slipping significantly again, adding billions of dollars to the liability. I'd like to point out when Yucca Mountain was going, there was hundreds of federal employees. My total federal team trying to do all these different projects is 24 people.

We've got to educate stakeholders and their business of long term projects. This is an over 200-year project from when we start to when we put the final fuel into the hole in the ground. When to amend the Nuclear Waste Policy Act? The Nuclear Waste Policy Act as written does not allow me to build a consolidated interim storage facility. I can license it, I can't build it. I also cannot look for a second repository, all right. I also cannot look for a second repository. What we're trying to do is we're trying to build trust with members of the general public and on Capitol Hill to show that we are making slow but steady progress to deliver on our requirements, and then hopefully next year, we can start to address about changing the Nuclear

Waste Policy.

Okay. That is a very quick summary of my program and where we're going. In the last ten months, we've really turned the program around, primarily from being an R&D program into a focused program which is all interlinked and then we'll drive towards what's a common mission. We are making progress, we have the railcar, the personal design, we're releasing expressions of interest for engineering support, also from the feedback on the package, and we're planning to do the demonstration cask in 2027. With that, I'll stop and take any questions.

MR. ANDERS: Thank you very much. We've got about five minutes for the panel if they have any questions of Mr. Murray. Michael and then Patrick.

MR. LUCAS: Thank you, Mr. Murray. That was a lot of really big numbers there. Could you just clarify for my own benefit, you said the Navy's doing about 900 shipments. Are those the five to seven casks at a time, or what does that mean?

MR. MURRAY: So the Navy in total, the nuclear Navy, after the submarines or aircraft carriers have decommissions, they remove the spent nuclear fuel from the reactor put it into a package, and then transport it to Idaho where they basically repackage it and store it,

waiting for a geological repository to open. So in the history of the nuclear Navy, over 900 shipments have safely been made from the west coast and the east coast to Idaho.

MR. LUCAS: Thanks, okay.

MR. ANDERS: Patrick.

MR. LEMIEUX: Thank you for the presentation, Paul. I also want to add that, you know, your talk at the Nuclear Energy Institute Conference back in the spring along with Steve Nesbit has impressed us enough that that's why we want to invite you guys here, so thank you for coming. And you've talked about the impressive steps you've made to make the transport of these wastes as safe as possible and the process for doing this, but I can't help to wonder where are they going? What are the potential CIS sites that you now have in mind as well as the potential national repository site that you have in mind, given that Yucca Mountain is not happening? Arguably, I would think those are the questions that concern our constituency the most at this point, what possibilities are there on the horizon for those?

MR. MURRAY: So for the consolidated interim storage facility, we will go out for an expression of interest for interested communities to come forward.

Not to make a commitment to take the fuel, we are not committing to send the fuel there, but we are going to follow the consent-based siting process for host communities to come forward. At this moment in time, the US does not have the commitment to build a future geological repository. That's a decision that has not been made.

MR. LEMIEUX: But are there any potential sites that are being considered, are there some that you're able to share that are in the process of being considered?

MR. MURRAY: So based on the work that's been done since the late 1950's, the only two states in the continental US that are not suitable for future geological repository are West Virginia and Idaho. Every other state has suitable geological media.

MR. ANDERS: Linda.

MS. SEELEY: Thank you, Paul. One quick question. You talked about shipping it by rail, but you didn't mention anything about how, say, at Diablo Canyon, how we would get it to the rail. And about the -- I think about -- according to the Department of Transportation, I think over 50 percent of our bridges right now are getting a D in their scorecards for being strong enough. So you're talking

about a quarter of a million pounds. How do you get that from Diablo Canyon to a railroad?

MR. MURRAY: So what we do -- that's a very good question by the way. So what we've been doing is we've been doing what's called the inventory study, so we can actually get them going to the shutdown reactor sites, and we're looking at the infrastructure that exists to look at actually being able to move the fuel off that site by -- by rail, by road, by barge, you know, to actually get it off the site, and then we've been doing hypothetical studies to show that we can actually move it by rail to a fictitious location in the center of the US, just to make sure that there's no show stoppers, and so that's what we've been doing. So when Diablo Canyon's turn happens, we will do the inventory study, make sure the infrastructure of the site was suitable, that the transportation routes were suitable, and then that would be how it went. The 12-axle railcar has been designed with 12 axles to distribute the load so it's not the heaviest weight on the rails at this moment in time.

MS. SEELEY: Thank you.

MR. ANDERS: We have two people that would like to ask questions. If we could make it quick, Dave, and then Bruce, and then we'll move onto the next

agenda.

MR. HOUGHTON: Yeah, I'll continue to be the terminology police here. You brought up the term consent-based siting, and that may be the first time that some of the audience has heard that term, and can you briefly describe what that is and how it differs from what was done in the past.

MR. MURRAY: So in the past, so Yucca Mountain congress was the final congress chosen for the Yucca Mountain site, as for final repository. We were then selecting sites, there's three sites, and then congress amended the Nuclear Waste Policy Act and just said "it's got to be Yucca Mountain," okay. And then -- so we've got to have -- you know, Steve talked about some of the other private initiatives to try and store spent nuclear fuel, right, to favor them by commercial companies who've picked a site and off they went. What we're trying to do is we're trying to build consent with the public to actually want to host one of these facilities. So we're going out, we're educating people, we're going to do outreach to the states, to communities, to regions to basically explain to them what we're trying to do, no commitments on either side, but then build consent for people that want it and don't feel forced, that this has been forced down their

throats, basically.

MR. HOUGHTON: Okay, thank you.

MR. ANDERS: Bruce, one last question.

MR. SEVERANCE: Bruce Severance. Thank you very much for your presentation and for making time for us. There's been some discussion about the high burn-up fuel and the fast neutron radiation that might cause embrittlement of some of the structures. Does that apply to the canister itself, how robust is the canister?

MR. MURRAY: The canisters are very robust, and the fuel itself is very robust. If there was some fear that some -- you know, spent nuclear fuel is a very, very solid mechanical structure. It's designed to withstand forces inside a nuclear reactor, if it overflows, the temperatures, the pressures, and then we take it out, we stick it in the pool, then we stick it in a dry storage canister, and it's not subject to anything, but people can then postulate things that would happen. In fact, very recently, we just conducted a series of simulated earthquakes on a vertical system and a horizontal system at the University of San Diego, the outside shaker table test. We built a full-sized mock-up of the storage system and shook it with this instrument out the yin-yang, and basically, the

conclusion of those results, the worst case earthquake scenario was equivalent to a rain drop hitting this fuel assembly, or in the extreme case, an angry wasp flying into the fuel assembly. It was underwhelming, to be honest. When you watch the video, it was underwhelming what happened to that canister and the fuel.

MR. SEVERANCE: What is the projected life of one of these canisters? I've heard they're expected to last at least 100 years, and what is that life expectancy relative to how long the radiation continues to be a danger within the canister?

MR. MURRAY: So the fuel remains radioactive. So the projected life of the canisters, it's going to be -- it's regulated by the Nuclear Regulatory Commission, and it depends on if it's a low-burning fuel or a high-burning fuel in the canister. And my office recognizes there's public concern about the canisters, so we have a large R&D program going to develop a way to monitor the structural integrity of the canisters in realtime, 365 days a year, right, and we hope to deploy the first of those systems in late 2026, is what we're aiming for. So we will come up with a way to monitor the canister to show people absolutely nothing is happening to that canister.

MR. SEVERANCE: If they last 100 years, do you

have the ability to remove the contents and put it in a new canister, transfer the contents?

MR. MURRAY: We would have to build what's called a mobile repackaging facility; one of those currently doesn't exist in the US. My old firm that I worked for, the French company, Areva, currently has three mobile repackaging facilities operational in France, repackaging high level waste. So there's an engineering problem if we have to repackage.

MR. ANDERS: Thank you. We need to move on to the next agenda item. So Linda, would you introduce the next topic, please.

MS. SEELEY: Yes, we're moving on now, thank you very much, Paul. We're moving on to international examples of spent nuclear fuel storage. Dave Houghton is going to introduce our next speaker.

MR. HOUGHTON: Thanks, Linda. So so far, we've been looking at the United States, its situation and what we have done, and some of the other countries around the world are some distance ahead of us in dealing with this issue. So we have three presentations in this next section. We're going to have two on Canada, the first one is from Jason Donev who's a professor of physics at the University of Calgary, he has a PhD in physics from the University of Washington.

He is a dual citizen of both Canada and the United States, and to prove that, he lives in Calgary and he went to high school in Bakersfield.

So that will be the first, and then we have a second presentation that Linda will introduce, and finally, we have a presentation from Finland that it was pre-recorded, we recorded the interview with Pasi Tuohimaa nine days ago. He's in Austria right now, and it's 4:00 a.m. there, so we took the liberty of doing that, and so that's our program that we'll be looking at. And so with that, I'm going to introduce Jason Donev who is speaking to us from Calgary.

And Jason, are you there with us?

MR. DONEV: I am here, I'm ready to talk.

MR. HOUGHTON: Okay, great, it's all yours.

MR. DONEV: All right, thank you for inviting me. I run Energy Education dot CA, which is the largest repository, if you'll excuse the term, of energy information for adults, everybody else was doing it on kids. So Energy Education dot CA, check it out, we have over 1,100 pages of information on anything you could ever want to know about energy. Because as it says on the slide, I believe solving the world's biggest problems require understanding energy. Next slide, please.

