**SESSION 1: Facilitated open discussion of the implications of repackaging spent nuclear fuel for transport or disposal.**

DANIEL: Good morning, everyone. Welcome, ladies and gentleman. My name is Rick Daniel. I'm from Cool Landing Facilitating. I'm excited to be here, because I'm learning a lot from you folks. And this breakout session the Nuclear Waste Technical Review Board designed to generate discussion, and the more lively the discussion, the more likely we are to highlight and characterize what the issues are.

I want to emphasize what Nigel said earlier. This is not about seeking solutions. It's about identifying issues, so this particular breakout session is going to focus on the implications of repackaging spent nuclear fuel for transportation and disposal.

To get things started, we're going to have a couple different perspectives that are discussed for five-minute presentations. We are not going to be taking questions after those presentations. The first presentation is going to be by Adam Levin of AHL Consulting. And, as I said, it's going to be about a five-minute presentation; and then immediately afterwards we're going to hear from Dr. Marvin Resnikoff, and so he will follow on right after Adam.

And then we're going to get into our discussion right off the bat.

So be thinking, as you hear these presentations and as the morning wears on, to go back to what Nigel said. As we raise issues, you can refer to the matrix to best characterize the issue. The more specific you can be for our rapporteurs, Dr. Lee Peddicord and Dr. Paul Turinsky, they're going to be our rapporteurs. They're going to report back after lunch.

And after lunch, as they run through these issues, as they highlight these issues, if you hear something that's maybe not quite accurate or we can tweak it or refine it to characterize it better, we're going to do that at that time. But we're not going to have elaborate discussions after lunch, okay? Those will just be fine-tuning things.

So, Adam, the floor is yours. Why don't you go ahead.

LEVIN: Good morning. First of all, thanks to the Board for the invite this morning, and glad to be here.

I wanted to talk today a little bit about what repackaging means to the utilities and the impact upon reactor operations. Three areas of major impacts, the first being dose and safety considerations. Additional radiation exposure. I think it's important for everybody here to understand that the utilities don't measure their

performance in terms of person rems. They measure their performance in terms of person millirems, okay?

So when you talk about the fact that a cask takes about 400 millirem to load, adding a series of additional casks to load, as John Wagner pointed out yesterday, adds significant amounts of person millirems to exposures. And the plants, again, are measured in terms of their performance on millirem basis, so this is a very important issue to the utilities.

The additional heavy lifts are also a big safety issue. Obviously the utilities are very focused on performance when it comes to the heavy lifts. It’s a major issue around a nuclear plant. So additional heavy lifts is a serious consideration.

Plant operations--and I’ll talk more about this at length in just a minute or so, but the use of the spent fuel pool crane and the refueling bridge, those are heavily scheduled during plant operations; so it’s difficult to be able to find the kind of time that you might need in order to repackage a lot of systems.

Radiation protection and security coordination. Typically at a nuclear plant you’ll have radiation protection and security folks that are moving around from major project to major project on the plant. So you’re now talking about having to coordinate additional radiation

protection and security folks for being able to respond and to take care of the operations of spent fuel movement in the plant.

Additional support staffing. Typically, at least from my experience working with Exelon, we required somewhere between 50 and 70 individuals to be either full-time or part-time added to--not added to the staff, but participating in a spent fuel campaign loading casks. So if you're now adding additional casks to load, you have to now coordinate with a significant increase in additional staffing support.

And then the cask loading costs, which are about $300,000 to $400,000 per cask for a welded system.

I think other folks covered this yesterday, but just very quickly, from the standpoint of the operating units, there is over 1,600 dry storage systems containing used fuel at this point. And just to put it into perspective, by 2020 there is going to be 2,900 of these, so almost 3,000 systems out there loaded with spent fuel.

The other point I did want to make here this morning is that all of the nuclear units out there are going to be in dry storage by about 2025. So, regardless of which nuclear plant you go to, by this point in time, which is 12 years from now, everybody is going to be in dry storage operations, which is not far down the road.

MAKHIJANI: Just clarifying--there may be room for clarifying questions, because the slide is unclear.

DANIEL: Okay, that’s okay. How about if we save the discussion for a little bit later. We can come--

MAKHIJANI: I’m not trying to discuss. Can you listen?

DANIEL: Sure. Give us your name and where you’re from.

MAKHIJANI: My name is Arjun Makhijani. What it says there is, estimated that all currently operating plants will need dry cask storage. It’s not clear to me whether all the fuel is going to be in dry casks or some. And that’s just a clarifying question. If you don’t allow clarifying questions, you can’t have a sensible discussion.

DANIEL: Okay.

MAKHIJANI: Thank you.

DANIEL: Thank you.

LEVIN: The statement here on the slide is correct as it stands. All the plants will need dry cask storage by 2025, okay?

There are ten shutdown units right now, which have dry storage. Some of them are in a position where they do not have a fuel pool available to them to return canisters into in order to repackage spent fuel. Zion has been added there. They will be in dry storage--I believe they’re starting later on this winter, and in about two years or so they should have all the fuel at Zion Station in dry

storage.

We have some additional shutdown units, as was mentioned yesterday, at Crystal River, Kewaunee, and SONGS; and all three of those are evaluating whether they want to be in wet storage or dry storage for decommissioning, at least the early stages of decommissioning. And they're going through that financial evaluation and bid process right now.

The other thing that I wanted to point out was that, beginning in 2029, those plants that have received 60-year--or have received an additional 20 years of license extension, so they have a total of 60 years on their license. Those normal retirements are actually going to begin with Dresden Unit 2 in 2029. So we're 15 years down the road from now, which is not a very long time we're going to actually start to retire the existing nuclear units.

What does repackaging involve? Very simply, returning the existing systems to the spent fuel pool, cutting open the canisters--excuse me--removing the lids from the bolted systems. I do want to point out here, this could be a potentially significant issue for a nuclear operator, because cutting open those canisters means that you'll be creating fines from milling operations; you'll be creating dross from cutting operations potentially in your spent fuel pool water. And that means there's an

opportunity for foreign material to be able to get into other fuel assemblies that are in the spent fuel pool, and potentially you don't want to return one of those to your reactor. So that'll be a major concern for operators.

Offloading the assemblies to spent fuel pool, placing them in the new canisters, and returning new, smaller dry cask systems to storage or transport.

So let's put a couple of numbers on some of this. I know Rob Howard got into this a little bit yesterday, but here's some experience from BWRs, the types of schedules that you can expect for loading systems at a nuclear plant. If you add a dual-unit BWR to your operating cycles, you roughly schedule about a week and a half or so typically per system with two weeks mobilization, two weeks for de-mobe, so your schedule for dry cask storage campaigns typically runs between 10 and 12 weeks.

You've got other uses for your overhead crane with the activities you see there, and they run typically about 24 weeks of operations at a plant.

Moving ahead, we've got other activities. Of course, we've got training involved. We've got scheduled time off, etc. for the crane operators. We've got special nuclear material inventories going on, non-outage operations, moving things around in the spent fuel pool.

So what it all means is that it results in a very

limited time window, very limited availability in the spent fuel pool for additional operations such as repackaging, typically on the order of four to five weeks.

Fuel loading and welding for the smaller systems, obviously there’s a lot of discussion about this. There could be some efficiencies introduced by designing in a specific way the smaller canisters so that the closure can be made more quickly. But it’s really the balance of the schedule that--you know, moving the canister into the pool, getting it loaded, bringing it back out of the pool, and moving it out to the pad, that’s not going to change for the smaller systems. So you’re going to have a couple days scheduled for that anyhow.

What might shorten up a little bit is the fact that you have less linear length of weld to make. You also have less fuel assemblies to put in. So you might shorten up the time frame--the schedule a little bit there.

Now, I haven’t included the thought of dealing with the canisters that you need to dispose of now as low-level waste, the materials that are in there, so I’ve kind of left that out of the schedule. And I’ve said optimistically we can assume that we’ll have one cask per week of these smaller systems that we’re going to load.

So let’s put the numbers together now. We’re looking at 9 to 11 systems that are going to be required

rather than the 4 to 5 systems to be loading the 32-assembly DSCs or between 31 and 38 for the 9-assemblies. So the bottom line is, you've got a minimum of nine weeks required, and that's extremely optimistic, to go into the 32s for BWR and as much as 38 weeks required to go into the 9-assembly systems. So the time isn't there. That's the bottom line. The time isn't available for use of the systems at the plant in order to be able to effect repackaging during operations.

The bottom line, the ability to go to smaller systems holistically improves the high-level waste management system. I don't think anybody is going to argue that. The flexibility added in there is very valuable.

But from the nuclear fuel cycle perspective, when you step back and look at not just the waste management but plant operations, it has a negative impact on the overall nuclear fuel cycle. And that's the point I wanted to make today. And Rob Howard addressed it yesterday, but I think from the utility perspective the flexibility for the smaller systems should be added outside or off the reactor site as opposed to at the reactor site, simply because of the impact on operations. I'll leave it at that.

DANIEL: Thank you.

LEVIN: Sure.

DANIEL: All right. Dr. Resnikoff is going to offer an NGO perspective.

RESNIKOFF: Hi, everybody. I work for NGOs, and I work for the State of Nevada, who have not reviewed what I'm going to say today. They can't be held responsible.

I started work on transportation--I'm going to focus on that--in 1975 when Nuclear Fuel Services, a reprocessing facility in West Valley, was shipping liquid plutonium out of JFK Airport; and I worked for the New York Attorney General, who was opposed to that. I thought this was a slam dunk, because these containers were designed to withstand a 30-foot drop, and most people know that planes fly higher than 30 feet. But the NRC fought it until finally Congressman Shoyer (phonetic) in 1981 introduced legislation, an appropriation bill that said you have to design these as well as they design black boxes that can survive air crashes, and the industry went and did that. At any rate, I developed my sense of skepticism about the NRC at that point.

Today I'm going to talk mainly about transportation issues. As I see it, the industry is pushing the boundaries. They are having high burnup fuel. They have large systems. They're moving from 24-PWRs to 32-PWRs in a storage cask, and I see there are major problems involved in doing all that.

First of all, the time in the pool for high burnup fuel, if you look at--I looked in particular at the NUHOMS

container. The time in the pool goes all the way up to 20 years for dry cask storage and longer if high burnup fuel is going to be transported. This has major ramifications for decommissioning reactors. Essentially, reactors cannot be immediately dismantled, because the fuel pools are going to remain. So I see safe store as the only option, and I see a long decommissioning period. Reactor licenses will have to be retained.

It would be helpful for us--I'm going to point out some of the ways that the Technical Review Board could help us out in the field. It would be helpful for us to have DOE run the ORIGEN code for high burnup fuel so we can actually see the heat output, the radioactivity, over time; and we can actually put that into calculations for how long fuel has to cool down. So it would be helpful for us if the Board would suggest that to DOE.

There are people in the room--I know Dr. Einziger is here--who have worked on the brittleness of high burnup fuel, the cladding ductility, and that affects transportation and disposal of high burnup fuel. And I don't believe these transportation issues have been well studied. I noticed that Earl Easton is here, who had a role in NUREG-2125, and those issues have not been well-examined in the NRC reports. This document, NUREG-2125, which deals with transportation, is a document that started as a three-

year document, and it moved into a seven-year period to actually produce it. It went from a budget of 400,000 to 1.3 million. And the State of Nevada requested a mere 30-days extension to review a 509-page report with numerous references, and the NRC declined to allow us to do that.

And I think it will be a major problem when these hearings arise concerning Yucca Mountain, if that ever takes place, because all the issues that should have been handled in this risk analysis that the NRC did are going to turn up again in the Yucca Mountain proceeding. And we'll extend that proceeding for long periods of time, and I don't see where the Department of Energy, the NRC, or the State of Nevada has the money to actually carry it all out.

So I encourage the Board to actually look into these transportation issues, particularly as they affect high burnup fuel. I am particularly concerned about the ductility of this fuel, the brittleness of the cladding, and have some concerns in particular about transportation accidents, because some of the accidents that have been discussed in NUREG-2125 involve major impacts where you have acceleration forces that are on the order of 140g. And I don't see where the fuel cladding would be able to sustain that, which I would imagine the fuel cladding would shatter under those

G-forces.

High burnup fuel also has disposal implications. If DOE intends to open up NUHOMS or Holtec canisters and repackage high burnup fuel, I see major problems arising, particularly if the cladding--if the fuel has failed.

So I would encourage the Board to actually do a serious investigation of that issue, perhaps answer the question whether these high burnup fuel assemblies have to be containerized before they are put into storage casks or into transportation of systems.

