**Session 2: Facilitated open discussion on the implications of direct disposal of large dry-storage canisters.**

LESLIE: Good morning. And thank you for joining the smaller but better discussion group this morning. My name is Bret Leslie, and I'm going to be your facilitator this morning. I am a Board staff member, but my hat today is not as a Board staff member. My job is to ensure that everyone's comments are heard and recorded. And as Nigel and Rod said, there's a lot of things that can be discussed, but we're really trying to focus on identification of issues and capturing those, and we're going to capture them in a bunch of different ways.

One, the meeting is being transcribed, so kind of the rules go, when you have a question, you can raise your hand or show a card. When you get the mic, identify yourself for the record, name and affiliation. That would be great.

I have two rapporteurs up here, Board members, Gerry Frankel and Sue Clark, and they're going to be listening and trying to capture things, because in the afternoon they have to present what they've heard from you all back to the entire group. So to the extent that we can outshine the other group, it's really important to be crisp.

So, anyway, I want the disposal group to go strong today. So if they don't understand something as you--let's

say, Tito, you raise an issue and you're trying to describe it, if they don't understand it, they're going to get my attention, and I'll probably say, "Well, can you re-explain it?" or "Gerry, can you ask a question so that you better understand it?" The idea is to really understand what the issue is and how it's phrased. Again, it's not about resolving the issues.

Scheduled to end at noon. If we're all dying at 10:30, we might take a short break; but I also have chocolate in my backpack to make sure you don't fall asleep. So if--up here, not in the back, not yet.

So you heard Nigel kind of lay things out. The material flows and the interaction matrices are over there. These are tools for us to allow to try to capture these issues. It's not to say that if you raise an issue and it doesn't fit in the framework it's going to be neglected as a facilitator, and they're going to be trying to capture the other issues, too. So if you see me walking around looking and writing things, I'm trying to make sure that between the transcript, the rapporteurs, and myself that we're trying to capture everything.

And the way we set up both of these was two five-minute presentations in the beginning, one from kind of an industry perspective, and we have Andrew Sowder, who will present five minutes. And I have asked him and Beatrice

Brailsford in the back from the Snake River Alliance to kind of provide some input at the beginning to kind of get the juices flowing, and I'm trying to encourage them to be crisp in terms of identifying the issues. They'll be presenting some information just as a way of background. Beatrice is going to be talking about--not commercial--but she'll probably be talking about DOE spent nuclear fuel.

So some of the things--kind of one of the other things is, think about all of the things you heard yesterday. There were things in Pete Lyons' talk that went into my head that could be asked to clarify things. For instance, is a commingled repository important when we try to decide what are the disposal requirements?

So I'll be asking--when I see people flagging and lacking of issues, I'm going to be trying to pull out some things, and I might be--you know, if you've identified yourself, I'm going to try to remember your name and maybe ask you, well, Andrew or Jean--so, anyway, that's kind of my role. My role is not to tell you what the issues are, but to encourage you to provide them to us so that we can hear them.

Any questions at this point? The only other thing I would say that the emergency exit is the same way you came in and straight out to the street and across the street.

So, with that, I think I'll turn it over to Andrew for the first presentation.

SOWDER: All right, it's dangerous to hand EPRI the mic and then say speak for five minutes. So I'll do my best.

Okay, I'm Andrew Sowder, and I'm here actually to kind of give, as I understand it, a perspective from the utility point of view, which, as the Chairman--as Rod mentioned yesterday, this tends to be a little bit shorter than the 100,000-year mark; and so I have my little catchy title here. But, again, the main point here is not so much to come up with solutions or make recommendation, but mainly to point out things not to forget when we're having our discussions.

So just by way of background, I call this the cats and dogs story. And I heard it mentioned yesterday about basically I think everyone agrees that the system we have today is not optimized, far from it. I even call it--people say we are operating on a once-through cycle. I say each individual plant site is operating on its own fuel cycle, given that we've basically relegated fuel cycle decision making to utilities on a plant-site-by-plant-site basis.

So I think this slide here or this image here is pretty telling. Basically, it's showing the accumulation of fuel assemblies in dry storage by year, starting here with Virginia, Surry--now Dominion's--kind of lead canister or cask experiment, you might say, all the way to today. Another one that I wanted to put in here--but, again, limited

to five minutes--I don’t have that much time. But, basically, for every fuel assembly that comes out of the spent fuel pool or goes into the spent fuel pool during refueling, one now has to go into dry storage. That’s where we are today in the U.S. industry by and large. There may be a few plants left that have room in their pools, but pretty much we’re on a steady-state basis, and it’s not a good steady-state.

So, again, when you’re thinking about options and that sort of thing, ten years ago we might have had--utilities might have even had a lot more room to think ten years from now, twenty years from now, but today they’re really facing on an outage-to-outage basis.

ZOBACK: Excuse me.

SOWDER: Yeah?

ZOBACK: Vertical scale on these drawings?

SOWDER: Well, I’ll just clarify. Vertical scale is--

LESLIE: That was Mary Lou. Let me reask: What’s the vertical scale… Let me correct the record. It’s Mary Lou Zoback. Anyway, Andrew, can you answer Mary Lou’s question?

And just a reminder, everything needs to be mic’d. I have Davonya here, too, so if you’ve got a question, just raise your hand.

SOWDER: Yeah. So the actual scale here is the number of independent spent fuel storage installations here. And,

meanwhile, we’ve called out basically two different points in time, you know, how that picture has changed just since 2004 to 2012, you know, essentially almost a doubling of both ISFSIs as well as assemblies in dry storage.

Another thing here, though, is, again, when people think of ISFSIs and dry storage, they tend to think, oh, well, there’s one or two systems out here. But, again, as was pointed out yesterday--and, again, I’m a big cat and dog lover--there’s a lot of mutts out here, and this--at one utility site alone, having three pads, it really has turned into a museum of sorts. So even on one site you can have multiple regulatory bases, site-specific and general licensing, as well as different systems.

So I’m not going to spend a lot of time on this. These are in your handouts, but I did want to give the basis for EPRI’s report and our analysis. Again, I think one of the reasons why I was asked to come today was, EPRI has done--we did our own independent assessment of direct disposal of dual-purpose canister systems at the time for Yucca Mountain.

So, you know, again, I think we were asked from that point of view that we had looked at this in the past, recognizing that was for a specific site and geology. But, again, everyone has slightly different numbers and estimates; but, you know, this is what we based ours on. You have to

make some assumptions projecting into the future; but, again, by and large, these dual-purpose canister systems are the lion's share in the U.S. What we've moved to are welded stainless steel systems.

This is some work from Ernie Hardin and Sandia. Looking at--again, it's interesting to look at what your geology might do to you in terms of thermal limits. But, again, one of the issues I'm just going to call out here is, don't get fixated on, you know, one parameter when that--although this is certainly a very important one if not maybe the most important single design parameter, but it certainly doesn't operate independently, and you have--in terms of--if we're here to bring up issues, things like commingling come into play, being creative about how you manage your repository.

So, as I mentioned, EPRI looked at the idea--because even if Yucca Mountain were to have gone ahead at the time, we would still probably be even loading some dual-purpose canister systems even though there was this transportation, aging, and disposal canister that was actually brought in and introduced as a systematic part of trying to integrate the system better.

So in terms of raising issues, I think this TAD system is one thing to bear in mind that I think was a very--at the time a very successful proposal and certainly was one

that the industry supported in terms of moving to a more standardized canister. But, of course, at the time we also had a place to send things to, and we knew how to design that canister. So without a site, it's very hard to actually design a canister that's truly standardized.

Also, I would just point out, actually, even in regulation and DOE's license application that direct disposal of DPCs was not actually ruled out, although I can be--if I'm wrong, please point that out. But our reading of the license application and the regulations was, you could actually, based on performance, dispose of DPCs directly.

So here is, just to summarize what I saw pulled out as the key criteria for DPC disposal, maybe even on a generic basis, basically, you know, it's nice to say let's dispose of dual-purpose canisters. But, as was pointed out, the utilities are moving to larger and larger ones, again because they have their own needs to fill on a different time scale. So the question comes: Do they physically fit? Can you shove them into the hole you've dug? And also Yucca Mountain was nice, because you had that nice level rail system. You could move things in by rail. But if you go to more of a shaft system, you suddenly have the problems that was raised yesterday in the German case of having to lower them into a--using a hoist system.

So, again, certainly mass of these things becomes a

real issue, a technical issue, not insurmountable but certainly challenging.

Then, of course, is rock wall temperature, seismicity and rock fall, you know, criticality, of course, is a major one, as well as how do these things influence long-term dose to the public, because that ultimately will likely remain one of the key measures or metrics.

So, in conclusion, of these reports, we found no real technical obstacles associated with disposal of at least some DPCs, some population. Again, that was to be determined what fraction could be disposed of. But that was, again, for a very specific case at Yucca Mountain.

So this is my issue slide of maybe trying to bring up--raise issues for discussion, basically, to not forget that you're designing and evaluating a system, not just individual elements, because what you care about isn't how one element performs for its own sake, but really that the overall repository system meets its performance objectives. And that's protecting basically the public and the environment.

Some things I'll just raise again, things to either don't forget about or let's question. Some of them maybe are assumptions, because, again, we've been operating in this Yucca Mountain mode of legislative limits of 70,000 metric tons for heavy metal, and no basis--no technical basis for

that limit. That was a legislative limit.

So, again, let’s not get stuck and think that, you know, repository footprints have to be limited or, you know, two-dimensional. And also what you put in the repository in terms of high-level waste commingling, high-level, low-level, greater than Class C. I even saw, mentioned by the Koreans of putting coal fly ash in there while you’re at it. So let’s get rid of another problem.

So co-disposal options, I think this is a way to maybe manage some of your heat load problems with hot packages, if you can co-dispose and certainly space out your hot packages with other wastes that are not so hot. Again, I think this was one of the benefits in the Yucca Mountain case of co-disposing cooler high-level waste packages.

A big one for EPRI is challenging what typically tend to be conservative values, estimates, criteria versus best estimate limits. And, again, in a positive sense, I heard this mentioned again yesterday, reflected yesterday, is, you know, that a lot of the thermal limits, again, tend to be--in all likelihood are conservative ones. And by pushing those boundaries, you may, again, relax some of these constraints on your repository design. We already have enough constraints. Let’s look for some more degrees of freedom.

And then also this question of are we talking about

thermal performance of the system under steady state conditions or when, in fact, it will likely just be a transient excursion of some kind of peak temperature. That's a very different system than a steady state system.

LESLIE: Wrap it up…

SOWDER: I'm wrapping up here.

So there are basically--this is just recognition that there are inherent limits, though, and this is really the limitations, I think, on even what we can discuss today. Without a site in mind, there are fundamentally some things that we can't know or decide upon without actually having a specific site and an engineered system.

And, finally, my parting word is, given that we're not starting with a clean slate anymore. This is not 1985, '84, '83, '82, '87. We're not starting with a clean slate. Perfect is the enemy of the good, and certainly don't forget the fact that we've already got loaded dual-purpose canisters. And these actually--if you want to think about it a different way, there are a lot of sunk costs in those canisters, and I'm not just talking about money-wise, but also worker dose and also risks that were incurred to load those.

So, again, thank you very much, and I'm at your disposal, so to speak.

LESLIE: Okay, so to speak. So an example is--and this

is kind of for everyone--is Andrew talked about a few things that kind of are taking--can I borrow your--that little green thing at the top there--the pointer. Okay, got it.

So he's talking about issues here that impact up here basically. He's saying, you know, he's not necessarily looking this direction. He's looking back.

SOWDER: Right.

LESLIE: And so, for instance, each of these bullets here are things that go into and could constrain the front end. And Andrew also tried to kind of say it's much easier to talk about specific things when you have a specific site.

And we'll allow a couple clarifying questions. But, again, remember that--and for the audience, remember, you'll be later able to raise issues like if you heard something from, like, Thilo's talk where other countries have perhaps looked at the footprints or other things, might be that there are other questions that could be asked.

Gerry, Sue, are you okay? Do you have anything?

FRANKEL: No, it's--

LESLIE: Okay. Could you identify yourself?

McCULLUM: Yeah, Rod McCullum, NEI. I'm not sure that what I have is a clarifying question. I was going to enjoin a discussion on your concept of going backwards from disposal to initial conditions. Do you want me to hold that?

LESLIE: Could you?

McCULLUM: Yeah, I'll do that.

LESLIE: I appreciate it. Okay. Beatrice?

And, again, our next speaker is Beatrice Brailsford from the Snake River Alliance, and she has no slides, but she has plenty to say.

BRAILSFORD: Which I am going to say in five minutes.

Thank you very much. The Snake River Alliance is Idaho's grass roots nuclear watchdog and advocate for clean energy. We were founded in 1979 and are a member-based group.