So been enjoying the talks, it's interesting hearing the US perspective for a change, I'm very used to the Canadian perspective on nuclear waste. We have some different terminology. We have low level waste, intermediate level waste, and what we call high level waste is spent fuel. So when we refer to high level waste in Canada, we are actually just referring to the spent fuel, and it looks an awful lot like this. This is empty, this has never been in a reactor, this is what a CANDU fuel bundle looks like. Ours are a whole lot shorter than the US fuel bundles, which we'll talk about in a little bit. So what we have is some waste that has been produced, it needs to be handled, it needs to be gotten rid of, so in 2002, parliament, which is sort of like congress and the president wrapped up together, passed the Nuclear Fuel Waste Act, that's 2002, to form something that you don't really have in the US, which is a crown corporation. This is a company that is owned entirely by the government and then reports to parliament, sort of like reporting to congress, but it is actually a company that is arm's length from the people who are producing the nuclear waste, it is arm's length from the regulator, the Canadian Nuclear Safety Commission, which is sort of like your Nuclear Regulatory Commission, that's the police officers that

tell people what to do.

So this Nuclear Fuel Waste Act in 2002 formed an organization called the nuclear waste management organization. So the NWMO formed in 2002 and started having a whole lot of conversations with Canadians. Because what they wanted to do is they wanted to find a way to move forward on nuclear waste. Next slide, please. Oh, that didn't work correctly. Interesting.

MR. HOUGHTON: That's your next slide, isn't it?

MR. DONEV: No, the next slide, the graphs aren't supposed to be up yet.

MR. HOUGHTON: They're all there, sorry.

MR. DONEV: Okay. Okay.

MR. HOUGHTON: PowerPoint to PDF translation perhaps.

MR. DONEV: I didn't realize there was going to be a PDF translation of my PowerPoint.

MR. HOUGHTON: We'll see if we can fix that, but do the best you can.

MR. ANDERS: I think we did a PDF of your presentation, so we'll see if we can fix that, but right now, please go ahead with what you've got.

MR. DONEV: We can just talk over the slide, it's fine.

So the NWMO went from sea to shining sea to shining sea, because we've got -- you know, we're a triangle with an ocean on the top as well, and they talked to Canadians, they talked to indigenous people, they talked to small municipalities, they talked to large municipalities, they talked to old people, they talked to young people, they talked to lots and lots of different people, and they noticed a lot of emerging themes when the NWMO went out to talk to Canada -- to talk to Canadians. And among the things they said was the Canadians wanted a consent-based siting process. They want -- we, as Canadians, wanted a community to say yes, I want to be there, I want to have nuclear waste in my community buried permanently. So the NWMO took the very, very daring act of saying we are looking for communities, much like the previous speaker mentioned, are looking for communities that are interested in learning more.

So this was not, in fact, a commitment to having spent nuclear fuel buried there but a commitment to being part of the discussion process. 22 communities came forward, of those 22 communities, a number of the communities said no, we don't want this, a number of communities were excluded for geologic reasons or there wasn't enough interest, just, it didn't work for a bunch

of different reasons. So when we look at these 22 different communities, of the 22 that are left, so if you can -- it's probably on a timer. So the -- one of the things that the commission said was we want the provinces that have benefited from nuclear power to host the repository. So that meant Saskatchewan, which has the highest uranium mine, highest grade uranium mine in the world, Ontario which gets 60 percent of its electricity from nuclear, Quebec or New Brunswick to host the repository. So they focused on communities within that. Three communities from Saskatchewan came forward. The remaining 19 came forward from Ontario. Two of those now remain. So the 19 and 21 that's Huron-Kinloss, that's on the shore of Lake Huron, so it should give you some idea of where that is in the US. And then number five is Ignace, and with Ignace, that's north of Minnesota.

Ignace has now voted within the past few months on whether or not they're -- they're willing to do this. The south Bruce Huron-Kinloss combined site is holding their vote sometime in the next couple months to say whether or not the municipality is ready to go. So next slide, please.

So the -- the response was that the vast majority of people of the 660 that voted, 590 said yes,

we're ready to vote, and the remainder were like not sure yet, not sure yet. But out of the actual vote, more than three quarters of the people who voted said yes. This was an overwhelming display within the municipality of an enthusiastic informed post community.

MR. HOUGHTON: Time check here, we're about halfway through our time, and we're on slide two or three, so let's -- just a heads up.

MR. DONEV: Okay. So that's what worked. The indigenous communities have not yet come forward, and if the indigenous communities say no, that completely halts this. Next slide, please.

So the options for waste, you can recycle or you can take what you've got and put it underground, that's already been discussed, so I won't really talk about it. Even if you recycle, you still have nuclear waste that you still have to deal with. Next slide, please. So much like what has already been discussed, in the short term for us, it's about ten years, you have spent nuclear fuel sitting in large pools of water, that water completely shields all the ionizing radiation, so it's the same method because the various experts for nuclear waste in Canada and US, Switzerland, et cetera, all talk to each other and come up with best practices, so we're doing very similar things. Next slide, please.

The time makes the fuel bundles less dangerous, so they want to hold off for decades, so that's why we're getting around to it now. Next slide, please.

So after 300 years, it's no more radioactive than getting a CT scan. Next slide, please.

So the interim storage, the medium term storage that is sitting on those pads that you have, for us, at most of our sites, this is Bruce Power, right next to one of the sites that's about to vote, this is the equivalent of that with a physicist for scale. We have those fuel bundles that are sitting inside of that dry storage container, those are also rated for 100 to 150 years, they'd probably last a lot longer than that, but that's what they're rated for. The radiation makes them slightly warm to the touch. So we're doing something very similar there. Next slide, please. We'll just skip this slide.

So we have five barriers to manage our risk. So this is very, very similar to what I believe the first speaker talked about, we want a deep geologic repository, and we want to keep water from it, because international experts all agree that that's what's going to move the radioactive material around, so this -- this has largely been designed for either of the two

remaining sites. Next slide, please.

The first barrier is the fuel pellet itself, it's a ceramic which doesn't dissolve in water, and our fuel pellets look an awful lot like your fuel pellets, they are different but they are very similar. Next slide, please.

The next thing is that it's kept inside of the fuel bundles, so it's a solid. It's the size of a fireplace log or a rolled up yoga mat. This is a "zurcoy" and this will keep water out. It also keeps radon gas in. Next slide, please.

This sits inside of a used nuclear fuel container. This is two and a half meters long, which is about nine feet long, which is much, much shorter than the containers that would go for the Diablo Canyon. So that's copper coated and the copper-coated containers will hold the nuclear fuel indefinitely in perpetuity. And they hold 48 of these fuel bundles, and that's what we've been working on here in Canada. Next slide, please.

These are then packed in bentonite clay, and that stops the water flowing. This is to keep from corroding the copper, which is holding everything inside. So it's lots of redundancy of what we're doing. Next slide, please.

So we only need one hole for decades of spent nuclear fuel. Can I get a time check?

MR. HOUGHTON: Yeah, we just caught up pretty well, we've got about two or three minutes left.

MR. DONEV: Okay, good.

So the one hole for decades of spent nuclear fuel to me is a success story. We've done consent-based siting, and municipalities are in favor of it. The indigenous communities may or may not be in favor of it, and you can make a strong case that the indigenous communities were not initially part of the consent-based siting, and as a result, it's far, far less clear whether or not they're going to want to do this. The south Bruce site was also a potential host for a low and intermediate level waste, so this is your mop heads, this is your gloves, this is your resins, your filters and so forth, and that did not get approval. The indigenous community, the Saugeen Ojibway Nation, voted resoundingly no, we will not take the low level waste.

So we are a whole lot closer to having a solution for our high level waste, which isn't necessarily going forward, the vote could still be no, in which case, Canada, with the NWMO, will go back to the drawing board and do this again. And that's what we've had to do with our low and intermediate level

waste, so a separate DGR plan is now starting based on consent-based siting, because we made the same mistake, if you'll excuse the accusation, that was made in the US where it was command and convince. We are now really recognizing that we have to be engaged with the community from the get go. When we do that, we get resounding support. When we don't do that, we get resounding no's. Thank you for your time and thank you for the invitation, I hope that was close to the time.

MR. HOUGHTON: Yeah, that was great, Jason, thank you very much. And so stick around, please. The format we're going to have, we have one more presentation on Canada from Gordon Edwards. Linda will introduce him just in a moment, and then we have the pre-recorded story from Finland where they actually do have a repository build now. So we'll do Q&A after those two with our panel. And so Linda, I'll hand it back to you to introduce Gordon.

MS. SEELEY: Okay, thank you very much, Jason. That was very interesting. Gordon Edwards is our next speaker from Canada, he's the president and co-founder of the Canadian Coalition for Nuclear Responsibility, which is a non-profit corporation established in 1975, he's a retired professor of mathematics and science at Vanier College in Montreal.

Gordon, are you there?

MR. EDWARDS: Yes, I just unmuted my microphone, I'm here.

MS. SEELEY: Okay. Welcome.

MR. EDWARDS: Thank you. And I'm going to share my slides if I can. And I just wanted to make a correction. It's not true that the Nuclear Waste Management Organization is a crown corporation. It is owned by the nuclear producers, it's owned by the utilities that produce nuclear waste. There was a ten-year environmental assessment of the concept of geological disposal in Canada, and during that assessment, they unanimously recommended that there should be an independent agency to look after nuclear waste, put the government of Canada decided not to do that and to put it right into the hands of the nuclear waste producers, which is one of the problems that many people are having with the process.