The next slide--and the last slide--I have attached a critique of NUREG-2125 when I sent my report into the Technical Review Board, and it has a lot of discussion about NUREG-25 (sic) and the concerns that we have about transportation. I'm going to mention several of them as it concerns transportation.

Transportation casks have impact limiters, and you saw this yesterday, at the end of each cask; so cask essentially looks like a barbell. So the most vulnerable position in a cask is a side impact. It's not an end impact where the impact limiters are. It's on the side. And there are several references, which have been conveniently omitted from NUREG-2125, which discuss side impacts. I'm particularly concerned about side impacts at railroad crossings. If the train sill directly impacts a transportation cask, the forces and accelerations can be

great enough to stretch the bolt lids and leave an opening to the cask interior. And then if you have high burnup fuel where the cladding is also shattered at the same time, then you can have material which actually gets out into the environment.

The cited references in NUREG-2125 do not include a sill impact where you actually have impact limiters at each end, and that increases the bending of the cask itself. We'd like the Board to look into these kinds of accidents.

We also have serious reservations about long-duration, high-temperature fires and the effect on the cask and fuel cladding. This is the reservation we have. I guess I should really have pictures rather than demonstrating with my hands, but casks have--transportation casks have neutron shielding around the cask and then a thin metal layer that goes around the neutron shielding. The thin metal layer is connected to the main core of the cask with metal holders, metal brackets, and that holds this thin outer metal cylinder in place. And that serves as a heat conductor. Plastic that's wrapped around a transportation cask actually serves as a blanket, and the metal brackets actually serve as heat conductors, so the heat can actually get out of the cask itself through these brackets.

But in a fire accident these brackets serve as a way for heat to get into the cask, and that isn't well

modeled in the models that I've looked at by the cask manufacturers. And we'd like the Board to seriously investigate fire accidents and take into account these metal brackets, which I don't believe HOLTEC or--and I've looked at those in great detail--HOLTEC has actually looked at and also the truck cask manufacturers have looked into. And I'd like the Board to also look into that.

The State of Nevada has been asking for some time for full cask testing. These new transportation casks, which are essentially a metal canister inside a transportation overpack, should be fully tested. That's the position that the State has. At least it should be tested so that we can benchmark the computer models. Right now this is all done by computer simulation and scale models, and the State would like full scale testing. And the State has requested this for many years.

I have one final point, which is malevolent events should be seriously examined. We don't have confidence that this has been done. Anti-tank weapons, such as the Russian Kornet or the French MILAN anti-tank missiles, can easily penetrate a meter of metal. So for transportation we remain concerned about not just an entrance hole into a pressurized cask, but events that also include an exit hole. Much more material can get out if you have a two-hole accident than if you just have a single hole into a cask. And also more gets

out if you assume the cask is pressurized, which calculations by LUNA have not assumed. This is of particular concern with high burnup fuel, which has large cesium inventories and suspect fuel cladding. So this is another matter which we would like the Board to investigate.

Those are my comments. Thank you.

DANIEL: Thank you, Dr. Resnikoff.

All right. So we're going to get into our discussion time. Again, we're trying to identify issues, not seek solutions. So who would like to start us off? There are microphones scattered throughout the room. If you need a microphone or when you want to speak or ask a question or do anything like that, just raise your hand, we'll get a microphone to you, we'll turn it on. Give us your name and the organization you're with.

MAKHIJANI: Hi. My name is Arjun Makhijani. I have a question about what happens in repackaging after the reactor is shut. Does the presentation mean that the spent fuel would have to be there? Because the way the NRC is approaching it in its waste confidence GEIS is that you can do dry-cask-to-dry- cask transfer. But from what I understood, there is an assumption that the spent fuel would always be there--the spent fuel pool would always be there. Thank you.

DANIEL: Anyone want to answer that question?

RESNIKOFF: Could you give us that again?

MAKHIJANI: Yeah. In your presentation, for repackaging you explained how the repackaging would be done by taking the cask into the spent fuel pool and the time it would take and so on. But after the plant is shut, there would be a lot of dry casks; and if repackaging is necessary, is one to infer that the spent fuel pool will always have to be there for the repackaging, or can one dispense with the spent fuel pool and assume that there can be a dry-cask-to-dry-cask transfer infrastructure?

LEVIN: If I understand the question correctly is, once the plant is shut down, you’ve got two situations. You’ve got one which is the plant is decommissioned, so what remains is dry cask storage on a pad at the site, and those are typically canisters inside of overpacks. You also have another situation, which the plant is shut down, and the spent fuel pool remains, so it’s shortly after shutdown, so you’re in that configuration.

For the situation where there is no spent fuel pool, then repackaging, if you will, or movement of the fuel, if you will, is only going to be in the existing canister. I don’t think that anybody is talking about opening up a canister at a site that has no spent fuel pool.

MAKHIJANI: From the way I read the NRC draft Generic Environmental Impact Statement, it seemed to me that they

are assuming that there would be--you know, in the case of no repository, they have a scenario that they have to do ordered by the court. I think they are assuming that they will have dry-cask-to-dry cask transfer. Maybe I didn't read it right, but that's the way I read it.

MOTE: I would like to make two comments. One is--

Sorry. Nigel Mote, Nuclear Waste Technical Review Board staff. Thank you. There is a substantial body of experience in the world about dry handling of fuel without it being in a pool. NAC, in particular, did a lot of repackaging in Iraq to get fuel out of Iraq under a U.N. program back in the early 1990s -- different fuel types and I'm not going to say that this is experience of handling commercial fuel assemblies.

This is an issue that's been raised, and I suggest you record the issue. We're in danger of slipping into trying to resolve it, and I wouldn't do that. What I would say is, it's a good question, and it's one that we wrestled with inside the staff in writing some of the documents in advance of this. I think we need to take account that both possibilities could exist. If I recall correctly yesterday, one of the presentations included an AREVA schematic, which said there was a pool, but there was also a dry handling facility. And AREVA at La Hague in France has a dry unloading facility. It's inside a hot cell, and there's

recovery systems, so there would need to be (inaudible), But my memory is that the presentation yesterday included a modular--mobile transfer system, which included the possibility of dry repackaging. So having recognized that, I would say that we record that that needs to be looked at as an issue of how you do that, whether it’s dry or wet.

DANIEL: Thank you, Nigel.

Sven, give us your name.

BADER: Sven Bader from AREVA. I just wanted to follow up on this. There’s actually three dry transfer options. There is a dry transfer system that DOE helped produce--Jeff’s not here--but it was in the 1990s. Transnuclear designed it. It actually went through an NRC review. It’s unclear to me if it actually got completed, but there is a dry transfer system. The mobile hot cell that we talked about, that’s a concept--that’s something not fully developed--that ideally would be moved between different sites so that it’s mobile. And then the third option is the hot cell, as Nigel noted, and that’s a fixed facility. We did a study for DOE on this under the IDIQ Act contract. It was Contract Number 14.

DANIEL: Diane.

CURRAN: This is Diane Curran. I want to ask Mr. Einziger--I think yesterday you were talking about transfer centers and hot cells, and I think you made an important

distinction as to what the basic requirements are and the costs. I'd just like to ask if you could clarify that a little bit whether there's such a choice or whether you actually mean a hot cell.

DANIEL: This meeting is to identify issues.

CURRAN: Yeah, I understand that, but, you know, there's also information about what we already know. And if there's something that's known--I guess it seems to me that it's useful if it can be quickly stated: Here's where to look for this information. And maybe that's how I want to present it. Where do you look?

DANIEL: Let's answer this question, and I want us to get back on identifying issues. So if you would answer it briefly, if you can?

EINZIGER: Irrespective of what you hear in the public venue, spent fuel is dangerous stuff; and so you just can't take it out of a canister and put it into another one. You have to have substantial shielding around it to protect your personnel. Whether that is in a fixed hot cell or a yet-to-be-demonstrated mobile facility, you still need that shielding. And shielding is heavy. And so I really question whether a mobile facility can be made and really be mobile.

Cost-wise, this is no small issue. Do I have any references I can say go to some document and it'll tell you

what the cost is? No. All I can tell you is that there are people who have worked around hot cells that tell me that it's not in the 10-million-dollar range. Maybe you should add another zero on it, somewhere probably between those, but that's just a guess. It's not an easy subject to be cracked. Dry-to-dry transfer I don't think has ever been demonstrated except for canisterized systems. Canisterized systems are fairly easy, because it's just essentially unloading and dropping it into another system. And remember, for systems that are directly loaded, there's a lot fewer of those.

DANIEL: Okay, so this could be--thank you. So this could be a particular issue that this mobile possibility isn't fully tested yet. You raised the cost, extremely high cost. Other issues? Yes, your name?

LANTHRUM: Gary Lanthrum, NAC International. Maybe not so much an issue, but maybe an undoing of an issue. A lot of questions have been raised about the ability to transport safely high burnup fuels and to later transfer them to another canister configuration. A lot of the high burnup fuels that are being loaded now are being loaded into damaged fuel cans before going into a dry storage canister, and that simplifies the ability to both transport and to subsequently handle the fuel. And so I think that needs to be taken into account. Don't assume that high burnup fuels

are going directly into a canister, just another basket without additional protections.

So your thermal loading will be lower, and your rad loading for a given canister will be less, because you'll have less fuel in the canister, and it will be configured in a damaged fuel can, which is much easier to handle than trying to deal with an assembly that may have cladding issues or other challenges.

DANIEL: Okay. I want to keep this on issues, folks, identifying issues.

EINZIGER: Just a clarification. Bob Einziger, NRC. Only one vendor not to be named is loading high burnup fuel into damaged fuel cans.

DANIEL: Okay. Judy.

TREICHEL: Judy Treichel, Nevada Nuclear Waste Task Force. It seems to me like we've got the cart racing to catch up to the horse. And very early on in this whole deal they talked about standardization of casks. And at the Yucca Mountain site it was going to be an MPC, multi-purpose canister, and then it turned into a TAD, and now we've got the STAD. But at any point--it can't happen any too soon that you start to standardize. And I'm not sure why they're not. I would guess it's because everything starts at the utilities, and maybe the utilities don't want to.

But on our chart here it shows loading, unloading,

loading, unloading over and over and over again. And at the very beginning when it's coming out of the reactors, I guess, the utilities want the biggest bang for the buck so you get the most huge canister. Then you start knocking it down so it can be transported to the storage facility, and I don't know then if you go back up to a bigger canister.

DANIEL: So the issue you raise, Judy, is lack of standardization for storage containers for canisters and casks; correct?

TREICHEL: Right. And then at the very end there is a big issue where the repository--a geologic repository--where a lot of the design depends upon what's going into it. And so getting something decided first, I would think, would be a really good thing.

DANIEL: Thank you.

HOWARD: Rob Howard, Oak Ridge National Lab. I think, to follow up on what Judy is saying, looking at the influence diagram here, so there's an arrow that comes back from disposal, and you can take it to any one of these other operations. And the issue is, well, what are the disposal requirements for that package? And so you have to--if you're going to do standardization, you have to either know or assume what the disposal requirements are and then move them back to these other operations. So I think that's the influence diagram implication there.

DANIEL: Okay. Nigel.

MOTE: Nigel Mote, staff. I'd like to clarify one thing, because Judy didn't say it the way I'd like it said. I'm not saying that that's wrong, and I'm sure there's some misunderstandings here. What Judy picked up is that we have repackaging several times on the diagram. That doesn't mean each time it gets repackaged. They are optional.

The understanding the Board has is that if you repackage from the dry storage containers, it will be once into a different container. If you did it at the reactor site, it's because you know that the container you put the fuel in will then be able to go all the way through to disposal. You wouldn't repackage until you know what you're going to need for the end point, unless there is some other configuration, some other influence. And that's another issue. If you have to repackage to remove from the reactor site and you still don't know what the disposal requirements are, you may have to repackage a second time.

So it's a good point that Judy raised. Our assumption was repackage once. But thinking about that it's on a number of cells, it may be that it has to happen more than once. I would expect that's in a limited number of cases, though. But that's another issue of how many times do you have to repackage--

DANIEL: --repackaging more than once.

MOTE: We want to stay away from selecting and saying you don't want to or you do want to. But in this case I'm sure there is a "don't want to repackage more than once unless you have to".

CURRAN: I have a follow-up question to Nigel. I guess, Nigel--this is Diane Curran--I would add to your question: What if the fuel degrades inside a canister? NRC is talking about very long-term storage on site, and it has to be repackaged yet again because it fails? I think that's a question.