Today I intend my remarks to just be a brief reminder. This morning we heard that Department of Energy spent fuel is out of sight but not out of mind, and I'm here to make certain that it is not only--it is in sight and in our minds. Because I am from Idaho, I'm going to focus on the spent fuel at the Idaho National Laboratory, but the other sites in the complex that store even more spent--far more spent fuel than Idaho are Hanford and Savannah River.

DOE owns about 2,400 metric tons of spent fuel; 11 percent of that is at the Idaho National Laboratory. Of our inventory in Idaho, about 60 metric tons is defense, and the rest is non-defense. All of the Nuclear Navy spent fuel comes to Idaho, and until 1992 it came to Idaho to be reprocessed. Currently there are about 27 metric tons of Nuclear Navy spent fuel in Idaho, and more than half of that

fuel came in after 1995.

The other sources of spent fuel in Idaho are random; 52 reactors have operated there, and most of that spent fuel is still in Idaho. Idaho also stores spent fuel from foreign, DOE, and university research reactors. We have commercial reactor fuel. INL spent fuel ranges from a hundredth of a kilogram up to 1,600 kilograms from four inches to fourteen feet. It's all sorts of sizes, burnups, claddings, enrichments, conditions. Some of it is fully intact and in very good shape, and some of it is in very, you know, almost radically not good shape. Three Mile Island comes to mind. Sodium bonded fuel is at Idaho so that it will eventually be pyroprocessed. The sodium bonded fuel comes from EBR-2 and the Fast Flux Test Facility in Hanford.

The fuel in Idaho is stored in all sorts of facilities. DOE's newest pool, which was built 30 years ago, stores a good deal of it. The spent fuel canal at the Advanced Test Reactor stores newly-generated spent fuel just as it comes out of the reactor. It's too hot to send across the highway to the 30-year-old pool.

A lot of the dry storage happens at what we call Building 603. It's one of our more modern facilities. It is dry, but one of the reasons it's dry is that they recently successfully repaired the leaking roof, and it depends on forced air ventilation to remove decay heat. We store spent

fuel on rail cars in demonstration casks on a pad in below-ground vaults with a lot of--not a lot--but a few different configurations in a hot cell, and the Three Mile Island fuel is stored in an NRC-licensed facility.

Idahoans have always been very concerned about the accumulation of spent fuel over the decades, and in the early ’90s the State sued the Department of Energy and the Nuclear Navy, reflecting that public concern. The suit was settled in 1995, and in that settlement the importation of commercial spent fuel to Idaho was banned. DOE and Nuclear Navy shipments were regularized, shall we say, you know, limits on how much can come in in any given year. The settlement agreement requires that all spent fuel be taken out of pools and put in dry cask storage by 2023, and it requires that all Department of Energy and Nuclear Navy--and most of the Nuclear Navy, because of a later addendum--all DOE and most of the Nuclear Navy spent fuel be out of the state by 2035.

So in no particular order, some considerations--oops, I’ve already gone over five minutes. One, this is not a technical issue, but the Snake River Alliance does not see any particular benefit in reversing the decision to commingle defense and non-defense spent fuel. We don’t see what problem that solves. We see what problems it might create.

I mentioned the fuel that comes out of ATR is newly generated and goes into water. It will probably still be

generating fuel in 2023 when no more fuel is supposed to go into water. That problem might be exacerbated by--right now the Department of Energy is looking at refurbishing and restarting a reactor it closed in 1994 called the Transient Reactor Test Facility, TREAT.

Another thing to keep in mind, the Nuclear Navy is moving its spent fuel out of wet storage to dual-purpose canisters. It has filled 50 of those at the Naval Reactors facility where there are no reactors, and it expects to load over 350 by 2035. Last year the head of the Naval Reactors program testified to congress that one-third of the current inventory of spent fuel from the Nuclear Navy was ready to be shipped to the repository. That might not be--that might be more hopeful than realistic.

Another thing, I think, to keep in mind is, are we moving--and this is, you know, maybe across other facilities. Are we moving spent fuel from inadequate old wet storage into inadequate old dry storage? And are we moving that fuel in a way that, you know, we require more follow-on conditioning, because we didn’t, for instance, get it dry all the way to begin with? So that’s another consideration.

And then I guess, finally, you know, all that fuel at Idaho--and it’s not a vast amount, I mean, I told you it’s a very small inventory. But it’s got 250 different attributes, you know, and all these things that you have to

take into consideration. All that fuel, as it is getting ready for whatever happens next, the flow chart shows that it’s characterized and conditioned in what is called the Idaho Spent Fuel Facility. That is a licensed facility. The license is held by the Department of Energy. It has not been built. And its mission in the Mission Need Statement is to handle all the fuel at the Idaho National Laboratory.

Now it is kind of being eyed for a larger mission, handling other spent fuel from other places. And, frankly, our concern--and I think it’s a legitimate concern--I know it’s a legitimate concern--is that the mission creep is going to take over the mission need before the facility is built, and we will end up with DOE’s spent fuel at the back of the line, out of sight, while other material is processed first. Thank you.

LESLIE: Thank you, Beatrice. But before you leave, okay, let me do a few things.

So although Beatrice was talking about DOE spent nuclear fuel, here is an example, I would say, where she has identified an issue way up at the top in terms of drying the spent nuclear fuel, because before it can be transported and disposed, it’s got to be appropriately packaged and dried. And so this is an example where one might argue that some of it’s already canisterized, but it’s not ready to be transported off. So there might be further conditioning and

repackaging of existing dry storage before the DOE spent nuclear fuel could be sent either to an interim storage or a final disposal.

And so there's this subtle difference between potentially what the commercial side is doing, but the DOE side spent nuclear fuel--did I capture that?

BRAILSFORD: Yes.

LESLIE: Okay. Any other questions? If not, then we're going to allow anyone to start to raise the issues. And, again, thanks, Andrew, and thank you, Beatrice.

We're going to start with the questions. And, again, you know the routine.

McCULLUM: Rod McCullum, NEI. Am I on?

LESLIE: Yes.

McCULLUM: Okay. And since we're here to raise the issues and not to solve them, which is kind of disappointing, but I've been to meetings where that's happened before.

I want to kind of fundamentally--and this is why I raised my hand early--challenge the notion--and I think this is a useful diagram--that there's a backwards arrow that goes from Line 11 down there where it says "Disposal" up to Line 2 where it says "Canister Loading."

In my world where time travel has not been invented yet, we can only go forward in time. We've loaded 1,700 of these things, 1,771 as of the end of the half year. We will

have loaded over 3,000, most of them welded, by--and I don't want to start the repackaging session. Those guys are going to talk about all the reasons why it doesn't make sense.

But the fundamental question I want to ask--again, we're here not to solve and make declarative statements; we're here to raise an issue--and I'll call this the initial condition problem--should the U.S. repository program moving forward define, as an initial condition that will guide our repository site selection, that it has to be able to direct dispose of existed loaded canisters? Because we can spend billions of dollars saying, well, where are the pros and the cons, you know, in designing portable dry transfer facilities and comparing that against what happens in--but if we say it is an initial--you know, I'm not saying we should, but we should ask that question, define it as an initial condition, have that--it actually simplifies the repository selection process going forward.

I'll give you an example. We could spend billions studying criticality and designing canisters to prevent criticality, or we could do criticality consequence analysis in deep geologic disposal. We'd find the short-lived criticality events you might have that aren't going to be noticed on the surface, and they're not going to have a long-term--but, anyway--

LESLIE: Okay. And I'm going to turn one of the things

you said back into an issue. So, again, Rod, you've raised a good way of thinking about it in the sense--in terms of how you treat things in the disposal space can influence what you do up ahead.

I mean, the example--and, again, for clarification, Rod is talking about how criticality is treated or how it could be treated in a repository license application. Currently DOE treats it a certain way. Probability is--it's screened out by keeping the probability of it occurring below the regulatory limit.

McCULLUM: And once you go to the initial condition of having to dispose of the existing--if you went to that--those canisters were not designed to prevent criticality underground a million years from now. So you then have to lose that paradigm.

But when you look at the resources--and the resources are important; we've already spent ten billion here--is it has a--it would have--if we chose to define that initial condition, it would have a tremendous value in focusing our resources going forward. I mean, I fundamentally challenge the notion that an arrow can go backwards from Line 11 to Line 2, you know.

LESLIE: No, but--okay, we got that.

McCULLUM: Is that resource value worth shattering all those paradigms? That's the question.

LESLIE: Okay, thank you, Rod.

And, Tito, I saw your hand.

And, Davonya, I'll direct the traffic and the microphone to folks.

And, again, you can either raise new issues or, as you hear things, bring up your own.

BONANO: Thank you. Tito Bonano from Sandia National Labs. You know, partly I agree with what Rod said, and we have two problems. One is: What do we do with the DPCs that already have been loaded? So, thus, I think in that context I agree with, we have an initial condition in Box Number 2 that we need to take into account.

But the other part of the problem is: What are we going to do with the ones that are going to be loaded in the future? If you remember the presentation that Jeff Williams gave yesterday, right now we have about 1,700 to 1,800 loaded DPCs. Most of that is old fuel. The question is: By the year 2050, we may have 10,000 to 12,000 of those DPCs, most of which are likely to be loaded with high burnup rate fuel.

So we have, in essence, two different problems, one of them, what do we do with the ones that we have already loaded, which we do not want to repackage? And in that context I agree with Rod's comment about we have an initial condition. But the other part of the problem is: What do we do with the ones that are going to be loaded in the future?

And that’s where I see the feedback mechanism coming from disposal back to Box Number 2.

LESLIE: Thank you, Tito.

And so, actually, the focus of this session is really thinking about what are the issues associated with going forward with the DPCs, which is all the issues above. And what Tito just said is, we have to think about down here on the way back, not for the ones that are already loaded, but as we go forward. And so that’s kind of the--did I capture that? That’s right.

So we’re dealing with both, and so kind of think about the DPCs that are loaded, what are now the issues here, and for the ones in the future, these are the feedbacks back up. Because in the other session they’re talking about repackaging, okay, you know, and the inputs here could influence that. And I understand all of the DPCs that already exist.

There’s a question back here?

FRANKEL: Frankel, Board. So I just want to--you’re the facilitator, but I’m trying to get the details here. And so I think, rather than just raise the issue that future DPC designs will affect everything, we want to be specific, you know, so what needs to be considered in DPC design that will affect transportation or loading into a disposal overpack. And it’s the details that we’re trying to capture here, not

just general issues. Is that correct?

LESLIE: Yeah, that's fine.

BONANO: So one of the things that--this is Tito Bonano again from Sandia National Labs. And I'm going to defer to Ernie Hardin real quickly. But one of the things that we've been thinking about is: Should we be loading future casks with neutron absorbers that are specifically designed to deal with criticality issues? Is that correct, Ernie?

HARDIN: Yes. I mean, there's a whole--we'll get into that.

LESLIE: No, we'll keep this--no, go ahead. And I'll get back to the back row. Let me get this flow going here, and then we'll come back to you guys in the back; all right?

HARDIN: Ernie Hardin, Sandia Labs. We're working on this problem, a team from multiple labs, and I think there is a logic here. There are different levels of preparation and design of a canister for disposal with respect to criticality. At one level you can make all future canisters bolted closure and design the basket so that in future you have the flexibility to open the canister and modify the contents to control criticality postclosure. Okay, that's one level.

At another level you can design a canister so that it is small enough or it has enough other materials in addition to spent fuel that it can never go critical no

matter its state of degradation. So that would be essentially the SKB approach. They have 4-PWR or 12-PWR assemblies per canister. They have a massive cast iron insert, and they project that the degradation of that system would never go to criticality.

And then you go to systems where you have more fuel in the can. You have the Yucca Mountain-type thinking, which was, for an oxidizing environment, we can get 10,000 years or maybe 100,000 years of chemical and mechanical lifetime out of neutron absorbers, which are basically made from 316 stainless steel, or in the case of the--actually, we were going to use sintered stainless with 304 and carbide. But the basket structure is also important, and that was to be 316. So that’s the story.

LESLIE: So those are solutions--

HARDIN: There’s one more point I want to make.

LESLIE: Okay.

HARDIN: They’re are all solutions. But the real point I’m trying to make is, it’s a branching problem. So it depends on the environment where this thing is going. And we ought to talk about reducing environments as being advantageous and smart choices, but we have not come up with the structural materials that will survive for a long period of time in reducing environments. So there’s an open R&D question there.

LESLIE: Okay, thank you, Ernie.

Did that clarify for you, Gerry? Just shake your head up and down. Yes? Okay.

Rod, is it on the same topic? Close enough?

EWING: Close enough.

LESLIE: Okay. Again, I've got you in the back. We'll get to you.