Another point I'd like to make is that the consent-based process that has been talked about only dealt with the one option, which is a geological disposal of radioactive waste, and did not consider the possibility of phasing out of nuclear power as an alternative option to proceeding with the industry, that was a source of contention as well. So my talk is

really about the basics of nuclear power, and I hope it is of some value to people. If I can just get it started.

Okay. If nuclear power were just generating electricity and nothing else, it would be safe, but it's also mass producing deadly radioactive poisons that were never found in nature before the nuclear age began just 85 years ago. For example, nuclear fuel can be safely handled before it goes into the reactor, but after it comes out, it is millions of times more radioactive and it will kill any nearby human being in a matter of seconds by an enormous blast of gamma radiation. What makes the used fuel suddenly so dangerous? Well, inside the fuel, there are literally hundreds of brand new varieties of radioactive elements that are created by the splitting of uranium atoms. These are smaller atoms which are the broken pieces, they're called fission products. For example, iodine 131, cesium 137, strontium 90, and hundreds more. These are radioactive varieties of nonradioactive elements that exist in nature all around us. They are human-made radioactive poisons, they're sort of like evil twins of what exists around us, and this is a list of about 211 of them, which is not a complete list, from Atomic Energy of Canada, Limited.

Just to give you an example, ordinary table salt has a little bit of iodine added to it, it's called iodized table salt. This is not radioactive. It goes to the thyroid gland, and it helps to prevent a terrible disfiguring disease called goiter. Well, nuclear plants produce radioactive iodine. It also goes to the thyroid gland, it also counteracts goiter, but it causes cancer. 6,000 children in Belarus had to have their thyroid glands surgically removed because of radioactive iodine given off from the Chernobyl accident in 1986. In northern England and Wales, for 30 years after Chernobyl, sheep farmers could not sell their meat for human comsumption in cases where it was contaminated with radioactive cesium. Now, cesium again is not radioactive in nature, but nuclear power makes radioactive cesium. To this day, hunters in Germany and Austria who kill a wild boar cannot eat the meat because of radioactive cesium contamination from Chernobyl almost 40 years ago. I'm having a little difficulty with -- you know, everything is made up of atoms. The only difference is that a radioactive atom will suddenly explode, it's called an atomic disintegration.

Radioactive atoms are like little time bombs. If they explode inside you, they can damage living cells, especially DNA molecules. When DNA is damaged,

it may make things grow in an unnatural way. Some of the radiation damaged cells can and do develop into cancers of a great many kinds. What's even worse is that if the reproductive cells are damaged, the eggs or the sperm, genetic illnesses can be passed on to children and grandchildren, and this danger remains as long as the radioactive wastes remain, which is essentially forever.

Every radioactive material has a half-life, that's how long it takes for half of the atoms to disintegrate. Some have very long half-lives. Plutonium 239, for example, has a half-life of 24,000 years, that's five times longer than the Egyptian pyramids have existed. And when a plutonium atom disintegrates, it doesn't disappear, it turns into another radioactive material that has a half-life of 600 million years. So radioactive wastes remain dangerous for millions of years.

This is a chart covering ten million years of projection after coming out of the reactor. They are the most toxic wastes ever produced by any industry ever. They are essentially indestructible. Countless billions of dollars are planned to be spent to keep these materials out of the food we eat, the water we drink, and the air we breathe. In fact, the real

products of a nuclear reactor, you could say, are radioactive waste and plutonium which remain dangerous for millions of years.

The electricity is just a little blip, a little short term benefit for a few decades. The radioactive legacy lasts forever. The very first reactors did not produce electricity. They were built for the express purpose of creating plutonium for atomic bombs. Plutonium is a uranium derivative, and it is created inside all uranium-fueled reactors. It's one of the hundreds of radioactive byproducts created by fission. Plutonium is the stuff from which nuclear weapons are made. Every large nuclear war had in the world's arsenals uses plutonium as a trigger. In fact, when they dismantle these weapons, they simply remove the plutonium and it's no longer a nuclear weapon.

But plutonium can also be used as a nuclear fuel. The first electricity-producing power reactor started up in 1951 in Idaho. It was called the EBR1 reactor, it suffered a partial meltdown. EBR stands for Experimental Breeder Reactor, and it was cooled not with water but with hot liquid sodium metal. Another sodium cooled electricity producing reactor was built right here in California, and it also had a partial meltdown, the Santa Susana reactor. The same thing happened to

the Fermi 1 reactor outside of Detroit, another sodium cooled reactor, another partial meltdown.

The dream of many nuclear proponents was and still is to use plutonium as the fuel of the future, replacing uranium. A breeder reactor is one that uses plutonium for fission and simultaneously produces even more plutonium than it uses. Breeder reactors are usually sodium cooled. But sodium cooled reactors have failed commercially all over the world, in the US, France, Britain, Germany, and Japan. Nevertheless, it is still the holy grail of the nuclear industry, the breeder reactor, so watch out.

This might be next on the agenda. There is in fact a sodium cooled reactor right now, the Natrium, that is being proposed in the United States. Also, in Canada, we have a Moltex reactor. To use plutonium, you have to extract it from the fiercely radioactive nuclear fuel. The technology of plutonium extraction is called reprocessing and must be carried out robotically because of the deadly penetrating radiation from the used fuel. In the past --

MS. SEELEY: Excuse me, Gordon, can you move on to -- because this is about our -- can you move on to the rolling stewardship idea.

MR. EDWARDS: Yes. Okay, fine.

MS. SEELEY: Thank you.

MR. EDWARDS: For the first 30 years of the nuclear age until the mid-1970's, no one knew about radioactive waste, and the nuclear industry did not tell anyone about it. People were told that nuclear power's clean and they believed it, but it was not true. In the mid-70's, radioactive waste suddenly became public knowledge, major reports in several countries called for a halt to nuclear power unless that problem is solved. The industry in self-defense claimed without real evidence that they had a solution to bury the waste in an undisturbed geological formation. But of course, the moment you dig, it is no longer undisturbed, and we don't have any scientific method for proving that if you put something underground that it will stay there forever, because the containers are going to disintegrate and they are the containers of the waste.

The fuel bundles themselves, the fuel assemblies are not the waste but the containers of the waste. All those hundreds of radioactive materials are inside. Any damage to the containers, even scratches or pinholes, will allow some of those wastes to escape. And they're not all contained in the fuel; some of them are in the gap between the fuel and the cladding. So rolling stewardship is a concept put forward by the

National Academy of Sciences in connection with other long-lived toxic wastes like heavy metals and asbestos.

When we do not have a solution to a waste problem, we must not simply abandon the waste. We must continue to look after it on an intergenerational basis, passing the responsibility on to the next generation along with the knowledge and the resources with the object of continually improving the safe storage from one generation to the next.

Now, rolling stewardship is not a solution to the waste problem but rather an acknowledgment that we do not yet have an actual solution. So instead of deserting the waste as the industry wants to do, we should monitor it and make sure it is retrievable. Instead of waiting for the containers to fall apart underground, we should repair and repackage and improve the packaging and other safety measures from one generation to the next. Instead of abandoning the waste, we should look after it. Instead of walking away from the waste, we should monitor it and keep it retrievable.

Geologic disposal assumes that you will abandon it. Leakage in a burial chamber will not be detected until it is too late. Rolling stewardship will allow us to take timely action to stop the leak and to

prevent recurrence. Instead of closing the door on research to find a genuinely permanent solution to the waste problem, rolling stewardship will keep that quest at the forefront of human consciousness. This sounds, to some, idealistic, but in fact, it is quite realistic. The worst thing about self-deception, thinking that you have a solution when you don't, is that you end up with a mess, a vastly inferior and dangerous form of rolling stewardship, because it was not planned for at the outset.

We know how to package these wastes well enough to keep the radioactive contents out of the environment. The containers should be thick-walled, very robust, built to last, but they should not be right beside major bodies of water. They should be subject to hardened on-site storage, away from the shores and protected against external forces. The main reason that nuclear waste storage is currently so unsatisfactory is that the industry has told us it is only temporary. We have to stop thinking that way. Because we do not have a solution, rolling stewardship is what we do in the meantime to keep ourselves and our environment safe from the radioactive legacy of the nuclear age.

One of the worst things about abandoning radioactive waste is that over the very long term,

amnesia sets in, and amnesia means that nobody anymore knows where it is or what it is, and consequently, there isn't the knowledge and the technology available to deal with it. Rolling stewardship on the other hand is predicated on the persistence of memory. The knowledge of these highly toxic wastes and how to deal with them must be kept alive from generation to generation because it remains an ongoing risk.

In 2019, I attended a three-day conference in Stockholm, Sweden, about how to warn future generations about the legacy of radioactive waste that we are leaving behind. We do not know even what languages people will be speaking in 2,000 years or 10,000 years, so how do we warn them? Do we put up a sign saying "do not dig here"? Will they understand the sign? And if they do understand it, will they obey it? If I were a future archaeologist who came across such a sign, I would say to my team "let's dig here."

The Stockholm conference was an interesting affair. One third of the participants were nuclear scientists from several countries, one third were independent commentators and critics like myself, and one third were librarians and archivists and museum curators. When you know little about radioactive waste but lots about preserving records, knowledge, and

memory, we were all aware that the problem we were addressing was similar to the problem of communicating with extraterrestrial intelligence.

How do we communicate with no assurance that they understand any of the human languages that we use today? One of the advantages of rolling stewardship is that one can more easily pass on the knowledge, information, and technology from one generation to the next rather than trying to communicate with a completely unknown society of the future. We can still leave records for future societies, but each generation can review the adequacy of those records and try to improve them.