DANIEL: Go ahead, Nigel.

MOTE: Nigel Mote, staff. I would say that is an issue. We don't need to go any further than that here. Yes, if there is fuel degradation, that isn't necessarily something that would have been taken into account in all subsequent operations. A quick comment. You know that the NRC has invited comments on the possibility of changing from assembly recovery to retrievability to package retrievability. I'm not going to say we need to discuss that, but that is something that needs to be taken into account in recording that issue.

DANIEL: Earl, do you have an issue?

EASTON: Earl Easton, private citizen. A related issue. Do the regulations, the way they're implemented, determine who does the repackaging? I mean, that's a very

important point. If I have to repackage damaged fuel to transport it, that means the utilities have to repackage it. If I can somehow take transportation out of the equation by going to a canister basis, it might mean that the receiving facility can repackage it.

So the issue is: Do the regulations have unintended consequences on who actually is going to do the repackaging?

DANIEL: Thank you, Earl. Dr. Resnikoff.

RESNIKOFF: I wanted to follow up on what Judy said and what Nigel said, and this relates to the economics of it. And this is what Earl raised. Who is responsible under the standard contract for packaging the fuel? My understanding--I'm not a lawyer--is that the utilities are responsible for that. So they're moving to larger and larger systems, which are cheaper per assembly to use, rather than a large number of small casks. If the utilities are responsible for that cost, then they're going to go to larger system, is the way I understand it.

DANIEL: So the issue you raise, Marvin, is the fact that the utilities have one bent towards larger storage as opposed to other areas of the cycle leaning more towards possibly smaller canisters.

RESNIKOFF: Exactly. And this was raised yesterday by the Chairman of the NRC when she said that there are two

different motivations here. One is for disposal, and the other is for storage.

DANIEL: Correct. Thank you.

MAKHIJANI: Thank you. I'd like to go back to something--

DANIEL: Your name?

MAKHIJANI: Arjun Makhijani, Institute for Energy and Environmental Research. I guess Mr. Howard left?

SPEAKER: He disappeared.

MAKHIJANI: I wanted to follow up on something that he said is, if the disposal arrow feeds back to earlier parts of the cycle, for instance like canister size that has just come up, and there are a number of canister or design canister material the Chairman, Dr. Ewing, raised yesterday--or this morning--the copper canisters in Sweden and so on--it means really that you can't decide on the earlier parts of the system till you know what kind of repository it's going to go into.

And so I would think that part of the feedback from this workshop, the next one, would be the issue of: Do we need to have a site before we can settle some of these critical questions? Because if you put it in salt, you've got one problem; if you put it in granite, you've got quite another problem.

DANIEL: Okay, so let me make sure I understand what

you're saying, Arjun. What you were saying is, we need to-- the issue is, we should determine first the repository and the nature of the repository, and that would determine the canisters and the nature and the characteristics of the storage and transportation canisters; correct?

MAKHIJANI: It would have a very central influence, not the only determining--

DANIEL: Right.

MAKHIJANI: I don't mean that.

DANIEL: But it would have a lot--that would dictate a lot of these other things, answer a lot of these other things.

MAKHIJANI: That is my view. And I think that's the implication of the view that Dr. Ewing expressed this morning that it's very important to know what kind of container you're putting in what kind of environment.

DANIEL: Right. Thank you, Arjun.

Lee, did you get that?

Peter.

SWIFT: Peter Swift, Sandia Labs. I appreciate that last comment. I fundamentally agree, it would be good to know what the disposal environment is. We can, however, separate between the container and the overpack. This point was made yesterday with respect to storage. The copper overpack in Sweden is that; it's an overpack; it's not the

thing you first package them into.

So the question here--I think this will come up in Josh Jarrell's talk tomorrow afternoon to the full Board. Is it possible to design essentially a generic standardized disposal canister now and then overpack it in a way that will work in any environment? And this isn't an open issue. I'm not sure it is. But it's something we are thinking about, and we'll hear more about it tomorrow.

CURRAN: Just a question for you, a clarification.

DANIEL: Diane, you're going to have to wait until I call on you. I need your name and--go ahead, Diane.

CURRAN: This is Diane Curran. Are you saying that if you standardize the container, it doesn't matter what the geologic environment is?

SWIFT: Peter Swift, Sandia National Laboratories. No, but I am saying that there are ways to--the question was: Am I saying that it's possible to have a standardized canister that essentially works in any geologic environment? We don't know. Once again, that's one of the hard questions ahead of us. But it is possible that you could design a standardized canister that could be put in something for transportation, taken to a disposal site, and then put in something different to be disposed of without the need to open it again at the disposal site. That would be Rob or John or Josh, if he's here. That would be the point worth

considering anyway.

The one thing is--keep this in mind--once you seal it, if you want to take it all the way to disposal, you really did seal it. So what you put inside, the hardware inside the canister, the criticality controls, those things you don’t get to change after you pick your disposal site later. So pick them carefully now to work in as broad a range of environments in the long-term future as you can.

DANIEL: Thank you, Peter. Nigel.

MOTE: Nigel Mote, staff. To try and distill this down to an issue, what I’m hearing is, it would be nice to know what the geology is so that you can design for it. Unfortunately, we can’t make that choice, because we’ve been trying to find the geology for the past 20 years or more. Right now we don’t have one, so we’re in the position where we have to make assumptions and decisions.

What this workshop is about is, identify that as an issue, because you may need to keep options--well, you do need to keep options open. There may be decisions you can make so that things don’t get any worse, and be aware that we don’t know what the geology is in determining how best to manage the system. But there’s a disconnect between that analysis and the utilities, because we have a commercial management initially in spent fuel management, and then we have a national program that follows from that. So one of

the issues is to what extent does that disconnect dictate the way things are going and create problems, if we can foresee them, we may be able to find a way to resolve or ease in some way.

SANCHEZ: Robert Sanchez with the Government Accountability Office. I'm not a technical person, and I'm at a technical workshop, so I'm a little over my head here. But I've got a couple of observations, I think. One was, on the chart that we see there's a couple of issues, I think, that are missing. One is cost, which I think is going to be a major driver of whatever technical decisions are made; and the other is time. And I think that's also going to be a major driver, and I think that's also going to impact the ability to implement any sort of technical solutions. And I think missing those from the chart--I think they have to be involved in the discussion.

A couple of issues like on time, degradation issues, I think, are things that have been brought up. I think one that's missing from here, but I think has been raised elsewhere, security. As the spent fuel, of course, cools down, it becomes less radioactive, security becomes an issue. And I don't see that reflected here.

And, of course, cost, the federal liabilities, and, of course, the cost to the industry, if repackaging is required, who does it when and where, I think, are probably

very major drivers in terms of what technical solutions are implemented. And I think those need to be part of the equation as well.

DANIEL: Very good. Thank you. Certainly issues.

EINZIGER: I just want to remind people--

DANIEL: State your name.

EINZIGER: Bob Einziger, NRC. I just want to remind people, there is nothing in the transportation regulation as it's written right now that doesn't--you can ship damaged fuel not in the can. You can ship debris not in the can. What the requirement says is you have to know what the content is that you're shipping.

So if you want to declare it all debris and you can show under that condition you can meet all the safety regulations such as containment and retrievability--well, not even retrievability, because there's nothing in the transportation regulation that talks about retrievability. If you can meet the criticality, you can meet the shielding, you can meet the heat transfer in a degraded state, you can transport it. The question you have to answer is, once you get it to the other end, can you handle it? Can you accept it?

DANIEL: So there's nothing in Part 71 that talks about retrievability?

EINZIGER: Right. So the question is: Do you even

want to keep it intact?

DANIEL: Susan.

HOXIE-KEY: Susan Hoxie-Key, Southern Nuclear. I wanted to add on to the point made by the gentleman from the GAO. One of the things that I don't hear us talking about in time is the fact that, as we go out in time, there will be more early shutdowns of plants. The longer we delay solving this, the more plants that are going to be in the decommissioned stage, because as we approach the license end of life, the utilities will be making decisions about major mods and major maintenance; and they will find that these large-dollar activities can no longer be economically amortized over the remaining life of the plant.

So as we approach the end of life, we're going to find plants not really making it to the end of their 60-year license life. And that's going to move the time frame, you know, forward earlier in time that we have to deal with this. So I'm just saying the sooner we--

DANIEL: Distill it down to an issue for us.

HOXIE-KEY: Okay. So we need to make decisions and move forward quickly, and how can we do that?

DANIEL: Okay. So actual implementation is an issue--

HOXIE-KEY: Yes. We don't have 20 more years to study, or we're going to be in a situation where every plant is shut down, and the only issue we're dealing with is these

orphan sites.

DANIEL: Good enough. Thank you.

EINZIGER: Bob Einziger, NRC. Just one question: Should plants be able to shut down and get rid of their pool until the fuel is gone?

DANIEL: Gary.

LANTHRUM: Gary Lanthrum, NAC. One of the other issues is contract requirements. Right now the discussion has been about whether or not you could repackage at utilities, but I don’t think there’s anything contractually that obligates utilities to do that. And so DOE is going to have to engage if they want additional work to be done at utilities, particularly during the window after shutdown and before the pool is removed. That would take a fairly significant set of contract negotiations that would have to be undertaken.

DANIEL: Okay, thank you, Gary. Nigel.

MOTE: Nigel Mote, Board staff. Gary, I’m sure I agree with you, and I don’t see anybody from DOE here. Jeff’s in the other session now.

As I understand it, there is nothing that is agreed so far that says DOE will pick up fuel, other than in bare assemblies. So the utilities may not need to repackage. But if there’s hardball being played, right now the only way out is for DOE to specify the container and for the utility to load them. And if it gets down to a legal

discussion--and I'm way outside any formality here, but we are expressing views--my understanding is that DOE could say, We're taking spent fuel, and until that time it's yours.

And I'm not advocating, but the issue out of this one--and I'm trying to think in terms of issues--is: Is there a way for the fuel to be taken away other than as bare fuel assemblies? Otherwise, this discussion is moot.

So the starting point is the current contract, and something has to change between now and the future for containers to be taken away other than in that way. That would dictate that repackaging is all at the utility sites. And I'm only saying that's the logical progression. I'm not advocating a view or taking a position, but the issue is: Can you remove that blockage?

DANIEL: Got that, Lee?

PEDDICORD: No.

DANIEL: Tell us again, Nigel, short and sweet.

MOTE: Okay. The issue is for fuel to be taken away from the site other than as bare fuel, there would need to be a revision to the standard contract under the Nuclear Waste Policy Act.

DANIEL: All right, thank you, Nigel. Issues, issues, there are a lot of issues.

NUTT: Mark Nutt from Argonne National Lab. Just

looking at the influence diagram you've got, I don't know if it's going to be an issue, but just walking through it, there's a tremendous amount of feedback all the way across it. And we heard earlier, if you start, things get delayed, more fuel goes into canisters, and those canisters have to be handled through the system. So the likelihood is they're going to get shipped to the storage facility and parked as canisters in the storage facility. When and where they're repackaged there or the repository can be decided later.

But, again, the longer we wait, the more fuel goes into canisters. So if the acceptance can begin--it all hinges around when acceptance of fuel starts and in what way that fuel is taken off the site. I think Rob or someone showed yesterday, there can be upwards of about 40,000 tons of fuel still sitting in the pools. That's game for reducing or doing anything with. You can keep it as bare fuel; you can store it as bare fuel; you could repackage it later once you have an idea. But if you can reduce, I guess I'll call it, the hemorrhaging of everything that's going into canisters--everybody thinks everything is going into canisters and moving off as canisters--I think there could be technical solutions and ways to turn that around provided once acceptance starts, and then you have tremendous flexibility throughout the system of dealing with what's left. We're always going to have to do something with the

canisters that are being loaded. They're going to have to be repackaged unless the guys in the next room can figure out a way to get them underground.

But it's going to be there. And the key is, can we do anything on the acceptance side and then on the interim storage side, if we go that route, to try to minimize the size of the problem.

DANIEL: Okay. So the issue is to try to quickly focus on minimizing the magnitude of the problem, as you put it, to stop the hemorrhaging.

NUTT: Correct. And there's feedbacks all the way across that system of how you operate and how you set that thing up.

DANIEL: Thank you. Okay, go ahead, you've got it.