EWING: This is Rod Ewing on the Board. So I'm commenting on kind of the stream of the discussion. And I'm sympathetic to the initial conditions approach, because we have to deal with what we have in front of us. I understand that it's a branching problem, and there are difficulties and the environment matters quite a lot in terms of the different components in the system.

But what I don't hear--and this is what makes me nervous--is simple discussions of canister, waste package, or dry cask lifetimes. Right? Because that matters a lot in geologic disposal. So as you change materials, forget the configurations, but as you go from corrosion-resistant alloys to stainless steel, I presume then the distribution of lifetime changes of the packages. And so before we accept the initial conditions as initial and that's what we have to deal with, it would be important to understand what that means in terms of long-term performance. Right?

Now, I presume stainless steel will not last as

long as Alloy 22. Right? And I think that may be important in compliance unless you change the geology. I mean, you could go to a better geology with your present initial conditions, but is that much flexibility in the system--is that the flexibility you would drive us toward? I mean, if I'm stuck with the initial conditions, can I then pick the repository environment?

HARDIN: This is Hardin with Sandia. I think the answer is a qualified yes. I mean, from the criticality point of view, in a salt repository where fluids would very likely have 6 molal sodium chloride concentration, we get quite a boost on the sub-criticality argument, even with the current inventory of loaded DPCs. That said, you know, I think it's important for us to carry forward other environments, other potential options, as geologic settings for disposal.

LESLIE: Thank you, Ernie. And now--

McCULLUM: Rod McCullum, NEI. I want to build on what Dr. Ewing said. And I think this is important. If you start with the initial condition and then go forward, and then you have to ask those questions, how do these things perform in the longer term, because they were not designed for that long a term. To me, the answer is in defense in depth and in having things you don't take credit for, but, you know, that give you some level of comfort for a period of time.

I think, looking forward--and I also agree that you

have an opportunity to change things with the ones you haven't loaded yet, but first you have to accept that initial condition. That's the basis for that negotiation. That's a whole other topic. But, for example--and I need to reference this since we're on the record--NEI Contention Safety-01 and NEPA-01 from the Yucca Mountain licensing process, Docket 63-001--we had an analysis in there that showed that you could directly dispose of the existing loaded canisters simply by wrapping them in Alloy 22, and then it would meet the Yucca Mountain performance criteria.

Now, are you going to take credit for any--are you going to take credit for that basket that wasn't designed for a million years? No. Are you going to take credit for that stainless steel shell? No. It's inside the Alloy 22. It's under the titanium drip shield.

So these things become--now, you also--you do have to look at negative effects. I understand that. But, again, if you accept that negative condition or that initial condition, you say, okay, I'm not going to take credit for any of these things. The fact that they're there gives me some additional defense in depth, which is important. But then I have to look at do they have negative effects. But then you are now going forward, and you're looking at--it's helping you focus your resources going forward.

Is there anything wrong with putting stainless

steel in salt? Is there anything wrong with putting these baskets in a granite repository? But now you've got an arrow that's moving towards disposal, not back the other way.

LESLIE: Right. And, Rod, we're going to talk a little bit more, and then we're actually going to actually try to start to really use this chart and identify the issues. I'm allowing this discussion to go forward kind of not really identifying the issues just to build the rapport in the room, get some initial thoughts out on the table, so--and I've forgotten--and then we'll get the back, and then I see these two guys, too, as well.

GUTHERMAN: Thank you, Bret. My name is Brian Gutherman of Gutherman Technical Services. My question is directed toward Andrew. The common denominator among the three processes we're talking about is thermal, and they're different for transportation, storage, and disposal. In your analysis, did you any kind of sensitivity studies as to what kind of cooling times would be required to get these DPCs from storage through transportation and into disposal?

SOWDER: Andrew Sowder, EPRI. I don't believe our--I'd have to get back to you on the specifics, but I don't believe we were looking at optimizing anything like surface storage time or anything like that; whereas, I think the focus of the DOE-sponsored work has been on using that as a variable to manage your thermal loads.

In our work we were just looking very narrowly at what fuel had already been loaded and probably some nominal storage. And I'd have to go back and look at the specifics. And looking at the impacts--we did the thermal analysis looking at the impacts on the specific geologic system.

GUTHERMAN: And I'll follow up--this is Brian Gutherman again--because that's an important matter here, especially as the DPC capacities increase to 37-P and 80-some-odd-B. You've got to get it there to dispose of it, and that transportation piece is a potential bottleneck in the system, even if it works on either end of the system in storage and disposal. So that has to be looked at holistically.

LESLIE: So let me reiterate what I heard Brian say, that basically he is doing what I asked him to do, which is, he gave the positive example is that, okay, here it is, we've got a high heat load; can we transport it? Okay? So this is canisters, maybe some of the existing ones, but also as they go forward, DPCs, if they're going to go direct disposal, they're going to have more heat. They may even make transportation even harder. I hope I tried to capture that.

So I'm going to go to Bill, and then we'll come back up this way to Tito and Ernie.

BOYLE: William Boyle, Department of Energy. I hope to follow in Brian's footsteps and identify a potential issue. And it occurs, actually, before disposal, and it's related to

the light green on the chart, which is “Consolidated Storage”, which is not a given or a certainty, but certainly a possibility.

And I’m focused on the storage systems that are using concrete, not all, but make it particular with respect to NUHOMS, which are the horizontal ones Andrew showed on one of his slides. And I’ll further make it particular. I visited Calvert Cliffs; and as part of that visit, I read their certificate of compliance for storage, and in the documentation it is stated there will be no undue galling, gouging, or scratching. And the licensees actually have to demonstrate this. They have to put it in and pull it out and show the NRC and say, see, we didn’t scratch it, gouge it, and that sort of thing.

If you have consolidated storage, again, using the NUHOMS’s example--but this applies to the vertical system somewhat as well--the geometry is a little different. But for the NUHOMS the storage device is slid in on metal rails, lubricated metal rails, and there they sit for decades potentially under heat, changing environmental conditions. And to get it to consolidated storage, you’d have to yank it out, handle it for transportation, transport it somewhere, take it out of the transport, and then shove it into something else again.

And who that owner is of that consolidated storage

facility might also have this requirement of no undue galling, gouging, or scratching. And I think it's an open question that we haven't done enough work on yet is that, will that come to pass, all that handling and that the consolidated storage facility would believably still be able to take them without a lot of scratching and gouging?

LESLIE: Thank you, Bill.

Tito, did you--

BONANO: This is Tito Bonano from Sandia Labs again. I think the question back here from Brian was have we looked at how long they need to sit in storage to cool down enough before we can transport it. Was that correct, one of the question you had?

GUTHERMAN: Yes, as it relates--

BONANO: So in that respect, we have done a couple of simple calculations at Sandia using the TS Calvin model as well as using the certificate of compliance, and how long they need to sit and cool down before transportation is a function of how you load them up with the fuel, whether it's high burnup fuel or--so in some cases it's anywhere from a couple of decades to maybe three or four, depending on how they're loaded up. So we have done some very preliminary calculations along those lines.

There is a particular senator from a West Coast state who is very interested in how long that fuel is going

to sit in some of those facilities.

LESLIE: Okay. Ernie, are you--

HARDIN: Yes, please.

LESLIE: We'll do Ernie, and then we'll come back to you.

HARDIN: Let me reiterate--Hardin, Sandia. Let me reiterate what Tito said. His presentation has some slides, and there are notes on there showing what reports you can find the thermal analysis in. And we drive it all the way down to different concepts, engineering concepts, of operation for a repository. And we come up with some insights like-- more important, the diameter of the package or the power output at a given point in time, things of that nature. So I think we've made some progress in that area.

I would like to follow up on the little discussion that I had with Rod Ewing on disposal concepts. And, you know, I mentioned that it was important to keep other options open besides the one you might favor such as maybe salt. Here is an insight, and there's an issue here, so bear with me.

Yeah, it would be tempting to say, look, let's let that disposal overpack be the comprehensive interface between any DPC and the disposal environment. Let's let it solve all of our problems. We can design it with thickness and materials such that it has containment lifetime that we

require, and we can rely on that containment lifetime to keep water out so it never floods and we don't have to worry--we can screen out criticality at that point. So that's an attractive proposition. The gotcha there is that it may not be plausible to claim that kind of performance on a set of 10,000-plus overpacks.

So, for example, Yucca Mountain--the probability of early failure of any waste package was estimated to be about $10^{-5}$ per package, and this was attributed to faulty materials, faulty fabrication, faulty testing and handling, damage during handling before emplacement. So with $10^{-5}$ per package, if you run the numbers, you see that we don't really have the reliability to say that flooding will never occur in 10,000 years for 10,000 packages at a probability of $10^{-4}$ per repository realization. Do you see the probabilistic problem in there? So the issue is: How do we get more reliability out of an engineered barrier?

LESLIE: Other questions or comments? Okay, yes, I'm sorry, right behind Davonya, and we'll come back up to Andrew.

SISLEY: Yeah, my name is Steve Sisley with EnergySolutions. And, Brian, you asked a question, you know, how long has DOE looked at how long it's going to take before they can transport these. The cask vendors determine that. I mean, they do an analysis of what--

LESLIE: If you can speak into the mic.

SISLEY: The cask vendors provide an analysis of how long the canisters have to age before they can be transported. I think the real question is how long do they have to age--once they get to a centralized storage facility or perhaps a repository, how long do they have to age before they can be disposed of? And that's really a function of the repository media. I mean, different medias--clay, granite--they have different allowable temperatures.

So I think, you know, looking at this system approach, you need to consider what your repository is going to be. I mean, I think we need to know what it's going to be and determine how long you have to age it. And the question, I think, that we have to ask is: Are the canister designs--are they going to be able to survive that long? In some of these repository meetings, let's say we get stuck with a clay repository. Heat load is very low. You may have to age it--with some of these large canisters, you may have to age it for hundreds of years before you can place it into the repository. Are those canisters designed to withstand a hundred years, you know, before they need to be repackaged? That's the question in my mind.

LESLIE: And I forgot--I didn't catch your name. I know you said it, but I--

SISLEY: Steve Sisley.

LESLIE: Thank you, Steve.

So Steve raised the same issue two different ways. And basically it's the idea of--and it can be storage either at the facility or storage here, but how long does it have to be stored before it can actually be disposed? And, on the other hand, he said, well, thinking about the different disposal options, like Tito had the slide yesterday that showed just how long for clay stone versus salt, those things also feed back in terms of thinking about how long these canisters have to last if you end up in disposing of clay.

So, hopefully, that completes the circle.

GUTHERMAN: This is Brian Gutherman. I just want to amplify. I agree with everything Steve said. And my prior remarks were more a logistics-oriented set of remarks inasmuch as the COCs certainly do say when you can ship these. But in my mind, I'm thinking about, do we have a continuum of canisters that can be shipped once we begin, or are we going to begin and then exhaust the ability to ship because we've got to wait, and then we have a dead zone there for transportation? I'm not saying I have the answer or even if that's a problem, but it's a consideration that needs to be thought through very carefully to make sure once we begin shipping we can continue.

LESLIE: All right, go ahead, Rod.

McCULLUM: Rod McCullum, NEI. I think this is an

opportunity to bring some things together if it doesn't make it too confusing, you know, the idea that we still have some we have to load; and if you start with that initial condition, then you have an opportunity, you have a negotiation, to ask for some in the future to be loaded differently so you don't get to that dead zone.

But I think, more importantly, I want to kind of turn to this question of, how long do they have to be stored before they can be disposed? I see it as more of an opportunity. And I'm looking at Tito Bonano's Slide 16 from yesterday. I don't know if you have the ability to call that up, and maybe it's not worth the time. That's a great slide; that's a great graph. You know, you see--

BONANO: I don't have it here.

LESLIE: Go ahead.

McCULLUM: You see you've got various periods of time and various geologies until you can put the waste packages into disposal. There is an element of that time that I think we need to give ourselves some credit here for, is that if you're focused on that direction, you know, you're going down that path, science has anywhere from 10 to 50 years to further sharpen its pencil, to further look at the question, to know things it doesn't know yet about the geologies. I tend to be an optimist in believing that the scientists will learn.

And, in fact, let’s say you shipped casks to an aging facility, you didn’t hit the--I don’t know what repository had an aging management pad, but I think there was one--and you’re saying, well, we may have to sit these out there for a hundred years--well, some of the higher burnup casks, you know, because Tito’s other idea of, well, let’s impose constraints on the future loading, didn’t quite get in place in time.

Well, that’s your initial condition again, but now you’ve got a team of scientists who are further refining their understanding of how heat affects the repository. You’ve got heater tests in the rock or in the salt or in whatever geology you’re in that are testing theories about how heat affects the way water moves. You’ve got 10 to 50 to 100 years to incorporate that result in amendments to your license for your repository.