The age of nuclear energy will come to an end, but the age of nuclear waste will continue forever unless we learn how to eliminate that radioactive waste permanently. As long as we continue to build and operate nuclear reactors, we are simply compounding an already intractable problem. Because no matter how fast we bury the old waste, the surface of Europe will always be prone to catastrophic releases from the freshly produced nuclear waste of new reactors which will accumulate every day in the core of operating reactors and in the immediate vicinity of those plants.

Burial is no solution as long as the industry

is growing or even maintaining the status quo. There will be at least 30 years of unburied waste at the surface at all times. California was wise to pass a law since 1976 that phases out the production of new nuclear waste by banning the building of new nuclear plants. It's time for other states and other nations to follow suit. Thank you.

MS. SEELEY: Thank you very much.

Okay, now, Dave.

MR. HOUGHTON: Okay, two rather different perspectives from our neighbors to the north. And to conclude this section, we are now going to hear from Pasi Tuohimaa, who has background in journalism and communications. Pasi works with Posiva Oy which is the company that designed and built the world's only, to date, geologic repository. And this is a pre-recorded interview that we did just over a week ago, and I mentioned the time difference, and that's why we did it that way.

So the interview was conducted by myself and Kara of this panel, and so we have 15 minutes of that, and after that, we'll have some Q&A. Thank you.

MR. SEVERANCE: Can you clarify that that Q&A's going to include Jason and Gordon?

MR. HOUGHTON: Yes.

MR. SEVERANCE: Okay. Thank you.

MR. HOUGHTON: We have Pasi Tuohimaa from Finland and he's going to be talking with us about the Olkiluoto spent nuclear fuel repository in Finland, and they're really the only one who has successfully pursued this so far. So I'm going to turn it over to Pasi now, he's going to tell us his story.

MR. TUOHIMAA: Hello, everybody, and greetings from Finland. My name is Pasi Tuohimaa, I'm a communications manager for Posiva, which is the company that is taking care of the final disposal of the Finnish spent nuclear fuel. We're just about ready to start the real operation, so we're quite far.

MR. HOUGHTON: So Olkiluoto is pretty much built at this point, and how long has it taken you to construct this and do the design work and everything?

MR. TUOHIMAA: Well, the whole process has been quite long, but I actually looked that in October, it's exactly 20 years since we started excavating the underground facilities, so it's been a long way.

MR. HOUGHTON: Was there a long process in site selection or was that fairly straightforward in your case?

MR. TUOHIMAA: The site selection was -- of course, the whole world was very different at that time,

there was no social media, there was no quick medias. We started it in the end of 70's, and in the beginning, we had more than a hundred sites all over Finland, but then we found out that the bedrock in Finland, it's quite suitable almost everywhere. So then we decided that the best places would be close to the power plants where there's also suitable bedrock. And because people were used to nuclear power, we had a really good track record, so did the other place, "Loby Saiid" from Helsinki. And actually, in the end, there was just five, and then two of the nuclear sites, they were really on the municipalities around them, they were really competing, which one of them would get the site. So it's been quite interesting, and that has been our message, that the more people know about nuclear, the less they fear about it.

MR. HOUGHTON: And then how big is the nuclear sector in Finland, how many plants do you have and what percentage approximately of the Finnish electricity is provided through nuclear?

MR. TUOHIMAA: Finland now has five functioning reactors, two east from Helsinki and then three at our site here in the west coast of Finland. The annual amount of nuclear energy or electricity in Finland is something like 45, 46 percent. Now we have

the first five final disposal tunnels ready to take the oldest cooled spent fuel, and then it goes in terms that then we continue excavating later on. And if everything goes as planned, we will continue for the next hundred years. This is short lived, Finland's approach to final disposal of spent nuclear fuel, and I put the Diablo Canyon Decommissioning Engagement Panel there as well, for the headlines.

MR. HOUGHTON: Thank you.

MR. TUOHIMAA: First of all, there's a picture of Olkiluoto Island, there you can see up there our three reactors, Olkiluoto the one in the middle, Olkiluoto the two on the right, and then Olkiluoto the three which is the newest one in Europe which at the moment is a 1,600-megawatt power plant, so it came to commercial production last year, so it will continue at least 60 next year, and then you need to cool down 40 years the spent fuel, so that's where the hundred years comes.

We have all the waste management in one island. We have the decommissioning waste repository at the end of the island, we have operating waste repository which is low and medium level waste, contaminated things from the power plant. Low level is tools, overall, things like that. And the medium level

is the kind of waste that we get in filters from the steam -- particles from the steam and then we put it in plutonium and then pack it.

MR. HOUGHTON: So everything except for spent fuel, pretty much.

MR. TUOHIMAA: There we have the interim storage for spent fuel, there's three pools, and we built three more pools, so all the waste that has been produced in this island during the last 45 years, it's there. And then here in the front we are building the encapsulation plan and disposal facility for spent fuel. It's always better to put it underground to a half kilometer or more than keep it on temporary storages. And people here, so do we feel, that our generation that has decided to make nuclear energy, it's our generation's responsibility to also take care of the waste and not leave it to the solar diary of the future generations or future taxpayers.

MR. HOUGHTON: So why don't you take us into the guts of this thing and show us the tunnels and everything that you have there.

MR. TUOHIMAA: Well, here you can see also in this picture, here in the left-upper corner, there's a long tunnel. This tunnel, which you can go down via cars and vehicles, it's a five-kilometer long tunnel,

and it goes -- there's like a small village, the technical area down there, and then the five first tunnels are there, but let's move on.

MS. WOODRUFF: How long do you have to store this material for it to be non-dangerous to people? I think in a documentary, I saw the expectation is a hundred thousand years. Do you agree with that?

MR. TUOHIMAA: That's a requirement, that's from the regulator. They decided that if you do this final disposal of spent fuel, you have to guarantee it's safe for at least a hundred thousand years. And we have the saying that we have taken the uranium from the rock and we put it back to the rock. Well, this sorts the time scale, that's how we started, and it's in the end of 70's, there were site investigations. Then the detail design, which we did together with the Swedes, which is this multi-barrier system. Then we started to excavate it in actually 2004, but first it was a research facility, and then we got the construction license in 2016, and now we are just about to start the operation and we'll end somewhere there, 2120.

Like I said, only safe final disposal is possible. This is the multi-barrier principle in short. You have the pellets, then fuel rod, fuel assembly, inner canister, which is cast iron, outer canister,

which is copper, then we have buffer bentonite clay around it, which is very -- it swells when it gets a little bit humidity, but then it's flexible, also, if there will be any rock movements. And then in the end, there's this almost half a kilometer of bedrock. But the capacity of the whole repository is 6,500 tons, uranium tons, and that means something like 3,250 canisters which are like 6 meters long, they are quite big ones.

Footprint, it's about two square kilometers. It's -- in this island, we are not under the power plants and we are not under the sea, so we're here. And our excavating volume will be, in the end of the project, about two million cubic meters. And we now have like ten kilometers of tunnels, and in the end, there will be like 50 kilometers of tunnels.

MR. HOUGHTON: Good.

MR. TUOHIMAA: There's some pictures where we are, that you can also see the structure here in the middle. We have already underground canister receiving station, we have canister storage rooms, we have a lot of air-conditioning, they're all completed now. There's a personal shaft which is 300 -- 450 meters, it's a really really fast elevator. That helped a lot, because it used to take like 25 minutes to go down. Now it

takes one minute, six seconds for the people. There are pictures of the first real final disposal tunnel, it's 350 meters long, it holds every six meters, and that's deep underground. There's a drilling machine, another one, that's also you can see a hole drilled underneath. Encapsulation plant, it's really a 500-million Euros complex, which everything is done remotely. You can see here the room number two, which is the encapsulation chamber where all the magic happens, there are docking stations for the canister and the fuel transport cask, the drying station for the spent fuel, and also the fuel handling itself, it's quite special.

MR. HOUGHTON: It's all robotic and done by machines, right?

MR. TUOHIMAA: Yeah, it's all robotic. No human beings can be there when you have highly radioactive stuff being encapsuled. There's a newer picture, what it looks like now. These were a bit older ones, but there's a fuel transfer machine in there, and everything is done automatically, and we are exactly testing it just right now.

MR. HOUGHTON: Okay.

MR. TUOHIMAA: We have a canister building, a machinery station, that's on the line as well. So the capsules are upwards, and just at the end of it, it's

the encapsulation chamber, then it goes down. It moves in the line, in the corridor, and then it pops up in the welding station, it's welded. It's actually a US-made welding machine, DuPont Industries, then it comes down, and the machining is done, and then it moves onto the storage on the ground level. And this is the canister transfer trolley in the canister transfer corridor where the huge six-meter capsule is upwards.

MR. HOUGHTON: And what was the total cost of this -- the entire site including the design and construction?

MR. TUOHIMAA: Well, we've said that so far, that when we'll start the operation, we have spent like 1 billion Euros, and then when we move on, we have calculated that that will be like 40 million Euros every year as keeping the process going.

MR. HOUGHTON: The 1 billion Euros, does that include the encapsulation plant which you said was 500 million?

MR. TUOHIMAA: Yeah, because excavating is not that expensive. It's -- the technology is in the encapsulation plant and the elevators, they are the costly things.

MR. HOUGHTON: Okay, interesting.

MR. TUOHIMAA: Although I know many waste

organizations in the world, they have spent much more money and they still haven't got anything, but it's just, you know.

MR. HOUGHTON: Right.