TREICHEL: Judy Treichel. Is there any way--and I don't know the answer--is there any way that you can have--I know regulation is always a dirty word, but something overarching. Because every time we transfer fuel, it's older and it's gotten more brittle. And many of the things that Marvin brought up are wrong with the fuel, and that only continues to get worse as you go on. And at the beginning of your chart, the bigger the canister, the better they like it. At the disposal end the smaller the canister, the easier to deal with the repository issues.

So I know that you're talking about the freedom of

the utilities here, but isn't there any kind of overarching regulator that can say you can't do this in the front end because it hurts the back end? I don't know how you would do that.

DANIEL: Judy, that's a good question, but it's a little off topic where we're trying to go right here, and I'd like someone to have a sidebar conversation with you on that, if we could, after this discussion. We're really trying to focus on these issues related to repackaging, okay? So I don't want to ignore you, but I'd like someone--Nigel.

MOTE: Let me try and get that to an issue. I want to say the issue is: How do you look at the national interest as a whole when you have two independent management steps in the chain? One is commercial, and one is governmental. And one is an independent operation on the utility side, and the other one is an integrated program on a national basis. The issue is: How do you resolve the conflicting interests of those two?

DANIEL: That's the one. Thank you, Nigel. Thank you, Judy.

ROWE: May I just--

DANIEL: Gene.

ROWE: Yeah. Gene Rowe, staff. I think that, to boil it down to a simple issue, I think the issue is that the

entity that is responsible for transportation and disposal is different than the entity that's responsible for storage. And obviously at this moment the DOE is the entity that's responsible for transportation and disposal at this point, and they have no influence, because of the Nuclear Waste Policy Act, on how the utilities load the canisters or how they do dry storage.

So the issue, I think, is resolving that conflict so that--and I don't want to come up with a solution, but the issue is that the DOE has no influence on how those canisters are loaded. And I think that is the bottom line for most of this discussion.

DANIEL: That's an issue. Thank you, Gene. Kris.

CUMMINGS: Yeah, I think that ties into--

DANIEL: First give us your name, please.

CUMMINGS: I'm sorry. Kris Cummings, NEI. I think your comments feed into exactly the issue I wanted to bring up, which was the issue of safety. The primary importance of the plants as they operate is that they operate safely, that they load these casks, and they do it in a safe manner.

And, yes, maybe bigger casks is more cost effective, but it's also safer, because you have less evolutions in your plant. You can do it in a condensed time frame. You have mobe, de-mobe, things like that. So there's a combination of the larger casks being--I guess I'd

call it the sweet point of being a cost effective, more safe solution to the dry storage problem.

We don’t have a repository. We don’t have a canister or a repository that’s been designed that can factor into the front end, the loading of the dry canister. So the utilities have taken on themselves with the cask vendors to design something that works for the system as it is right now. When we get a repository, and we have a design, and it may make sense to package into things that are good for disposal. But until that happens, we need to make sure that we continue to focus on safety in the bigger systems are that.

So I guess the issue that I would have the Board would be: What is the safest thing that we can do in the context of the situation that we have now? Not in 40 years or 35 years in 2048 when we have a repository, but what is the safest thing to do now?

D’ARRIGO: Diane D’Arrigo, Nuclear Information and Resource Service. When you said the less evolutions at the plant required--

CUMMINGS: I mean in terms of loading a cask. So if you load 5 casks instead of 9 times as many, meaning 45 casks, that’s five evolutions of a cask loading. That’s what I meant by evolution was a cask loading of itself. And then if you load 5 big casks versus 45 casks of the small

ones, then you've got a lot less operations that you're doing in terms of sealing that cask and things like that. So that's what I meant by an evolution.

DANIEL: Okay. Issues related to repackaging, for storage, and disposal--I mean for transportation or disposal. Diane.

CURRAN: I want to follow up on an issue that was raised just a minute ago. What I heard it as was: How does the Nuclear Waste Policy Act constrain the DOE from resolving this conflict between various interests at different stages of this? I'd like to add a question, which is: Does the Nuclear Waste Policy Act or the Atomic Energy Act constrain the NRC from doing that in any way, and how would the two agencies interact?

DANIEL: Okay. Gene.

ROWE: I think this is one issue where we can let the NRC off the hook. I don't think the issue that's being discussed really--the NRC really doesn't have any impact on that decision. The NRC doesn't care whether they're big packages or little packages. What the NRC cares about is that it's done safely.

CURRAN: Well, you know, to me, I'd like to keep that issue on the table. I think that's too simplistic an answer, because the NRC is concerned with safety from cradle to grave. So it's not--the NRC doesn't put on blinders and

say, We're only going to look at this point and not another. I think it deserves some consideration.

ROWE: I don't disagree, okay?

CURRAN: Okay.

DANIEL: We have representatives from the NRC here. This session is being transcribed, so, Mike, you heard it; right? Good enough.

And, Diane, you're welcome to talk with Mike afterwards. Michael will talk to you right now.

CURRAN: But just to finish, when we raise issues--when we put issues into the hopper, is there a process for taking them off the table when someone's put them on? Because that's what I heard happening, oh, your issue wasn't legitimate.

ROWE: No, no, no.

DANIEL: I think, Diane, this session is about the repackaging of spent nuclear fuel. This whole session is designed to talk about the repackaging of spent nuclear fuel for transportation and disposal.

Nigel.

MOTE: I'd like to try and get the issue out of this, because I think it's important. And I would make it generic and say: To what extent does existing legislation--whether it's regulatory or not, to what extent does existing legislation constrain the options that may lead to the

optimum management of fuel within the system?

DANIEL: Okay, Mike, go ahead.

WATERS: This is Michael Waters of USNRC. First of all, this is not the person who can speak on behalf of the staff, but I think Kris Cummings and then Diane raised the questions. I would like to understand better how repackaging these casks/canisters are indeed safe at a power plant. I think we need more risk analysis to do that. But I also think Diane is correct. The NRC is responsible for safety of the spent fuel with regards to the licensee in the area of storage and disposal. So the question of safety does transcend across industry and DOE, and I think it is a legitimate issue you can consider over the lifetime of spent fuel what is the safest approach. On the other hand, the NRC does not have a policy on that, and we do have (inaudible)to look at storage separate from disposal--

MAKHIJANI: Could I follow up on that a little bit, and then I have a question--

MAKHIJANI: Arjun Makhijani. Sorry about that. Just a remark here to the facilitator is, you know all decisions that involve containerization, dry storage, size of canister have implications for repackaging. So I think an idea that some issues can be ruled out of this workshop because they’re not directly repackaging, in my opinion, is to misconstrue what the idea of--how broad the implications are

of the kinds of decisions we're talking about. Just my opinion. You can take it or leave it.

DANIEL: Point taken, Arjun.

MAKHIJANI: I have a follow-up question for the gentleman from Argonne. I'm sorry, I didn't get your name.

I understood from what you said you implied that most or all of the--that repackaging will be required before disposal for what is now in dry canisters and what will be. Did I misunderstand you or--

NUTT: Mark Nutt from Argonne National Lab. If you look at some of the design work and the stuff that the Department of Energy under the Used Fuel Disposition Campaign are looking at the--I call them the European designs--those are all much smaller canisters. So if you're going to take one of those designs and utilize one of those, yeah, you're going to have to repackage what's in the large storage canisters into those canisters.

Now, the work they're talking about in the other room is the feasibility or potential for direct disposal of the large canisters. If that can be--if a site can be found and that can be demonstrated feasible, you wouldn't need to repackage. But that's over there. We're talking about the need to have to repackage those canisters, and it's all to meet the disposal requirements.

MAKHIJANI: Could I follow up just to clarify?

DANIEL: Sure, Arjun. There’s the microphone.

MAKHIJANI: Arjun Makhijani again. So this is kind of a--thank you very much--very informed clarification, because the French repository, for example, that we’ve looked at in my institute and evaluated, we thought that large boreholes would be very difficult in that repository location. So one kind of possible feedback with very major implications for site selection of what the utilities are--and repackaging--for what the utilities are now deciding in terms of, you know, it being more economical and maybe less worker exposure and so on.

Maybe there would be a lot more worker exposure down the line, and one issue for the NWTRB to examine is: What are the implications down the line for worker exposure, safety, repackaging, and site selection of the decisions that utilities are now making regarding canister size. Because, actually, the Chairman of the NWTRB was part of our team when we first looked at the French repository, not the second time around. And this is just an absolutely huge issue in terms of constraining site selection.

DANIEL: Okay. So what you’re saying, Arjun, is--you’re saying the issue is: Based upon what the utilities are doing now, what implications does that have in repackaging and hence exposures to individuals in repackaging as you go through the cycle?

MAKHIJANI: Plus site selection, because if you don't want to repackage, that is going to constrain your site selection. If you don't want to constrain your site selection, it's going to mean repackaging. So there is a feedback.

DANIEL: Thank you.

SUBIRY: Juan Subiry, NAC International. I think another issue that we need to get very serious about is the transport requirements of having a very large number of canisters if you do repackage, especially at the utilities that will be shipping, and utilities do move to a higher-capacity system for the reasons that Kris Cummings mentioned -- safety, economics. But also they have an end in mind, and their end is to ship the fuel off site.

And if you are going to, for example, triple the number of canisters that you will be generating at a facility, there are serious security consequences. There are a lot of, for example, rail transport infrastructure considerations, cost, scheduling, things like that that the industry really needs to consider. That, in my view, will probably favor, if repackaging is the decision, to be done at the receiving site. It's an issue that needs to be evaluated.

I believe that if that decision to repackage at a receiving site is made, then, in contrast, the logic will

tell you that moving to a higher-capacity system at the site is the right thing to do, because you will have fewer systems and at the receiving facility fewer receipts and, therefore, fewer packages to repackage. Thank you.

DANIEL: Thank you, Juan.

BECKER: Steven Becker, Board. The gentleman from the GAO identified several non-technical drivers about the ability to make and implement these technical decisions. Here’s another one that has thus far been conspicuous by its absence: What needs to be done to better incorporate the public into these technical discussions and decisions?

DANIEL: Thank you. Okay, Judy.

TREICHEL: Judy Treichel. This is just a question. Is it assumed that all transportation is rail, or is it assumed that the transportation overpack or cask can go by either rail or truck?

DANIEL: Nigel.

MOTE: Nigel Mote, staff. Can I turn that into an issue and say, for all transportation stages, all modes of potential transportation need to be considered, and the implications of those upstream and downstream need to be taken into account in optimizing the system.

TREICHEL: Okay. Judy Treichel. Then that means you’ve got to have smaller packages.

MOTE: Mote, staff. No, if you have small packages,

then there will be different considerations, limitations, than if you are transporting large packages. To try and keep it at the issue level, what we're looking for is: What implications do you need to take into account in looking at how to optimize the system?

And if we're looking at repackaging, yes, you'd have small packages at the disposal point. But as the previous discussion considered, you can do that in different places; and where you do it will be determined by transportation regulations, commercial analyses, other influences. But as the issue, I would say that you need to be open-minded and say -- well, let me put it in terms of the discussion matrix. If you look at transportation from a potential interim storage facility to the repository, what are the implications of that transportation requirement for storage at the interim storage facility?

If you have long-term storage, does that include your repackaging so you have more transportation operations? If you repackage at the disposal facility, then you have less transportation operations from the central storage facility. But less transportation means bigger packages. So there's an interplay between all of these, and the issue is to keep the options open and look at how best to manage the system. Small packages could be rail transportation; and large packages presumably could be barge or rail.

TREICHEL: Judy Treichel. Well, you have some reactors without rail access and some reactors where you have bridges that won't handle those loads, there are some reactors that can't get waste away from them by either barge or rail.

MOTE: Then the issue is to look at the limitations of individual sites in planning the transportation system.

TREICHEL: Okay.

MOTE: Judy, I agree with you. I mean, I know a lot of sites where there are transportation limitations. We can't take account of that. That's a downstream operation for DOE or the subsequent implementer or the utilities. The issue, as far as we're concerned, is there are limitations based on reactor site access limitations.

TREICHEL: I guess I was just making a point for smaller containers.

DANIEL: I want to take a break in the discussion here and refocus us on this matrix. If you look to the--if you take a look at the matrix, look at A-1 and look--it talks about spent nuclear fuel in the fuel pool.

Is this a possible issue that the storage racks in the spent fuel pool might be different--or the storage racks in the spent fuel pool might be different than in the storage container, and therefore the criticality issues may be different? Is that an issue? Look at each one of these things. Look at the relationship of these items as you go

down through the matrix. I'd like to focus us back on the technical issues that be falling out of these various functions. Sven.