So I’d want to capture that element of time as an opportunity--and this gets into the whole stepwise repository concept--an opportunity to refine the repository concept as you’re loading, because you’ll have some stuff you can load on day one and then some stuff you can’t.

LESLIE: Okay, thanks, Rod.

I’m going to go to the back, because I haven’t heard anything, and I saw Steve had his hand up. And then we’ll come back up. Thank you, Andrew, for reminding me, I

still owe you. So we'll go Steve and then Andrew; all right?

FRISHMAN: Steve Frishman, State of Nevada. What I'm going to say is somewhat in line with what Rod just said, but also many of you will hear that it's a familiar line here.

Ernie just sort of laid out the real question in this room that is the question that's on the agenda, only he laid it out in terms of, how do we get more reliability out of the engineered barrier? That's the big question as far as dealing with geologic disposal or isolation. What you're talking here is the stuff that you guys talk all the time. You don't have to be in this room to be talking this. This is the conversation you have all the time.

The real question is--if we're going to have as a goal geologic disposal, then the question is: How do we get more reliability out of our understanding of the site? And this is what Rod was talking about. But we have to remember that--I think--and I've voiced this before--I think it's an unfortunate regulatory constraint that isolation means prohibit or delay release. You guys are all working on the delay and how can you extend the delay. The real objective is to have a site where, as the 1980 EIS said, you don't need an engineered barrier after about a thousand years.

So I think that while, yes, it's very important to understand the problems that are there and the problems that are being magnified all the time, but you're arguing how to

beat a site rather than how to take advantage of a site. Taking advantage of a site involves understanding to a great extent how that site is going to work rather than, as unfortunately with Yucca Mountain, trying to figure out how to make it work.

So I think all of this conversation is very useful if you keep in mind that a long-lived engineered barrier is not an inevitability in the system. And years ago--well, in 1990, just before we had our horrible nexus meeting, Chris Whipple was telling me, “You’re going to have to get used to the idea that the whole thing is going to be an engineered barrier.” And I told him, “No, I’ll never get used to that idea, because it’s a false idea.”

So now I think we’re in a position where, yes, it’s worth discussing these problems as laid out and that you need to be looking forward to the one thing that we can probably do better, because we’ve already--and Yucca Mountain has proved that--we’ve already figured out we can do a lot better on figuring out how to, using data, actually do some modeling that is credible.

LESLIE: Thank you.

FRISHMAN: So that’s the beginning of what I may be thinking about today.

LESLIE: Okay. And I’m sure we’ll come back to you as you have more thoughts.

I owe Andrew, and then I'm going to get a new person, and then I'll go over to Ernie. So, Andrew.

SOWDER: Andrew Sowder, EPRI. I wanted to ask a question, because one thing that I'm not hearing--I'm hearing a lot of technical discussion, and that's in NWTRB's name. Are we also discussing institutional issues that impact--for example, I'm hearing--one of the big questions that's being raised is: How could we transition to maybe a different waste container from--waste package from a DPC to the future? Of course, you have that transition period.

So that means the utilities are going to have to change their behavior, and someone's going to have to pay for that new material, that new package. Some would say, well, suddenly we had a stainless steel container, now we have a gold-plated container. One of the institutional issues, I think, that's not being recognized is, as I understand it, the utilities are not--well, if they want to get reimbursed by the Judgment Fund, for example--tell me if this out of bounds, but they have to prove that that's a justified expense.

And so when I hear things like, "Well, let's add something new to the container that's not necessarily needed for storage or transport but for disposal," will the accountants at DOJ approve that for reimbursement. And so--

LESLIE: It's slightly outside, but we've recorded it

and you've got it in--

SOWDER: Yeah. So it's a major barrier for changing that behavior.

McCULLUM: Rod McCullum, NEI. While you're on that--and I promise I will be quick here--just to point out, there is a precedent for what Andrew just talked about, and that's the TAD. You know, that kind of got lost in the shuffle of Yucca Mountain; and I think the issue here is, it's worth studying the TAD experience when you look for how to make this transition from what we've already loaded to what we might want to load in the future, because in that case industry did agree--and Yucca was designed as a hybrid. The license application has them receiving so many DPC's and repackaging them--and we had our contention, but never mind--and then, you know, industry loading TADs going forward. Industry had agreed to load TADs going forward, and then the whole thing disappeared.

But in all those development of that TAD specification and the multiple vendor license applications that were submitted in accordance with the TAD specification, there was a lot of lessons learned for how you bring together the science of a repository and, as Andrew said, what is needed for storage. I think, given this is a new Board, that's something that should be studied closely.

LESLIE: And now I'm going to come up to--thank you for

passing that, Andrew--identify yourself.

ALSAED: Halim Alsaed, affiliated with Idaho National Lab. My comment or issue that I want to raise is related to criticality for direct disposal of DPCs and how that relates to storage and transportation criticality work. And the question was prompted by several remarks that were made that DPCs were designed to meet criticality safety requirements for storage and transportation, but not necessarily disposal.

And that's sort of a binary-type thinking. It either is designed for something or it's not designed for something. And that certainly is a valid statement to make when you're talking about deterministic-type regulation for storage or transportation. And those deterministic regulations generally drive you to do idealized configurations and idealized geometry when you are making a determination whether your system is critical or sub-critical, and we know in reality you will have anything but those idealized geometries. You're not going to have optimally spaced pens and optimally moderated systems and perfectly corroded neutron poisons down to their maximum theoretical sense. And that's what has driven the maybe significant conservatism for transportation and storage for criticality safety.

Now we're talking about disposal regulation, which is the most risk-informed regulation we have where

probabilistic-type analyses do have some room. So the question that I have and the issue that it raises: What's it really take from an analysis perspective to truly transition from the deterministic thinking of it works or it doesn't work to more of a probabilistic thinking that takes into account all the details of the configuration. Sure boral will not survive in a repository environment in total, but that doesn't mean that it disappears, and some credit can be taken for it.

Same thing with the geometry, it may or may not be--it likely will not be idealized geometry.

So the issue is, as a regulation, it is allowed for; but as a practice, in the DOE analysis for Yucca, as well as the perception, public and political, isn't there yet. And what can we really do to get it to accept a true probabilistic evaluation for these configurations? The analysis is there. The question is appreciating and valuing and understanding what that means.

LESLIE: Thank you. And could you repeat your name one more time, because the mic didn't get turned on quick enough?

ALSAED: Certainly. It's Halim Alsaed.

LESLIE: Okay, thank you, Halim.

Ernie and then Jean.

Thank you, Davonya.

HARDIN: Thank you. Hardin, Sandia. I have a

collection of issues for you here, Bret.

LESLIE: Okay.

HARDIN: One of them is the 10,000-year-versus-million-year regulatory period for FEPs screening. I don't even think I need to elaborate on that. But the regulations are subject to change. I understand they're going to be revised. And this is a very important question. A million years is a totally different period for screening out something like criticality that depends on anything that's engineered that we put in the system. Enough said.

With that said, though, Dr. Ewing did mention Alloy 22, and I'll throw this out there. It does have corrosion resistance at both oxidizing and reducing conditions, according to my understanding. It might be the right matrix to use for a neutron absorber material that does have even better lifetime than some of the ones that have already been developed and documented. So there is a big R&D question: Are there materials out there that we just haven't discovered or developed yet for keeping the basket configuration predictable and absorbing neutrons?

Okay, and here's another insight I'd like to try to share with you briefly. I think of these different alternatives in terms of how we would represent the safety case and what the probabilistic risk assessment would end up looking like. And is it plausible, and is it complicated, or

is it simple? So no concept with an extremely complicated safety case is going to be easy to license.

So, with that, the concern is not to couple up different scenarios. So criticality is one scenario, and we don't want criticality to be coupled with seismic ground motion. We don't want it to be coupled with human intrusion. So keep that in your thinking. Whatever solutions we come up here, the scenarios need to be separated--separable.

LESLIE: Okay, thank you, Ernie. Could you pass it down to Jean Bahr?

BAHR: Jean Bahr, Board member. Given the diversity of the types of packages that we already have as the initial conditions, and if we're thinking about how that translates then to repository siting for disposal, is it possible that there might be different geologic settings, geochemical conditions, that might be good for one kind of package and less good for it, but--is it actually possible to use that information in choosing a site, or are we left with a situation where there may be different kinds of geologic settings that are going to be more appropriate for different kinds of packages? And I think that question gets amplified in the commingling case where we're talking not just about spent nuclear fuel, but various types of high-level waste.

LESLIE: Tito, do you want to address that? I hate to put you on the spot, but--

BONANO: That's okay, that's okay, Bret. Tito Bonano, Sandia. I think in one of my slides in my presentation yesterday--I think it's the one that--Slide Number 6, the one that I called the obstacle course. There was a box to the lower right-hand corner that talks about that specific issue, especially if we start looking at the existing DPC inventory. That becomes either a direct or indirect siting criteria.

I mean, we don't know the answer to that, but I think that goes back to what Jean just said. It's one that I kind of passed, because it's a policy decision that I think is outside the scope of the presentation or certainly way above my pay grade. But it's something that, I mean, at some point in time, you know, we hope that we can form some of those decisions in the future. But I think that's one possibility.

LESLIE: Okay, thank you, Tito, for addressing that.

Jim Rubenstone. And that's perfect timing. I was going to turn to the NRC potentially. Jim.

RUBENSTONE: We're still on the same wave length.

LESLIE: Identify yourself.

RUBENSTONE: Jim Rubenstone, USNRC. This has been touched on in a couple areas, but I just wanted to add it from a regulator's point of view.

Although the regulations for generic disposal in a deep repository will probably be evolving as time moves

forward, I think the concept of performance-based risk informed will remain; and that makes the performance assessment a major part of the regulatory process. And maybe I'm missing something, but I think one of the contributions of the TAD was it, to some degree, simplified the performance assessment in that you had a restricted diversity of materials, a restricted diversity of configurations, that were being analyzed as part of the application and review.

And as you're expanding that roster of different materials and different configurations and different types of waste packages going in, that will add complications to your PA. And I don't know how to price out costs of complicated PA versus complicated packaging, but there are some trade-offs there. So I think we have to keep that in mind as we're trying to think in a performance-based risk-informed setting.

And the second point that Bill touched on--and I think this is also something not to lose sight of--is that when you are evaluating through your performance assessment how different packages would go into a given repository, it's not necessarily for these types of issues how they're designed, but the state they will be in when they are in place. And in some cases, when you're talking about multiple decades up to centuries of aging in order to accommodate the various limits, you shouldn't be presuming that the package is going to be in the same shape as it was when it left the

fabricator.

So that’s a consideration. And in some cases, if you’re talking 100 to 150 years, this question of direct disposal may be mooted by other concerns that come up in that period.

LESLIE: Jim, thanks.

And for my rapporteurs, I’ll help them here a bit. Jim was talking about an issue that is related from canister loading down to disposal, which is, basically, if you have a lot of different types of canisters and you try to directly dispose, that means you’re going to have to evaluate the behavior of those things when it comes time to disposal.

RUBENSTONE: And just to clarify--

LESLIE: Jim.

RUBENSTONE: --in the performance assessment it’s more than just does this contribute or does this not contribute. But the fact that some material is there has to be treated--and I hate this word--synergistically with everything else that’s going on, because it may, in fact, change the behavior, you know, the local behavior in a given canister as opposed to saying I can analyze this one set of conditions and then extrapolate out to the multiple canisters that are all the same and just treat that probabilistically.

So it just makes your performance assessment somewhat more challenging. Not saying it can’t be done, but

it does sort of add the burden there.

LESLIE: I'm going to--how about if you just hand the microphone next, then I'm going to go Halim, Rod, and Jean.

BOYLE: William Boyle, DOE. This topic I'm about to bring up, it's an e-mail I just received. It doesn't matter who I got it from, but I think it's a topic of interest to some people in the room.

The judgment in the NARUC case, the National Association of Regulatory Utility Commissioners, it's the lawsuit about the mill per kilowatt-hour fee; it was just released. The Secretary of Energy is ordered to submit to congress a proposal to change the fee to zero until such a time as either the Secretary chooses to comply with the act as it is currently written or until Congress enacts an alternative waste management plan in accordance with the opinion of the court filed herein this date.

LESLIE: Thank you, Bill, for adding an additional complexity. Okay. So let's get back to this, and we'll have Halim and then Rod and then Jean.

So, Halim, is that you?

ALSAED: Yes, yes, Halim Alsaed. The point I would bring up here is about the subset of canisters in storage right now, the 300 or so canisters, that are single-purpose for storage only, and they're not transportable based on their current design, because they don't meet either

structural requirements or criticality requirements. VSE-24s at several of the sites, including Palisades, are an example of those canisters.