MR. TUOHIMAA: But that's our expenses. In the end, you can say that it's like 5 billion Euros, but that's hypothetical, because it's so much in the future.

MR. HOUGHTON: Was there opposition to this or was pretty much the citizenry of Finland on board with this, was that a difficulty for you?

MR. TUOHIMAA: In the beginning, when the site selection was in a different place and people didn't know, if you go north and eastern Finland, they didn't know about anything, they didn't have any experience, they didn't know about the safety culture in the power plants, they were very skeptical. And our message is that it's really difficult to go somewhere where people do not have industrial identity or nuclear identity, and this has been the message to all of our customers worldwide, that it's better to start looking the place where you already have trust, where you have been open and transparent and people know your safety culture, they have family members, they have friends who work in the power plant, they're not scared, they know it's like, you know, in Diablo Canyon for sure.

MR. HOUGHTON: Yeah.

MS. WOODRUFF: So I just wanted to confirm the total cost, because I think I read it was about 3.9 billion US dollars total cost. Do you think that's a reasonable figure?

MR. TUOHIMAA: What is the total cost? Is it now or is it after a hundred years? So it's really difficult to -- I would say it's 5 billion Euros in the total cost in the end. But right now, it's 1 billion.

MS. WOODRUFF: And then secondly, when you think about a hundred thousand years, I think if you call a generation 25 years, that's about 4,000 generations where this will be stored, and I guess the question that comes to mind is for future generations, are you going to try to warn them to not go down there and discover this toxic material, or conversely, are you going to try to hide it so people don't think about considering what's down there, or is there some other approach that you're considering?

MR. TUOHIMAA: This is the question I've asked quite often, but the concept is we had really, really philosophical discussions a long time ago, and we decided that there's no need to mark it at all. The thing is that as long as we are here, as long as future generations, as the societies are like they are now, of

course, the information is there, but then if you think next ice age, for example, after 10,000 years or something when there's two kilometers of ice on top of Europe, there's no Paris left, there's no London left, there's no industries left, no Helsinki, no Stockholm, everything is demolished, or if there would be a -- a huge explosion in the world that everything is to disappear, and then some humankind of people, they start, you know, living again, how do we know what kind of language, what kind of signals do they understand? And then if you would mark the site, it would all be demolished anyway by the ice, so there would be nothing left. So it's better to put it down, fill up the tunnels, put back the granite and the rocks, and just close it, and then it's there.

MR. HOUGHTON: That's the word from Finland. So we have a little time, I'll let Chuck monitor some Q&A here, and you can be the master of that, Chuck.

MR. ANDERS: We have a few minutes, as Dave said, for some questions of our speakers that are online, or Dave who participated in the interview.

Bruce.

MR. SEVERANCE: Yeah, I'm always interested in life cycle cost, and if we have a responsibility to isolate and show good stewardship for the waste, what is

the plan like, at least a thousand years or you kind of give up after 500? Do -- do federal agencies have a sense for how long they're going to watch the nuclear waste? And I had one other question, just because the dynamics of how things get done in Finland and Canada, and I realize the Finnish presenter isn't here, but one of the issues in the United States that's created a lot of barriers are the, you know, relationship between state and federal agencies and the dynamics of that, you know, tending to cause, you know, a stick in the mud, you know, that would interfere with eventual solutions at least in the United States. So what is Canada doing differently in order to kind of overcome those differences between local and federal interests?

MR. HOUGHTON: Bruce, I can tackle the first part of your question about how long do you do this, and on behalf of Finland and what Pasi has described, the plan is to construct and place the waste for the next hundred years, and then to back fill, and then to walk away, so that's their plan.

MR. ANDERS: And I'm wondering if either Gordon or Jason has a comment on how Canada might be doing it differently than the US.

MR. DONEV: Absolutely. Dr. Edwards, would you like to go first or second?

MR. ANDERS: Let's go with Jason and then Gordon.

MR. DONEV: Okay. So if you divide it out, we've got a $24 billion project, and if you look at the amount of electricity that goes towards, that's $36 to store a Canadian's nuclear waste for a year for the hundred-thousand-year life cycle, because that hundred thousand years to a million years, the engineering is there one way or the other. As to how Canada is making sure that federal and provincial and municipal governments all cooperate, we also have problems with that, that is very much a difficulty. One thing that Canada did do differently in setting up our government from how the US has set up our government, because I am both, is that the delineation of responsibilities is actually laid out more clearly. So I do think that there will be provincial and federal conflict on whatever the final repository is. But we have very clearly laid out that the impact assessment agency and the Canadian Nuclear Safety Commission are the governing bodies that actually have to sign off on this, but they will have to work with certain provincial authorities. I don't want to get too lost in the weeds here, but that's actually what's next.

If one of these two sites gets picked, that

does not necessarily mean that there will be a site there, it does not necessarily mean that it's a go. What happens after that point is a long assessment process where there's a lot of opportunities for intervenors to come in and say this is why this is a problem. So there will be collaboration between the federal, provincial, and municipal governments, there will also be conflict. As a physicist, I think I'm sort of tapping out my limit on that, but I'll turn it over to Dr. Edwards.

MR. ANDERS: Gordon, go ahead. Thank you.

MR. EDWARDS: Yes, it's true, there are kind of differences for sure. Manitoba is the only province that actually excavating an underground research laboratory and they passed a law making it -- forbidding the burial of radioactive waste in the province of Manitoba, so they were not even included in the NWMO search process. Saskatchewan, they did have a consultation with their population, and the population rejected the idea of accepting high level radioactive waste in that province. In New Brunswick, they didn't even try to find a site in New Brunswick, but in Quebec, there was a unanimous resolution, and there's very few unanimous resolutions coming out of the National Assembly of Quebec because of internal divisions, but

there was a unanimous resolution against the idea of importing radioactive waste from any other jurisdiction for permanent disposal in Quebec.

So there was also an incident, by the way, in the United States when they were originally looking at two possible sites, one in the southwest and one in the north east, where the Canadian government sent a note to the US government through their ambassador saying that Canada would not look favorably on a high level radioactive waste site on the border with Canada where the water flows into Canada, and that's one of the reasons why the north east site was dropped from the law. The law was amended, as was mentioned by earlier presenters, where originally they were looking for two sites and then they narrowed it down to only the one, Yucca Mountain.

So there's many a slip between the cup and the lip as they say, and it's quite possible that they could come up empty handed as they did previously. They were trying to find -- back in the 1980's, they were trying to find a home for voluminous radioactive waste hailings from uranium mining and processing. These are not high level radioactive wastes but very voluminous and toxic wastes that are very long-lived, and they spent eight years trying to find a consent-based community in

Ontario, and they ended up coming up empty handed, so that could also happen again.

It is quite clear, one thing that's quite clear is that the assurances that governments are given by the industry that this would be a relatively simple thing, to bury the waste in an undisturbed geological formation, has turned out to be abysmally wrong, and it's -- it's led us to wonder whether the whole idea of abandoning it in an underground repository when we have no scientific way of knowing that it will in fact stay there for these periods of time, whether this is really a wise decision and whether the law should be changed in both Canada and in the United States to reflect a more realistic appreciation of the situation.

MR. ANDERS: Thank you both, Jason and Gordon.

Panel, any other comments, questions, or discussion? Linda.

MS. SEELEY: Just a quick comment. Sitting here, listening to these presentations and about how -- we have these ideas and hopes that we will have a permanent repository, if that's even a good idea, because we don't know what's going to happen in the next hundred thousand to a million years, this idea of rolling stewardship seems much more sensible to me to keep it in sight, to keep looking at it and changing it

and making sure that it doesn't escape into the biosphere. We've got it, and it seems to me that the responsible thing to do is to take care of it, it's like having a bad kid that you know doesn't mean to be bad, but you have to take care of them and watch them and make sure they don't do something to harm the rest of the world.

MR. EDWARDS: To add one little point, in Germany, they had a geological disposal for much less radioactive waste, low and intermediate level waste, called the asitu salt mine, and they put those wastes down there for many decades, and now the German government has discovered that that's been a complete fiasco and they're removing the waste from the underground repository back to the surface again at a cost of more than $5 billion, and it'll take 30 years, and it's not an easy job to get the waste out of there again. So this is a kind of a nightmare scenario. We all know that you can put the waste underground. The question is is it going to be safe there? And what happens if it turns out that it was a bad choice and you've got to take it out again? We've already seen that happen with one repository and possibly two in Germany, thank you.

MR. ANDERS: We have Paul Murray has his and

up for a comment. Paul.

MR. MURRAY: So several things. The National Academy of Sciences in the US first recommended that the US should have a geological depository in 1957. Ever since then, our best scientists, our best engineers have continuously recommended that in the US that we have a geological repository. All other countries with nuclear programs, with the exception of Spain and the Ukraine, have moved forward with geological repository programs. In the US, we've had to have the geological repository operating in Carlsbad, New Mexico, for 25 years to dispose of transuranic waste from a weapons production program. The facility just received a 15-year extension to its operation. So I'm going to say that the best scientists in the world and the best scientists in the US recommend that we have a deep geological repository for the disposal of our spent nuclear fuel and high level waste.

Remember, we have 140,000 tons of spent nuclear fuel, we have 21,000 high level waste canisters, we have the spent nuclear fuel from the naval reactors, and we have the DOE spent nuclear fuel.

MR. ANDERS: Thank you. One last comment from Jason, and then we'll move on.