BADER: Sven Bader, AREVA. During our studies in IDIQ 14, some of the things that we've assumed were that the fuel is retrievable after transportation. And by regulation, I'm not sure that's true. And so another consideration, another issue is, after you've sat on the pad for 40 years and then you do transport, do you think the fuel will still be retrievable into another package?

DANIEL: So you're talking about retrievability of spent fuel--

BADER: Retrievability after transportation was one of our issues. Another issue that we had is: What exactly is failed fuel? Different people define failed fuel differently, and it seems like an issue that might be worth bringing up is getting a succinct definition of what failed fuel is.

DANIEL: So as far as--

BADER: In this context, yes.

DANIEL: We need to have a collective understanding as to what constitutes failed fuel, and there's nothing right now. It's different understandings between different groups; correct?

BADER: Correct.

DANIEL: Okay. Lee, good on those?

PEDDICORD: No.

DANIEL: No. Give us those again, the various--

BADER: Retrievability after transportation concerning the history before transportation.

DANIEL: Okay. And different--what constitutes failed fuel and the implications.

BADER: Just to add one other issue to that is, you know, the implications of wet transfer after dry storage.

DANIEL: Implications of wet transfer after dry storage. Okay, thank you, Sven. Diane.

CURRAN: This is Diane Curran. I just want to follow up or, I guess, develop a little more the issue that Nigel and Judy were talking about. And what occurred to me was that, getting back to the issue of transportability, there may be some drivers or some overriding factors that--are there factors that--are there safety-related factors that drive the choices of, say, for instance, what size package you use at the reactor site and--

DANIEL: So maybe the issue being what are the most critical safety factors in repackaging--

CURRAN: Right. Are there some that trump everything else that you consider? And also one of the issues that’s come up here is the degree to which standardization can be done and when is it done. Are there some factors that

really get in the way of standardization? It's just a question.

DANIEL: Another issue is what factors most inhibit standardization.

CURRAN: Yes.

DANIEL: Okay. Marvin.

RESNIKOFF: Marvin Resnikoff. Jeff Williams pointed out yesterday that there are different heat requirements for these casks between storage and transportation. In other words, he looked at 32-PWR-element casks and had a maximum heat of 34 kilowatts. But in transportation, because there's more similar circulation to cool the fuel, the heat requirement goes down to 20 kilowatts. So those larger casks have to sit on the pad longer than if it were a smaller cask.

DANIEL: Okay. How about going back to A-1 in the matrix, what if uncanistered fuel assemblies were transferred to the consolidated storage facility? Would there be a pool that would need to be built there? Is that an issue?

HOWARD: Rob Howard, Oak Ridge National Lab. I think the issue that you're getting at is, we need to define the storage system if you're going to move their fuel from the reactor to the consolidated storage facility. And that choice, as Mark Nutt pointed out, of storage system that you

use will have implications if you have to repackage at the storage facility.

DANIEL: Okay. Robert.

SANCHEZ: Robert Sanchez with GAO. I just have a question, because I don’t have the answer to it, and I don’t know if anyone else does, so I don’t even know if it’s an issue. And that is, on the standard contract, if the bare fuel that DOE is supposed to pick up at the fence, if there is any sort of requirement that it meets certain thermal or radiation, I guess, requirements so it is transportable.

Because it seems to me as if DOE is saying they’re not going to take spent fuel from the large canisters already there and that industry is responsible for repackaging. And I don’t want to speak for industry, but it kind of seems the obvious that they’re just going to take stuff from the pool. And I understand that the pools are restrained enough in terms of the configuration of the assemblies that are in the pool that they’re going to pick the hottest, youngest fuel that they can to take out of the pool, so giving them some freedom in terms of, again, loading more assemblies in the pool. And that may constrain what DOE is able to move in terms of canisters, I mean, taking something for transportation.

If industry is compelled because DOE is not taking spent fuel from the canisters--that is, the older, cooler

fuel--and industry is compelled to give the younger, hotter fuel to DOE, I'm not sure that that's going to be a win-win situation, and that may offer some further constraints.

I don't know if that's an issue or not, so I don't know what the answer is, if there is anything in the standard contract.

DANIEL: All right, thank you. Do we have anyone here from DOE? This is on the same topic?

D'ARRIGO: Yes, it's--Diane D'Arrigo, Nuclear Information and Resource. I just needed clarification. When we talk about bare or, whatever, plain fuel from the pool being taken anywhere, obviously it has to be in some kind of container. So I'm just trying to visualize what's meant when--it's been said a couple of times, and obviously bare fuel isn't moved anywhere via container.

MOTE: I'll answer that -- Adam Levin might choose to add something. When fuel assemblies come out of the core, they're put into the spent fuel racks in the spent fuel pool to cool. Those can be put into bolted casks for storage on the site. A bolted cask can go back in the pool, be unbolted; the fuel assemblies can be taken out. Some of those casks can be transported. But until the fuel is put into a different canister, you can pull the fuel assembly out as a fuel assembly unless it's degraded.

The utilities have moved to putting those bare

fuel assemblies into canisters and sealing them, because potentially that has--it gives them more independence. They can move that around as a unit; and, as we've heard, it's more economical than handling--than storing bare fuel assemblies long-term on a pad. The bare fuel assemblies means that they are in the same form that they came out of the reactor. They can be handled as those fuel assemblies where a sealed container with 30-PWR or 80-PWR assemblies, and that gets handled as a package of that many fuel assemblies. So bare fuel is just a single fuel assembly.

D'ARRIGO: In a canister?

MOTE: No, in a location in either a rack or a bolted cask for storage.

D'ARRIGO: So if it's in a bolted cask, it's also--you can call it bare fuel or whatever you're calling it if it's in a bolted container?

MOTE: Yes. It means it's not in a sealed container--excuse me--it's sealed but it's not welded sealed. The canisters we're talking about are very large and they're seal welded so that the fuel--

D'ARRIGO: One assembly per--

MOTE: No, 32 assemblies, 64 assemblies, depending on--

D'ARRIGO: I'm sorry, I've been reading on it, but I don't have all the details. Okay. So you've got a bunch of assemblies, and they're in a container that's not bolted or

that's not welded, and that is considered bare fuel.

MOTE: Yes.

D'ARRIGO: Okay.

DANIEL: Go ahead.

JONES: This is Jay Jones, Department of Energy, and I'm with the Office of Nuclear Energy. I just want to go back to the standard contract a little bit. I know there are a lot of issues between DOE and the utilities on the acceptance of fuel. And we have an Office of General Counsel, who is actually dealing with the standard contract. So I don't think at this point there are any issues that we can resolve here on a technical basis without input from the General Counsel.

DANIEL: Thank you. And, again, we want to stay away from talk about resolving issues. We're not going to do them here. We're trying to identify, identify, identify issues.

BERLEPSCH: Thilo Berlepsch from Germany -- DBE. One question for clarification first. There are CASTOR casks in Germany. They are only bolted. Would that mean that there are bare fuel in them? Really, it's just for understanding.

MOTE: Nigel Mote, staff. As far as we term it in this country, yes, it means that you have not put those assemblies into a package which may or may not be considered a disposal package that is seal welded. If it's not seal

welded, for this discussion we consider it a fuel assembly to be bare assemblies, because they can be handled as bare assemblies without having to cut open a container.

BERLEPSCH: Okay, thank you. Then one comment or one issue concerning the size of the casks. Our experience in Germany is that we can transport these heavy casks even on the streets. The CASTORs are 220 tons. The transport is rather slow. I have to admit that. But you can at least transport it to the next train station. But there other things concerned with the size as well, of course, and this is just a transport on the facility, on the repository site, of course, which is then an issue on how to handle all the different casks. I think it’s a big issue for you.

So when you’re thinking of the receiving site and you are thinking of--I forgot the number--30 different casks, then you have to have the means at the site to really handle all these different casks, and you have to store them, somehow on the site, and this needs quite a lot of requirements on the storage itself to have these very different casks on the site.

DANIEL: So the issue being, as far as handling and storage and transporting these, there’s a lot of considerations to take into consideration, a lot of implications, for the various sized casks and storage canisters and things like that; correct?

BERLEPSH: Especially when you handle them at one site, at the receiving site.

DANIEL: Especially when they're handled at one site.

CUMMINGS: I guess this is a different issue I wanted to raise. Oh, sorry, yes. Kris Cummings, NEI. One of the other limitations associated with coming from storage to transport, other than the thermal requirements that you have a much higher thermal ability in a cask in storage versus transportation, is the criticality requirements. In storage it's been certified by the NRC, and you don't have to assume pure water ingress into the cask. This is really an issue for the PWR reactors, which have soluble boron in their spent fuel pool.

Meanwhile, in transportation you have a specific requirement, and you have to assume that pure water gets into the cask. There have been several studies that have been done both by the NRC and EPRI that have shown that the probability or the risk of such an event happening when you have a transportation accident that's over water, that gets the water in and would cause a chain reaction, is incredibly low; several orders of magnitude below the safety criteria that the NRC has.

So one of the issues that I think would be good for the Board to look into is to relook at that issue as to whether it makes sense to have that additional limitation in

the transportation side for these varying credible events when the NRC has certified the storage and transportation casks to not leak the helium that's in there. They've certified that. That's not part of the licensing basis. They've basically certified that these casks--the welded ones--I want to make that clear--the welded ones do not let the helium out. So if the helium can't get out, how can the water possibly get in on the transportation side?

DANIEL: One of the issues you're raising is the difference in criticality requirements between transportation and storage.

CUMMINGS: Correct. That's correct.

DANIEL: Gene.

ROWE: I would like to expound on that a little bit and carry it to disposal, because the disposal requirements are also different than the transportation or storage requirements because of the long-term requirements for storage. So the issue is, in my mind, that the criticality requirements across this chart are different depending on which phase you're in.

DANIEL: Good. Thank you, Gene. Jim, do you want to add to this discussion or a new one?

WILLIAMS: I want to insert a question at some point.

DANIEL: Okay. We're going to hear about your issue, and then we're going to take a break, a ten-minute break.

So go ahead.

WILLIAMS: Jim Williams. I just wanted to ask a question or raise an issue that I don't think I've heard quite, and it has to do with monitoring what's going on in a sealed canister once the stuff is sealed. And my understanding is that that monitoring capability is very limited. So that introduces an uncertainty about what's happening to that spent fuel over time. That is exaggerated then or has greater implications once you put it into a transportation mode where it's getting shaken around.

And so it sort of leads to--and then reading the waste confidence study assumes that dry transfer can happen indefinitely into the future on a hundred-year basis, I don't know that--you know, there's a bunch of things, sort of when do you do what and so forth that sort of gets, to me, introduced by the fact that we really don't know very much in precision about what's the status the fuel once sealed.

DANIEL: Okay. So the issue you're raising, Jim, is: How do you monitor the contents of the fuel as it--

WILLIAMS: I'm not sure if the question is how to monitor, but rather how to make decisions since we cannot really monitor.

DANIEL: Okay. So how do you make decisions on the content when you don't have the ability to monitor it? And

this is maybe amplified a little bit by what Dr. Resnikoff raised earlier about high burnup fuel as it’s transported and the ductility of it and all.

So let’s take a ten-minute break. While you’re taking a break, be thinking about issues, issues. And we’ll see you in ten minutes, folks. Thank you.

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

DANIEL: Thank you. Please have a seat. I just want to encourage all of you in our final hour together here for really trying to focus on the technical issues related to repackaging during the facilitation, transportation, and disposal. So, I want to drive this hard.

I would ask Gene Rowe from the Board to give us an example using the matrix. So, Gene?

ROWE: Yeah. Okay. If you look at the matrix, and this one is applicable to several different evolutions, but if you look at canister loading, B-2, and what impact that has on disposal, which is K-11, it's really very similar to D-4 to K-11, or G-7 to K-11, or J-10 to K-11. It was discussed in general this morning, and I think a lot of good points were made. But I think that to boil it down to a simple issue is

like--if you want to do any repackaging for disposal, you

have to define what the disposal requirements are. And at this point, the disposal requirements are, I'll say, vague, at best. So, the issue is in order to do a repackaging for disposal, the disposal requirements need to be defined. And that's a very simple, I think, issue, and that's the type of thing we're trying to do is boil it down to something simple like that.

DANIEL: Before we start, just an administrative item, folks. If you haven't registered, please register when you leave the room, because we want to make sure that we have everybody's organization and contact information. If you speak, we definitely want to have the right spelling of your name and all, so please, if you haven't registered, please do so. Okay? Thank you.

Thilo?