If the repository safety case relies on the geology, to say preclude presence of water, and so in those canisters are water with a significant amount of chlorine in it, 6 molal as Ernie just mentioned earlier, which would be sufficient to demonstrate subcriticality in those canisters, or we rely on an engineered overpack to preclude water as well for the duration of the regulatory period, then we'll have solved the disposal question for those single-purpose canisters that are already licensed for storage. The only gap we have is transportation. To repackage them for transportation, even though they meet disposal requirements, it seems to be an unduly unnecessary step.

So the question is or the issue that has to be resolved, there's regulatory aspects that have to be met, but there is room for exemptions from those regulatory requirements. Should those exemptions recognize the fact that those single-purpose canisters are disposable now, and they don't really need to be packaged or repackaged.

LESLIE: All right, thank you. And that's more over in that session, but we've captured it anyway in terms of repackaging, because this session is really looking at DPCs and moving forward.

ALSAED: Certainly, but the issue has always been those single-purpose canisters were considered outside of the disposal category, and I want to put them back in that disposal category.

LESLIE: Okay. Rod, are you going to be ready?

McCULLUM: I am ready.

LESLIE: Okay, there you go.

McCULLUM: I was just forwarding the good news. We're celebrating that decision.

But, you know, getting back to this question of more complicated performance assessment, and obviously, looking at what would be involved in cutting open these welded systems and all that, I'd rather give the performance assessors more work to do. But in that regard, I would point out that one size does not have to fit all here. As a first order principle, there's probably a lot of parameters we can address by bounding, and I know sometimes performance assessment guys don't like bounding analysis. But, you know, there's a lot of things about these casks that we can say, well, you know what, if we just assume something pessimistic here, that takes care of these parameters.

And then beyond that we may find of the 1,771 casks we can only do that or somehow complicate the performance assessment and specify it and tailor it for 1,631 of the casks. Well, then you might have a more limited set that you

can’t directly dispose of, okay? But, again, if you start out with that initial condition and you find you have an outlier and you have to deal with 50 outliers as opposed to 1,700 outliers, you really advance the system, and you put the performance assessors to good work to define that. And I think the guys that are sitting at computers where there’s no radiation exposure and heavy lifts and disrupting of reactor operations, those are the guys that should be doing that work.

LESLIE: Actually, did you have your hand up? Yes. And then I’ll come up to Andrew.

SISLEY: I just wanted to comment on the store-only canisters. I think the comment has been made that they’re not transportable, and that’s just not true. They’re just not licensed for transportation at this point, and there’s lots of things that we can do as an industry to get those transported. So just keep that in mind. And it’ll have to be a decision where we weigh off the benefits of licensing those canisters for transportation versus opening up those canisters and repackaging the fuel. So I think we need to be careful about saying that those canisters are not transportable. They’re just not certified for transportation at this point.

LESLIE: And because I can’t keep track of everyone’s name, could you repeat your name again?

SISLEY: Steve Sisley, EnergySolutions.

LESLIE: And, again, for people who aren't experts, are we talking about the bare fuel when we're talking about the non-transportable, or is it something else?

SISLEY: We're talking about spent fuel that is currently packaged in casks, canisters, that are not licensed for transportation. They're only licensed under 72 for storage.

LESLIE: Okay, thank you for that clarifying response.

I'm going to come up front, and then we'll head back to the back row here. Andrew.

SOWDER: Andrew Sowder, EPRI. At risk of disrupting a very collegial discussion here and stating some heresy--and, again, I'm just putting this out here--I'm hearing a lot of discussion about--and certainly understandably so--about preventing failure--any failures of the package or even the repository system, you know, again, essentially zero risk is where a lot of the discussion, a lot of the engineering, is focused on.

But when you're looking at 100,000-to-a-million-year horizon, the idea that--it's going to fail. One way to look at it is, well, let's talk about managed failure and do putting in your DPCs--can that be accommodated within a risk perspective where a leaky repository is a much more equitable distribution of risk over time and could in essence improve

your overall performance, again? Perhaps heresy--and I'd be happy to hear the responses to that--but we're talking about a systems approach and also, if we're talking about a performance-based compliance standard, it's not saying zero risk; and we're looking at uncertainties over tens to a hundred thousands of years. Thank you.

LESLIE: Thank you, Andrew.

Rod and then the back, because I--

EWING: Rod Ewing on the Board. Just a comment. I think, actually, this is what we do. I mean, we have a regulation that very long time periods would be 100 millirem to the exposed, so this is a leaking repository. And so the risk is managed by the regulation and judged to be appropriate. So I'm not sure which direction you're--

LESLIE: That's fine. That's a good enough conversation.

Back row, either Jeff or Brian.

WILLIAMS: Yeah, this is Jeff Williams. I just want to comment on Steve Sisley's remark about these are not certified for transportation. Well, in fact, the storage ones are not certified for transportation, because they weren't really designed for transportation. So if you look at quite a bit--if you take the Oconee canisters that are sitting down there, and then you go to the ones at Rancho Seco and you see the differences in design, to make them

transportable, it’s quite a bit different. They’ve got additional structural plates in them. They have flux traps in them. They have neutron absorber materials in them. So it would be quite a challenge, I think, to make those storage-only canisters transportable.

That was my only comment.

LESLIE: Okay. And I think I’ve forgotten Jean, so, sorry, Jean.

BAHR: Jean Bahr from the Board. There are two columns on this Matrix G and J, loading into disposal overpack. And this expresses my ignorance somewhat, but at some point the canisters themselves may become so large that the overpack that you have to put over them, well, the canisters might be transportable and disposable, but where does the overpack become a limit on feasibility of hoisting, size of drifts or holes that you might want to put these things in?

LESLIE: And, Jean, thank you for perfect behavior in terms of identifying where we are. And, again, this was--you know, basically she has pointed out the issue of these canisters. Even though they’ll be shipped and transported, they’ll probably go into an overpack, or if there’s a standard one that’s already transported in the future, the size of those overpacks, does it constrain disposal options?

And I’m going to let Tito, and then we’ll go back to the back.

BONANO: Tito Bonano from Sandia Labs. That’s certainly one of our considerations. I think in one of my slides yesterday again--I think it was Slide 12--I said, you know, you look at the DPCs by themselves as roughly about 50 metric tons. Then when you add the overpack, you’re adding another 20 to 30 metric tons to that. So you’re looking now at 70 to 80. Then you put the shielding for transport, and you add--you know, it becomes from 70 to 80, and it goes to 140 to 160 metric tons. And then when you add the cart and you’re putting it down vertical holes, then you’re talking about a 175-metric-ton weight going down a shaft.

So that kind of gives you a perspective of how heavy these things are, and that’s why sometimes we refer to them as the big honkers; okay?

The one thing that we have not talked about--because we’re assuming that once the packages get down they will never come up--if they have to be retrieved from the underground, you need to have--now you’re talking for the hoist you have an additional weight of the cables and all that stuff. So these are really heavy--you know, hot and heavy just like me.

LESLIE: Thank you, Tito.

Do we have any other--let me test the audience. Do we need a short break, or do we want to continue a little bit more?

SPEAKER: I'd vote for a break.

LESLIE: Okay, we'll let Rod do one last comment, and then the group will take a quick 10-minute break so that we can come back and get reenergized and try to focus on, again, identifying the issues as we move forward. So, Rod.

McCULLUM: I just want to kind of second what Tito said. And that's an excellent use of the matrix, because loading into the disposal container does appear on there twice. And, you know, the short answer--is that a constraint, is no. But the reason it's a no is why that's useful, because those are all design parameters. Those are all ramp-versus-shaft questions. How big of a crane question do you need? Because it goes without saying, you're not going to put the disposal canister on the road.

And that goes--and I'm sorry if I'm a broken record here--that goes to the value of setting the initial condition, because once you set that as the initial condition that we're talking overpacks here, now you have to address those design parameters. You have to draw those arrows. Does it make sense to do a shaft? Does it make sense to--do I have to do a ramp? Do I have to manufacture these things on site now that they're so big? But that's all about focusing the design and sending the design off in a direction where the arrows do end up at disposal down there, which is where we're all trying to get.

LESLIE: Okay. So I have about 10:30, and we'll take a 10-minute break, get up and stretch, and I'll actually have a bag of open candy at the back of the room when you come back in.

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

LESLIE: If we could have people take their seats, although not everyone's back, I want to try to get this show back on the road. Of course, I'll let my rapporteurs get ready to exercise their fingers a little bit more here.

And kind of just to check in where we're going in this process, although we've put this framework together and we're trying to get people to do it, it was one way to try to guide the discussion. And rapporteurs are taking as good a notes as possible. When you see what they report out this afternoon, understand it's what we've heard, we're going to rely on the transcript as the Board develops the issues and probably puts them into this matrix and posts them. But just realize that I'm going to allow the discussion to kind of go the way it's gone so far. To the extent that folks can put it in this framework, that's fantastic. But I'm not going to disrupt things to kind of force it that way.

So, again, that's kind of where we're at. You'll hear the ideas this afternoon being reported out. And if we totally missed the point, you'll have the opportunity to

raise your hand, because that will also be facilitated so that we can clarify things there as well.

So that’s just kind of where we’re at. I wanted to check in with you and let you know we’re doing okay. But we still have an hour and 15 minutes more of issues to get out on the table. So, with that, are there anyone right now that wants to start the conversation again or with a question?

Okay. Yes, Rod. Hold on one second.

Davonya, did you manage to find paper?

DAVONYA: Yes.

LESLIE: Okay, thank you. Go ahead, Rod.

EWING: This may put us a little off the track of previous discussions, but sitting here I imagined 20 years from now--some of us aren’t here, probably I’m not here--but we regather and we could well be discussing the same situation. That’s the sad reality.

And so I guess the question that occurs to me is: If we had to make a list of actions we could take related to these diagrams that would maintain flexibility, are there things we could do now that would allow the group that meets 10 years from now a wider range of options? And one point that came up in discussion over the break was: What if all of these casks were bolted instead of welded? Would that be a positive step in terms of flexibility? And there must be other actions that could be taken.

LESLIE: Any follow-ups? Yeah, Rod, in the back.

McCULLUM: Well, I can certainly see how there would be advantages to going forward we'll do the bolted casks. Of course, the utilities have reasons now for loading the welded systems, and those reasons lie exactly in that concept of flexibility, because with that flexibility comes uncertainty. And I guess what I'm trying to push for here is, let's get some certainty on the front end of the system; let's get a direction; let's head towards that direction within that flexibility.

But as long as the utilities don't see a program, if there's a very real program that is demonstrated, it's going to be taking these bolted system, then again you invoke the TAD precedent. As was shown in the TAD, the utilities were willing to load TADs, because they knew there was a program on the other end that was going to receive them.

But I don't think you'll--you know, this is a free market economy. We've got three vendors working in this field. They're very competitive. They're very innovative. You can't put that constraint on absent having something that is probably less flexible than you like on the other end. Having a program that convinces the utilities, they're going to tell the vendors, no, I want a bolted cask, when everything else in my business case is telling me to load a welded cask. So you're going to have to give up some

flexibility to get us there, I think.

LESLIE: Okay. Jean.

BAHR: Following up on what Rod said in terms of decisions we could make now, given that the sheer size and weight of some of the larger casks may place significant constraints on what kind of a setting you can site a repository in, would it make sense to place some sort of a maximum size on canisters and casks going forward, recognizing that we already have some that are quite large, but would that give us flexibility, and what would be the trade-offs? And I recognize that there’s economic trade-offs for the utilities, and in particular the reason that they’re going to the large casks is because of economics.

LESLIE: Well, okay. We’ll continue the conversation with Rod. And that was Jean Bahr before.

McCULLUM: On behalf of the industry, I can answer the most basic trade-off is, if obviously you’ve placed a limit on the size of the casks, then we would have to load more casks; we would incur more radiation exposures; we would incur more expenses. And then the problem of how many casks already loaded we have to deal with in the future would also be exacerbated, because we would have, in fact, loaded more casks.

And, once again, I continue to be a broken record. The only thing that would drive right now a competitive open

free market industry to accept that constraint would be a very real program on the other end, a reason to load smaller casks, because right now we are enhancing safety and meeting ALARA goals by loading fewer casks, which means loading higher capacity casks. And I think that is the most important thing at the power plants right now.

LESLIE: Thanks, Rod, for bringing the perspective of the workers in as well. I think sometimes even in disposal we take for granted the real risk with the operations. So I appreciate the perspective. Thank you.

Other questions? Steve in the back, and then we'll get a new person going here. Could I remind folks to identify themselves? That was previously Rod McCullum. And now?

FRISHMAN: Steve Frishman, State of Nevada. Earlier there was just sort of a half a line that I think probably needs a little more exploring, and that's that we're at a point now where the nature of the fuel itself due to high burnup is changing rapidly. And so the balance of the inventory is changing rapidly. And there was a question raised that nobody ever sort of latched onto, and that's that, is there some point at which we could say today's case is one case, the future is another? And today's case we know what we have. We know that the DOE is just starting a program sort of looking into what the implications of that

are to the point of using fuel that is already irradiated.