MR. DONEV: Thank you. As a scientist, I do

agree with those brightest best scientists. I would not put myself in that category, but I do agree. And one of the reasons I agree is working with the indigenous communities, they talk a lot about learning from the rock, and there's some rock that we've learned from in Canada where we see that uranium has stayed in place half a kilometer under the surface for millions of years with no engineering to keep it in place. So we are looking at that. We are also looking at the Aclocabal mine in Africa where there was a natural nuclear reactor, and the geology just kept the fission products in place for billions of years, a thousand times longer than what we need. So scientists are actually looking -- and engineers are looking at what nature can tell us about what happens with these radionuclides under the rocks. And it's very impressive that without engineering, it stays put, and with engineering, I'm confident it would be even more stable. Yes, this is a difficult problem, this is not something that's easy to do, and that's why smart people have been working for a long time to do their absolute best to solve this as best they can. That's what I wanted to add. Thank you.

MR. SEVERANCE: Can I ask one really short thing? I promise it's five seconds.

Gordon, could you just elaborate on what the

fiasco was? Was there ground water intrusion or what was the issue in Germany that you said required them to pull all the waste back to the surface?

MR. ANDERS: Gordon, I think you're muted.

MR. EDWARDS: Yes, the problem of seepage, the waste had been seeping into the ground water for about ten years, and because of the bad public relations that would accrue to revealing that this leakage was occurring, it was kind of hidden for about ten years until finally, the people in charge of the repository fessed up and said yeah, it's really happening, and that's when the German government was quite scandalized and said this has got to be corrected, and the only way to correct it now is to just simply get all that waste out of there and try and do the best recovery we can. So I might also mention that the whip project, where -- that was mentioned in Carlsbad, New Mexico, they had a situation where one of the underground drums exploded and turned into a flame thrower and sent radioactive dust 750 meters vertically upwards to the surface as a result of chemical reactions taking place in the drum. So we don't always know what's going to happen underground. We have to remember that this waste is not inert, it's active. It's radioactive, it's chemically active, it's biologically active, and so -- and there's

even the possibility, very remote, but a real possibility of spontaneous criticality occurring over a very long period of time.

But these containers that are being talked about are temporary, they're not going to be lasting forever by any means. In a relatively short period of time, there will be no containers.

MR. ANDERS: Thank you. We need to move on. We want to make sure that we have time for public comment. And so I want to remind everyone, if anyone does want to make public comment, there are some blue cards right over here, and please fill those out and give them to me, and you'll have the opportunity to make public comment.

For those of you online, if you would like to make a public comment, please raise your hand. We have one more speaker before the public comment period begins, so I'll turn it back to Linda for either thanking our guests in this wonderful conversation and to move forward.

MS. SEELEY: Yeah, thank you so much, Canadians and Pasi, yeah, so much.

Bruce.

MR. SEVERANCE: Yeah, thank you. It's my pleasure to introduce Manuel Camargo. He is a principal

manager for strategic planning at San Onofre Nuclear Generating Station, which is often referred to as SONGS and he's -- he works with Southern California Edison and has the responsibility that includes spent fuel management and disposition. He has also headed up an effort along with David Victors who lives down in that same area to create a national spent fuel policy committee. I had the pleasure of serving on that committee for a short time. What that did was develop a seven-page concise policy statement that became the basis for advocating and meetings with people in congress to support a national repository as well as consolidated interim storage. Manuel, thank you very much for making the trip up here today from San Diego, it's really greatly appreciated.

MR. CAMARGO: Absolutely, I appreciate it. So Manuel Camargo, Southern California Edison, that has been covered. I have four content slides that I'll walk through briefly, and actually, for your convenience, I'm starting with sort of the summary, starting with my key point. So we've talked a lot tonight about some of the challenges, and to a degree, part of what this group that David Victor helped convene and that Bruce and others supported is to look at what we do going forward.

So first, I would say that the spent nuclear

fuel is going to remain at reactor sites like Diablo Canyon and like SONGS unless there is advocacy, coordinated advocacy, in order to make something happen at the federal level. Paul and Mr. Nesbit talked about issues related to the Nuclear Waste Policy Act, and so there is action that's required in order to kind of break loose this kind of stalemate that we're in at present, with the exception of some key issues, progress as it relates to consolidated interim storage. So I would say that on-site storage is very robust in independent spent fuel storage installations, the dry storage facilities that have been discussed, but it's very expensive.

So $2 million per day, and more than $10 billion to date has been spent for paying for that on-site storage that really never should have had to happen should the federal government had obeyed its -- followed its own law in the Nuclear Waste Policy Act and implemented that law. And also the communities around these reactor sites, including here in the San Luis Obispo area, did not consent to the long-term storage of -- the perpetual storage of spent fuel in their community, same with the 70-plus sites across the country where you have nuclear plants. And also, I think very importantly, you know, we should not pass

this problem on to the next generation, it's time to solve this problem, and so that's something that we've been working on and one of the key issues that the David and Victor group helped to address.

So we do see that a window of opportunity is opening. You've seen in the last couple of years that the Department of Energy is working on part of the solution, Consolidated Interim Storage, so that's good. We did partner with local governments back in 2022 -- we, Southern California Edison, partnered with local governments in order to form an advocacy coalition called Spent Fuel Solutions, and David Victor is an adviser to the -- to that group, and they're well positioned to lead the way in terms of an advocacy piece and working with congressional leaders, so I'll talk to that briefly. And you know, I would say that with some help, we can actually make something happen.

So here's our current situation. On-site storage is safe. These canister systems, yes, are -- per the Nuclear Regulatory Commission, they're good for a hundred years or more with aging management, sort of the kind of healthcare maintenance to ensure that we understand what's happening with these canisters over time, that's done at all the sites including here at Diablo Canyon. And we also, as an industry, including

at SCE and SONGS, have identified a way to mitigate a potential issue with the canisters if ever there was to be an issue, meaning a repair.

And then I would say that the -- the dual purpose canisters are good for long term, they're good for on-site storage and off-site transportation. So at a high level, I would say that one of the challenges we have in this base, certainly people here in this room are aware of the challenge, but at a high level, this issue does not get enough attention, and so we're working on that as well, and part of that challenge as well is that there's very little pressure on congress to do something and make something happen.

So here's what we're doing about that. There's really three keyword strings, creating awareness, supporting the US Department of Energy and what they're doing now in Consolidated Interim Storage, and then advocating for legislative reform. On the first one, including legislators in the vicinity of San Luis Obispo, we just passed a joint assembly resolution in the state legislature calling on congress to perform, so we appreciate that, it's part of raising awareness, opinion editorials, those sorts of things.

For the DOE, working on consent-based siting, we appreciate that work, and also, they're working on

some confidence building initiatives, which is helpful. And then finally, legislative reform, so that's important. There's basically four key things that we think you need to get done, more like six, but in terms of the two most important are our single-purpose entity. Every other country that has an active spent fuel program for a repository is as a single-purpose entity. Ours is being led by the Department of Energy, and we do appreciate the work at the Department of Energy, but they have a lot of fish to fry, many priorities. A single purpose entity is one thing that we'd like to see changed in the Nuclear Waste Policy Act.

Two is reliable funding, right. If you look back to 2010, one of the ways that the program was stopped, by turning off the money spigot.

And then, you know, authorizing the DOE to work on consent-based siting for other repositories, Yucca Mountain is really at a standstill, so to get the program moving, you really need to give the DOE the -- or the single-purpose entity the authority to work on other repositories.

And then there's this quirky thing about the linkage between consolidated interim storage and a permanent disposal facility. Paul Murray talked about that, that needs to be addressed.

So finally, we did form this coalition, it's a broad-based coalition with, you know, labor, business, local government, Native American representation, more than 250 people, and we are current in that we're taking the learnings from the group that Bruce and others helped to support and working with congressional leaders at present to introduce legislation hopefully early next year. If you'd like to join, Spent Fuel Solutions Now dot com is the website, you can sign up there, because we could really use the support. That's what I would offer.

MR. SEVERANCE: Yeah, of course I have a question. I would like to ask you if you could talk to us a little bit about the community activism that's gone on down near SONGS and the -- my understanding is they have something like our decommissioning panel, and what kind of outreach are you doing there locally in order to gain support for letter writing or contacting, you know, congressional leaders, et cetera. And, you know, since you've got a coordinated effort to actually lobby and travel to Washington and things like that, what can community, you know, leaders and participants do to perhaps create coalitions at more of a local level in an area like San Luis Obispo, what would you recommend?

MR. CAMARGO: Sure. Yeah, so what I would

offer is, you know, going back to let the assembly joint resolution that we passed just in August of this year, that's really a message bill to send a message to congress, and that's being followed up with the two state legislators who authored that bill, are working on opinion editorials, I would say that you can look at the coalition that was formed, the Spent Fuel Solutions, you can look at replicating that here, or just joining the coalition. We are looking to expand it. Your former colleague, Will Almos, here on this panel, we've had recent conversations with him, he's now -- actually spends his time half here and half in Wyoming, and we've had over the past several weeks conversations with him and a senator in Wyoming, and we're broadening that to see if they'd be looking to replicate. So I think it's things like opinion editorials, it's raising awareness for the issue. You know, again, the problem is really, to my mind, is that there is no problem, right, nobody's dying because they're living next to an ISFSI. Elsewhere in the country, you have communities and an indigenous community, in one particular area, where that is 300 yards from an ISFSI. We have a popular surfing beach, you know, down at San Onofre, and, you know, this storage is safe, there's really no problem there. You know, congress really doesn't have much pressure on it.