VON BERLEPSCH: So, Thilo Berlepsch from DBE just directed to this. I would suggest to specify it a bit more. I wouldn't say it's a sequential process. You have to do it at the same time. You have to look at the same time on the development of possible disposal canisters and the repository, because as he already said, they're working together, the two systems.

DANIEL: Respond to that, Gene.

ROWE: I guess I'll make a comment that I heard from one of the DOE managers at one of our Board meetings--and I

may be out of place when I say this, but the comment, which I agree with 100 percent, is you should design your repository for the waste stream, not design the waste stream for the repository. And because we have such a diverse waste stream, to try to take all of the cats and dogs that we have out in the industry and try to standardize that into one frog that can go into a repository, I think that the repository should be designed to accept all of those cats and dogs. Not an easy thing, but I think that should be one of the objectives.

DANIEL: So take a look at--I'm sorry; go ahead.

What is your name, please?

EINZIGER: Bob Einziger, NRC. One thing I haven’t seen considered here is intermediate steps. And as an example, we talked about coming out of storage and going to transportation and do we meet the transportation requirements, and then you talk about disposal. But an intermediate step is if you go to the interim storage site again, because you come out of storage and then you have to meet all the transportation requirements in terms of heat and ability of the canister if you're using it for moderator exclusion again, and a fuel loss, so--and then, if you're going to go to an interim storage site, you have the issue of meeting once again all of the requirements of Part 72 with respect to the canister. If you have a canister that's

at a site where you have salt, you may have corrosion of that canister. Now you put it in a transportation cask and you have to ask yourself what changes are in that transportation casks to that canister. And then once again when it goes into the storage site, will it meet the storage site requirements? And I haven't seen anybody asking questions of the intermediate conditions. It always seems to be one step to the next, but not one step to the third point.

DANIEL: Well, distill it down for us as an issue. So, you're saying there's not recognition of intermediate steps, or--

EINZIGER: I'm saying you can't look at just one leg of that chart. You've got to look at the full path and take into account all of the intermediate steps when you decide what conditions a particular system has to meet.

DANIEL: Okay. Let's look at the chart. Look at B-2 canister loading. What implications does that have on storage at the consolidated storage facility? What issues are associated with that?

ROWE: I think that's an excellent point, and I think that the issue is, especially if you're going from an ISFSI at the utility site to transportation from a utility site, I think that that point is a valid point. How do you meet the 71 requirements if the cask has been stored for an extended

period of time? How do you verify the integrity of the fuel? 71 requires that you can't have a reconfiguration of the basket internals for transportation, so how do you verify that? So, the issue is how do you somehow--if you're going from C-3 to E-5, especially after extended storage, how do you verify that you meet the 71 requirements? That's the issue.

DANIEL: Okay, so you're talking about going from the intermediate storage facility to transporting it.

ROWE: And I think that goes to the next point--is if we then go to a consolidated storage facility for an extended period of time and you want to transport it to a repository, it's the same issue. How do you verify that you meet the 71 requirements after extended long-term dry storage?

EINZIGER: Well it's even bigger than that. It's after you transport it, how do you meet the interim storage facility's requirements?

ROWE: I agree. So, if you're going from E-5 to F-6, how do you know that you meet the 72 requirements? Very good comment.

DANIEL: Peter Swift.

SWIFT: Peter Swift, Sandia. Going to the last step there, disposal, Gene, you referred to the need to know what the disposal requirements are. And I would suggest an issue

is that we don't actually have a regulatory definition of a disposal standard here. It's EPA's responsibility, not the NRC's, to write the governing standard, and EPA--anybody here from EPA? I don't think so. That was something the Blue Ribbon Commission pointed out in their report. We need prompt action to move forward on our disposal standard, and that would help. I mean, generically we know in general what the package, the container is--should isolate and contain the waste in that environment. But are there specific subsystem standards as in Part 60? We just don't know. So, that's an issue, the lack of certainty about the standard.

DANIEL: Got that, Lee? All right. Thank you, Peter. Bob?

EINZIGER: Bob Einziger, NRC. Earl Easton and myself and a few other people at the NRC at one time in the past worked on a project to harmonize the regulations between storage disposal and transportation, and I think that document is available somewhere. Earl may know a little bit more about it, but that might be useful in trying to look at this issue.

DANIEL: All right. Technical issues. Anyone? Judy?

TREICHEL: Judy Treichel. I don't know how technical it is, but if you do wind up doing repackaging in every

place that it's shown on this chart, is there somebody that guarantees that they know what the package is when it gets to disposal? Because I think that is a requirement that you've got to be able to trace back everything that's in that package that you're going to dispose.

DANIEL: So is that like to ask, Judy, if there's an entity that will establish an audit trail to follow the thing through all the processes and steps? Is that what you're saying?

TREICHEL: Yeah, and it goes back to the overarching-- there should be something that knows what's going on with fuel from its birth to its demise.

DANIEL: Okay. So what's the plan for cradle to grave monitoring of those canisters as they go? Alright, Lee?

SPEAKER: Or is the question inventory tracking.

TREICHEL: That's it as well. Inventory tracking--

DANIEL: Inventory tracking?

TREICHEL: --as well as a history of--

SPEAKER: That’s a lot easier than characterizing--

DANIEL: I'm sorry. We're going to miss you on the microphone. We got it though. Okay, anyone else? Arjun?

MAKHIJANI: Yeah, Arjun Makhijani. I do think it's more than inventory tracking, the point that Judy makes. For example, I was talking to our German colleague, Thilo, at the break, about the Castor cask versus some other casks

that we have. As I understand it, in Germany they have the ability to, at least indirectly, monitor the helium pressure inside the Castor cask. But here, once it is sealed, at least in some cask designs--I might be wrong, and certainly open to being corrected--we have information at the time that it's sealed, but after that we don't have any monitoring ability as to whether there have been leaks. So, we store it for 40 years or 60 years. We don't even know whether there has been air ingress into the canisters and whether there has been consequent corrosion. And so the ability to monitor the insides of the casks, especially in terms of helium pressure, I would think is a big issue as to whether there should be a requirement. Because in terms of repackaging, when you reopen it, you at least ought to know whether you're opening an intact canister whether you're reopening a canister whose insides have been subject to corrosion potential.

ROWE: All right. This is Gene Rowe, Board. Yeah, you've got to separate casks from canisters on that. The Germans use casks, okay? In the United States the casks that contain bare fuel have a double seal with a pressure monitor between the seals to monitor either inflow to the cask or outflow from the cask, so it detects a leak in or out. So, the casks are monitored; the canisters are not.

MAKHIJANI: So correct me--are you saying that after

the cask is sealed, that there is an ability to get a signal as to the helium pressure? So, after three decades we know whether the helium inside the canister is still at the original pressure?

ROWE: Okay. What I said is there's a difference between casks and canisters.

MAKHIJANI: Right. I got that.

ROWE: The casks are monitored. The canisters are not monitored.

MAKHIJANI: So my bottom line then is correct is that after four decades of storage, we don't know whether the helium pressure inside the canister--and, you know, I did mix up the two terms, and that's fine--I know the difference. But we do not know whether the canister is still intact in terms of whether there had been leaks, and whether the helium pressure is still the same, or whether there has been air ingress into it.

ROWE: You are correct.

DANIEL: All right.

MAKHIJANI: Thank you.

DANIEL: I think we've talked a little bit--we touched on that just before the break, too, a little bit, so we have that twice in there, which is fine.

What about a site where a canister may not meet transportation requirements and they don't have a spent fuel

pool or they don't have a utility pool. It's been decommissioned. Is that an issue?

Rob? And if it's an issue, where would it be?

HOWARD: Rob Howard, Oak Ridge National Lab. Jeff Williams, yesterday in his presentation, pointed out that there are 308 canisters that don't have transportation CofCs. Those are all at facilities that have operating pools. So, all of the stranded sites, or orphan sites, however you want to name it, all of those canister systems are transportable. So, I don't think it's an issue today; it may be an issue tomorrow, but not today.

DANIEL: Okay. Nigel?

MOTE: Nigel Mote, Staff. I'd like to add a supplementary issue to that -- one Susan Hoxie-Key and I talked about at the break. As Rob said, today there are no packages at the stranded sites that cannot be transported, or should I say they were intended to be designed for transportation. There may be issues, but certainly that's not ruled out. As time goes by, utilities will find themselves in a position where more reactors shut down, and there will come a time where some of the fuel on stranded sites is in containers that cannot be transported. And so there are some key time points that will come--excuse me. There are some key technical points that will change over time. That issue is what is the time dependence of the

relationships that we're looking at? Are there--I'm tempted to say “points of no return”, but it isn't a point of no return –- it's a discontinuity in the issues, because time may overtake flexibility, and that needs to be taken into account in optimizing the system, if that's the right way to put it.

DANIEL: Absolutely.

Be with you in just a minute, Bob.

EINZIGER: Bob Einziger, NRC. I brought this up before but I'll bring it up again, and that is how do you change the gaskets on those sites where you have direct loaded canisters even if it has a transportation license if you don't have a pool?

DANIEL: That goes back to what Nigel, I think, was saying. What's the time dependence on—-well, the issue stands.

Robert?

SANCHEZ: Robert Sanchez, GAO. Just, I guess, an observation. Again, looking at it from a non-technical point of view, it seems to me that some of the factors--and I think Nigel said it really well in terms of loss of flexibility over time, but there's another thing that could impact the loss of flexibility, or impact flexibility, I guess, and that is the consent based siting approach and what the states and local communities are willing to accept

in terms of storage, packaging, repackaging, that sort of thing, on their sites.

And I don't know that any of these issues that are here are insurmountable technical issues. I think that everything I've heard in the work that I've done is that they're--it's a matter of choice. It's a matter of cost; it's a matter of what the stakeholders involved are willing to agree to, not so much a matter--I mean, some of it is going to be driven by some technical issues, but they're not all insurmountable. It's a matter of what the stakeholders are willing to abide by. And the flexibility, I think, is a major issue involved with that. And perhaps over time some of that flexibility will go away as well. I don't see it increasing. But, again, it's the stakeholders and that's maybe the consent based siting approach. Not just the siting, but the whole consent based approach from start to finish on that.

One example I was sharing with Peter Swift just earlier was on--we'd done some work earlier to look at if you didn't have a pool at a site, how would you package? And we asked a lot of experts the different options, and we went to them and asked about dry transfer and wet transfer, and it came down to, I guess, to a consensus, more or less, that it was a wash either way, because it was going to cost about the same and take about the same amount of time. You

had so many redundancies you had to build into a dry transfer system that it was going to cost about the same amount as a wet transfer system. It came down to just a matter of choice in the end. And I think that's maybe one of the things that could impact the flexibility on this issue. Just an observation on that that I don't think you want to leave out the consent based approach in each of these steps, because that may have as much of a role as the engineering.

DANIEL: Good enough. Thank you, Robert.

Anyone else? Okay. Let's go back to the matrix. Let's talk about actual loading and repackaging. If you can see there in the consolidated storage facility, what impact might that have on canister loading going back the other way? Any thoughts?

Go ahead.

CUMMINGS: Kris Cummings, NEI. I'd asked this question yesterday to DOE about the ability of repackaging to be done under Part 72, whether it's at a centralized interim storage facility or at the sites, and there it would be the sites that don't have a Part 50 license. And then NRC, I seem to recall, had a different answer, that it's not as simple as saying a yes or no.

So I think one of the issues is it needs to be looked at, and maybe that's more of a regulatory issue than

it is for the Nuclear Waste Technical Review Board, is what changes would need to be made to 72? Do we need a new set of regulations for centralized interim storage facility where you would be doing repackaging of fuel assemblies, not necessarily canisters? You can do repackaging of canisters under Part 72, because you're not changing that confinement boundary.

So, the issue is do we have the current regulatory requirements and regulatory structure that would allow you, at a centralized interim storage facility, to do repackaging of individual fuel assemblies? Because I can think of issues that--fuel drop and what's the offsite dose, and things like that, and I don't think you'd be able to meet an offsite dose of 25 millirem at a Part 72 facility if you had like a fuel drop. So, I think that's a true issue that needs to be looked at is the regulatory structure.

DANIEL: Okay.

ROWE: Gene Rowe, Board Staff. I think you can expand that also into the sites that no longer have a facility. So, the regulatory issues of does the regulatory framework exist to allow repackaging at a site that is not under 10-CFR-50?

DANIEL: Bob?