And is it logical that there is some kind of a break where going forward we could, very much as you're suggesting, maybe have a slightly different world for what is now being produced and what is going to be produced relative to what we already have in hand and either know a lot about or have at least the beginnings of a program to know a lot about it.

LESLIE: Thank you, Steve. And then we'll come up to Efi, and then we'll go to Andrew.

And identify yourself.

FOUFOULA: Yeah, I wanted to come back to the point--

LESLIE: Efi--

FOUFOULA: Efi Foufoula with the Board. I wanted to come back to the point of, you know, what is more safe in transporting, what is safe in a repository. And I want to just start by saying that in my mind--I was discussing at the break--we're talking about the evolving landscape of a nuclear waste repository; that is, we're not talking about a Yucca Mountain or a subsurface kind of medium that we worry about. We worry about transportation over the whole U.S. And the time scales of risk safety are completely different; that is, the time-scale of risk in the accident that happens because of transportation is of the order of a year to 10 years as opposed to 10,000 years or a million years in a

repository.

So how to put all this together is a new arena. I mean, you cannot compare the risk of something that might happen, the unknown or known, versus something that you know that you have control. And also you have to add to the 10,000 or 10,000,000 years safety the issues of being able to have a flexibility because the quality changes.

So, again, what I want to bring up is something that we started talking about in pieces, that the time scales and the regulations that have to change to address both the short time transport surface issues versus long-time safety and subsurface brings us in a completely different initial condition and makes the problem more difficult. But I wonder whether we can demonstrate that more flexibility, new technology, can really demonstrate more safety for the overall systems approach to the whole problem.

LESLIE: Thank you, Efi. Andrew is going to be next. Actually, before I go to Andrew, I got a note handed to me-- and thanks for my support staff. Anyone who asks questions, please make sure you did sign up on the front table, because we want to make sure we get your names right for the transcript. And so that’s just a reminder.

Sorry, Andrew, go ahead.

SOWDER: Andrew Sowder, EPRI. I do want to put the technical question of high burnup fuel into some context,

because I think just by the very fact that we now have high burnup fuel going into dry storage indicates that fuels have been driven to higher burnups for quite a while now. And so we do have, actually, an understanding of the behavior and some of the properties. We don't have the extent to which we understand the lower and older fuels, but industry and other groups have been collecting data on this for decades now. So it's not an unknown, and there are issues that have been raised, and those are being addressed now.

But I just wanted to give a little bit of perspective that it's not that we're just now starting to look at high burnup fuel. What we are doing is we're just now starting the high burnup confirmatory demonstration project. But certainly the actual properties of the cladding, etc., those have been the subject of multi-year programs, international programs, for many years. And so I just want to kind of give that perspective. But there is a body of knowledge out there, addressing high burnup fuel and its performance.

I just want to point out one thing. In terms of context and perspective, the most extreme environment that the fuel will likely encounter in this system is while it's in the reactor, being driven very hard for a purpose. Once you get it out into storage and certainly hanging out in an inert environment at lower temperatures, if you look at this

systematically, the fuel is not in an extreme environment. And so, again, I think a lot of times people tend to look at this in a compartmental fashion. But the fuel was designed to operate in a reactor, and the conditions it's experiencing under dry storage are actually very mild, and most of the fuel will do quite well.

And that's just a--that's not a technical statement; that's just more of a perspective statement.

LESLIE: Thank you, Andrew. And I'm going to go to Ernie and then over to Jean.

HARDIN: Sure, this will be quick. Hardin, Sandia Labs. On high burnup I have a perspective on thermal for you.

LESLIE: Thank you.

HARDIN: It is going to be necessary to be able to safely transport the fuel to the repository up to a hundred years after reactor discharge. That hundred is a somewhat round number. I could go into the reasoning here, but especially for high burnup fuel, which has more heat output obviously, we need to be able to age that longer and to lay the eventual emplacement in the repository. So a hundred years is a nice round number.

LESLIE: Okay. Well, I'll bring it back over here. So does that mean this is an issue for hundred-year storage at a reactor? Does it mean--and, again, I'm playing through this. Does that mean this facility doesn't get decommissioned for a

hundred years? I'm being very--pushing the envelope here--but does it mean that you think about centralized storage for some part of it? How does that--given that you're going to have to store it before you transport it, that's pretty enlightening.

So I'm going to go Rod and then to Jim.

HARDIN: Hardin, Sandia. It may not be universally true for all geologic settings, but a hundred years, like I said, is a round number.

LESLIE: Sure. Jim, did I see your hand, too? I'll go to Rod and then Jim and then Rod. Rod McCullum--oh, sorry, Jean.

McCULLUM: Yeah, I think that's a good distinction. Now you've got some connections between some of your boxes here, because what you're talking about is, it makes more sense to transport earlier before the degradation mechanisms may be of much of a concern. But then it makes more sense to dispose of later. So are you talking about an aging management plan at the repository? Are you talking about parameters that affect where the central interim storage facility is located vis-à-vis where the repository might be located? Which brings into play the two decision-making processes, which they'll come in in the licensing anyway.

And this gets to this question of looking at the certain risks, you know, the things that can happen to you in

a one-to-ten-year time frame and finding a way to value those against the longer-term risks. I mean, when I was looking at Yucca Mountain, I used to think, okay, you know, we're arguing about less than a dozen millirems to some hypothetical individual that's going to be here thousands of years in the future, and we're making decisions that are going to expose real people to slightly more amounts of radiation here in the present day.

So does system need the issue? Now, I can't answer those questions. But the system needs a way to prioritize and value the relative risks so that you can make decisions about when do you transport, when do you dispose, and how do you balance off the two?

LESLIE: Thank you, Rod. And I'll get back to Jim and Rod Ewing. First, Jean.

BAHR: Jean Bahr from the Board. I wanted to get back to this issue of the packaging risk, that loading things in larger packages now certainly limits the risk to the workers at the plant. But are we fully accounting for the fact that that could then require repackaging and more risk, not in the ten-thousand-year time scale, but in the hundred-year time scale, to other workers? So I think one of the dangers is that we're compartmentalizing things and not looking at the disposal system there. So I accept that you're minimizing risk at the reactor by what you're doing, but that might not

minimize the short-term risk.

LESLIE: Thank you, Jean.

RUBENSTONE: I just wanted to get--

LESLIE: Identify yourself.

RUBENSTONE: Jim Rubenstone, NRC. I wanted to get a clarification. I think what Ernie was referring to is that the hundred-year time scale is for disposing of high burnup fuel in order for its thermal outputs to be more accommodating to a geologic environment.

HARDIN: Yes.

RUBENSTONE: Yes, because the question of transport of high burnup fuel is a separate issue. And the NRC is reviewing several certifications now for transport of high burnup fuel, and it certainly will be possible well before a hundred years of storage to transport high burnup fuel safely. And one of the questions that has come up--and the Chairman mentioned this as part of her comments yesterday--is one of the evolving issues in high burnup fuel.

And I understand Andrew’s perspective on the reactor environment being more aggressive than some storage environments is that if hydride reorientation is a phenomenon that we need to be concerned with and the information out there is developing, then there may be issues with what people refer to as a ductile to brittle transition in certain types of cladding as the fuel cools. So in some sense

transportation of warmer but not very hot fuel may have a lower risk of degrading cladding than letting it sit for a hundred years at a given site. So there are different issues for the different legs of the concern.

And Dr. Bahr's point about transferring risk, I think, gets back to the idea that we need to look at this as a system that if you're optimizing certain aspects from a risk point of view--and I know optimization is not a popular phrase in the U.S. environment for waste management; it has been used more in other international context--is that you well may be making things okay for a given operation without considering the full range.

Now, NRC as the regulator tries to take a broad enough view that, as long as we set regulatory standards and ways of meeting them for any given operation, that you're not necessarily disproportionately weighting the risks to one operation rather than another. And that gets to Rod's point about how you set limits for performance of a repository for some hypothetical individual at some point in the future. The whole idea of the regulatory framework is you're not directing the burden necessarily more to one place than another, but you're setting acceptable levels of risk at any stage.

LESLIE: Before you give up the microphone, let me ask a clarifying question. And I see a couple other new hands.

And I still have Rod Ewing to get the mic to.

But, Jim--and this is kind of a tie between the hydride and something that Rod said and, I think, maybe Ernie. So it sounds like--and I may be completely wrong, but there is a time frame in which this cooling--and you can take cooling as a function of time--it becomes problematic if it's cooled or stored for too long, and then it couldn't be transported or--

RUBENSTONE: Potentially. I think there's still a lot of evidence that needs to be gathered, and this gets into some of the constraints that are placed on how long fuel resides in a pool before it goes into dry storage. There are strict limits--industry, I think, often doesn't hew strictly to the strict limits of how long you have cooling before you put it into storage. It gets into how you load different canisters. Of the loaded population of canisters out there, not all of them were loaded to their thermal limits at the time.

So I think this gets into some of the discussion of doing screening on individual canisters. Of the 1,700-odd that are out there now, some of them are probably already cooler than one would predict. And this circles back to another hat that I wear in the NRC about looking at some of our extended storage issues. In general, the constraint that people load to thermally going from pools to storage is,

during the drying is when the fuel experiences the highest outside-of-reactor temperature. And there's a 400C limit that NRC puts on that, because during the drying process, before you've backfilled it with the inert gas, in the vacuum the fuel is less effective at getting rid of its heat.

So there are models--the thermal models for evolution of the fuel in dry storage are too conservatively to not hit that temperature limit during the drying stage. What we're lacking--and probably this could be contested as well--what I feel we're lacking is enough validation of the models about how conservative they are to the warm side. I don't know how close we're actually getting in practice, because we don't, in fact, measure temperatures directly during the drying process.

And then as time goes by, if the models are biased to keep it below a given temperature during the drying process, after decades of storage, when does it start passing into cooler regimes where you may have other issues coming up, one of which may be this ductile to brittle transition, other issues relating to performance of the canisters in service.

And I'll put in another plug for DOE sponsoring this high burnup demo. One of the major benefits of this is not that it's just going to be a "close it up and look in ten years", but we want to try to get monitoring information,

including temperature and other parameters in essentially real times so we can validate some of our models.

LESLIE: Jim, thank you for a very long, clarifying remark. Can we pass it over to someone new first, and then, Rod, we'll get to you?

PHILLIPS: Thank you.

LESLIE: Your name?

PHILLIPS: Chris Phillips from EnergySolutions. I just wanted to come back on the commentary about compartmentalization and how, if the utilities reduce their worker dose uptake by using the biggest canisters, that could well have implications down the line for other workers' dose uptake. That's absolutely true. But I wanted to make the point, I don't think we're going to resolve that until the nation has a plan for how it's going to actually deal with the UNF of a repository and consolidated storage. Until you have a system that's planned, you can't do an assessment of the overall safety of the system, because it doesn't exist.

So inevitably I fear we're going to be stuck with utilities doing what's best for them until we have an overall plan within the U.S. for what we're going to do. And it's actually got worse, because we haven't got any repository now, of course. It's actually got worse rather than better. It's a bit of a bleak assessment, but I don't think anything is going to happen until there's an overall system against

which you can judge. Then you might be able to work with the utilities to get them to do stuff that will reduce overall costs and dose uptake throughout the entire system. But you won't do it until you've got that.

LESLIE: Thank you, Chris. And now I'm going to go to Nigel. And can people quickly raise their hands so I can keep track of other people who want--okay, thank you. Go ahead, Bob--I'm sorry, Nigel.

MOTE: I'll try to do an imitation, yes. I have to stand and I have to speak faster.

So, just to follow up on and give a counterpoint to Andrew's point about high burnup fuel, there's a lot of experience; there's literature; we all look forward to the DOE high burnup fuel demo. All of that's positive. But I point out that we know precious little about the behavior of high burnup fuel as a waste form, how it corrodes. If you go to the literature and look for very simple corrosion studies of high burnup fuel, there are very few, and that's because, of course, it's difficult to do.

On the point of extreme environment, certainly in-reactor conditions for UO2 are very extreme. But as a material, the really extreme environment for UO2 is UO2 in contact with water, a few bicarbonate molecules in it. So that's where UO2 alters very rapidly. So that's the extreme environment, in other words, the disposal environment.

And all of this is by way of emphasizing the importance of the package. So if the large casks are very durable and provide an excellent barrier to access of water and so on, then that's attractive. But I think we have to pay careful attention to the geologic disposal.

LESLIE: Okay. I'm going to get one person over here, and then I'll go to Ernie. And it's not Mary Lou Retton; it's Mary Lou Zoback.