All that -- the $10.6 billion that I mentioned in damages, that gets paid through the Department of Justice in the justice fund, and congress doesn't touch that, congress doesn't appropriate those funds. So there's really not enough pressure. So I would say finding your way to add pressure, things like joining a coalition or forming a coalition, letters to the editor, all those things, I think will help, and coordinated advocacy, I think it would make sense. As we look to introduce legislation ideally early next year, it's going to be very tough, it's going to be very challenging, we will need bipartisan support, and ideally support from communities across the country. So to the degree that we can coordinate efforts and timing, I think we'll have the greatest impact.

MR. SEVERANCE: I would appreciate if you could just add, you know, 30 seconds of commentary on how the Spent Fuel Solutions coalition really has a number of people that are environmental activists at the local level working and collaborating directly with utilities, because there's very much an overlapping interest in solving the storage problem, and how broad was the base of people that participated in that? My recollection is that there were people from power plants all over the country that were participating in our

meetings. Do you know how many power plants contributed to that initiative?

MR. CAMARGO: Yeah, probably about a half a dozen or so power plants, and yeah, across the country from the northeast to here on the west coast, I would say as well the -- we do have environmental groups on that coalition, California Environmental Voters, you know, Coast Keeper is another environmental group, but we could use more help, and folks who have a common interest in solving this issue, whether, you know, you're pronuclear, antinuclear, whatever your position is, if you want to solve the challenge as it relates to the offsite storage and disposal of spent nuclear fuel, I'd say right now is a great time to get engaged. You know, to my mind, being optimistic, we will see legislation introduced. Getting that legislation passed may take multiple congresses and is going to take a lot of coordinated effort to get it done.

MR. SEVERANCE: And that website again was now dot com?

MR. CAMARGO: Spent Fuel Solutions Now dot com.

MR. SEVERANCE: Thank you.

MR. CAMARGO: Other questions from the panel for me?

MS. SEELEY: One.

MR. LATHROP: Thank you. Not so much a question, but I just wanted to kind of bring forth the panel's vision for used fuel at Diablo Canyon for the benefit of the public. If you read our document, I believe it says in there that one of the strong visions or desires is to have the used fuel relocated off site as soon as possible, I think with a little caveat as far as an approved location. And so the used fuel, again, whether you're pro or antinuclear, is there, it's an issue that needs to be dealt with, and at least in my experience with going around sharing information from a tribal perspective, what I have discovered is that there's just a lack of knowledge as far as what it's all about, all the way from safety and all these kinds of things. But I think it's very important that we manage this in a responsible way. And also in relationship to the finances, there's a tremendous amount of dollars being spent, and it really doesn't make a lot of sense, the way, and so it's a problem, again, whether you're in favor or against, that needs to be solved, and I would really strongly suggest that people need to learn a little bit more about it and also try to come together with a solution whether it's interim, above grade, below grade, you know, there's all kinds of opinions about

that. If you want a Native's position on it, we have a strong belief when it comes to the environment that you take very little from the environment and you put very small back into it. In other words, you take little from the earth and you put back little to the earth. So from the standpoint of having a deep depository for used fuel, it's not a concern of mine as a Native person, because I see we're putting a small amount back to nature, and I think it was also addressed by the gentleman from Canada that when you take a look at uranium in the earth, it stays pretty stable, and so those are just comments that I just wanted to put on the table.

MR. SEVERANCE: Scott, could you just mention for 30 seconds the initiative that you're involved in for consent-based --

MR. LATHROP: Sure, not a problem. We're part of a consortium of the 13 that was addressed earlier by Mr. Murray, and our goal or our charge is essentially go and do community engagement to try to inform the community all the way from mining issues, the nuclear cycle, looking at also used fuel, just to try to educate people so that they can make an informed decision on anything going forward in reference to potential consent-based siting for interim storage.

MS. SEELEY: Quick question, Manuel. You said that you have a method to mitigate any kind of a leak or crack. What's that method?

MR. CAMARGO: It's called cold spray, is the general term, we call it metallic overlay. So it takes -- so if you do have an issue, let's say a crack in a canister, the shell of a canister, it accelerates a nickel at supersonic speeds, and when that nickel makes contact with the metal, the shell of the canister, it creates a molecular bond and seals it. So they call it cold spray, it does in part a small amount of heat, but small as it relates to other types of welding techniques. If you were to use an arc welder or something like that, you'll create what's called a heat affected zone, and then you do create a potential future problem in that heat affected zone by imparting too much heat into the canister shell. So in contrast, by accelerating a nickel at supersonic speeds, the level of heat that's introduced is much lower, and so you mitigate the risk. You can basically fix the crack and mitigate the risk of future issues in that affected zone.

MS. SEELEY: And do you pull the canister out?

MR. CAMARGO: That's an excellent question. The answer is no. So this can be done -- so you know

from here at Diablo Canyon that the industry uses remote robotics in order to do NC2 inspections of canisters, so we use the same basic technology to take a nozzle, a laval nozzle it's called, that's attached to a remote robot, and it crawls down inside the canister while the canister is still in its module and does the work there. So --

MR. SEVERANCE: Can you describe what a module is and, you know, the concrete sleeve versus the steel so people can visualize that this is a robotic device that slips in there? I thought people might be confused by that.

MR. CAMARGO: There are different types of systems, and we have two different systems employed at SONGS actually similar to what you'll have here, and so for instance, with the vertical system, it has magnetic wheels, the robot crawls down on the wheels to get to the right spot and then it points the laval nozzle at that spot. Anyway, and at SONGS, we also have a test canister in that vertical system and we actually deployed and tested it in that as well as in a laboratory, we've done what's called destructive examination, which is to take a coupon of metal, use this process on it, and then cut it apart to demonstrate the sufficiency of the molecular bond.

MR. SEVERANCE: Thank you.

MR. CAMARGO: Thank you.

MR. ANDERS: Thank you, Manuel.

Our next agenda item is public comment, and I have two cards, folks here. If anybody else would like to speak, please fill out a card. There will be three minutes for public comment, and it'll be entered into the record and part of the official transcript of the meeting.

So the first speaker is Francene McClintock. And I would like you to state your name and spell your name for our court reporter, please. And then also, give us your residence and any affiliation you might have. So Francene.

MS. MCCLINTOCK: Hello, so I'm a public citizen, I live in Ventura right now, and my name is Francene McClintock, F-R-A-N-C-E-N-E, McClintock, M-C-C-L-I-N-T-O-C-K. And they mentioned this, I should have my glasses on, Nuclear Waste Policy Act, I think you said 1982, I think, I don't know, I thought it was '85, but I guess it's '82, and I didn't understand the deference between -- I thought it differentiated between military and commercial, but it almost sounded like that gentleman was talking about one dump where military and commercial nuke waste would go into a repository, so if

we really did rolling stewardship and hard and on-site storage above ground, could that go on a military base? I guess is my question.

And then I also wanted to ask about Curie's, because Madam Curie, I guess, died of cancer, and that was the whole idea of radioactivity, is it has Curie's. So in the low level waste dump phase, they always talked about square feet or cubic feet that you had to have the snoop dump that was so big, and it sounds like here you're talking about tons, and I'm just curious how many Curies we are actually talking about in the United States, military, commercial, in Russia, in the whole world, et cetera. Just I wish they would talk about the Curies, because that is the reason we have to isolate it from the biosphere. Thank you, that's all.

MR. ANDERS: Thank you. Next speaker is Dolores Howard and is followed by, this is what the card says, Nikola Tesla.

MS. HOWARD: Hello, my name is Dolores Howard, I'm a resident of Paso Robles, and you spell my first name D-O-L-O-R-E-S H-O-W-A-R-D for my last name. The extended operation of Diablo Canyon means the generation and on-site storage of even more high level radioactive waste in an active seismic zone. The extended operation is unnecessary and dangerous for us and for future

generations that will question why we left them this horrible legacy. Although it is true that the community of San Luis Obispo never agreed to Diablo Canyon site turning out to be a long-term storage site, neither did future generations agree to our planet being a permanent repository excavated and abandoned with nuclear waste. At Diablo, the current pads are designed to hold only the accumulative waste as of the expiration of current licenses. Storing spent fuel in pools is much more dangerous than storing it in dry casks. The Union of Concerned Scientists states that a large radiation release from a spent fuel pool could release more cesium 137 than the Chernobyl disaster, resulting in thousands of cancer deaths and hundreds of billions of dollars in decontamination costs and economic damage. The continued operation is not necessary. We have the supplies, the battery storage, one of the largest fleets in the world, Elliot Manes, our chief executive, the California Independent System Operator, states that in the current situation, the state has been in a position to reliably meet load inside California and export quite a bit of energy outside of California to other parts of the west. Recent joint reliability assessments by the CEC and CPUC highlight the state's ability to meet and exceed power needs through renewable energy investments

and an increase in battery storage.

Let's remember the generations upon generations that will need to steward this dangerous waste wherever it is, let's begin that process now. Let's stop Diablo operations at the end of current licenses. The license for unit one expires November 2nd, 2024. Let's close unit one immediately. Thank you.

MR. ANDERS: Thank you. Our next speaker is Peter Allen, I think, or Nikola. State your name and your city and please spell your name for our court reporter before you start.