EINZIGER: Yeah, you have here container loading and repackaging under consolidated storage. Is that container

loading and repackaging as it comes out of transport into storage, or is it out of storage into transport, because they could be different requirements. I think maybe it would be different approaches.

DANIEL: Both. It's really both, and that's an issue right there, that there would be different requirements as to whether it's coming in or going out.

Am I right, Gene?

ROWE: I don't think that--excuse me. I'm not sure--Gene Rowe, Board Staff. I don't think that the requirements, whether you do it as soon as the canister arrives or just before the canister leaves, I think it's still does the regulatory framework exist. I think technically there's issues. There's no question technically there's issues. But for a regulatory point of view, I think that it's no difference.

EINZIGER: When you go into storage, you have to make sure that you maintain containment--let's say you come out of transportation and you have a canister that isn't meeting the storage requirements. You may have to change the canister. When you come out of the storage from the consolidated system, the container, the canister, may be bad, but it's not required for transportation, so you may not have to change it. So, there are different things that you have to consider in the two ends.

MOTE: A supplementary technical issue in the same area. The issue is to what extent does a decision of repackaging on receipt—or on dispatch affect the design of the spent fuel storage facility? And in terms of design, if you repackage on receipt, you can have a standardized facility where every container is the same. If you repackage as you dispatch from the site, you would have to have multiple storage container types on that site, and there may be implications of that for (inaudible) facilities and so on. So, the issue is: to what extent does that decision of repackage on receipt or repackage on dispatch influence the facility design.

HOWARD: Rob Howard, Oak Ridge National Lab. I'm not sure if you're assuming a process that may not be there where there's another alternative, and that's storage then packaging and then storage at the interim storage facility. So you could bring in bare fuel in a canister, put it in a pool, leave it in a pool for decades, and then package, put it on a pad. Leave it on the pad for decades and then move it.

DANIEL: Pass it right back behind you, Rob.

NUTT: Mark Nutt, Argonne National Lab. For the DOE program, we did a report that looked at--it was a fiscal year 12 report that look at all this. And the design of the facility will depend on what the strategy is to shipping the

fuel to it and when it starts. Everything could be put in canisters at the reactors and shipped to the facility and everything looks like a big PFS. Could be a decision to take bare fuel, and there's a variety of different options, as Rob just indicated, for what that facility might look like. And the answer is, we don't know, and it depends on a lot of decisions. And a lot of analysis should be done down the road to determine what that thing might look like. But, yeah, there's huge decisions on what happens up front, what happens at the end. Do you handle fuel coming in the door, do you repackage when it goes out, and I think the answer is you just don't know.

D'ARRIGO: Diane D'Arrigo, Nuclear Information Resource Service. This may not be the right time to ask this, but when do we get to talk about a scenario where if--and this was mentioned earlier--we need to have the definitions for the disposal criteria and, in reality, that's not coming today. And yet the fuels need to do something with it right away and centralized storage is not today. So for the fuel that's at the sites, and maybe--I guess the scenario I think needs to be discussed but it doesn't fit into either of these workshops, is storing it at the site without the consolidated storage.

NRC, in its response to the court decision, has to look at indefinite recontainerization. So, there's going to

be repackaging they say every 100 years anyway. So, at some point I think we need to look at what the criteria are for continued recontainerization at the utility site with the option of going straight to disposal without bothering with an interim step and reducing the amount of transport. It's sort of obvious to me that that's an option, but I haven't really heard that given any credibility here, so I'm putting it out as a technical option.

And then raising the concern that--well, that's it.

DANIEL: Okay. Thank you, Diane.

MOTE: Nigel Mote, Staff. That was a question. Let me see if I can capture that as an issue. I think the issue is: what happens at each stage if the subsequent stage is delayed indefinitely. Is that a--

D'ARRIGO: Part of it. That's the larger question, and then as far as technical concerns that people in the public have, if we've got major transportation schemes going on between different consolidated--and between utilities and consolidated sites, who's looking at the technical option of keeping it there and recontainerizing it there as needed, and maybe it won't need to be recontainerized as often because we don't have criteria for disposal yet. So, it just seems, from a public perspective, people do believe that there is a concern with the safety of transport,

although that’s been dismissed by many, that there is a significant portion of the population that's concerned about those technical issues. So, in order to minimize that--to look at the options for how to store it more securely at the site, at the onsite ISFSI.

MOTE: Mote, Staff. I'm not sure I'm seeing a distinction between taking account of indefinite delay at each point and what you said--I'm not trying to--

D'ARRIGO: Okay. Well, you're assuming that there could be indefinite delay for consolidated storage and indefinite delay for disposal. So I guess it's not a big difference, but I wanted to at some point talk--if you're going to keep it where it is and minimize transport dangers, does that fit into the scenario. And then we need to discuss what's the safest way to store it indefinitely where it is until there is disposal and disposal criteria.

MOTE: So it's how do we make provision for management in the event of long-term interruption to the program.

D'ARRIGO: Yeah.

MOTE: The management meaning leave it here or repackaging or whatever.

D'ARRIGO: Well, what the court was saying, 60, 160, and indefinite.

MOTE: Okay, but in terms of trying to distill it down to an issue, it is--take account of the potential for an

interruption, potentially long term, and what do you have to do to provide for safe management in the event that happens?

Is that capturing it?

D'ARRIGO: In the absence of transport.

MOTE: Okay. I meant not to be implicit. I mean, if it's at the reactor site or an interim storage site, then it can't go any further for a prolonged period, then there may be a need to do subsequent handling operations, repackaging.

D'ARRIGO: Okay. Well, I wanted to make sure that it discussed the onsite options as well as--well, definitely discuss that, because there's a basic assumption that there will be consolidated storage, and I'm saying there's a question about that. So let's face the reality that we could have long-term onsite storage.

MOTE: Okay. Lee, can you nod if you have that?

PEDDICORD: Well, that was a pretty disjointed conversation.

D'ARRIGO: Okay. Use this--and I'll try and distill it into a sentence. Look at the technical requirements and implications of indefinite onsite storage in the absence of transporting, the absence of consolidated storage and disposal. So look at—is that too long? Look at onsite storage. Look at the technical options--

PEDDICORD: Look at the technical requirement for indefinite long-term--

D'ARRIGO: Onsite storage at utility sites.

DANIEL: Thanks.

EINZIGER: Bob Einziger with NRC. We don't license for indefinite storage; we license for 40-year terms. So, the question really that you should be asking yourself, what happens if a utility comes up for a relicense and you can't make the safety case for relicense. What do you do?

DANIEL: Are you good on that, Lee? All right. Lee, you’ve got a tough job. I'm glad I'm here and not there.

What about criticality and thermal requirements? Are they the same for storage and transportation? Is that an issue?

EINZIGER: There's an easy answer. They are the same. You can't be critical.

DANIEL: Okay. How about thermal or hot? So, they're basically the same whether--

SPEAKER: No.

DANIEL: Peter?

SWIFT: Peter Swift, Sandia National Laboratories.

Bob, could you clarify you were not speaking for the NRC there?

EINZIGER: I'm never speaking for the NRC.

SWIFT: Again, this--in disposal, which you didn't have on your list. You had transportation and storage for criticality and thermal issues. In disposal, there are

uncertainties associated with the lack of a final regulation there again. And that is one of the places where because you would seal a canister before it went underground, and if we would have to seal them now, we would have to pick whatever criticality controls we chose now to work in a broad variety of potential geologic environments. So, that's the issue I was getting at there.

DANIEL: Okay. Got that, Lee?

Earl?

EASTON: Oh. My name is Earl Easton, private citizen. You know the transportation regulations were written in a time where we didn't think casks would sit around for 20 years, da-da-da-da-da, and all the criteria was based on shipping pretty near term. Storage was written at a time where, well, Yucca Mountain was going to open 20 years from now, 40 years, and so we have a 20-year period, 40. Maybe it's just time to look at that again, the whole regulatory framework, because all the underlying assumptions have changed.

When Bob brings up that you've got to check the seals on these casks, well, it is true in a transportation cask we routinely have them change seals or check seals every year. But does that make sense in something sitting around for 20 years? And, you know, containment was based on somebody being in the warehouse with packages for a long

period of time. That's what the leak rate was based on. Does that make sense for a spent fuel cask? Does the surface contamination, which was based on shipping radioactive material with food stuffs, and was set very low, make sense for spent fuel, which is never sent by Fed Ex that I know of.

So, maybe it's time to actually go back and look at the underpinnings of all the regulations to see which make sense, which don't make sense. Because what may have been a safety case years ago for one particular circumstance or regulations one size fit all, may not be the optimal way to do things now. So, two types of issues: Technical and regulatory.

DANIEL: All right. So, you get on that one, Lee? All right.

Thank you, Earl.

Rod, and then Diane. Diane. We'll take Diane.

CURRAN: This is Diane Curran. I have a follow up to Earl's issue, and this is a concern. I am here in part representing Eureka County, Nevada, which could be a host site for transportation of casks to Yucca Mountain. And one of the concerns that comes up in my mind, sitting here, is you’re talking about the cats and dogs, are we going to be transporting cats and dogs, lots of real variety of casks, and is there a real variety of issues such that Eureka

County would have trouble planning for emergency response because there's such an array of risk coming down the road? That's a question I just have no answer to, but sounds like it could be an issue.

DANIEL: So, let's put that in the flavor of an issue. Local government planning--and I don't want to put words in your mouth--but local government planning is difficult due to not understanding the nature of the technical designs of casks and storage transportation?

CURRAN: Well, you kind of got at it, but it's more that it was many, many different kinds of transportation containers, or the contents vary a lot such that the risks, I would assume, would vary in terms of what kind of an accident you might have, because the contents are variable. That's the issue that I'm concerned about. It's not so much the communication, it's more the nature of the problem is very variable and therefore difficult to anticipate.

DANIEL: Okay. All right. Thank you, Diane.

Arjun:

MAKHIJANI: Arjun Makhijani. A couple of issues there. You know, we talked about the relationship of the regulations for a repository to repackaging and storage and all the early-on decisions. I think there are actually two sets of regulations we should think about. One is the EPA regulations that the BRC recommended be done early and

before site selection and so on, and I agree with that, actually. The other is the NRC regulations, which go into the performance of the canisters and so on. And so that latter one is actually very directly related to the nature of the site. The first one is not related to the nature of the site. It's simply what kind of maximum dose limits are we going to set. And I guess if it's like 10 CFR 191, are they going to be emission limits? Which, I think, actually, gets into the NRC realm as to what kind of canisters they should be and so on. So, I think the NRC--the absence of NRC regulations in regard to the nature of the system and the interaction between the pieces is actually more critical--and I raise that as an issue--more critical to the kind of problems that we're talking about. Assuming that EPA regulations will be reasonably protective of health, and we might all interpret that in our own way. So, that's kind of one issue I wanted to raise.

And I have a question issue if I might.

DANIEL: Yes.

MAKHIJANI: In 2001 there was a petition filed by people near Prairie Island that the NRC did not know how to transfer damaged fuel from one container to another. And the NRC's response was you're right, we don't know now, but we'll know that the fuel is damaged when we get it out, and we'll quickly put it back in--that is a paraphrase--and then

we'll figure out what to do.

I think this is a huge issue that the NRC actually has punted the issue of failed fuel and its management, especially much more important now than it was in 2001, because now the repository program has fallen apart. So, I think the problem of failed fuel management is an absolutely huge issue, especially for repackaging. I raised this yesterday.

DANIEL: Okay.

MAKHIJANI: And I think it should be considered, and the NWTRB maybe ought to write a letter to the NRC to get its house in order so it can be considered properly.

DANIEL: Thank you, Arjun.

MAKHIJANI: Thank you.

DANIEL: Bob?

EINZIGER: For once—in a very few times--I'm going to agree with Earl. The issue they're looking at, the requirements in '71 and '72 are continually going on, and NRC has a license improvement program going on right now looking at what changes, if any, should be made to the current regulations to homogenize them and improve them. And in the extended storage program, later down the line there is a task to look at how these regulations might have to be changed to look at long-term storage. So, that is an already ongoing program. I don't know about homogenizing

with the repository, because we don't know what to homogenize with.

DANIEL: Technical issues. We're coming down to the final 15 minutes, folks, so let's go back to the matrix. We've heard about sites that are going to possibly be orphans at a certain time. What about between the intermediate storage facility and transportation? What issues having to do with repackaging exist that we know of?

Rob?

HOWARD: Rob Howard, Oak Ridge National Lab. One issue there would be, are there changes in the material that are caused from going from storage to repackaging to the methodology of repackaging if you get it wet again or you do it dry? Does it matter for how that material will perform when it's transported again.