ZOBACK: Mary Lou Zoback, Board. I've been listening to this discussion and all the wonderful points that have been raised. And it's a bit hard to get my head around, but the gentleman behind Tito who just spoke--oh, sorry--without a final plan, there seems to be infinite number of possibilities, and that's extremely frustrating. And Tito did an excellent job of kind of framing what the final plan, the geology of the final plan, the configuration of the repository, how that would impact things.

And I hope we're all still thinking the potential for multiple repositories. I know that everybody's so beaten down that it's hard to even imagine you could ever get one, but maybe two different geologies might provide more flexibility in thinking of flexibility.

But the issue I want to raise is really--I can't tell you which box it is, because I think it's a whole bunch of boxes, and it's the value of data. And I think you

mentioned it, you know, we're kind of assuming everything's performing--all of X canisters perform a certain way. And they've been sitting--some of them have been sitting on the ground for 25 years, right? We heard the problem's been around for 25 years? How are they performing in terms of temperature and things like that?

The more data we can get--I was so impressed with the Germans. Here their program is halted, but they've been testing everything a thousand times and putting it in, taking it out. And, you know, we need data. We've spent a lot of time with finite element modeling. That seems to be very popular, but as much flexibility and as much data, I think, will help improve the flexibility and constrain the infinite-finite element model.

So that's not very helpful, but I feel like we're missing the data we need. And that goes to helping inform the risk evaluation.

LESLIE: Thank you, Mary Lou. Ernie? And then we'll come back and--

HARDIN: Yeah, Bret. Hardin, Sandia. A quick follow-up to the transport of high burnup fuel up to a hundred years. I think getting it to the repository and getting it underground are two separate events, but they may both be subjected to the same regulatory test. So I'm not convinced that just getting it there is enough, that the condition of

that fuel needs to be known so that we can get it underground also.

LESLIE: Just checking with my rapporteurs.

SOWDER: Andrew Sowder, EPRI. Just a little bit of feedback on the request for data. Certainly the utilities and the industry have heard the call and, I think, definitely agree. And to that end, we are starting to look at doing some of the first in-service inspections of some of these systems; because, you're right, they were put out there on the pad, and we're just now getting the opportunity to go in there and start looking at in-service inspections and trying to come up with non-destructive evaluation techniques and those sorts of things.

But, again, that work is just now beginning, and hopefully we'll be getting more and more data coming in. This is not necessarily part of the demonstration program; this is in parallel with that. And I know the Department of Energy and probably the Nuclear Regulatory Commission are also sponsoring parallel efforts, doing separate effects testing and that sort of thing.

So all of that--you know, the whole point of, I think, my comment here is just to reaffirm what you had said; and I think everyone recognizes that need. And eventually the industry is working towards an aging management plan, because, again, these things weren't supposed to originally

be aging to this extent where they needed an aging management plan, but given that's where we are today, you know, I think the recognition is there, and you need the data to support that so you understand what needs to be monitored and managed.

LESLIE: Thank you, Andrew. And I think I'm going to allow my rapporteurs, who I've had my back to them most of the time, they did get my--go ahead.

FRANKEL: Gerry Frankel, Board. So it's going to be my job to try and bring this together this afternoon. And what I'd like to do is to try and formulate a narrative and throw it out to you and let you respond to it and let me know if it's crazy, okay, and maybe what should be changed. And maybe that can direct some of the discussion till noon.

So I think we all here will agree that repackaging is complicated, expensive, potentially dangerous, and so there's a lot of simplicity and advantages in direct disposal. And we have talked about maybe separating what's been done in the past and maybe in the future to improve the likelihood of success, let's say, or improve the whole plan for direct disposal.

And Tito really formulated or threw out the three areas, three real concerns, which were the weight, the thermal effects, and the criticality, postclosure criticality. Those are the three he talked about. And then

Rod mentioned maybe the fourth, which would be environmental stability. But is it possible that there really are engineering solutions based on good science to deal with all of these issues, that handling heavy things--I don’t know, it’s an engineering problem. Maybe there are ways to do that. So, to me, that doesn’t seem to be a deal breaker.

Thermal effects, well, it’s all about the design of the repository, spacing of the drifts, spacing of the canisters, depending upon the geology. But it can be handled, it seems to me.

Criticality issues, criticality control, maybe can be improved going forward with smart designs of canisters that are formulated with the idea of direct disposal in mind. And, of course, we have to maybe deal separately with the ones that are existing now.

My specialty, actually, is corrosion. So I think that we can deal with environmental issues separately with smart solutions, considering overpack that will be specific for a given final geology that’s going to be decided later. But maybe we can just bend that and say we’re going to be able to deal with the specifics, whether it’s saturated salt or clay or whatever. We’ll be smart about that later.

Then there are issues with high burnup fuel and when to transport and when to store. But there seems to be a way, a smart way, to deal with all of that.

So is there a narrative that makes sense where you can say we have some very big packages now and lots of different sizes, but let’s try and constrain that as best as possible by harmonizing the regulators and the Department of Energy and the utilities with a concept of moving forward with direct disposal for the future in dealing with packaging--dealing with this as soon as possible but then having some--and maybe they’re smaller--in the future they’re going to be smaller, let’s say, to allow for easier transport and handling but then separating out the--Mary Lou says that maybe we have different repositories, maybe something that’s specific for these large packages that are going to have thermal properties, and they’re going to be handled differently than the ones in the future.

So is this--my question then--and maybe to help me--is this an area that makes sense, that can be a way to move forward?

LESLIE: And, kind of, that’s not really what we are trying to do. What we’re trying to do and report back is the issues. And so--

FRANKEL: But are those the issues with direct disposal? That’s my question.

LESLIE: Okay.

FRANKEL: Are those the issues with direct disposal? Is that the narrative to describe what the issues are?

LESLIE: Okay, that’s helpful. So for the next couple of minutes I’d like the participants to help Gerry make sure--and Sue--make sure that they--based upon that’s what he’s heard. And, again, during the lunch break Roberto over there and myself will work on this. But now is an opportunity for you all to kind of help clarify.

I’m going to start on this row. I’m going to go Tito and the person who hasn’t talked, Ernie, and then I’m going to come up here. So, Tito.

BONANO: Tito Bonano from Sandia. So, Gerry, to answer your question, there was another point, another nugget, that I think is important to capture. There has been information here in a variety of forms--I think Jean mentioned it--from a systems perspective. I think Chris alluded to that, too, in his comment, and so did Rod, when he said, you know, with Yucca it was easy to convince the utilities to go to the TAD, because we had an end game defined.

The main problem with--you know, the lack of a system perspective is a problem. And it’s going to be an issue, because we do not know what that end game is. And if you look back at the presentation I gave yesterday, we made an assumption about what the regulatory framework would be for that end game. There is no guarantee that the best way to--you know.

So even our calculations and results we showed

yesterday are conditioned on the fact that we made an assumption of what that regulatory framework would be for disposal. We don't know whether that's going to be the case or not. So the lack of understanding what the disposal options are going to be is going to be problematic into deciding, especially moving into the future, how do we have that feedback mechanism from the real back of the back end to the front of the back end.

So I think that's a perspective that I would suggest--recommend including as well.

LESLIE: Thank you, Tito. And could you pass the microphone down?

And could you identify yourself?

SCAGLIONE: John Scaglione, Oak Ridge National Laboratory. Basically, I just wanted to discuss a little bit about the summary on criticality control and what we can do going forward. It was kind of hinted at a few times in different people's talks--I know Andrew brought it up--that they had looked at the consequences of criticality occurring in a repository. This has been done at the Center for Nuclear Waste Regulatory Research out in San Antonio.

And, you know, sure, there's a lot of things we can do moving forward to help future DPCs that would help this direct disposal of criticality. But, you know, we do have a backlog of 1,800 casks also that we will need to deal with,

and that's going to grow over time. And, you know, going with the risk-informed approach is the proper way to address some of those issues concerning criticality with the existing canisters.

Ultimately, our final product that we're looking at is the dose to the persons standing out there thousands of years from now. And what we need to understand is, what is that impact on that guy if we do have a couple--we're not saying that we're allowing criticality, but we need to understand what the implications of that would be on the dose.

LESLIE: Okay. And Ernie and then I think it was--

HARDIN: I could add something to your summary, which is the importance of choosing a geologic setting. I know we're not supposed to be talking about cost here, but I just wanted to throw out some factoids for you. The long-lived neutron absorber material proposed for the Yucca Mountain TAD would have added $400,000 to the cost of every waste package. And if we go forward with a similar strategy, we're talking about adding $5 to $10 billion to the cost of disposing of the full range of inventory that we project from the U.S. commercial side.

So these decisions matter. And the geologic setting that you select is--the earlier we can do that, the better off we are.

LESLIE: Okay, sorry, I'm forgetting where my microphones are. And that was Ernie Hardin.

ALSAED: Halim Alsaed. I just want to add a few more things to what John Scaglione and Ernie talked about regarding the criticality safety issue. And I will keep the focus of the discussion on identifying the issues rather than proposing the detailed solution.

There are two pieces to it, as John outlined. There is determination of the likelihood of a criticality event in the repository, and there is determination of the consequences of that event on the (inaudible). So the issues that we have are: How do we go about determining the true likelihood of a criticality event in the repository rather than just some hypothetical condition that could or could not occur?

The more you know about those DPCs, the 1,700 or so that are loaded and whatever to be loaded, the more we can-- the better we can quantify that likelihood of criticality. And I'm talking about two things, obviously the design of it, but that information is easily attainable. But the other piece is the fuel-specific information. We're crediting levels of burnup for disposal criticality; there are a little bit more than what's credited for transportation.

The more you know about those assemblies, their history in the reactor, how they were depleted, their

specific design parameters, the more accurate your model is of that system. And generally that leaves you to determine that those assemblies are actually less reactive than, say, models for transportation.

The vehicle to get that information was the RW-859. 2002 is the last draft of it. There is another one maybe in the works. But there has been continuing efforts to get more and more information into the RW-859 regarding assembly design, depletion parameters, history, specific power, burnable poison, a lot of that information that wasn't available in the 2002 one and may or may not be available in the next revision.

And there has always been an issue that we've have had between DOE and the industry, a collaboration issue that would allow for the most detailed information that we can possibly get about those assemblies so we can determine the reactivity potential.

So the issue is, how can we get DOE and the industry to legally communicate a little bit better and maybe get more information about those assemblies in a way that would allow for more accurate or more precise modeling of those systems to determine the actual likelihood of criticality, which will be far lower than what we've determined so far.

The second piece to complete the risk argument is

related to consequences. It's allowed by the regulation, it was allowed by 10 CFR 63, but there has always been a continued discomfort with performing a consequence analysis because of political public perception, although it's allowed by the regulation. And so the question here is, we are still determining it's a low likelihood event, but what can we change regarding the culture? And all parties--industry, DOE, NRC, and the NWTRB certainly--to see if that path can be explored; and if it can be explored, what formal steps can we really take forward? How can we actually get that issue to be put on the table, a decision made collectively by all the stakeholders?

LESLIE: Thank you, Halim.

And, you know, as I've thought about this, I didn't go through my ground rules at the beginning of the meeting, and we've been very good without ground rules. No sidebar conversations, please, if we can.

Rod, I'll get to you after Bill Boyle.

BOYLE: William Boyle, Department of Energy. I just wanted to say that it seemed like a reasonable narrative to me, but I want to put in a plug to not forget the point that Jim Rubenstone made and that I made that, depending upon how the future turns out--and none of us know--we could face challenges well before disposal. If there is a long passage of time and the materials change, there might be technical

questions related to storage. And the point I made is, if there are repeated handlings, things may occur that pose challenges related to storage as well.

So it's not just a disposal issue. There's the possibility of challenges for storage and transportation as well.

LESLIE: Thanks for bringing that back.

EWING: Just a quick comment on Ernie's call for knowing what type of geology we would be dealing with. That's certainly very important. The Board's been looking around the world at other nuclear programs, and particularly consent-based programs, and one question has been: How do you do it and how long does it take? And a very subjective judgment is 30 years. So I think as we make our own plans, it could be we have more time than we want. On the other hand, maybe this is--this should shape our thinking. We won't know the type of repository very quickly if we go through the consent-based process.

LESLIE: Thank you. Hold on a second. I'm going to go over there, and then I'll come over to--

CLEMMENS: Hi. Jack Clemmens with Chicago Bridge and Iron. As I've been listening to a lot of the discussions today, what struck me was, we're saying it in a lot of different fashions, but until the repository is known, one of the things that we as an industry need to do is figure out

how long can the fuel in its existing condition, whatever container or canister it's in, stay where it's sitting.

And I say that because it may take a while to establish the repository; and so while it's sitting there, we should be studying what's happening to it. Maybe it's gathering of the data, maybe it's the high burnup, the low burnup, it's the different types of containers. And if it's not going to be able to stay there for a while where we can extend the license with the NRC, then what other kind of engineering systems do we need to be adding to protect it to allow it to stay there longer?