MR. ALLEN: Peter Allen, P-E-T-E-R A-L-L-E-N. I lived in the Five Cities my whole life and I live -- reside in a small corner of San Luis Obispo, and I'm really happy to be here. I can see that everybody's looking concerned, and I'm hoping that we can come -- I'd love to be on the panel, you all are very concerned citizens, I'd love to set precedent that we can conquer this for the whole world. From what I've seen, everybody is struggling, trying to do the right thing, and they're hurting everybody in the planet, which it's going to be. But people have told me that this is going to be a meltdown from nuclear wars to nuclear energy plants, and so it's been a battle. I believe

Nikola Tesla's knowledge was mothballed for future -- for people wanting to monopolize off of energy. And so anyways, I have some hot topics.

So being that there's 30 years --

MR. SEVERANCE: Can you talk directly into the microphone?

MR. ALLEN: Absolutely.

For 500 million years of waste is completely absurd, and I wish I was smart enough to be a nuclear engineer, physicist, and -- but I'm not, and -- but I wish that they were reducing the fuel down to spent fuel which it would be less of a waste and it'd be hopefully easier to manage. So I know they're reducing it down, pulling the water out and processing it, but I think it's absurd to put it into our drinking water, but it's going to land there anyways when they put it in the ocean and it circulates and it's -- it's what you don't know that you don't know, just like sewer water, nobody wants to drink it, but it's -- they're living off their septic. So -- so yeah, the legacy for future generations and wanting to hide it from them for the future, because they're wanting to save money, it hurts my heart, and I know it hurts all of you here also for -- for these dump zones in your backyard where your grandchildren and future generations are going to be

potentially leaking and they're going to have cancers and they're going to be on potassium pills. So people are getting hurt in these plants, working in containment, where they have to be scrubbed down with a wire brush, I don't know the correct thing, but obviously, they get cleaned up and hopefully they can live their life. And when I was in Russia, I met a girl who her dad went to Chernobyl for two hours to do something after the meltdown -- okay, am I cut off? Okay. I'd love to be on the panel.

MR. ANDERS: Thank you. I don't -- I don't see anyone online with their hands raised. I would like to remind everyone here and online that you can submit written comments on the panel's website, that's Diablo Canyon Panel dot org, and when you submit those written comments, all the panel members see them right away. So please feel free, if you want to add something to what you talked about or you know someone who would like to make a comment that couldn't be here, please encourage them to make those comments, because the panel members do see those.

We do have one -- oh, we have two, good. First is Sheila Baker and followed by Jane Swanson. So if anyone else online would like to make a comment, please raise your hand.

Go ahead, Sheila.

MS. BAKER: Okay, thank you. Sheila, S-H-E-I-L-A, Baker, B-A-K-E-R. I don't agree that it's a popular idea that holes and big, big places that should be dug in the earth, and with this substance placed in the earth. And I -- I think that it's not a sustainable way, I mean, we are so used to using this planet to our -- whatever we want, okay, that we do things that we don't even stop and think that not everyone feels that way and that digging holes and placing radioactive stuff in the earth is not really very good. The other comment I want to make is -- or question, are the two states that have been designated as interim storage states, that would be Texas and New Mexico, my part of the objection would be the transportation on freeways, highways, and freight on the railways. So anyways, thank you so much.

MR. ANDERS: Thank you very much.

Our next speaker is Jane Swanson. Jane, go ahead.

MS. SWANSON: Yes, thank you. My first comment is I completely endorse the comments of Dolores Howard who spoke shortly before me, and sorry, I didn't identify myself. Jane Swanson, J-A-N-E S-W-A-N-S-O-N, spokesperson, San Luis Obispo, Mothers

for Peace. So Dolores Howard fully expressed the opinions and viewpoints of the Mothers for Peace, and I thank her for doing that. I also want to thank the panel and PG&E for this opportunity to learn from each other, to ask questions, and to express opinions. We are aware that PG&E is not obligated to act upon the input given at these meetings, but it's still a value to learn from each other and to share opinions and resources. The guest speakers that we had from Canada and elsewhere were excellent, and also the questions from the members of the board of the panel were very excellent, so thank you for a very useful meeting and I'll let it go at that, thank you.

MR. ANDERS: Thank you, Jane. I don't have any other speakers in public or online, so we have a few minutes for the panel to have discussion. Any thoughts, observations, any additional questions?

MR. SEVERANCE: I just wanted to say I really appreciated the thoughts that Gordon Edwards had to contribute, that there should be a culture of ongoing stewardship and monitoring that, you know, sticking it in the hole and burying it and forgetting about it after a hundred years just doesn't seem to me to be a prudent solution, given the scenario of what happened already in Germany. I think it's going to require ongoing

security, ongoing monitoring of ground water, mitigation measures, and I -- I would hope that the solutions are thoughtful with an eye for our impact on future generations. It just seems that for us to get the benefit of cheap energy now with long-term impacts for, you know, the next 4,000 generations seems shortsighted in my opinion, so we have to take on the full life cycle costs of monitoring that waste for, what, thousands of years. I mean really, there should be an ongoing culture of stewardship.

MR. ANDERS: Thank you, Bruce.

Any other observations or comments?

Patrick and then Michael.

MR. LEMIEUX: I'm just echoing what he just said. It was news to me as well, the rolling stewardship approach to it, a very interesting one. I'm not sure I completely agree with Bruce, though, however. I think it oversimplifies things a little bit when you try and think of that kind of stewardship for 4,000 generations, and I think that the gentleman, Pasi from Finland, illustrated that with his example of ice age every 10,000 years, which is a fraction of the period for which these wastes have to be monitored, in addition to things like wars, that happen periodically over such a period of time. So while, I mean, we have plenty of

time to accept rolling stewardship before these things happen, I think I'm still not convinced that that's the 100,000-year solution. I think given enough evidence of geological repository that can withstand the -- the likelihood of -- of failures I think needs to continue to be investigated, and I hope that we continue to have this conversation. So I really appreciate the comments from everyone, I think it's -- we need to -- to continue this conversation.

MR. ANDERS: Thank you, Patrick.

Michael and then Dave.

MR. LUCAS: I want to thank my colleagues for putting together a really fantastic evening of commentary with our guests, and it's been very valuable for me. The one thing I'm left with is this idea of life cycle costing and how we take into account the full life of these processes. The one comment I thought was very informative was the idea that even at the beginning of the mining cycle, the uranium tailings, which have been disastrous for so many indigenous reservations in the southwest, among other places, that's an ongoing issue, and with the increase of fuel requirements that we're seeing across the board with new nuclear plants and the continuation of this, that becomes an issue as well as this idea of waste at the end that we don't

really have a good solution for. You know, I loved hearing these ideas, but I'm kind of left with I have no concept of what's the ethical or moral thing to do with this kind of generational impact. So this has been very enlightening, and I just thank everybody for their comments.

MR. ANDERS: Okay, Dave and then final thoughts by Linda.

MR. HOUGHTON: Wow, there's a lot to think about and to say about this topic. The word that kept coming up in key points was the word "trust," and that is a key element of what's happened in Finland, where they're actually moving forward in doing something. That word came up again in both the Canadian presentations, and it's a difficult thing to reestablish, and this industry has not really built that. Though we're trying now, I think this panel and this process is an example of attempting to build that trust and openness and transparency and having dialogue about this and the other issues that surround nuclear power and Diablo Canyon in particular. So it's a difficult thing, and we can't wish it away, and like it or not, it's a part of the bigger issues of climate change, and I don't have my mind made up on whether or not nuclear is part of the solution to reducing our

carbon impact on the atmosphere, but that's an even bigger tragedy of the comments that affects everybody on earth. And so we've got -- we've got some real issues to deal with, and I come away enlightened but also with lots of new questions, and the discussion will continue and I'll leave it at that for now.

MR. ANDERS: Thank you, Dave.

Linda, final thoughts, and adjourn the meeting.

MS. SEELEY: I just have one comment about -- that came to me when you were talking, Patrick, about rolling stewardship, about keeping it above ground and monitoring it. Maybe in the future, with scientific progress, we'll find a way to de -- what do you call it, detoxify it, I don't know if that's the right word, but to make it actually safe. And so I think like thinking about burying it underground, I don't -- I don't know what's the best solution, I can't say, but I -- but I keep thinking that maybe there will be some kind of progress made to be able to detoxify it, but I want to thank everybody for coming here tonight and our panel, our speakers who you -- you brought things to our minds that we don't ordinarily think about, and we very much appreciate it, and we are the -- like it or not, we've got this problem. We didn't ask for it and -- but we've

got it, and so I feel like our panel can maybe do something to help pave the way to fixing it. So it's -- I feel very grateful to you, Chuck, for helping us figure this out, and to the planning committee for hanging in there and doing a great job, and to PG&E for facilitating this whole thing. Thank you.

MR. SEVERANCE: I just want to thank Manuel Camargo one more time for driving all the way up here to talk about the spent fuel initiative, and I'm deeply grateful, really, to all the speakers, I thought it was just a tremendous well-rounded presentation from everybody, thank you.

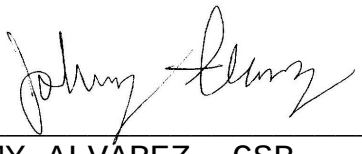
MR. ANDERS: Thank you all, and the meeting's adjourned, and everybody travel safely.

(Adjourned at 9:00 p.m.)

STATE OF CALIFORNIA)
) SS.
COUNTY OF SAN LUIS OBISPO)

I, JAHMY ALVAREZ, Official Certified Shorthand Reporter of the State of California, County of San Luis Obispo, do hereby certify that the foregoing pages numbered 1 to 121, inclusive, contain a full, true and correct transcript of my shorthand notes, and a full, true and correct statement of the proceedings had and testimony given as reflected herein.

Dated this 15th day of October, 2024.



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