DANIEL: Okay. Does that--I'm going back to the Rob from NRC. Does that start to go into some those intermediate steps that you were talking about? Was it you that talked about intermediate steps between?

EINZIGER: All the guidance--

DANIEL: And that this is Bob Lyons (sic) from the NRC.

EINZIGER: Yoohoo. All the guidance that we have given so far has been based on the fuel not going back into the pool. The only thing we do right now with respect to the pool is going back into the pools to make sure that there's

not sufficient thermal strain that's going to fail the fuel. But whether it will change the properties if you're going to rewet it again is a subject that needs to be considered. As you go through another drying cycle, how is it going to affect, especially for high burnup fuel, the reorientation or the ductility or things like that. So, yes, it's an issue that would have to be considered.

DANIEL: Okay. Anyone else?

ROWE: Rick, can I consolidate that down a little simpler?

DANIEL: Yes. Do it.

ROWE: Gene Rowe, Board staff. What issues associated with rewetting the fuel? How does rewetting the fuel going from dry storage to a fuel pool impact the integrity of the fuel assembly?

DANIEL: And does it make any difference if it's high burnup fuel?

ROWE: Yeah, you've got to look at all the fuel. Just going from a dry environment to a wet environment, and as Bob indicated also, then going--if you're going back into dry storage, you have to go through another drying process, and what impact does that second drying process have on the fuel integrity.

DANIEL: How about are there any byproducts in repackaging that we're going to have to deal with? When we

talk about repackaging, does it create a lot of low-level waste or products that we're going to have to deal with? Anyone have any insight on that? Thoughts?

Sven?

BADER: Sven Bader, AREVA. Well, the obvious thing is that you have these canisters that just--and all the internals of that, which we'll have to figure out what to do. We did a study on reuse, repurpose, or recycle. I'm looking back to see if Pat Schwab's here. But we did a report on this, and that's the largest quantity of waste you're going to have from this activity. And the rest of it depends on whether you’re going to do dry transfer or wet transfer.

For dry transfer, our experience at La Hague is that we get far less low-level waste associated with dry transfer activities than associated with the wet transfer activities. But then again the wet transfer activities are a fallback position in case you have failed fuel or damaged fuel.

DANIEL: Okay.

SPEAKER: What was it? Transfer at La Hague you saw far less?

BADER: Far less low-level waste associated with dry transfer. It's about a factor of four, I believe.

ROWE: Okay. I'd like to expand on that one a bit

also. The Yucca Mountain project, when we were talking about emptying the canisters, an issue came up as to are the canisters really considered low-level waste? If you have a canister with a failed element in there, you could have isotopes that are contained in that canister that will preclude it from being disposed of as low-level waste. And to identify those isotopes is not easy. To clean those isotopes is not easy. So, I think the issue is how do you confirm that the empty canisters are considered low-level waste.

DANIEL: Good. Thank you, Gene.

Gary?

LANTHRUM: Gary Lanthrum, NAC. A minor side issue is that each--or most--of these sites that have waste in storage, particularly shutdown sites, or exclusively the shutdowns, also have GTCC waste in these same types of canisters. And to some extent, the GTCC waste needs a disposal pathway that is not fully developed or identified. So, some of the same issues that we're discussing for spent fuel may also exist for the GTCC waste and needs to be addressed accordingly.

DANIEL: Thank you, Gary.

Arjun?

MAKHIJANI: I have a follow-up for Mr. Bader. Did I get your name right? Arjun Makhijani. At La Hague do you

necessarily transfer spent failed fuel in pools, and why would that be? Because we would need to presumably have spent fuel pool infrastructure, because there are failed fuel elements here that we know.

BADER: Sven Bader from AREVA again. Yes, failed fuel is transferred only in the pools, and it's basically to minimize any kind of doses to the operators from releases.

EINZIGER: Bob Einziger from the NRC. I just want to make a clarification between the French practice and the U.S. practice. In the U.S., we allow fuel rods with pinholes and tight cracks, which are failed fuel, to be handled as part of the normal population. So, they're not put in damaged fuel cans, and they can be in a cask. While in France, that's not the case. They get put into isolated--depending on what country I don't know what they call them, canisters or cans or whatnot--so there is a difference between the two, because we do have failed fuel that's in the general population that we just handle like any other fuel.

DANIEL: Okay. Thanks.

Robert?

SANCHEZ: This is Robert Sanchez with GAO. Just another quick question. This is probably more for the vendors and the utilities, but on the chart, the canister loading is in one cell, but I kind of wonder how that will

be impacted by the large number of expected retirements coming up in the year 2040 or thereabouts. The next 10 years will see a fairly large number of retirements, and I expect that the spent fuel pools will be full at that point. I don't think the utilities are going to unload them unless they have to, and at that point you're going to have a very large number of assemblies that will be in a large number of pools, and a large number of reactors that are retiring all at the same time. And will the vendors and utilities--I know, that kind of work to unload a pool is fairly labor intensive and very--it can cause a lot of specialties, whether they'll have the provisions to do that and the vendors will be able to supply, I guess, the canisters on the numbers required during that time. I don't know if there's any technical issues, but it certainly may create some other headaches.

DANIEL: Okay.

LOWITZ: Tony Lowitz (phonetic) with CB&I. The trend is to offload all of that fuel out of the pools into dry storage as soon as possible, because of a variety of reasons such as having to maintain the spent fuel pool island with security, all the systems that are required to keep that going. And so to get it into safe store position, we like to move it to dry fuel.

DANIEL: Thank you. Anyone else, technical issues?

There's got to be more, folks.

Nigel, did you have anything?

MOTE: Nigel Mote, staff. One of the issues that came up this morning from Rod is that the disposal cell has in it a multitude of aspects: feasibility, long-term degradation, performance underground. I would just like to raise that issue and see if there are issues that come out of thinking not about disposal as emplacement, but about disposal as emplacement followed by a hundred thousand years, a million years. And the sort of thing that comes to my mind is to what extent does the choice of location of repackaging have an impact on those issues? And it's not so much the location, but the implication of the location has on timing.

If you repackage at the utility site, and then you have 100 years of storage, and then you put the package underground, the fuel and the package have been stored for 100 years in that configuration. If you repackage at the repository site, then it is much later in the chain of events, much later in operational sequence, much later in time scale. To what extent does the need to meet the repository performance requirements that we don't have--not raising that provocatively, but recognize that we don't have, so let's try to be foresighted. If we have to have retrievability over a timeframe that currently is not part of the thinking, as it happens in smaller countries, then

how does that play back into determining when you repackage?

And Judy made the point before of do you repackage more than once, and I think many of us would have defaulted to, well, no, of course you don't, but it's a real issue. If you need to retrieve on a prolonged time scale after emplacement and you did have to repackage up front to move the stuff away from the site, because right now it's in a container that doesn't meet transportation requirements, that necessarily means you do repackage twice for different reasons, and I think that issue needs to be taken into account. It is the time dependence of repackaging on how you meet disposal requirements. Or maybe it's the other way around, it's how the disposal requirements play back into the decision making of the location of repackaging.

SWIFT: Can I ask a question?

DANIEL: Sure.

SWIFT: Peter Swift, Sandia. Nigel, is the issue you're getting at there that perhaps not just the timing but the amount of handling of the fuel will affect its long-term performance, it's performance over a hundred thousand years?

MOTE: I meant all of that. There is one issue there, which is timing, but there's a lot of sub-issues, which is how does that play into the requirement for handling safety, casks, low-level waste generation, all of those issues.

SWIFT: Peter Swift, Sandia National Labs. I'm trying

to reframe as an issue. Is the issue that we should be considering now, at the beginning of a storage process, the impacts of the choices we make now on long-term performance of the waste form, the fuel itself?

MOTE: I'm sorry, would you say that again?

SWIFT: I'm trying not to offer a solution. I'm trying to raise an issue, and I think the issue you're raising is that what we do now, the choices we make now with respect to storage in particular, but handling choices, packaging and handling choices in the next, say, 50 years, could result in different conditions of the fuel as it enters its permanent disposal phase later. And so we could, in some way, be protecting the fuel now so it will work better in the far future. And if that is indeed the issue, then the second, the correlated issue, and one I'm trying not to raise the solution for, is to what extent do different disposal concepts actually rely on the long-term performance of the fuel form. And the answer, which you're not supposed to give, is that some do and some don't.

MOTE: We'll ignore the last sentence and say, yeah, that's the issue.

DANIEL: Lee, do you have a decent facsimile of that issue?

PEDDICORD: Say it again, Peter.

DANIEL: I'm glad he asked him and not me.

SWIFT: Peter Swift, Sandia. The issue, I believe, is to the extent to which we should be considering how the choices we make now about storage and packaging, how those choices may affect the performance of a waste form, which basically is the fuel assembly, over hundreds of thousands of years after disposal.

And then the part I said at the end was that a corollary issue is to what extent do different disposal concepts actually rely on the long-term performance of the fuel form. Is it something that is important? And the answer to that is in some cases in some concepts it does matter, and in some it doesn't.

DANIEL: Nigel.

MOTE: Staff. Yes, that captures that point. In terms of looking at how cells later in the matrix play back to the beginning, not correlate, but an extension or an inversion of that is to what extent should the decision-making operations on the surface respond to the need for ensuring long-term performance underground in accordance with regulatory requirements.

And the way that might play out is it might affect the choice of where you repackage, because the longer you leave it to repackage, the more you're going to know about the requirements for the disposal, the operation and the regulations for disposal.

DANIEL: Gary?

LANTHRUM: One more temporal issue is that as plants shut down, the infrastructure supporting those plants typically degrades and goes away and that becomes particularly important for transportation. And to the extent that plants are loading into large transportation systems, it doesn't preclude your ability to transport those casks later on or canisters later on, but if your rail infrastructure goes away, it certainly complicates it by having to do an intermodal system in between. And so there's a timing issue of when you make those shipments and maximize the use of the best transportation system to minimize impacts to the local communities when you're making the shipments.

DANIEL: Thank you. Can we talk at all about retrievability once in disposal issues associated with that? Implications of repackaging and retrievability once it's in disposal?

Peter, you need a microphone.

SWIFT: Yeah. Peter Swift, Sandia National Laboratories. So, the first, as a point of clarification, retrievability in the storage and transportation world means something quite different than it does in the disposal world. Retrievability in storage and transportation means more or less the ability to get the fuel assembly intact

back out of the container that you put it in. In a repository, retrievability means the ability to bring the waste material back up to the land surface. And this is where we get into legal and regulatory uncertainties. What will a future regulation actually require with respect to retrievability?

The current regulations--the NRC regulations and Nuclear Waste Policy Act required that the waste be retrievable during the operations of a repository. They were silent on what happened after the repository was sealed, which is, I think, what your question was getting to. The EPA, in Part 191, created a requirement that it be possible but not easy to remove most of the waste for a reasonable period after the repository was sealed. But EPA's Part 191 may or may not be the governing regulation. So, I didn't answer your question at all, but the issue is we have a fundamentally--not a technical issue, but a societal choice and a regulatory choice about what type of retrievability standard do we want to have.

DANIEL: Okay. Thank you. Judy?

TREICHEL: Judy Treichel. In line with that, you may not want to be able to retrieve, or you may not want to plan to retrieve, because you're screwing with the isolation capability.

SWIFT: Peter Swift. That is something that the--the

European community has debated these points for a very long time. And, indeed the NEA wrote a report on that where they concluded exactly that point, that retrievability should not be achieved--long-term retrievability should not be achieved at the expense of isolation. Good point.

DANIEL: Thilo, do you have any thoughts on that, what you do in Germany?

VON BERLEPSCH: Thilo Berlepsch from DBE. Well, the current situation, at least in Germany, is that we are required to plan for retrievability during operation and then for another 500 years. We have to show that it is possible to get back the waste somehow. But, still, I think the point was made every plan to get the waste back somehow is on the cost of isolation of the facility down under the earth.

DANIEL: Okay. All right. Thank you.

Any additional issues? You guys aren't hungry, are you?

It's 12:02, I believe, and I appreciate your participation and your patience. Wanted to just reiterate something that both Rod Ewing and Nigel Mote mentioned earlier, and that is that the window remains open to all issues. If you go home at night and you're talking to your spouse and something comes up, there's means of responding. There's the website, there are cards, and I know these guys

will give you their personal cellphone numbers as well if you want. So, thank you all very much, and we'll see you again.

(Whereupon, the meeting was recessed for lunch.)