And in that regard, I know the utilities may not like that, but if the goal is to go to direct disposal, what's the purpose of the consolidated storage? It gets to what Bill Boyle is saying. It's more handling. It's transportation. The best solution would be to leave it where it is until we figure out what we're going to do with it and protect it for as long as we can and start looking at that now.

LESLIE: Thank you. And I'm going to go over to Sue, and then we'll go back to Rod.

BRANTLEY: Sue Brantley. I'm on the Board. I'm just curious, kind of pursuant to Gerry's comments, if we do choose direct disposal, does that preclude certain geologic media, or could we always engineer to be able to direct

dispose in any geologic media?

SPEAKER: We're not doing solutions.

LESLIE: Can you say it one more time in a different way? And then--okay, all right, all right. Actually, Sue, if you don't mind handing the microphone back to Bill for a perspective from the DOE.

BOYLE: William Boyle, Department of Energy. I'll turn it a bit from the geology to state definitively there is at least one repository concept or disposal concept that's been discussed yesterday that will not work ever with the existing DPCs. That's borehole disposal. That's out.

LESLIE: Okay, Rod, and then we'll go up to Mary Lou. All right. Rod.

McCULLUM: I just want to address what was just said a little bit. The question of how long we can safely store this stuff is not an unknown. The NRC has a regulation, 10 CFR Part 72, that has licensed these systems for 20 years with the option of a 20-year extension. The data that we have now, that rule in 2011 was revised. It's 40 years, 40-year extension. We're looking at the high burnup fuel, but when you look at how recently we've been loading high burnup fuel, we'll have that data when we need that data. And that's the way the process works.

So we have many, many decades here of confident storage. You know, what we have here is a question of how to

focus our efforts going forward, and I think that needs to be part of the narrative. I mean, we talk about placing constraints on things going forward, but before you can negotiate any of those constraints--I again refer back to the TAD example--there has to be something you're negotiating based upon.

To me, the first constraint would be, you're going to do direct disposal. You lay that initial condition out there, then you have the opportunity to provide the assurance of the utilities that they will accept the canisters, the 1,700 that have been loaded. Then you can further talk about, well, what ones would you like them to load going forward. That might be better if you had a central interim storage facility, because then you can decouple some of these questions.

If DOE is able to receive the 1,700 and wants to show up at a reactor site with a bolted system or whatever, because you think you might need that going forward, if you've got a place to take it, you can negotiate that. If you don't have that, if you don't have a constraint on the very back end--and I think the most important constraint is that initial condition--then there is really no basis for negotiation. Then the utilities are going to do the things they need to do to protect their workers, to protect their rate payers, and they're going to load the biggest casks they

can, and they're going to keep doing it.

So the biggest constraint is placing a constraint on the uncertainty right now.

LESLIE: Thanks, Rod. Okay, Mary Lou, and then we'll come over to Ernie. And, again, this--Gerry, are you getting things okay? We're going in the right direction, so we'll continue. Go ahead, Mary Lou.

ZOBACK: Okay. I want to insert a geologic perspective. All the discussion has been on how safe everything is at the site, because the canisters are blah, blah, blah. They're at 74 sites around the country. They're all on river flood plains or all on the coast. There are unprecedented natural hazard events that occur, a liquefaction event at one of these sites that maybe would damage cement platforms.

I don't think saying it's safe where they are if there's no certainty that they're safe where they are. There is risk associated with these sites as well, and that's something that has to be factored in. Is it better to have risk at 74 sites or an interim storage site where you consolidate that risk? But there's a lot of perspectives in the status quo that need to be considered.

LESLIE: Thank you. Ernie?

HARDIN: Right. Hardin, Sandia. I wanted to give a perhaps more respectful answer to the question about whether DPC direct disposal could exclude a geology. We think in

terms of disposal concepts. We've written up a few of them that we think might work. And the bottom line is that it trades with time. So it's how long are you willing to decay store the fuel before it's disposed of?

For the studies that have been done at Sandia, Oak Ridge, and Livermore and elsewhere, which Tito described in his presentation, we chose 150 years from reactor discharge for actual closure of the repository panel. Recognizing that spent fuel has been and will be generated in this country for over a period of 90-plus years, you see the need for using a relative measure of time.

So 150 years. We had proposed other concepts, you know, some time ago that might have gone up to 300 years, and we got shot down on those. But this is an issue that certainly your opinion would be valued.

LESLIE: Okay. Let me go to Chris and then Rod.

PHILLIPS: Chris Phillips, EnergySolutions. I was going to say something similar to what Ernie just said. The narrative, as I heard it, made it sound as though direct storage of DPCs was possible in all circumstances. And I just wanted to make the point and reiterate, really, that that is true only if you accept either a restricted geology and/or you accept really long pre-repository storage times. It isn't a done deal.

If you put restrictions on pre-repository

emplacement storage times, then you're limited to certain actual geologies. And we've just got to bear that in mind. I think that the narrative has to reflect that. It isn't necessarily going to work--direct disposal of DPCs--without some of those restrictions being made.

LESLIE: Okay. Could you turn around with the mic and--

McCULLUM: First, I just want to say for the record, I was not arguing for longer on-site storage. I was simply citing the regulatory basis that exists for safety for what I hope is as long as it's going to take us to make these decisions. And in regard to that decision-making, getting back to the point Ernie made, if a decision to commit to direct disposal eliminated a certain geology, I would call that progress.

Now, granted, you have to make a decision within that as to how long you want to store. But, okay, now you're forcing another decision. You're forcing decision-making going forward, which I think is what we should all be about. And if we use that forcing function, we--I heard about we need data. We focus our efforts. Now we know where we need the data, and we know what the mission of collecting that data is.

And if it ends up that there's five potential geologies, and when we really get a good answer to that how long do we want to surface store question. If only three of

them will work for direct disposal, great, we've just narrowed down the site selection process. And that should be the goal here, because I think if we keep punting, that's not serving anybody. So, yes, narrowing down geologies by fixing on direct disposal is progress.

LESLIE: Other people? Other questions, comment? Sorry, go ahead, identify yourself.

ALSAED: Halim Alsaed. And I'll talk about retrievability. And given that it's a cross-cutting issue for storage, transportation, and disposal as well, currently 10 CFR 72 requires retrievability at the assembly level. And there are no really specific retrievability requirements for transportation, and Yucca Mountain was designed to be a retrievable repository. However, that was not terribly well-defined for either canister level or assembly level.

NRC earlier this year was asked for some input from the industry, DOE, and other stakeholders on whether the retrievability definition should stay at the assembly level or should it be done at the canister level. And regardless of where that goes, whether it stays at assembly level or it gets changed to the canister level, would have significant implications on continued storage, transportation, and disposal of DPCs. In particular, if it goes into the canister level only and no longer requiring retrievability at the assembly level, then that certainly limits the options,

and it drives you further to direct disposal of the DPCs.

LESLIE: Name?

RUBENSTONE: Jim Rubenstone, NRC. NRC evaluates natural hazards at all dry storage locations, and we believe that we have made decisions that they are safe now. So we understand there are natural events that can disrupt things, but we like to think they have been evaluated. And this goes through the renewal process. As Rod has pointed out, they are term licenses, and they need to be renewed. And with each renewal stage, I think there are issues that were not--you know, can be raised that both natural hazards and aging management issues come up at the renewal stage that need to be looked at more closely than when they are initially established.

So I understand the concern. I'm not saying it's not important, but we do have a framework for evaluating that.

The retrievability question, this often brings up confusion, because the term "retrievability" is used in two ways in our regulations. There's the retrievability in the storage 72 space, Part 72 space, which is this question that NRC has solicited input on and is currently evaluating to make a recommendation to the Commission about retrievability from storage at the assembly level or at the canister level. And I think that's one of the issues that's probably being discussed in the other room.

In the repository sense, the retrievability under Part 63 was: At what stage can the emplaced waste packages by taken out of the repository? And it wasn't a question of assembly or canister question, but under the Nuclear Waste Policy Act, retrievability and the ability to remove the waste packages out of the repository if safety issues arose needed to be considered up to the point of permanent closure. So it's an unfortunate use of the same word to mean two slightly different things.

And I think one of the other questions and getting back to the bigger issue was that, even though we're looking at technical questions and not policy or cost questions, is there will always be trade-offs between the costs and the policy implications of direct disposal versus repackaging. And it may be too simplistic to look at it as an either/or issue.

I'm getting into my personal opinion here, but of the 1,700 that are loaded now in dry casks and however many coming, which may or may not be subject to other considerations and how we design these future casks, we shouldn't get into the idea that we have to come up with a means of disposing of all of these loaded casks directly. There may be some subset which is more favorable than others.

This circles back to the question that Halim raised about getting the accurate data for how each individual cask

has been loaded, what's in there. Some of those may be more amenable. A lot of the calculations that have been done have been done based on somewhat bounding conditions that may not apply in all instances. So there may be some subset of the existing loaded casks or ones to come that are more amenable to direct disposal as opposed to trying to make calculations or finding a geologic setting that allows all of the ones to be disposed.

LESLIE: Thank you, Jim. Other comments, questions?

EWING: Just a personal comment.

LESLIE: Rod Ewing.

EWING: Yeah, Rod Ewing, Board. So from my perspective, letting direct disposal drive site selection would be a very serious mistake, because you run the risk then of not having a geologic site. I mean, using a single criterion like this, the initial conditions, to drive you to judgments about long-term performance, that's quite a leap.

And, as an example, of course, when we talk about suitable geologies for these large packages, we're thinking about salt because of the high thermal conductivity. But, remember, for the WIPP site the compliance period is 10,000 years, and we're talking about a million. And it may not be so easy to find a site that can be accepted under present regulations or the old regulations.

LESLIE: We'll go to Tito, and pass the--

BONANO: Tito Bonano, Sandia. I think, Rod, you make a very good point. And I think it's--I'd like to clarify that when we talked at Sandia about the analysis of the geologies, you know, the different geologic environments, we're talking in general terms. I think there is a big wild card here, and it is when you go to a specific site, okay, some of these general arguments that we've made, whether it's salt, hard rock, or sedimentary rock, you know, we get into a site-specific realm and that there might be uncertainties. I think that there are some issues.

For example, if we went to a million-year requirement in some of the soil that's around WIPP, that there are some of us, including myself, that have some concerns about whether or not a million-year requirement could be satisfied because of, you know, (inaudible) dissolution, and things like that.

So I think--you know, I wanted to make sure that, to clarify, that when we're talking about geologic environments at this point, we're talking about generic geologic environments and not necessarily site-specific. I think Dr. Pete Lyons made it very clear yesterday, at this point in time we are only allowed to look at generic sites.

LESLIE: Okay, thanks. We're slowing down. I'm slowing down. But I think we've made good progress--well, I can't talk and speak at the same time. But I want to check back in

with Sue and Gerry. Are you feeling a little more comfortable about where we've been and where we're going? And, again, I will remind folks that, you know, they're trying to take as good a notes as possible. And if we've blown it, then I'm sure you'll raise your hand and say, well, you know, we really meant to say that. So, again, give them some leeway this afternoon as they try to capture real time what they heard.

Do you have additional clarifying questions that you want to follow up with specifically? You have to use the mic.

LESLIE: Okay. Yeah. And that's the advantage. We go second, the tail end of disposal.

Other comments or questions? We don't have to stay to noon. I'm happy to stay to noon. Kind of, we're about 10 till.

Ah, yes, I knew there was something else I needed to do. But I'll still entertain other comments or questions.

Okay, seeing none, kind of remind folks and thanking folks, kind of the path forward is, we're going to regroup after lunch, all back there. We will hear the report-out from the other session first. So kind of keep in mind what you've heard here.

Rick Daniel, the other facilitator, will help the rapporteurs entertain questions. And then after that session

is over, then Gerry is on the hook to present what we've heard. And, again, I'll be facilitating the questions and comments. We might hear things completely different from the other group, but also that's your opportunity to say, no, you know, what we heard was slightly different. And so it's not just a feedback from the Board members who have served as a rapporteur, but it's also an opportunity to kind of think, listen, and then contribute further.

We are going to try to put these things back into the tables and list the other issues by December 2nd on the Board Web site. And we'll clarify this at lunch. When I have talked to Nigel, it looked like we were supposed to be accepting comments on your comment cards or through this Web site, which is also on the Save-the-Date on our Web site, to the 16th. So we'll clarify--you know, today is not the end of the day. Your input is not just right now. It's this afternoon and also beyond a little bit.

And I think, with that, I really appreciate your patience with me as I tried to run around and keep the thing going on. And you should give yourself a hand. And if there's any chocolate at the back of the room, feel free to take it. Thank you very much.

(Whereupon, the lunch recess was taken.)